PISA Data Analysis Manual

SAS® SECOND EDITION

Programme for International Student Assessment

OECD

PISA
Data Analysis Manual

SAS, SECOND EDITION

Programme for **I**nternational **S**tudent **A**ssessment

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of 30 democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

Foreword

The OECD Programme for International Student Assessment (PISA) surveys, which take place every three years, have been designed to collect information about 15-year-old students in participating countries. PISA examines how well students are prepared to meet the challenges of the future, rather than how well they master particular curricula. The data collected during each PISA cycle are an extremely valuable source of information for researchers, policy makers, educators, parents and students. It is now recognised that the future economic and social wellbeing of countries is closely linked to the knowledge and skills of their populations. The internationally comparable information provided by PISA allows countries to assess how well their 15-year-old students are prepared for life in a larger context and to compare their relative strengths and weaknesses. The initial results for PISA 2000 is found in *Knowledge and Skills for Life – First Results from PISA 2000* (OECD, 2001), for PISA 2003 in *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004a) and for PISA 2006 in *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007).

The *PISA Data Analysis Manual* has been developed to provide researchers with various techniques needed to correctly analyse the complex databases. It helps researchers confidently replicate procedures used for the production of the PISA initial reports and thematic reports, and accurately undertake new analyses in areas of special interest. In addition to the inclusion of the necessary techniques, the manual also includes a detailed account of the PISA 2006 database. This information for PISA 2000 is found in the *PISA 2000 Database Manual* (OECD, 2002a) and for PISA 2003 in the *PISA 2003 Data Analysis Manual* (OECD, 2005b)

This *PISA Data Analysis Manual* is a revised edition of the *PISA 2003 Data Analysis Manual* (OECD, 2005b). The chapters in the manual are expanded to cover various analytical issues in PISA in general, while applying examples from all available PISA surveys – PISA 2000, PISA 2003 and PISA 2006.

The following new features are included in this manual:

- Chapter 1 is expanded to include how the PISA data can be used, and what can be examined with the PISA data for various stakeholders such as policy makers, researchers, experts on survey methodology.

- Chapter 2 is new and provides a brief description of important features of the PISA data and a section introducing "shortcut" approaches which will facilitate the cumbersome computation process using plausible values and replicate weights. This chapter also provides a detailed description of when these shortcut approaches can be used as well as advantages and disadvantages of using them.

- Chapters 3 to 13 are largely based on the *PISA 2003 Data Analysis Manual* (OECD, 2005b), but the following updates and modifications are implemented in the macros.
  - The macro for regression analysis has a new function to compute R-square and its standard error.
  - All macros have a new function of flagging "cautious" statistics which are based on too few observations. Users can set the criteria for the minimum number of students and schools as well as the minimum percentage.

- Chapter 14 is expanded to include more examples such as added values analysis, which examines the student residuals of a regression with school factors. The following new macros intended to facilitate computation are also presented:
  - macro for quartile of indices and mean performance by the quartile with standard errors,
  - macro for relative risk,
  - macro for effect size.
- Chapter 15 is expanded to include an introduction to a three-level model. Macros for multilevel (two-level) regression are also developed and these provide the decomposition of variance of continuous variables.
- Chapter 16 is new and provides three examples of possible analysis with the PISA data.

PISA is a collaborative effort by its participating countries, guided by their governments on the basis of shared policy-driven interests. Representatives of each country form the PISA Governing Board, which decides on the assessment and reporting of results in PISA.

There are two versions of this manual – one for SAS® users and one for SPSS® users. The OECD recognises the creative work of Christian Monseur in preparing the text, syntax and macros for both versions of the manual. The coding for the SPSS® user manual was prepared by Eveline Gebhardt and Alexander Daraganov. The main editorial work was carried out by Miyako Ikeda, Sophie Vayssettes and Maciej Jakubowski in the OECD secretariat with the help of Julie Harris. The PISA assessments and the data underlying the manuals were prepared by the PISA Consortium under the direction of Raymond Adams.

Ryo Watanabe
Chair of the PISA Governing Board

Barbara Ischinger
Director for Education, OECD

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User's Guide

Preparation of data files

All data files (in text format) and the SAS® control files are available on the PISA website (*www.pisa.oecd.org*).

SAS® users

By running the SAS® control files, the PISA data files are created in the SAS® format. Before starting analysis, assigning the folder in which the data files are saved as a SAS® library.

For example, if the PISA 2000 data files are saved in the folder of "c:\pisa2000\data\", the PISA 2003 data files are in "c:\pisa2003\data\", and the PISA 2006 data files are in "c:\pisa2006\data\", the following commands need to be run to create SAS® libraries:

```
libname PISA2000 "c:\pisa2000\data\";
libname PISA2003 "c:\pisa2003\data\";
libname PISA2006 "c:\pisa2006\data\";
run;
```

SAS® syntax and macros

All syntaxes and macros in this manual can be copied from the PISA website (*www.pisa.oecd.org*). The 17 SAS® macros presented in Chapter 17 need to be saved under "c:\pisa\macro\", before staring analysis. Each chapter of the manual contains a complete set of syntaxes, which must be done sequentially, for all of them to run correctly, within the chapter.

Rounding of figures

In the tables and formulas, figures were rounded to a convenient number of decimal places, although calculations were always made with the full number of decimal places.

Country abbreviations used in this manual

AUS	Australia	FRA	France	MEX	Mexico
AUT	Austria	GBR	United Kingdom	NLD	Netherlands
BEL	Belgium	GRC	Greece	NOR	Norway
CAN	Canada	HUN	Hungary	NZL	New Zealand
CHE	Switzerland	IRL	Ireland	POL	Poland
CZE	Czech Republic	ISL	Iceland	PRT	Portugal
DEU	Germany	ITA	Italy	SVK	Slovak Republic
DNK	Denmark	JPN	Japan	SWE	Sweden
ESP	Spain	KOR	Korea	TUR	Turkey
FIN	Finland	LUX	Luxembourg	USA	United States

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The Usefulness of PISA Data for Policy Makers, Researchers and Experts on Methodology

PISA – AN OVERVIEW

Are students well prepared to meet the challenges of the future? Are they able to analyse, reason and communicate their ideas effectively? Have they found the kinds of interests they can pursue throughout their lives as productive members of the economy and society? The OECD Programme for International Student Assessment (PISA) seeks to provide some answers to these questions through its surveys of key competencies of 15-year-old students. PISA surveys are administered every three years in OECD member countries and a group of partner countries, which together make up close to 90% of the world economy.[1]

PISA assesses the extent to which students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society. It focuses on student competencies in the key subject areas of reading, mathematics and science. PISA seeks to assess not merely whether students can reproduce what they have learned, but also to examine how well they can extrapolate from what they have learned and apply their knowledge in novel settings, both in school and non-school contexts.

The PISA surveys

PISA focuses on young people's ability to use their knowledge and skills to meet real-life challenges. This orientation reflects a change in the goals and objectives of curricula themselves, which are increasingly concerned with what students can do with what they learn and not merely with whether they have mastered specific curricular content.

Key features driving the development of PISA have been its:

- policy orientation, which connects data on student-learning outcomes with data on students' characteristics and on key factors shaping their learning in and out of school in order to draw attention to differences in performance patterns, and to identify the characteristics of schools and education systems that have high performance standards;
- innovative "literacy" concept, which is concerned with the capacity of students to apply knowledge and skills in key subject areas and to analyse, reason and communicate effectively as they pose, solve and interpret problems in a variety of situations;
- relevance to lifelong learning, which does not limit PISA to assessing students' curricular and cross-curricular competencies, but also asks them to report on their own motivation to learn, their beliefs about themselves, and their learning strategies;
- regularity, which enables countries to monitor their progress in meeting key learning objectives;
- breadth of geographical coverage and collaborative nature, which in PISA 2006 encompasses the 30 OECD member countries and 27 partner countries and economies.

The relevance of the knowledge and skills measured by PISA is confirmed by recent studies tracking young people in the years after they have been assessed by PISA. Studies in Australia, Canada and Denmark display a strong relationship between the performance in reading on the PISA 2000 assessment at age 15 and the chance of a student completing secondary school and of carrying on with post-secondary studies at age 19. For example, Canadian students who had achieved reading proficiency Level 5 at age 15 were 16 times more likely to be enrolled in post-secondary studies when they were 19-years-old than those who had not reached the reading proficiency Level 1 (Knighton and Bussiere, 2006).[2]

PISA is the most comprehensive and rigorous international programme to assess student performance and to collect data on the student, family and institutional factors that can help to explain differences in performance. Decisions about the scope and nature of the assessments and the background information to be collected

are made by leading experts in participating countries, and are steered jointly by governments on the basis of shared, policy-driven interests. Substantial efforts and resources are devoted to achieving cultural and linguistic breadth and balance in the assessment materials. Stringent quality assurance mechanisms are applied in translation, sampling and data collection. Consequently, the results of PISA have a high degree of validity and reliability, and can significantly improve understanding of the outcomes of education in the world's most economically developed countries, as well as in a growing number of countries at earlier stages of economic development.

Although PISA was originally created by the governments of OECD countries, it has now become a major assessment tool in regions around the world. The first PISA survey was conducted in 2000 in 28 OECD countries and 4 partner countries, using written tasks answered in schools under independently supervised test conditions following consistently applied standards. Another 11 partner countries participated in the same survey in late 2001 or early 2002. The second survey was conducted in 2003 in 30 OECD countries and 11 partner countries/economies and in 2006 the third survey included 30 OECD countries and 27 partner countries/economies. In 2009, PISA will be carried out in 30 OECD countries and 37 partner countries/economies. Table 1.1 provides the list of participating countries/economies where PISA 2000, PISA 2003 and PISA 2006 have been conducted and PISA 2009 is planned.

Table 1.1
Participating countries/economies in PISA 2000, PISA 2003, PISA 2006 and PISA 2009

	OECD countries	Partner countries
PISA 2000	Australia; Austria; Belgium; Canada; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands;[a] New Zealand; Norway; Poland; Portugal; Spain; Sweden; Switzerland; United Kingdom; United States	Albania; Argentina; Brazil; Bulgaria; Chile; Hong Kong-China; Indonesia; Israel; Latvia; Liechtenstein; Macedonia; Peru; Romania; Russian Federation; Thailand
PISA 2003	Australia; Austria; Belgium; Canada; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Spain; Sweden; Switzerland; Turkey; United Kingdom;[b] United States	Brazil; Hong Kong-China; Indonesia; Liechtenstein; Latvia; Macao-China; Russian Federation; Thailand; Tunisia; Uruguay; Serbia[c]
PISA 2006	Australia; Austria; Belgium; Canada; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Spain; Sweden; Switzerland; Turkey; United Kingdom; United States[d]	Argentina; Azerbaijan; Brazil; Bulgaria; Chile; Colombia; Croatia; Estonia; Hong Kong-China; Indonesia; Israel; Jordan; Kyrgyzstan; Latvia; Lithuania; Macao-China; Republic of Montenegro; Qatar; Romania; Russian Federation; Republic of Serbia; Slovenia; Chinese Taipei; Thailand; Tunisia; Uruguay
PISA 2009	Australia; Austria; Belgium; Canada; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Korea; Luxembourg; Mexico; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Spain; Sweden; Switzerland; Turkey; United Kingdom; United States	Albania; Argentina; Azerbaijan; Brazil; Bulgaria; Chile; Colombia; Croatia; Dominican Republic; Dubai (UAE); Estonia; Hong Kong-China; Indonesia; Israel; Jordan; Kazakhstan; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Macao-China; Republic of Moldova; Republic of Montenegro; Panama; Peru; Qatar; Romania; Russian Federation; Republic of Serbia; Shanghai-China; Singapore; Slovenia; Chinese Taipei; Thailand; Trinidad and Tobago; Tunisia; Uruguay

a. Response rate is too low to ensure comparability. See Annex 3 in OECD (2003), *Literacy Skills for the World of Tomorrow – Further Results from PISA 2000,* OECD, Paris.

b. Response rate is too low to ensure comparability. See Annex 3 in OECD (2004), *Learning for Tomorrow's World – First Results from PISA 2003,* OECD, Paris.

c. For the country Serbia and Montenegro, data for Montenegro are not available in PISA 2003. The latter accounts for 7.9% of the national population. The name "Serbia" is used as a shorthand for the Serbian part of Serbia and Montenegro.

d. Reading results are not available in PISA 2006. See Chapter 6 in OECD (2007), *PISA 2006 – Science Competencies for Tomorrow's World,* OECD, Paris.

Together with the PISA 2000 and PISA 2003 surveys, PISA 2006 completes the first cycle of assessment in the three major subject areas – reading, mathematics and science. PISA is now conducting a second cycle of surveys, beginning in 2009 with reading as the major subject and continuing in 2012 (mathematics) and 2015 (science).

Table 1.2
Assessment domains covered by PISA 2000, PISA 2003 and PISA 2006

	Major domain	Minor domains
PISA 2000	Reading literacy	Mathematical literacy Scientific literacy
PISA 2003	Mathematical literacy	Reading literacy Scientific literacy Problem solving
PISA 2006	Scientific literacy	Mathematical literacy Reading literacy

PISA defines the assessment major domains as follows:

- **Reading literacy**: An individual's capacity to understand, use and reflect on written texts, in order to achieve one's goals, to develop one's knowledge, and potential and to participate in society.
- **Mathematical literacy**: An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.
- **Scientific literacy**: An individual's scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues, understanding of the characteristic features of science as a form of human knowledge and enquiry, awareness of how science and technology shape our material, intellectual, and cultural environments, and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen.

Across the world, policy makers are using PISA findings to: gauge the knowledge and skills of students in their own country in comparison with those of other participating countries; establish benchmarks for educational improvement, for example, in terms of the mean scores achieved by other countries or their capacity to provide high levels of equity in educational outcomes and opportunities; and understand relative strengths and weaknesses of their education systems. The interest in PISA is illustrated by the many reports produced in participating countries,[3] the numerous references to PISA results in public debates and the intense media attention shown to PISA throughout the world.

HOW CAN PISA CONTRIBUTE TO EDUCATIONAL POLICY, PRACTICE AND RESEARCH?

PISA does not necessarily answer all questions asked by policy makers, educators or educational researchers. In particular, the following aspects need to be considered, both in terms of restrictions and of potentialities related to the study design:

- PISA is measuring "knowledge and skills" for life and does not have a strong "curricular" focus. This limits the extent to which the study will be able to explore relationships between differences in achievement and differences in the intended or implemented curricula. On the other hand, special consideration is given to the out-of-school factors with a potential of enhancing cognitive and affective learning outcomes.
- PISA students are randomly sampled within schools, not from intact classrooms or courses and therefore come from different learning environments with different teachers and, possibly, different levels of instruction. Consequently, classroom-level variables, including teacher-level variables, can only be collected either at the individual student level or at the school level. PISA does not therefore automatically provide specific recommendations on how teachers should teach.

- PISA uses an age-based definition of the target population. This is particularly appropriate for a yield-oriented study, and provides a basis for in-depth exploration of important policy issues, such as the effects of a number of structural characteristics of educational systems (*e.g.* the use of "comprehensive" versus "tracked" study programmes, or the use of grade repetition). On the other hand, the inclusion in the study of an increasing number of non-OECD countries (where the enrolment rate for the 15-year-old age group is maybe less than 100%) requires that a proportion of 15-year-olds still in school be taken into account in the analysis of between-countries differences.

Further, educational issues or challenges highly depend on economical and societal contexts; therefore, what is relevant for one country might be totally irrelevant for another country. As contextual questionnaires have a limited length, testing constraints require making choices in the data that will be collected.

Finally, PISA data do not prove causal relationships. Implementing a pedagogical practice or structure in a country based on the observed outcomes in other countries where these practices or structures exist does not guarantee the success of a given reform. Educational systems largely differ and even if some characteristics seem to be associated with higher performance, PISA does not look at the details of policies and practices within schools at a micro level, and therefore cannot describe how these educational features interact.

However, as PISA is designed to provide schools, local communities and countries with an opportunity to identify their own strengths and weaknesses, a large set of pointers can be identified and communicated to policy makers. Through the additional collection of information on students and their educational environments, PISA allows the identification of social, cultural, economic and educational factors that are associated with student performance. Using the data from questionnaires, analyses linking contextual information with student outcomes allows PISA to address differences:

- between countries in the relationships between student level factors (such as gender and socio-economic background) and outcomes;
- across countries in the relationships between school level factors and outcomes;
- in the proportion of variation in outcomes between (rather than within) schools, and differences in this value across countries;
- between countries in the extent to which schools moderate or increase the effects of individual-level student factors and student outcomes;
- in educational systems and national contexts that are related to differences in student outcomes across countries;
- in any or all of these relationships over time.

The OECD has largely been analysing the results of the first three cycles of PISA and their implications for policy makers. The most important key findings are summarised in the next section.

Key results from PISA 2000, PISA 2003 and PISA 2006

Differences between countries

At the education system level, PISA has and will continue to inform countries on their average performance and more importantly, how this performance evolves over time. The PISA initial reports (OECD, 2001, 2004, 2007) show that among OECD countries, only 10% to 15% of the variation in student performance lies between countries. These results may suggest that the major issue is located within countries. However, country differences in performance should not be underestimated. The expected growth in student performance for one year of schooling is usually estimated at about 0.30 standard deviation. For instance, the difference between the averages of lower grade and upper grade in the Third International Mathematic and Science Study is equal to 0.29 standard deviation (Beaton *et al.*, 1996). In this context, more than two years of schooling separate the top performing OECD countries and the bottom performing OECD countries. Obviously, this difference is large enough for investigating factors that may be associated with higher performance at the country level. A few major features can be identified from the first three data collections of PISA:

- **High performing countries in one domain tend to perform well in other domains**. The correlations between domains at the country level are all above 0.90. Top performing countries in one domain are also among top performing countries in the other domains and the reverse. This result may reflect high or low demanding curricula across domains but may also reflect the effect of economical background, such as gross domestic product (GDP) or the influence of educational structures.
- **Differences in pattern of results according to how students are admitted to schools, grouped across schools and grouped within schools**. In schools systems where students are divided into different school groups at relatively early ages, the socio-economic differences in performance by age 15 are relatively large through school composition effects, while the average level of performance is not higher compared to comprehensive education systems. This is likely one of the most important clear-cut finding of PISA: differentiation at an early age damages equity without any discernible benefit for quality. Equity and quality are not incompatible aims. This result is even reinforced by the longitudinal profile of Poland. In 1999, Poland implemented a massive reform of the schooling system, which now provides a more integrated educational system. Between 2000 and 2003, Poland succeeded in raising the average performance of 15-year-olds for the three domains assessed by PISA. A more detailed analysis also showed that this improvement is mainly attributable to an increase at the lower end of the distribution.
- **Higher performance in schools that keep track of student performance at a public level**. Performance standards can only be maintained if they are consistently implemented and assessed. Different countries use various forms of external assessment, external evaluation or inspection, and schools' own quality assurance and self-evaluation efforts. While there is no single model that best supports school improvement, higher performing countries in PISA have been putting increased emphasis on the monitoring of their schooling systems.
- **Higher performance in countries giving more autonomy to schools to formulate the school budget and to decide on budget allocations within the school even after accounting for other school and system level factors as well as demographic and socio-economic factors**. Similarly, students in educational systems that give more autonomy to schools in educational matters such as textbooks and courses offered, tend to perform better, but this effect is not significant after accounting for some other school and system level factors.

Differences between schools within countries

PISA 2000, PISA 2003 and PISA 2006 showed that the percentage of variation in student performance between schools varies greatly from one country to another. On average, at the OECD level, about 30% of this variation lies between schools. However, northern European countries consistently present across cycle percentages below 20% while in some countries like Belgium, Germany and Austria, more than 50% of variation in student performance lies between schools. A few factors that correlate with school performance have been isolated:

- **The school social intake is the strongest single factor associated with school performance**. It is not just the characteristics of an individual's family but also the characteristics of the families of other students in the school that are closely associated with how well students in the school performed in PISA. On average, students who attend schools with a more advantaged "social profile" are likely to show considerable

higher levels of performance than those attending less advantaged schools. This effect, usually denoted as the "school composition effect" in literature, tends to be higher in countries that differentiate students into various groups or tracks at an early age.

- **Higher performance is found in privately funded schools and in schools that compete for students, but there is no statistically significant effect in either case once the combined effect of individual student socio-economic background and the average socio-economic background of all students in the school are taken into account**. The performance of private schools does not tend to be higher once demographic and socio-economic factors have been taken into account.
- **A modest relationship exists between certain aspects of school resources and student outcomes**. However, much of this relationship disappears when the socio-economic status of the students is accounted for, thus suggesting that there is dependence between school resources and student socio-economic characteristics, *i.e.* students from high socio-economic backgrounds are attending schools with better educational resources.
- **Ability grouping for all subjects within schools appears to have a small negative effect**. Schools which tend to avoid grouping students by ability tend to perform better.
- **The atmosphere created by students and teachers has measurable positive effects**. The PISA results underline the particular importance of school climate as a factor affecting school performance. Its effect is more discernible than the level of school resources. However, school climate also correlates with student background characteristics, showing that the schools with better learning climates are generally attended by students from high socio-economic backgrounds.

Differences between students

Among the numerous relationships identified by PISA at the student level, the findings which are most relevant to policies are:

- **Overall, socio-economic difference is the strongest single factor associated with performance in PISA, accounting for about a fifth of all variation in student scores**.
- **The level of students' engagement at school and in a particular domain is related to educational outcomes**. For instance, those who are habitual readers and who enjoy reading are more likely than others to have high levels of reading literacy. Greater engagement in reading can be a consequence, as well as a cause. A student's overall engagement at school is also a key factor in secondary education. PISA also showed that schools where students perform poorly overall have a tendency to be those where students become disengaged.
- **There are strong relationships between students' attitudes, learning strategies and performance**. The evidence from PISA suggests that students who are more self-confident and highly motivated do better at school largely because they are more inclined to invest in learning strategies that work. These findings suggest that strategies to improve teaching and learning techniques need to do more than just offer students a learning toolkit. Students will only use learning tools if they feel motivated and believe in their capacity to learn.

FURTHER ANALYSES OF PISA DATASETS

As shown by these key findings, PISA offers an inexhaustible source of information for analysing educational issues, and testing hypotheses or educational models that can be translated into policy implications. Even if the initial three PISA and subsequent thematic reports made an extensive use of the PISA data, there are many other possible analyses that may have policy implications.

A substantial amount of variables collected at the student, parent and school levels by PISA are still underused. For example, one of the education issues that significantly interests policy makers and educators is the issue of student's homework. What is the relationship between performance and time spent on homework? Is this relationship consistent across educational systems or does it vary from one system to another? Are there any characteristics of the educational system that relate to the strength of the relationship between homework and performance? To what extent does this relationship interact with student family background and school characteristics? The next section will present a grid that organises contextual variables collected by the PISA surveys and that shows the breadth of information that can address relevant policy issues.

Some other variables, largely used in the OECD initial and thematic reports, also deserve further investigation, to gain a deeper understanding of how these variables are related to performance. Indeed, PISA has identified hundreds of relationships between students, schools and, to a lesser extent, country characteristics and performance. It also showed substantial country variability in the strength of these relationships, but such variation has not yet been fully examined. These data should be scrutinised in relation to the structure of educational systems. Our understanding of how educational systems work will indisputably increase once the variability in relationships is at least partly explained. For instance, PISA 2003 measured several student attitudes such as self-perception, motivation and anxiety in mathematics. As shown in the OECD initial report (OECD, 2004), the strength of the relationship varies extensively from one country to another. While intrinsic motivation explains about 10% of the variation in student performance in mathematics in northern European countries, it only explains 0.4% of the variation in the Netherlands. Does this mean that intrinsic motivation does not matter in the Netherlands? Interestingly, standardising student performance and intrinsic motivation within schools and within grades will substantially raise their respective correlation. Obviously, intrinsic motivation matters in the Netherlands, as in all highly tracked systems. This example illustrates how the structure of educational systems may affect survey outcomes. Furthermore, why is the gender difference in intrinsic motivation the largest in German-speaking countries, *i.e.* Austria, Germany, Liechtenstein, Luxembourg and Switzerland? Is it simply a language-by-item interaction or does it represent a broader cultural effect mediated by teachers? There are obviously economical, cultural and/or geographical similarities between educational systems and these similarities should guide to some extent the analyses conducted to better understand the variation of the strength in the relationships between performance and contextual variables. A better understanding of these variations will facilitate the translation of results into policy recommendations.

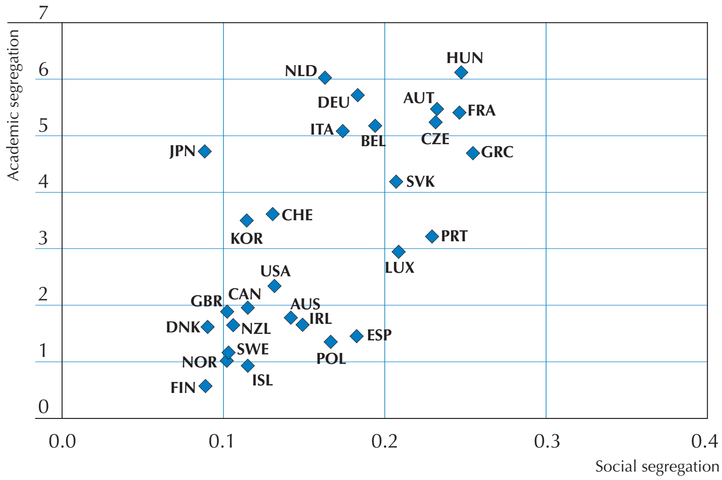
Additionally, the increasing diversity of educational systems participating in PISA provides a unique opportunity to measure the relationship between the characteristics of the educational systems and their respective performances or equity in educational opportunity. Quality and equity should be investigated in conjunction as much as possible because they are intimately intertwined. As previously mentioned, the large-scale reform in Poland consisting of the implementation of a comprehensive system has considerably reduced inequities in student performance, while raising the overall quality in education.

Monseur and Lafontaine (2008) have shown that the relationship between academic segregation and social segregation is intertwined (Figure 1.1). Academic and social segregations reflect the importance of grouping practices into different schools according to social or academic criteria. In this example, the academic segregation index is measured by the intraclass correlation, *i.e.* the percentage of variance that lies between schools for student performance in science in PISA 2006 and social segregation is measured by the intraclass correlation for the international socio-economic index of occupational status (HISEI) in PISA 2006. Unfortunately, it is not possible to know whether social segregation is an antecedent or a consequence of academic segregation. For example, in countries with a substantial percentage of students

enrolled in private schools with admission fees, one might suspect that academic segregation is partly a consequence of social segregation. In other countries such as Belgium or Germany where students are grouped at an early age mainly by performance, social segregation may be a consequence of academic segregation.

Figure 1.1

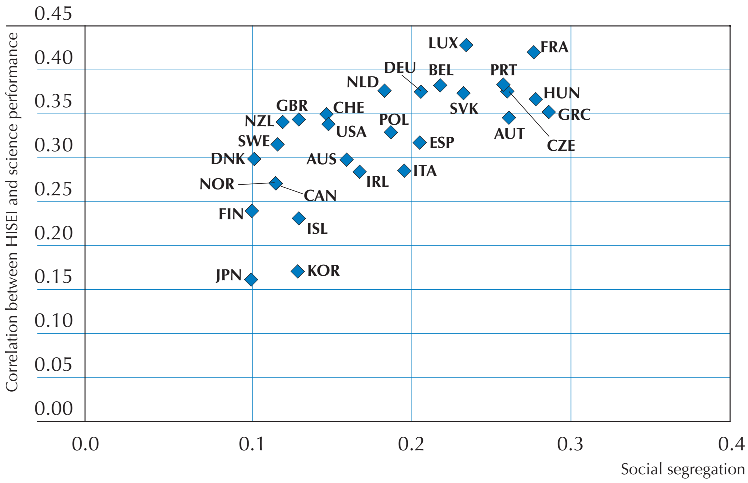
Relationship between social and academic segregations



Social and academic segregations, largely mediated through differentiation, have substantial consequences on the equity of the education system. Figure 1.2 shows the relationship between social segregation and equity.

Figure 1.2

Relationship between social segregation and the correlation between science performance and student HISEI



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Countries in which students tend to be grouped according to their social background usually present a higher correlation between performance in science and family socio-economic background. The difference in the strength of the correlations is significant as they range from about 0.15 (Japan and Korea) to slightly less than 0.45 (France and Luxembourg). The structure of educational systems is, therefore, obviously associated with the extent to which students' socio-economic background determines their performance.

The relationship between segregation and social inequities is summarised in Table 1.3.

Table 1.3
Correlation between social inequities and segregations at schools for OECD countries

Difference in performance between the 25th percentile of the most disadvantaged students and the 25th percentile of the most advantaged students			
	Reading literacy (PISA 2000)	Mathematical literacy (PISA 2003)	Scientific literacy (PISA 2006)
Academic segregation	0.33	0.66	0.44
Social segregation	0.44	0.47	0.52

Correlation between socio-economic background and performance			
	Reading literacy (PISA 2000)	Mathematical literacy (PISA 2003)	Scientific literacy (PISA 2006)
Academic segregation	0.36	0.44	0.40
Social segregation	0.60	0.57	0.70

Source: Monseur, C. & Crahay, M. (in press). Composition académique et sociale des établissements, efficacité et inégalités scolaires: une comparaison internationale. Analyse secondaire des données PISA 2006. Revue française de pédagogie.

The more a country groups students according to their academic performances or socio-economic background, the bigger the difference of performance between the 25% most disadvantaged students and the 25% most advantaged students, and the higher the correlation between socio-economic background and performance. As already stated, this relationship between the structure of the educational system and its social inequities cannot be interpreted as a causal relationship. However, it would be worth analysing how the indicators of social inequities, and in particular the correlation between socio-economic background and performance, will evolve in Poland.

Table 1.3 also reveals the strength of the PISA study. The relationship between a student, a school or an educational system characteristics and its respective performance can be analysed across domains within a data collection or across data collections for one particular domain. This would allow establishing the relationship between commonness and distinctiveness.

Finally, PISA is an outstanding source of data for methodological experts in the context of trend indicators. How stable are these trend indicators? How sensitive are they to the methodological context of the surveys and to the content of the test? These are only a few examples of methodological issues that can be investigated with the PISA data.

Contextual framework of PISA 2006

This section describes the contextual framework of PISA 2006 in order to present the breadth of information collected by PISA that can address relevant policy issues. Figure 1.3 presents a conceptual framework for organising variables collected by the PISA surveys: at the student level (or parent level), at the school level, and at the educational system level through contextual questionnaires. This figure does not present any causal relationships. Figure 1.3 consists of two dimensions: four different levels and three different types (*e.g.* antecedents, processes and outcomes):

- **At the system level**, the macro-economic, social, cultural and political contexts set constraints for the educational policies in a particular country. Outcomes at the system level are not only aggregated learning outcomes but also equity-related outcomes.
- **At the level of the educational institution** (this includes out-of-school providers), characteristics of the educational provider and its community context are antecedents for the policies and practices at the institutional level as well as the school climate for learning. Outcomes at this level are aggregates of individual learning outcomes and also differences in learning outcomes between subgroups of students.
- **At the level of the instructional units**, characteristics of teachers and the classrooms/courses are antecedents for the instructional settings and the learning environment; learning outcomes are aggregated individual outcomes.
- **At the student level**, student characteristics (*e.g.* gender, age, grade) and background (*e.g.* socio-economic status, parental involvement, language spoken at home, peer effects) are antecedents for the individual learning process (*e.g.* perseverance, time on task) and learning outcomes both in cognition and attitude.

Figure 1.3
Conceptual grid of variable types

Antecedents	Processes	Outcomes
Level of the educational system		
Macro-economic, social, cultural and political context	Policies and organisation of education	Outcomes at the system level
Level of educational institutions		
Characteristics of educational institutions	Institutional policies and practice	Outcomes at the institutional level
Level of instructional units		
Characteristics of instructional units	Learning environment	Outcomes at the level of instructional units
Level of individual learners		
Student background and characteristics	Learning at the individual level	Individual learning outcomes

Hypotheses about (at least some of) the relationships between the elements in this two-dimensional grid can be derived from existing conceptual frameworks and subsequent research. Existing conceptual models typically assume antecedents to influence processes, which in turn produce learning outcomes, and conditions on higher levels are usually supposed to impact on those at lower levels.

Some models also expect that outcome variables have an effect on the learning process and thus, allow for a non-recursive relationship between learning process and learning outcomes. For example, positive or negative experiences with subject-matter learning can influence process variables such as habits and attitudes towards the learning of a subject, increase or decrease of the amount of time spent on homework, etc. Another example is long-term interest in a subject or domain, which can be the outcome of learning but can also affect the students' commitment to learning.

It also needs to be recognised that vertical or horizontal relationships may not be the only explanations for differences in learning outcomes. Antecedents at the school level, for example, are often influenced by process variables at the system level, such as educational policies. As another example, the possibility that the socio-cultural context (antecedent at the system level) might have an influence on instructional practices (process at the classroom level) can in turn lead to differences in student outcomes.

Figure 1.4

Two-dimensional matrix with examples of variables collected or available from other sources

	Antecedents	Processes	Outcomes
The education system as a whole	**Cell 1:** Macro-economic and demographic context *For example:* ▪ Gross Domestic Product ▪ Distribution of wealth (Gini index) ▪ Percentage of immigrants	**Cell 5:** Policies and organisation of education *For example:* ▪ Organisation of education (school autonomy, programme structure) ▪ Teacher qualifications and training requirements ▪ School entry age, retention	**Cell 9:** Outcomes at the level of the education system *For example:* ▪ System level aggregates of: reading, mathematical and scientific literacy ▪ Habits in relation to content domains ▪ Attitudinal outcomes ▪ Life skills and learning strategies ▪ Equity related outcomes
Educational institutions	**Cell 2:** Characteristics of educational institutions *For example:* ▪ The involvement of parents ▪ Social intake ▪ Source of funding, location and size ▪ Type of educational provider (*e.g.* out-of-school, educational media programme)	**Cell 6:** Institutional policies and practice *For example:* ▪ Instructional support including both material and human resources ▪ Policies and practices, including assessment and admittance policies ▪ Activities to promote student learning	**Cell 10:** Learning outcomes at the institutional level *For example:* ▪ Institution level aggregates of: reading, mathematical and scientific literacy ▪ Habits in relation to content domains ▪ Affective outcomes (*e.g.* attitudes to mathematics) ▪ Life skills and learning strategies ▪ Differences in outcomes for students of various backgrounds
Instructional settings	**Cell 3:** Characteristics of instructional settings *For example:* ▪ Teacher qualifications ▪ Classroom size	**Cell 7:** Learning environment *For example:* ▪ Ability grouping ▪ Teaching styles ▪ Learning time	**Cell 11:** Learning outcomes at the level of instructional setting *For example:* ▪ Classroom motivation to learn ▪ Average classroom performance
Individual participants in education and learning	**Cell 4:** Individual background *For example:* ▪ Parental occupational status ▪ Parental educational level ▪ Educational resources at home ▪ Ethnicity and language ▪ Age and gender	**Cell 8:** Individual learning process *For example:* ▪ Engagement and attitudes to science ▪ Self-concept and self-efficacy when learning science ▪ Motivation to learn science	**Cell 12:** Individual outcomes *For example:* ▪ Reading, mathematical and scientific literacy ▪ Affective outcomes (*e.g.* attitudes to science)

Hundreds of relationships can be derived from this grid and therefore it would be impossible to represent all of them in a single model. Models would be different depending on the interest of researchers.

Figure 1.4 presents a two-dimensional matrix with examples of variables collected or available from other sources for PISA 2006. As shown earlier, PISA does not limit student outcomes to academic performance. PISA also measures student's self-related cognitions (self-concept, self-efficacy), learning strategies, long-term interest in a subject and educational expectations. Figure 1.4 clearly demonstrates the diversity of information collected by PISA, which can provide empirical support to issues addressed by educators, psychologists, sociologists, economists and so on.

Influence of the methodology on outcomes

The main objectives of the PISA surveys condition the definition of its target population, sampling design, what is to be assessed and, to a lesser extent, the data collection procedures. All these methodological components might affect the survey outcomes and any researchers analysing the PISA data and interpreting the results should always contextualise the results in the survey methodology.

It is not always easy to know beforehand which methodological component will affect the survey outcomes. In PISA, the definition of the target population is certainly one of the methodological components that have such potential influence. Indeed, by selecting an age population, in a number of the participating educational systems (depending on the grade retention policy) target students are enrolled in more than one grade. Moreover, as the target population more or less corresponds to the end of compulsory education, 15-year-olds are, in some countries, distributed in different types of schools. Table 1.4 presents the distribution of students per grade and per International Standard Classification of Education (ISCED) level. With just a few exceptions, 15-year-olds are distributed in both lower secondary and upper secondary education.

Table 1.4

Distribution of students per grade and per ISCED level in OECD countries (PISA 2006)

		Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12	Grade 13	ISCED 2	ISCED 3
OECD	Australia	0.0	0.1	9.2	70.8	19.8	0.1	0.0	80.1	19.9
	Austria	0.3	6.4	44.6	48.7	0.0	0.0	0.0	6.7	93.3
	Belgium	0.4	4.4	31.1	63.2	1.0	0.0	0.0	6.8	93.2
	Canada	0.0	1.7	13.3	83.8	1.2	0.0	0.0	15.0	85.0
	Czech Republic	0.6	3.5	44.3	51.5	0.0	0.0	0.0	50.4	49.6
	Denmark	0.2	12.0	85.3	1.4	1.1	0.0	0.0	98.9	1.1
	Finland	0.2	11.7	88.1	0.0	0.0	0.0	0.0	100.0	0.0
	France	0.0	5.2	34.8	57.5	2.4	0.0	0.0	40.0	60.0
	Germany	1.6	12.3	56.5	29.3	0.3	0.0	0.0	97.3	2.7
	Greece	0.5	2.1	5.3	78.8	13.3	0.0	0.0	8.0	92.0
	Hungary	2.2	5.5	65.7	26.6	0.0	0.0	0.0	7.7	92.3
	Iceland	0.0	0.0	0.2	99.2	0.6	0.0	0.0	99.4	0.6
	Ireland	0.0	2.7	58.5	21.2	17.5	0.0	0.0	61.3	38.7
	Italy	0.3	1.5	15.0	80.4	2.8	0.0	0.0	1.7	98.3
	Japan	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
	Korea	0.0	0.0	2.0	97.3	0.7	0.0	0.0	2.0	98.0
	Luxembourg	0.2	11.8	53.4	34.4	0.1	0.0	0.0	64.2	35.8
	Mexico	2.3	8.1	33.5	48.9	5.1	2.0	0.0	44.5	55.5
	New Zealand	0.0	0.0	0.0	6.2	89.4	4.4	0.0	6.2	93.8
	Norway	0.0	0.0	0.5	99.0	0.5	0.0	0.0	99.5	0.5
	Poland	0.6	3.8	95.0	0.6	0.0	0.0	0.0	99.4	0.6
	Portugal	6.6	13.1	29.5	50.7	0.2	0.0	0.0	50.2	49.8
	Slovak Republic	0.7	2.2	38.5	58.7	0.0	0.0	0.0	38.6	61.4
	Spain	0.1	7.0	33.0	59.8	0.0	0.0	0.0	100.0	0.0
	Sweden	0.0	1.9	95.9	2.2	0.0	0.0	0.0	97.8	2.2
	Switzerland	0.8	16.1	62.6	20.3	0.3	0.0	0.0	82.8	17.2
	Turkey	0.8	4.5	38.4	53.7	2.6	0.0	0.0	5.3	94.7
	United Kingdom	0.0	0.0	0.0	0.9	98.4	0.7	0.0	0.5	99.5
	United States	0.8	1.0	10.7	70.9	16.5	0.1	0.0	12.4	87.6

In some countries, such as France and Greece, lower education is usually provided in different institutions from upper secondary education. As grade retention presents some interactions with gender, immigration or the student socio-economic background, uneven distribution per level of education will be observed. In France, for example, only 35% of the 15-year-olds still in lower secondary education (in *collèges*) are female while they represent 55% of the 15-year-olds in upper secondary education. Regarding the immigration issue, only 38% of native 15-year-olds are in lower education while 63% of immigrant students are at that level of education. This uneven distribution may influence the effect of school variables, such as the disciplinary climate, on the student or school performance. Caution is, therefore, required in interpreting such effects.

The structure of education systems also affects the school variance and any multilevel regression analyses. Indeed, the distinction between upper and lower secondary education is part of the within-school variance in some countries where both lower and upper secondary education are provided in one educational institution. On the contrary, in other countries where lower and upper secondary education are provided in separate educational institutions (*e.g.* in France), this distinction will contribute to the between-school variance.

Does this mean that PISA provides biased estimates of school variance? Certainly not, but the school variance computed on PISA data could lead to some overstatements such as "the school catchment area in France is useless as it does not reduce inequities between schools", unless the nature of the PISA data and the structure of the educational system are correctly taken into account in interpretation. In interpreting such between-school variance, it always needs to be kept in mind that PISA's target population is 15-year-old students. For instance, if the data is based on a population of 16-year-olds, the variance caused by the difference between the two adjacent grades would contribute to the within-school variance, but not to the between-school variance.

The school variance is also affected by the definition of a school within each participating country. As described in Annex A3 in the PISA 2003 initial report (OECD, 2004) and in Annex A2 in the PISA 2006 initial report (OECD, 2007), in some countries, sub-units within schools were sampled instead of schools, which may affect the estimation of the between-school variance components. In some countries such as Austria and Japan, schools with more than one study programme were split into units delivering each programme. In the Netherlands, for schools with both lower and upper secondary programmes, schools were split into units delivering each programme level.

As previously mentioned, the structure of education systems and the definition of the sampling units have an impact on the interpretation of the between-school variance. It is thus highly recommended that analysts carefully review their outcomes and their policy recommendations in the light of the structures of education systems and the definition of schools as sampling units.

Notes

1. The GDP of the countries that took part in PISA 2006 represents 86% of the 2006 world GDP. Some of the entities represented in this report are referred to as partner economies. This is because they are not strictly national entities.

2. For more information, visit *www.pisa.gc.ca/yits.shtml* (YITS, the Canadian stydy); *http://www.sfi.dk/sw19649.asp* (the Danish study) and *www.acer.edu.au* (the Australian study).

3. Visit *www.pisa.oecd.org* for links to countries' national PISA websites and national PISA reports.

2

Exploratory Analysis Procedures

PISA DATA ANALYSIS MANUAL: SAS® SECOND EDITION – ISBN 978-92-64-05624-4 – © OECD 2009

INTRODUCTION

PISA surveys use complex methodologies that condition the way data should be analysed. As this is not yet included in standard procedures included in the statistical software packages such as SAS® or SPSS®, this manual describes the methodologies in detail and also presents syntax and macros developed specially for analysing the PISA data.

First of all, PISA does not draw simple random samples of students from exhaustive lists of 15-year-olds. The sampling design applied in PISA, its rationale and its consequences on how data should be analysed are mainly presented in Chapters 3 and 4. Briefly, PISA usually samples students in two stages: schools are first sampled and then students are sampled in the participating schools. Such sampling design increases the standard errors of any population estimates. As most of the statistical packages assume the data were collected on a simple random sample, analysing the PISA data with such software would systematically underestimate the standard errors and therefore lead to reporting non-significant results as significant. This would jeopardise the credibility of the programme.

Secondly, PISA uses imputation methods, denoted plausible values, for reporting student performance. From a theoretical point of view, any analysis that involves student performance estimates should be analysed five times and results should be aggregated to obtain: *(i)* the final estimate; and *(ii)* the imputation error that will be combined with the sampling error in order to reflect the test unreliability on the standard error. The detailed description of plausible values and its use are presented in Chapters 6 and 8.

All results published in the OECD initial and thematic reports have been computed accordingly to these methodologies, which means that the reporting of a country mean estimate and its respective standard error requires the computation of 405 means as described in detail in the next sections.

This chapter discusses the importance and usefulness of applying these recommended procedures, depending on the circumstances and on the stage of the data analysis process. Alternatives that shorten the procedures will be also presented, as well as the potential bias associated with such shortcuts.

The chapter is structured according to the three methodological issues that affect the way data should be analysed:

- weights,
- replicates for computing the standard errors,
- plausible values.

WEIGHTS

Weights are associated to each student and to each school because:

- students and schools in a particular country did not necessarily have the same probability of selection;
- differential participation rates according to certain types of school or student characteristics required various non-response adjustments;
- some explicit strata were over-sampled for national reporting purposes.

Weighting data is a straightforward process in SAS®. Most of the SAS statistical procedures include a WEIGHT statement. Box 2.1 presents the weight statement in the proc means procedure, while w_fstuwt is the variable name of the student final weights.

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Box 2.1 **WEIGHT statement in the proc means procedure**

```
proc means data=temp1;
var pv1scie;
weight w_fstuwt;
run;
```

The syntax of Box 2.1 will provide unbiased estimates of some statistics such as mean and percentile. However, it will return biased estimates of the variance and consequently all related statistics such as standard deviation and standard error. For example, in order to compute weighted variance, SAS® firstly computes a weighted sum of square according to the following formulae:

$$SS = \sum_{i=1}^{n} w_i (x_i - \bar{x})^2$$

with w_i the weight for student i, X_i the value of student i for variable X and $\bar{X}$ the weighted mean estimate of variable X.

Then, as the default setting in SAS®, the weighted sum of square is divided by degree of freedom, which is equal to *N-1* for the variance. Consequently, the results largely overestimate the variance and its related statistics.

To overcome this problem, VARDEF must be specified in the proc means procedure. It indicates the divisor that will be used in the computation of the variance. Four divisors are available:

- *N*, *i.e.* the number of valid observations;
- DF for Degree of Freedom, which is equal to *N-1* for the variance;
- WGT, *i.e.* the sum of the weights for the valid observations;
- WDF for the Weighted Degree of Freedom, which corresponds to the sum of the weights minus 1.

As the default divisor is DF, the sum of squares, with weighted or without weighted, will be divided by *N-1* when the VARDEF option is not included. The DF divisor will largely overestimate the variance and its related statistics. Realistic estimates of the variance can be obtained with the WGT or WDF divisors by adding VARDEF=WGT or VARDEF=WDF.

It is, however, worth noting that SAS® does not compute standard errors with these two divisors of WGT and WDF. This is not an issue for computing the final estimates for reporting, since replicates are used for computing standard errors, as described in the following section. But, when analysts are interested in computing rough estimates of standard errors for provisional exploratory analysis, this becomes an issue. One way of obtaining realistic rough estimates of a standard error,[1] without using replicates, is to normalise the weights. The weight included in the database should be multiplied by a ratio of the number of observations to the sum of the weights. In other words, the weights should be multiplied by the total number of students and divided by the weighted total number of students. This linear transformation will ensure that the sum of the weights is equal to the number of observations. In this context, the VARDEF option does not need to be specified in SAS®.

Can analyses be conducted without weighting the data? Figure 2.1 represents the unweighted and weighted mean proficiency estimates in science for OECD countries in PISA 2006. In most countries, the difference is negligible. However, for some countries, the difference is quite substantial. Large differences between weighted and unweighted means usually result from over-sampling some strata in the population for national reporting purposes.

Figure 2.1
Science mean performance in OECD countries (PISA 2006)

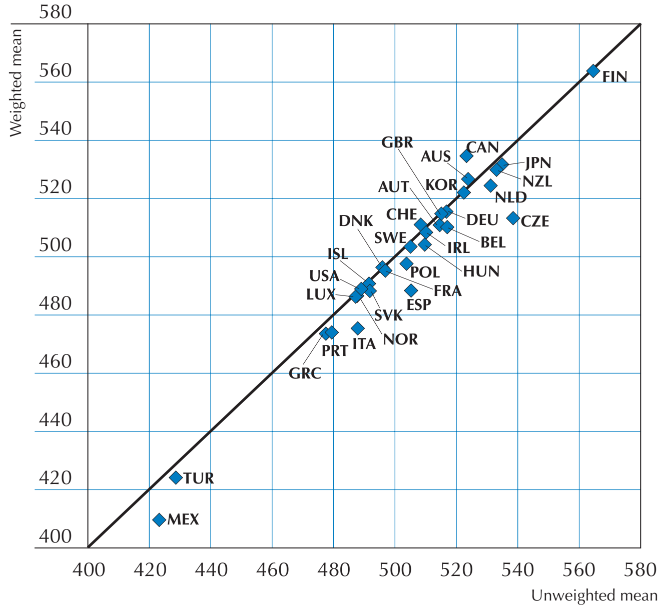


Figure 2.2
Gender differences in reading in OECD countries (PISA 2000)

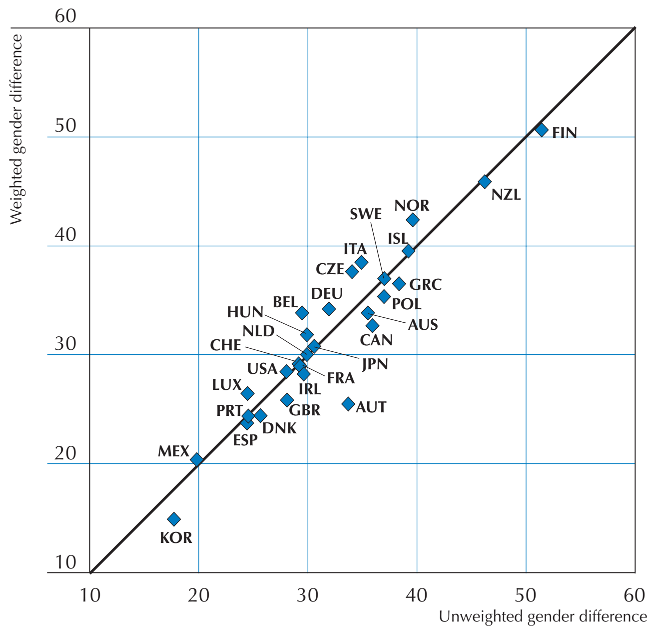
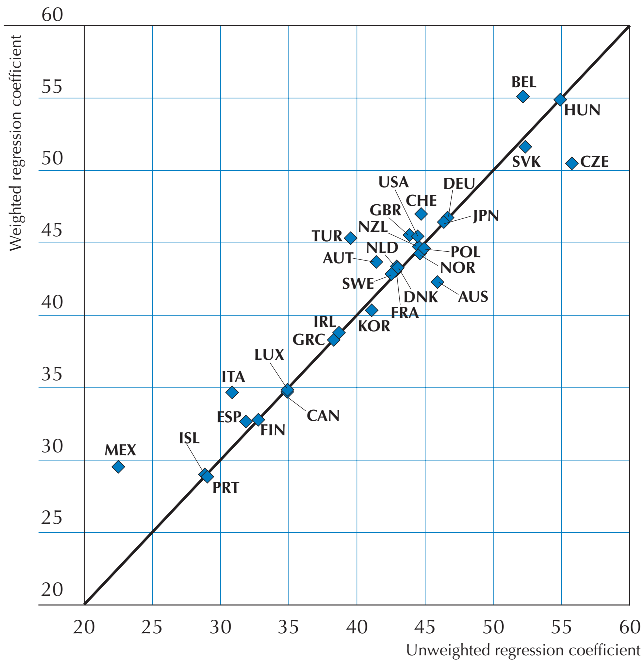


Figure 2.2 compares the unweighted and weighted gender differences in reading in PISA 2000. In most countries, the difference is negligible, but in Austria, for instance, the unweighted and weighted gender differences are equal to 33.5 and 25.4 respectively. Uneven distribution of males and females per type of schools (vocational versus academic) and differential participation rates per type of schools might explain such gaps between unweighted and weighted gender differences.

Finally, Figure 2.3 presents the unweighted and weighted regression coefficient of student socio-economic background (ESCS) on mathematic performance in PISA 2003. As shown by the figure, differences between unweighted and weighted coefficient are sometimes not negligible.

Figure 2.3

Regression coefficient of ESCS on mathematic performance in OECD countries (PISA 2003)



These three examples clearly demonstrate the impact of the weights on population parameter estimates. The bias of unweighted estimates could be substantial.

In conclusion, the weighting process does not make the analysis procedures more complex and guarantees that population estimates will be unbiased. Analyses should therefore always be weighted, at any stage of the process, whether it is the provisional exploration of the data or the final analyses before reporting.

REPLICATES FOR COMPUTING THE STANDARD ERROR

PISA applies two-stage sampling instead of simple random sampling. Chapter 3 describes the sampling design of the PISA surveys in detail and why such a design is implemented. This section, however, briefly describes the differences between these two sampling designs in order to provide rationale for using replicate weights. As previously indicated , statistical packages such as SAS® or SPSS® make the assumption that data are collected on a simple random sample of individuals.

One of the differences between simple random sampling and two-stage sampling is that for the latter, selected students attending the same school cannot be considered as independent observations. This is because students within a school usually have more common characteristics than students from different schools. For instance, they would have access to the same school resources, have the same teachers, be taught a common curriculum, and so on. Differences between students from different schools are also greater if different educational programmes are not available in all schools. For example, it would be expected that differences between students from a vocational school and students from an academic school would be bigger than differences between students from two vocational schools.

Furthermore, it is likely that within a country, within subnational entities, and within cities, people tend to live in areas according to their financial resources. As most children tend to attend schools close to their homes, it is assumed that students attending the same school come from similar socio-economic backgrounds.

A simple random sample of 4 000 students is therefore likely to cover the diversity of the population better than a sample of 100 schools with 40 students observed within each school. It follows that the uncertainty associated with any population parameter estimate (*i.e.* standard error) will be greater for a two-stage sample than for a simple random sample of the same size.

Reporting accurate and unbiased standard error estimates is of prime importance, since these estimates could be used for reporting differences that are statistically significant between countries or within countries. Reporting gender differences, for example, might lead to educational reforms aimed to reduce the gap between males and females. It is therefore essential to assure that these differences are indeed statistically significant.

Earlier student assessment surveys used to increase the simple random sample standard errors by the design effect (usually denoted in the statistical literature as DEFF) were roughly estimated on a few key variables for some population estimators, such as means, correlation and regression coefficients. For instance, in the First International Mathematics Study (FIMS) (Husen, 1967):

> "four subsamples of each subpopulation were obtained – this meant that instead of having only one sample representing a population, there were four. The purpose of doing this was twofold: *(i)* the standard errors of sampling could be obtained from the comparison of subsamples and, *(ii)* the answer sheets for each subsample could be shipped separately; thus if one was lost, three still remained."[2]

The International Association for the Evaluation of Educational Achievement (IEA) Six Subject Survey extended the FIMS procedure for the estimation of standard errors by integrating the scientific development of John Tukey on the Jackknife replication method. The whole sample for each country was divided into ten subsamples, following the sampling structure, and then ten complementary samples were obtained by leaving out, from the whole sample, each subsample in turn. Population estimates were then computed on each complementary subsample. The variability of these population estimates was used to estimate the standard errors and their respective design effect. The comparison between these design effects and their respective theoretical design effects based on the school variance and the average within school sample size showed quite consistent results, which allowed using the theoretical design effect.

As noted by Peaker (1975), "this evidence was combined with the evidence from the Mathematics Study in 1967, and suggested that appropriate values of DEFF were 2.4 for criterion means, 1.6 for correlations and 1.4 for regression coefficients."

In the late 1980s, the power of computers allowed the systematic use of replication methods. Standard errors were estimated for the Second International Science Study (SISS) by the Jackknife method for unstratified sample which consists of creating as many complementary samples as the number of schools in the whole sample. Each complementary sample was created by dropping one school at a time. The IEA Reading Literacy Study also used this replication method as well.

This manual presents how these replicates are computed in detail (Chapter 4) and how to estimate a standard error with these replicates (Chapter 7).

This section discusses the consequences of not using the replicates for estimating the standard errors and the appropriateness of using them in all phases of the data analysis process.

The PISA Technical Reports (OECD, 2002c, 2005, 2009) describe the sampling design effects for the performance country mean estimates in the chapter devoted to the sampling outcomes. Mathematically, the design effect corresponds to the ratio between the unbiased estimate of the sampling variance for a particular parameter and the sampling variance for that parameter if the observed sample was considered as a simple random sample. In PISA 2000, the sampling design effect for the country mean estimate on the combined reading literacy scale ranged from 2.32 to 19.92. This means that the actual standard error is from 1.5 to 4.4 times larger than the simple random sample standard error. In PISA 2003 and PISA 2006, countries requesting an adjudication of their data at a subnational level had to over-sample. The sampling design was, therefore, less effective and the design effect was higher. For instance, the design effect for the country performance mean estimate of Mexico was higher than 50 in PISA 2003.

Table 2.1 presents the type I error depending on the design effect. For instance, with a design effect of 4, a data analyst using the standard error returned by statistical packages assuming simple random sample will be working with the type I error of 0.33. As 0.01, 0.05 or 0.1 are normally used for the criteria of the significance level, this is a very important difference. Let us suppose an analysis estimates gender difference in science performance. When the gender difference is significantly different from 0 at the significance level of 0.33, the analysis has a 33% chance of being wrong in saying that there is a significant gender difference.

Table 2.1
Design effect and type I errors

Design effect (coefficient of increase)	Type I error	Design effect (coefficient of increase)	Type I error
1.5	0.11	11.0	0.55
2.0	0.17	11.5	0.56
2.5	0.22	12.0	0.57
3.0	0.26	12.5	0.58
3.5	0.29	13.0	0.59
4.0	0.33	13.5	0.59
4.5	0.36	14.0	0.60
5.0	0.38	14.5	0.61
5.5	0.40	15.0	0.61
6.0	0.42	15.5	0.62
6.5	0.44	16.0	0.62
7.0	0.46	16.5	0.63
7.5	0.47	17.0	0.63
8.0	0.49	17.5	0.64
8.5	0.50	18.0	0.64
9.0	0.51	18.5	0.65
9.5	0.52	19.0	0.65
10.0	0.54	19.5	0.66
10.5	0.55	20.0	0.66

The design effect varies from one country to another, but it also varies from one variable to another within a particular country. Figure 2.4 compares the design effect on the country mean estimates for the science performance and for the student socio-economic background (ESCS) in PISA 2006. The design effect on the mean estimate for the student socio-economic background is usually smaller than the design effect for science performance, since grouping students into different schools is usually based on their academic performance and, to a lesser extent, based on student socio-economic background.

Figure 2.4

Design effect on the country mean estimates for science performance and for ESCS in OECD countries (PISA 2006)

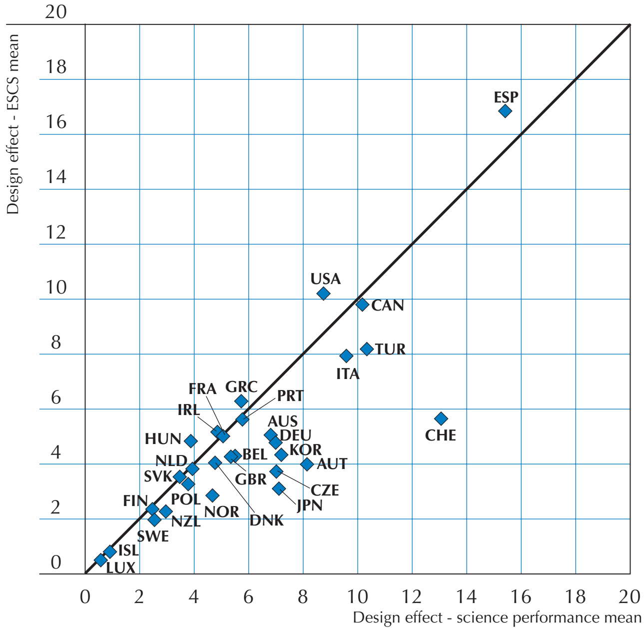


Figure 2.5 compares two different types of standard errors of the regression coefficient of ESCS on science performance: one is computed just as simple random sample (SRS) and the other is computed with replicates (unbiased). In Figure 2.5, the following can be observed:

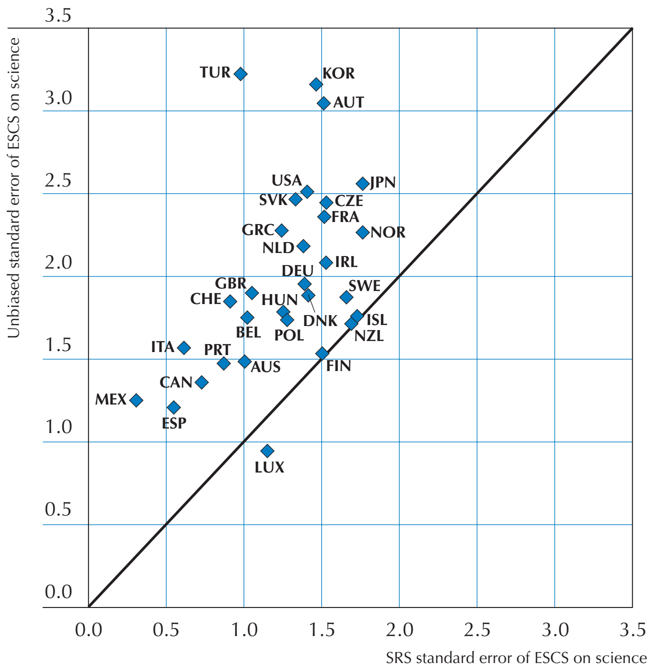
- For most countries unbiased standard errors are bigger than SRS standard errors (*i.e.* dots are above the diagonal line),[3] but unbiased standard errors are not twice as big as SRS standard errors. This means that design effects are not as big as two in most countries. This result, therefore, supports the notion that design effects for regression coefficients (Figure 2.5) are smaller than design effects for mean estimates (Figure 2.4), as already noted by Peaker (1975).

- No specific patterns between SRS and unbiased standard errors are observed in Figure 2.5. This means that the design effect for regression coefficients varies from one country to another.

As illustrated by these few examples, the design effect depends on: *(i)* the population parameter that needs to be estimated; *(ii)* the sampling design of the country; *(iii)* the variables involved in the analyses (in particular the importance of the between-school variance relative to the within-school variance). Therefore, it would

be inappropriate to suggest a single design effect for a particular parameter to be used for all countries to obtain a rough estimate of the actual standard error, based on the simple random sample standard error – especially given the increasing number of countries implementing a study design for regional adjudications and the large number of countries implementing international or national options.

Figure 2.5
Simple random sample and unbiased standard errors of ESCS on science performance in OECD countries (PISA 2006)



In sum, the results that will be reported have to be computed according to the recommended procedures, *i.e.* standard errors have to be estimated by using the replicates. During the exploratory phase, analysts might skip the replicate computations to save time. Instead, analysts could use the normalised weights and apply design effects. But, it is advised not to wait until the last stage of the process to compute unbiased estimates of the standard errors. Indeed, it might change a major outcome that would require rewriting some section of the reports. It is also important to note that analysis with the PISA data for only one country might inflate the standard error by using some fixed design effect values. This would require starting by estimating sensitive values of design effects for parameters such as mean, correlation, regression coefficient and so on. With a little practice, the procedures developed for analysing PISA data are not a constraint anymore. Moreover, with standard computers, these procedures do not take more than a couple of minutes.

PLAUSIBLE VALUES

This section briefly presents the rationale for using plausible values. The detailed description of plausible values and its use are presented in Chapters 6 and 8.

Since the Third International Mathematics and Science Survey conducted by the IEA in 1995, student proficiency estimates are returned through *plausible values*.

> "The simplest way to describe plausible values is to say that plausible values are a representation of the range of abilities that a student might reasonably have. (…). Instead of directly estimating a student's ability θ, a probability distribution for a student's θ, is estimated. That is, instead of obtaining a point estimate for θ, (like a WLE[4]), a range of possible values for a student's θ, with an associated probability for each of these values is estimated. Plausible values are random draws from this (estimated) distribution for a student's θ." (Wu and Adams, 2002)

As will be described in Chapter 6, plausible values present several methodological advantages in comparison with classical Item Response Theory (IRT) estimates such as the Maximum Likelihood Estimates or Weighted Maximum Likelihood Estimates. Indeed, plausible values return unbiased estimates of:

- population performance parameters, such as mean, standard deviation or decomposition of the variance;
- percentages of students per proficiency level as they are on a continuous scale, unlike classical estimates which are on a non-continuous scale;
- bivariate or multivariate indices of relations between performance and background variables as this information is included in the psychometric model.

Usually, five plausible values are allocated to each student on each performance scale. Statistical analyses should be performed independently on each of these five plausible values and results should be aggregated to obtain the final estimates of the statistics and their respective standard errors. It is worth noting that these standard errors will consist of sampling uncertainty and test unreliability.

The plausible value methodology, combined with the replicates, requires that the parameter, such as a mean, a standard deviation, a percentage or a correlation, has to be computed 405 times (*i.e.* 5 plausible values by one student final weights and 80 replicates) to obtain the final estimate of the parameter and its standard error. Chapter 8 describes an unbiased shortcut that requires only 85 computations.

Working with one plausible value instead of five will provide unbiased estimate of population parameters but will not estimate the imputation error that reflects the influence of test unreliability for the parameter estimation. With a large dataset, this imputation error is relatively small. However, the smaller the sample size, the greater the imputation error.

Table 2.2 to Table 2.5 present the differences for four population parameters (*i.e.* mean, standard deviation, correlation and regression coefficient) between the estimates based on one plausible value and the same estimates based on five plausible values. These analyses were computed on the PISA 2006 science performance data in Belgium. Simple random samples of various sizes were selected. Each table shows:

- the estimated statistic based on one plausible value,
- the estimated standard error based on one plausible value,
- the estimated statistic based on five plausible values,
- the estimated standard error based on five plausible values,
- the sampling error based on five plausible values,
- the imputation error based on five plausible values.

With a sample size of 6 400 students, using one plausible value or five plausible values does not make any substantial difference in the two mean estimates (510.56 versus 510.79) as well as in the two standard error estimates (2.64 versus 2.69). In term of type I error, that would correspond to a shift from 0.050 to 0.052.

Table 2.2
Mean estimates and standard errors

Number of cases	Estimate on 1 PV	S.E. on 1 PV	Estimate on 5 PVs	S.E. on 5 PVs	Sampling error	Imputation error
25	500.05	19.47	493.87	21.16	20.57	4.55
50	510.66	17.70	511.48	16.93	16.76	2.18
100	524.63	12.25	518.00	12.42	11.70	3.81
200	509.78	7.52	509.46	7.79	7.56	1.72
400	507.91	6.34	508.31	6.52	6.46	0.86
800	507.92	4.55	508.69	4.58	4.50	0.79
1 600	506.52	3.54	507.25	3.44	3.39	0.52
3 200	511.03	2.77	511.48	2.76	2.70	0.49
6 400	510.56	2.64	510.79	2.69	2.67	0.23

Notes: PV = plausible value; S.E. = standard error.

Table 2.2 also illustrates how the imputation error increases as the sample size decreases. With a sample of 25 students, the imputation error is as big as the sampling error with a sample of 800 students. However, even if the imputation error is quite large with a sample of 25 students, working with one plausible value instead of five would correspond to a small shift in type I error from 0.05 to 0.072.

Under normal assumptions, the imputation error implies that the average, *i.e.* 493.87 for a sample of 25 students, can vary from 485 to 503. Using one plausible value instead of five for a very small sample may therefore have a considerable impact on the parameter estimates.

Table 2.3
Standard deviation estimates and standard errors

Number of cases	Estimate on 1 PV	S.E. on 1 PV	Estimate on 5 PVs	S.E. on 5 PVs	Sampling error	Imputation error
25	116.86	14.87	114.99	13.62	11.95	5.97
50	106.53	17.05	104.38	15.32	15.00	2.88
100	90.36	8.79	90.73	8.75	8.19	2.81
200	101.66	6.49	101.18	6.75	6.50	1.65
400	97.52	3.63	97.67	4.39	3.83	1.95
800	100.03	2.66	99.97	3.65	2.92	2.00
1 600	96.82	2.51	96.36	2.41	2.35	0.48
3 200	100.66	2.09	100.29	2.19	2.14	0.42
6 400	98.66	1.97	99.09	2.01	1.94	0.48

Notes: PV = plausible value; S.E. = standard error.

Table 2.4
Correlation estimates and standard errors

Number of cases	Estimate on 1 PV	S.E. on 1 PV	Estimate on 5 PVs	S.E. on 5 PVs	Sampling error	Imputation error
25	0.57	0.13	0.65	0.13	0.11	0.07
50	0.58	0.12	0.58	0.13	0.12	0.05
100	0.47	0.09	0.49	0.09	0.09	0.03
200	0.54	0.05	0.54	0.05	0.04	0.02
400	0.40	0.05	0.40	0.05	0.05	0.01
800	0.39	0.04	0.39	0.04	0.04	0.00
1 600	0.45	0.02	0.45	0.03	0.02	0.01
3 200	0.43	0.02	0.43	0.02	0.02	0.00
6 400	0.43	0.01	0.44	0.02	0.01	0.00

Notes: PV = plausible value; S.E. = standard error.

Table 2.5
ESCS regression coefficient estimates and standard errors

Number of cases	Estimate on 1 PV	S.E. on 1 PV	Estimate on 5 PVs	S.E. on 5 PVs	Sampling error	Imputation error
25	57.76	24.99	51.43	28.32	27.34	6.73
50	34.19	11.20	31.64	11.67	10.90	3.80
100	37.44	12.33	41.19	12.43	11.90	3.28
200	36.43	7.60	41.60	8.65	7.92	3.17
400	53.27	5.43	53.89	5.79	5.61	1.31
800	47.83	4.20	47.98	4.62	4.26	1.64
1 600	47.26	3.12	47.86	3.56	3.17	1.48
3 200	47.98	2.45	48.22	2.54	2.53	0.25
6 400	46.91	1.92	47.23	2.08	1.97	0.63

Notes: PV = plausible value; S.E. = standard error.

Similar conclusions can be drawn from the three tables above that refer respectively to standard deviation, correlation and ESCS regression coefficient.

CONCLUSION

This chapter briefly described the three methodological components of PISA that condition the data analysis process: weights, replicates and plausible values. It also discussed the consequences of not applying the recommended statistical procedures according to the data analysis phase.

In summary, the recommendations are:

- At any stage of the data analysis process, data should always be weighted. Unweighted data will return biased estimates. The importance of weighting the data is reinforced by the increasing number of countries that request a data adjudication at a subnational level, since such a request requires oversampling in almost all cases. As weighting data does not slow down the data analysis process and can easily be implemented in statistical packages, there is no valid reason for skipping this process.

- Use of replicates for estimating the standard error is certainly the methodological component that slows down the data analysis process the most. During the exploratory phase of the data, it is not of prime importance to estimate the standard error with the replicates. Standard errors returned by statistical software with normalised weight, and inflated by a rough estimate of the design effect, can provide the data analyst with an acceptable indication of the statistical significance of hypotheses. However, any results that will be published or communicated to the scientific community and to policy makers should be computed with replicates.

- Finally, using one plausible value or five plausible values does not really make a substantial difference on large samples. During the exploratory phase of the data, statistical analyses can be based on a single plausible value. It is, however, recommended to base the reported results on five plausible values, even on large samples. This will guarantee consistencies between results published by the OECD and results published in scientific journals or national reports. Further, results based on five plausible values are, from a theoretical point of view, incontestable.

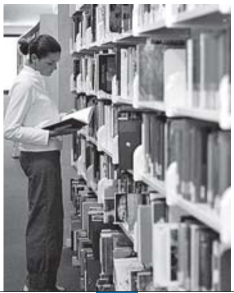
Notes

1. This rough estimate of standard error is based on the assumption of a simple random sample.

2. In the IEA Six Subject Survey, a box containing answer sheets from Belgium fell out of a boat into the sea.

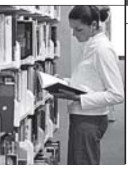
3. PISA in Luxembourg is not a sample survey but a census. SRS does not take into account the school stratification variables, while PISA does. Therefore, in Luxembourg, SRS standard errors are bigger than unbiased standard errors.

4. Weighted Likelihood Estimates.



3

Sample Weights



INTRODUCTION

National and international surveys usually collect data from a sample. Dealing with a sample rather than the whole population is preferable for several reasons.

First, for a census, all members of the population need to be identified. This identification process presents no major difficulty for human populations in some countries, where national databases with the name and address of all, or nearly all, citizens may be available. However, in other countries, it is not possible for the researcher to identify all members or sampling units of the target population, mainly because it would be too time-consuming or because of the nature of the target population.

Second, even if all members of a population are easily identifiable, researchers may still draw from a sample, because dealing with the whole population:

- might require unreasonable budgets;
- is time-consuming and thus incompatible with publication deadlines;
- does not necessarily help with obtaining additional and/or required information.

Drawing a sample can be done in several ways depending on the population characteristics and the survey research questions. All sample designs aim to avoid bias in the selection procedure and achieve the maximum precision in view of the available resources. Nevertheless, biases in the selection can arise:

- If the sampling is done by a non-random method, which generally means that the selection is consciously or unconsciously influenced by human choices. The importance of randomness in the selection procedure should not be underestimated;
- If the sampling frame (list, index, or other population record) that serves as the basis for selection does not cover the population adequately, completely or accurately.

Biases can also arise if some sections of the population are impossible to find or refuse to co-operate. In educational surveys, schools might refuse to participate and within participating schools, some students might refuse to participate or simply be absent on the day of the assessment. The size of the bias introduced by the school or student non-response is proportional to the correlation between the school, or the student, propensity to participate and the variables measured with cognitive tests or contextual questionnaires. For instance, it may be that low achievers are more likely to be absent on the day of the assessment than high achievers. On the other hand, it would be less likely to observe a correlation between the height of a student and his/her propensity to participate. The non-response would therefore not introduce a bias in the height mean estimate.

To limit the size of the bias due to non-response, international education surveys require a minimal student participation rate. For PISA, this minimum is 80%.

Finally, if the sampling units do not have the same chances to be selected and if the population parameters are estimated without taking into account these varying probabilities, then results might also be biased. To compensate for these varying probabilities, data need to be weighted. Weighting consists of acknowledging that some units in the sample are more important than others and have to contribute more than others for any population estimates. A sampling unit with a very small probability of selection will be considered as more important than a sampling unit with a high probability of selection. Weights are therefore inversely proportional to the probability of selection.

Nevertheless, a sample is only useful to the extent that it can estimate some characteristics of the whole population. This means that statistical estimates computed on the sample, including a mean, a standard

deviation, a correlation, a regression coefficient, and so on, can be generalised to the population. This generalisation is more reliable if the sampling requirements have been met.

Depending on the sampling design, selection probabilities and procedures to compute the weights will vary. These variations are discussed in the following sections.

WEIGHTS FOR SIMPLE RANDOM SAMPLES

Selecting members of a population by simple random sampling is the most straightforward procedure. There are several ways to draw such a sample, *e.g.*:

- The *N* members[1] of a population are numbered and *n* of them are selected by random numbers without replacement;
- *N* numbered discs are placed in a container, mixed well, and *n* of them are selected at random;
- The *N* population members are arranged in a random order, and every $\frac{N}{n}$th member is then selected; or
- The *N* population members are each assigned a random number. The random numbers are sorted from lowest to highest or highest to lowest. The first *n* members make up one random sample.

The simple random sample gives an equal probability of selection to each member of the population. If *n* members are selected from a population of *N* members according to a simple random procedure, then the probability of each member *i* to be part of the sample is equal to:

$$p_i = \frac{n}{N}$$

For example, if 40 students are randomly selected from a population of 400 students, the probability of each student *i* to be part of the sample is equal to:

$$p_i = \frac{n}{N} = \frac{40}{400} = 0.1$$

In other words, each student has one chance out of ten of being selected.

As mentioned previously, weights are usually defined as the inverse of the probability of selection. In the case of a simple random sample, the weight will be equal to:

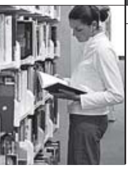
$$w_i = \frac{1}{p_i} = \frac{N}{n}$$

The weight of each of the 40 students selected from a population of 400 students will therefore be equal to:

$$w_i = \frac{1}{p_i} = \frac{N}{n} = \frac{400}{40} = 10$$

This means that each student in the sample represents himself or herself, as well as nine other students. Since each unit has the same selection probability in a simple random sample, the weight attached to each selected unit will also be identical. Therefore, the sum of the weights of the selected units will be equal to the population size, *i.e. N*.

$$\sum_{i=1}^{n} w_i = \sum_{i=1}^{n} \frac{N}{n} = N$$



In the example,

$$\sum_{i=1}^{40} 10 = 400$$

Furthermore, since all sampled units have the same weight, the estimation of any population parameter should not be affected by the weights. For instance, consider the mean of some characteristic, *X*. The weighted mean is equivalent to the sum of the product of the weight and *X* divided by the sum of the weights.

$$\hat{\mu}_{(X)} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

Since w_i is a constant, the weighted mean and the unweighted mean will be equal.

$$\hat{\mu}_{(X)} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} = \frac{w_i \sum_{i=1}^{n} x_i}{w_i \sum_{i=1}^{n} 1} = \frac{\sum_{i=1}^{n} x_i}{n}$$

However, even with an equi-probabilistic sample, statistical software packages might return different results for weighted and unweighted data. As mentioned in Chapter 2, SAS® proposes for instance four options for dividing the weighted sum of square, *i.e.* *(i)* the number of valid observations; *(ii)* the number of valid observations minus 1; *(iii)* the sum of the weights for the valid observations; and *(iv)* the sum of the weights for the valid observations minus 1. By default, SAS® divides the weighted sum of square by (n–1) while SPSS® divides it by the sum of the weight minus 1.

Table 3.1
Height and weight of ten persons

Individual	Weight	Height
1	10	160
2	10	162
3	10	164
4	10	166
5	10	168
6	10	170
7	10	172
8	10	174
9	10	176
10	10	178

Table 3.2
Weighted and unweighted standard deviation estimate

	Standard deviation estimate
SAS® unweighted estimate	6.0553
SAS® weighted estimate default option	19.14854
SAS® weighted estimate option = N	18.1659
SAS® weighted estimate option = DF	19.14854
SAS® weighted estimate option = WGT	5.74456
SAS® weighted estimate option = WDF	5.7735
SPSS® unweighted estimate	6.0553
SPSS® weighted estimate	5.7735

Table 3.1 presents the height of ten individuals and Table 3.2, the different standard deviation estimates returned by SPSS® and SAS®.

Table 3.2 clearly indicates how a population estimate can be affected by the weighting process offered in the statistical software, even with an equi-probabilistic sample. Data analysts are strongly recommended to carefully read the software documentation related to the weights.

SAMPLING DESIGNS FOR EDUCATION SURVEYS

Simple random sampling is very rarely used in education surveys because:

- It is too expensive. Indeed, depending on the school population size, it is quite possible that selected students would attend many different schools. This would require the training of a large number of test administrators, the reimbursement of a large amount of travel expenses and so on;
- It is not practical. One would have to contact too many schools; and
- It would be impossible to link, from a statistical point of view, student variables to school, class, or teacher variables. Educational surveys usually try to understand the statistical variability of the student's outcome measure by school or class level variables. With just one or only a few students per school, this statistical relationship would have no stability.

Therefore, surveys in education usually draw up a student sample in two steps. First, a sample of schools is selected from a complete list of schools containing the student population of interest. Then, a simple random sample of students or classes is drawn from within the selected schools. In PISA, usually 35 students from the population of 15-year-olds are randomly selected within the selected schools. If less than 35 15-year-olds attend a selected school, then all of the students will be invited to participate.

This two-stage sampling procedure will have an impact on the calculation of the weights and, similarly, the school selection procedure will affect the characteristics and properties of the student sample.

Suppose that the population of 400 students is distributed in 10 schools, each school containing 40 students. Four schools are selected randomly and within schools, ten students are selected according to a similar procedure. Each school, denoted *i*, has a selection probability equal to:

$p_{1\_i} = \frac{n_{sc}}{N_{sc}} = \frac{4}{10} = 0.4$ with N_{sc} being the number of schools and n_{sc} the number of schools sampled.

Within the four selected schools, each student, denoted *j*, has a selection probability equal to:

$$p_{2\_ij} = \frac{n_i}{N_i} = \frac{10}{40} = 0.25$$

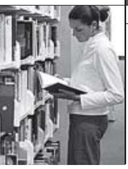
with N_i being the number of students in school *i* and n_i the number of students sampled in school *i*. This means that within each selected school, each student has a chance of one in four of being sampled.

The final selection probability for student *j* attending school *i* is equal to the product of the school selection probability by the student selection probability within the school, *i.e.:*

$$p_{ij} = p_{1\_i}\, p_{2\_ij} = \frac{n_{sc}\, n_i}{N_{sc}\, N_i}$$

In the example, the final student probability is equal to:

$$p_{ij} = p_{1\_i}\, p_{2\_ij} = \frac{n_{sc}\, n_i}{N_{sc}\, N_i} = \frac{4*10}{10*40} = 0.4*0.25 = 0.10$$



The school weight, denoted w_{1_i}, the within-school weight, denoted w_{2_ij}, and the final student weight, denoted w_{ij}, are respectively equal to:

$$w_{1\_i} = \frac{1}{p_{1\_i}} = \frac{1}{0.4} = 2.5$$

$$w_{2\_ij} = \frac{1}{p_{2\_ij}} = \frac{1}{0.25} = 4$$

$$w_{ij} = \frac{1}{p_{ij}} = \frac{1}{0.1} = 10$$

Table 3.3 presents the selection probability at the school level, at the within-school level, and the final probability of selection for the selected students, as well as the weight for these different levels where schools 2, 5, 7 and 10 have been selected.

Table 3.3

School, within-school, and final probability of selection and corresponding weights for a two-stage, simple random sample with the first-stage units being schools of equal size

School label	School size N_i	School probability p_{1_i}	School weight w_{1_i}	Within-school probability p_{2_ij}	Within-school weight w_{2_ij}	Final student probability p_{ij}	Final student weight w_{ij}	Sum of final weights $n_i w_{ij}$
1	40							
2	40	0.4	2.5	0.25	4	0.1	10	100
3	40							
4	40							
5	40	0.4	2.5	0.25	4	0.1	10	100
6	40							
7	40	0.4	2.5	0.25	4	0.1	10	100
8	40							
9	40							
10	40	0.4	2.5	0.25	4	0.1	10	100
Total			**10.0**					**400**

As shown in Table 3.3, the sum of the school weights corresponds to the number of schools in the population, *i.e.* 10, and the sum of the final student weights corresponds to the number of students in the population, *i.e.* 400.

In practice, schools differ in size. Often, school enrolment numbers tend to be larger in urban areas than rural areas. If schools are selected by simple, random sampling, the school selection probability will not change, but within the selected schools, the student selection probability will vary according to the school size. In a small school, the student selection probability will be large, while in a very large school, this probability will be small. Table 3.4 shows an example of the results obtained from schools of different enrolment sizes.

Table 3.4

School, within-school, and final probability of selection and corresponding weights for a two-stage, simple random sample with the first-stage units being schools of unequal size

School label	School size	School probability	School weight	Within-school probability	Within-school weight	Final student probability	Final student weight	Sum of final weights
1	10							
2	15	0.4	2.5	0.66	1.5	0.27	3.75	37.5
3	20							
4	25							
5	30	0.4	2.5	0.33	3.0	0.13	7.50	75.0
6	35							
7	40	0.4	2.5	0.25	4.0	0.10	10.00	100.0
8	45							
9	80							
10	100	0.4	2.5	0.10	10.0	0.04	25.00	250.0
Total	**400**		**10.0**					**462.5**

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Table 3.5
School, within-school, and final probability of selection and corresponding weights for a simple and random sample of schools of unequal size (smaller schools)

School label	School size	School probability	School weight	Within-school probability	Within-school weight	Final student probability	Final student weight	Sum of final weight
1	10	0.4	2.5	1.00	1.0	0.40	4.00	40.0
2	15	0.4	2.5	0.66	1.5	0.27	3.75	37.5
3	20	0.4	2.5	0.50	2.0	0.20	5.00	50.0
4	25	0.4	2.5	0.40	2.5	0.16	6.25	62.5
Total			**10.0**					**190.0**

Table 3.6
School, within-school, and final probability of selection and corresponding weights for a simple and random sample of schools of unequal size (larger schools)

School label	School size	School probability	School weight	Within-school probability	Within-school weight	Final student probability	Final student weight	Sum of final weight
7	40	0.4	2.5	0.250	4.0	0.10	10.00	100.0
8	45	0.4	2.5	0.222	4.5	0.88	11.25	112.5
9	80	0.4	2.5	0.125	8.0	0.05	20.00	200.0
10	100	0.4	2.5	0.100	10.0	0.04	25.00	250.0
Total			**10.0**					**662.5**

With a simple, random sample of schools of unequal size, all schools have the same selection probability and the sum of school weights is equal to the number of schools in the population. However, the sum of the final student weights are not necessarily equal to the number of students in the population. Further, the final student weights differ among schools depending on the size of each school. This variability reduces the reliability of all population parameter estimates.

Table 3.5 and Table 3.6 present the different probabilities and weights if the four smallest schools or the four largest schools are selected. As shown in these two tables, the sums of final student weights vary substantially from the expected value of 400. The sum of school weights, however, is always equal to the number of schools in the population.

The focus of international education surveys such as PISA is more on the student sample than on the school sample. Many authors even consider that such studies do not draw a school sample *per se*. They just consider the school sample as an operational stage to draw the student sample. Therefore, a sampling design that consists of a simple random sample of schools is inappropriate as it would underestimate or overestimate the student population size. It would also result in an important variability of final student weights and consequently increase the sampling variance.

In order to avoid these disadvantages, schools are selected with probabilities proportional to their size (PPS). Larger schools will therefore have a higher probability of selection than smaller schools, but students in larger schools have a smaller within-school probability of being selected than students in small schools. With such procedures, the probability of a school to be selected is equal to the ratio of the school size multiplied by the number of schools to be sampled and divided by the total number of students in the population:

$$p_{1\_i} = \frac{N_i * n_{sc}}{N}$$

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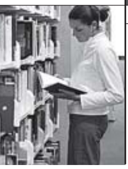


The formulae for computing the within-school probabilities and weights remain unchanged. The final probability and weight are still the product of the school and within-school probabilities or weights. For instance, the school probability for school 9 is equal to:

$$p_{1\_9} = \frac{N_9 * n_{sc}}{N} = \frac{80*4}{400} = \frac{4}{5} = 0.8$$

The student within-school probability for school 9 is equal to:

$$p_{2\_9j} = \frac{n_9}{N_9} = \frac{10}{80} = 0.125$$

The final probability is equal to:

$$p_{9j} = 0.8*0.125 = 0.1$$

As shown in Table 3.7, the school and within-school weights differ among schools, but final student weights do not vary. The weights therefore do not increase sampling variability. Further, the sum of final student weights corresponds to the total number of students in the population. However, the sum of school weight differs from the expected value of ten, but this does not present a major problem as such educational surveys are primarily and mainly interested in the student sample.

Table 3.7

School, within-school, and final probability of selection and corresponding weights for PPS sample of schools of unequal size

School label	School size	School probability	School weight	Within-school probability	Within-school weight	Final student probability	Final student weight	Sum of final weight
1	10							
2	15							
3	20	0.2	5.00	0.500	2.0	0.1	10	100
4	25							
5	30							
6	35							
7	40	0.4	2.50	0.250	4.0	0.1	10	100
8	45							
9	80	0.8	1.25	0.125	8.0	0.1	10	100
10	100	1.0	1.00	0.100	10.0	0.1	10	100
Total	**400**		**9.75**					**400**

With a PPS sample of schools, and an equal number of students selected in each selected school, the sum of the final student weights is always equal to the total number of students in the population (non-response being ignored at this stage). This will be the case even if the smallest or the largest schools get selected. The sum of the school weights, however, is not equal to the number of schools in the population. If the four smallest schools get selected, the sum of school weights is equal to 25.666. If the four largest schools get selected, the sum of school weights is equal to 6.97.

In order to keep the difference between the number of schools in the population and the sum of the school weights in the sample minimal, schools are selected according to a systematic procedure. The procedure consists of first sorting the schools according to their size. A sampling interval is computed as the ratio between the total number of students in the population and the number of schools in the sample, *i.e.:*

$$Int = \frac{N}{n_{sc}} = \frac{400}{4} = 100$$

A random number from a uniform distribution [0;1] is drawn. Let us say 0.752. This random number is then multiplied by the sampling interval, *i.e.* 0.752 by 100 = 75.2. The school which contains the student number 76 is selected. Then the sampling interval is added to the value 75.2. The school which contains the student having the student number 176 will be selected. This systematic procedure is applied until the number of schools needed in the sample has been reached. In the example, the four selection numbers will be the following: 75.2, 175.2, 275.2 and 375.2. See Table 3.8.

Table 3.8

Selection of schools according to a PPS and systematic procedure

School label	School size	From student number	To student number	Part of the sample
1	10	1	10	No
2	15	11	25	No
3	20	26	45	No
4	25	46	70	No
5	30	71	100	Yes
6	35	101	135	No
7	40	136	175	No
8	45	176	220	Yes
9	80	221	300	Yes
10	100	301	400	Yes

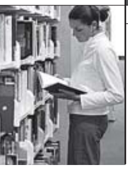
Sorting the school sampling frame by the measure of size and then using a systematic selection procedure prevents obtaining a sample of only small schools or (more likely) a sample with only large schools. This therefore reduces the sampling variance on the sum of the school weights, which is an estimate of the school population size.

WHY DO THE PISA WEIGHTS VARY?

As demonstrated in the previous section, a two-stage sample design with a PPS sample of schools should guarantee that all students have the same probability of selection and therefore the same weight. However, the PISA data still needs to be weighted.

Different factors contribute to the variability of weights:

- **Oversampling or undersampling of some strata of the population**. Usually, the school population is divided into different subgroups, called strata. For instance, a country might decide for convenience to separate the urban schools from the rural schools in the list of schools. In most cases, the number of students selected in the rural stratum and in the urban stratum will be proportional to what these two strata represent in the whole population. This stratification process guarantees for instance that a predefined number of schools within each stratum will be selected. Without the stratification, this number might vary. Nevertheless, for national reporting purposes, a country might decide to sample more students than what would have been sampled based on a proportional allocation in some part of the student population. Suppose that 90% of the student population in a country pursue academic tracks and 10% of the students pursue vocational tracks. If the national centre staff wants to compare the performance of the students by track, then it would be necessary to sample more vocational students than what would be sampled based on a proportional allocation. Further, since PISA 2003, the OECD offers countries the opportunity to adjudicate the data at a subnational level. This process however requires countries to sample at least 50 schools and 1 500 students per subnational entities. This requirement of course leads to some oversampling. Some subnational entities were separately adjudicated for Italy, Spain and the United-Kingdom in PISA 2003 and PISA 2006, and Belgium in PISA 2006.



- **Lack of accuracy or no updated size measure for schools on the school sampling frame**. When schools are selected with a probability proportional to their size, a measure of size needs to be included in the school list. In PISA, this measure of size is the number of 15-year-olds in each school in the population, but national statistics per school and per date of birth are not always available. Therefore, the measure of size can be the number of students in the modal grade for 15-year-olds, or the total number of students in the school divided by the number of grades. Further, even if national statistics per school and per date of birth are available, these data might be one or two years old. Therefore, inconsistencies between the number of 15-year-olds at the time of testing and the measure of size used in the school sample frame generate some variability in the final student weights. Let us suppose that school 9 in Table 3.7 has 100 15-year-old students at the time of testing. When schools were selected from the list of schools, the measure of size was set at 80. The school weight was set at 1.25. The within-school weight will be equal to 100 divided by 10, *i.e.* 10 rather than 8. Therefore, the final student weight will be equal to 12.5 instead of the expected 10.
- **School and within-school weight adjustment for school and student non-response**. Some schools, and within the selected and participating schools, some students might refuse to participate. To compensate for this non-response, a weight adjustment is applied at each level where non-response occurs. For instance, if only 25 students out of the 35 selected students from a participating school are present on the day of the assessment, then the weight of the participating students will be multiplied by a ratio of 35 by 25. The student participation rates vary from one school to another, and therefore the final student weights vary. A similar procedure is also applied to compensate for the school non-response. It should be noted that student non-response adjustment has been modified for counterbalancing different participation rates. More information about these adjustment factors is available in the PISA Technical Reports (Adams and Wu, 2000; OECD, 2005, forthcoming).

CONCLUSION

This chapter briefly described: *(i)* what a weight is and how to compute it; *(ii)* what the PISA sampling design is and why such a design is considered the most appropriate; *(iii)* why the PISA final student weights show some variability.

All statistical analyses or procedures concerning the PISA data should be weighted. Unweighted analyses will provide biased population parameter estimates.

Notes

1. *N* usually represents the size of the population and *n* the size of the sample.

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4

Replicate Weights

INTRODUCTION

In most cases, as mentioned in Chapter 3, national and international surveys collect data from a sample instead of conducting a full census. However, for a particular population, there are thousands, if not millions of possible samples, and each of them does not necessarily yield the same estimates of population statistics. Every generalisation made from a sample, *i.e.* every estimate of a population statistic, has an associated uncertainty or risk of error. The sampling variance corresponds to the measure of this uncertainty due to sampling.

This chapter explains the statistical procedures used for computing the sampling variance and its square root, the standard error. More specifically, this chapter discusses how to estimate sampling variances for population estimates derived from a complex sample design using replicate weights. First, the concept of sampling variance is examined through a fictitious example for simple random sampling. Second, the computation of the standard error is investigated for two-stage sampling. Third, replication methods for estimating sampling variances are introduced for simple random samples and for two-stage samples.

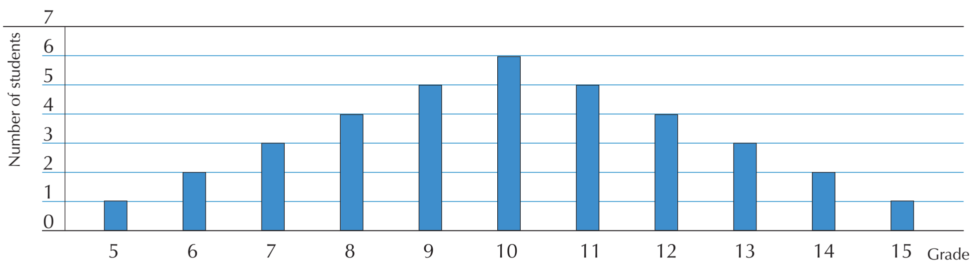
SAMPLING VARIANCE FOR SIMPLE RANDOM SAMPLING

Suppose that a teacher decides to implement a mastery learning approach in his or her classroom. This methodology requires that each lesson be followed by a student assessment. In the example given, the teacher's class has 36 students. The teacher quickly realises that it would be too time-consuming to grade all assessments and therefore decides to select a sample of tests to find out whether the material taught has been assimilated (Bloom, 1979).

However, the random sampling of a few tests can result in the selection of high achievers or low achievers only, which would introduce an important error in the class mean performance estimate. These situations are extreme examples, but drawing a random sample will always generate some uncertainty.

In the same example, before selecting some tests, the teacher grades all of them and analyses the results for the first lesson. Figure 4.1 presents the distribution of the 36 students' results. One student gets a grade 5, two students get a grade 6, and so on.

Figure 4.1
Distribution of the results of 36 students



The distribution of the student grades corresponds to a normal distribution. The population mean and the population variance are respectively equal to:

$$\mu = \frac{1}{N}\sum_{i=1}^{N} x_i = \frac{(5+6+6+7+\ldots+14+14+15)}{36} = \frac{360}{36} = 10$$

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2 = \frac{\left[(5-10)^2+(6-10)^2+\ldots+(14-10)^2+(15-10)^2\right]}{36} = \frac{240}{36} = 5.8333$$

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Table 4.1
Description of the 630 possible samples of 2 students selected from 36 students, according to their mean

Sample mean	Results of the two sampled students	Number of combinations of the two results	Number of samples
5.5	5 and 6	2	2
6.0	6 and 6 5 and 7	1 3	4
6.5	5 and 8 6 and 7	4 6	10
7.0	7 and 7 5 and 9 6 and 8	3 5 8	16
7.5	5 and 10 6 and 9 7 and 8	6 10 12	28
8.0	8 and 8 5 and 11 6 and 10 7 and 9	6 5 12 15	38
8.5	5 and 12 6 and 11 7 and 10 8 and 9	4 10 18 20	52
9.0	9 and 9 5 and 13 6 and 12 7 and 11 8 and 10	10 3 8 15 24	60
9.5	5 and 14 6 and 13 7 and 12 8 and 11 9 and 10	2 6 12 20 30	70
10.0	10 and 10 5 and 15 6 and 14 7 and 13 8 and 12 9 and 11	15 1 4 9 16 25	70
10.5	6 and 15 7 and 14 8 and 13 9 and 12 10 and 11	2 6 12 20 30	70
11.0	7 and 15 8 and 14 9 and 13 10 and 12 11 and 11	3 8 15 24 10	60
11.5	8 and 15 9 and 14 10 and 13 11 and 12	4 10 18 20	52
12.0	9 and 15 10 and 14 11 and 13 12 and 12	5 12 15 6	38
12.5	10 and 15 11 and 14 12 and 13	6 10 12	28
13.0	11 and 15 12 and 14 13 and 13	5 8 2	16
13.5	12 and 15 13 and 14	4 6	10
14.0	13 and 15 14 and 14	3 1	4
14.5	14 and 15	2	2
			630

The standard deviation is therefore equal to:

$$\sigma = \sqrt{\sigma^2} = \sqrt{5.833} = 2.415$$

The teacher then decides to randomly select a sample of two students after the next lesson to save grading time. The number of possible samples of 2 students out of a population of 36 students is equal to:

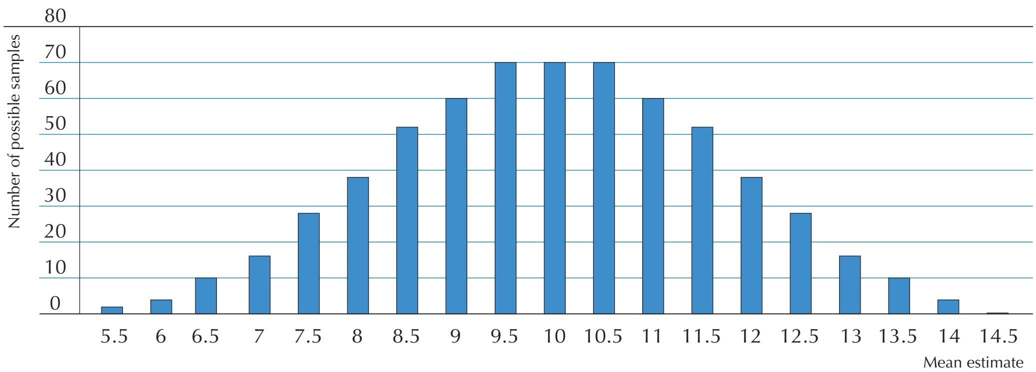
$$C_{36}^{2} = \frac{36!}{(36-2)!2!} = 630$$

There are 630 possible samples of 2 students out of a population of 36 students. Table 4.1 describes these 630 possible samples. For instance, there are two possible samples which provide a mean estimate of 5.5 for student performance. These two samples are: *(i)* the student with a grade 5 and the first student with a grade 6; and *(ii)* the student with a 5 and the second student with a 6. Similarly, there are two ways of selecting a sample that would produce a mean grade of 6: the two sampled students both receive a grade 6 or one student receives a 5 and the second student receives a 7. As only two students obtained a grade 6 (4.1), there is only one possible sample with two grades 6. Since Figure 4.1 shows that there is only one student who received a grade 5 and three students who received a grade 7, there are three possible samples of two students with a grade 5 and a grade 7.

As shown in Table 4.1, there are 2 possible samples with a mean of 5.5, 4 possible samples with a mean of 6, 10 possible samples with a mean of 6.5, 16 possible samples with a mean of 7, and so on.

Figure 4.2 is a chart of the frequency of samples by their mean estimates for all possible samples of 2 students from 36.

Figure 4.2
Sampling variance distribution of the mean



As for all distributions, this distribution of the means of all possible samples can be summarised by central tendency indices and dispersion indices, such as the mean and the variance.

$$\mu_{(\hat{\mu})} = [(2 \times 5.5) + (4 \times 6) + (10 \times 6.5) + (16 \times 7) + (28 \times 7.5) + (38 \times 8) + ... + (2 \times 14.5)] / 630 = 10$$

The mean of all possible sample means is equal to the student population mean, *i.e.* 10. This result is not a coincidence, but a fundamental property of the mean of a simple random sample, *i.e.* the mean of the means of all possible samples is equal to the population mean. In more formal language, the sample mean is an unbiased estimate of the population mean. Stated differently, the expected value of the sample mean is equal to the population mean.

However, it should be noted that there is an important variation around this expectation. In the example considered, sample means range from 5.5 to 14.5. The variance of this distribution, usually denoted as the sampling variance of the mean, can be computed as:

$$\sigma^2_{(\hat{\mu})} = [(5.5 - 10)^2 + (5.5 - 10)^2 + (6 - 10)^2 + ... + (14.5 - 10)^2 + (14.5 - 10)^2] / 630 = 2.833$$

Its square root, denoted as the standard error, is equal to:

$$\sigma_{(\hat{\mu})} = \sqrt{\sigma^2_{(\hat{\mu})}} = \sqrt{2.833} = 1.68$$

However, what information does the standard error of the mean give, or more specifically, what does the value 1.68 tell us? The distribution of the means of all possible samples follows approximately a normal distribution. Therefore, based on the mathematical properties of the normal distribution, it can be said that:

- 68.2% of all possible sample means fall between –1 standard error and +1 standard error around the mean; and
- 95.4% of all possible sample means fall between –2 standard errors and +2 standard errors.

Let us check the mathematical properties of the normal distribution on the sampling variance distribution of the mean. Remember that the mean of the sampling variance distribution is equal to 10 and its standard deviation, denoted by the term "standard error", is equal to 1.68.

How many samples have a mean between $\mu_{(\hat{\mu})} - \sigma_{(\hat{\mu})}$ and $\mu_{(\hat{\mu})} + \sigma_{(\hat{\mu})}$, *i.e.* between (10-1.68) and (10+1.68), or between 8.32 and 11.68?

Table 4.2 shows that there are 434 samples out of 630 with a mean comprised between 8.32 and 11.68; these represent 68.8% of all samples. It can also be demonstrated that the percentage of samples with means between $\mu_{(\hat{\mu})} - 2\sigma_{(\hat{\mu})}$ and $\mu_{(\hat{\mu})} + 2\sigma_{(\hat{\mu})}$, *i.e.* between 6.64 and 13.36 is equal to 94.9%.

Table 4.2
Distribution of all possible samples with a mean between 8.32 and 11.68

Sample mean	Number of samples	Percentage of samples	Cumulative % of sample
8.5	52	0.0825	0.0825
9.0	60	0.0952	0.1777
9.5	70	0.1111	0.2888
10.0	70	0.1111	0.4000
10.5	70	0.1111	0.5111
11.0	60	0.0952	0.6063
11.5	52	0.0825	0.6888
	434		

To estimate the standard error of the mean, the mean of all possible samples is computed. In reality though, only the mean of one sample is known. This, as will be shown, is enough to calculate an estimate of the sampling variance. It is therefore important to identify the factors responsible for the sampling variance from the one sample chosen.

The first determining factor is the size of the sample. If the teacher, in our example, decides to select four students instead of two, then the sampling distribution of the mean will range from 6 (the four lowest results being 5, 6, 6, and 7) to 14 (the four highest results being 13, 14, 14, and 15). Remember that the sampling distribution ranged from 5.5 to 14.5 with samples of two units. Increasing the sample size reduces the variance of the distribution.

There are 58 905 possible samples of 4 students out of a population of 36 students. Table 4.3 presents the distribution of all possible samples of 4 students for a population of 36 students. This distribution has a mean of 10 and a standard deviation, denoted standard error, of 1.155.

This proves that the size of the sample does not affect the expected value of the sample mean, but it does reduce the variance of the distribution of the sample means: the bigger the sample size, the lower the sampling variance of the mean.

Table 4.3
Distribution of the mean of all possible samples of 4 students out of a population of 36 students

Sample mean	Number of possible samples
6.00	3
6.25	10
6.50	33
6.75	74
7.00	159
7.25	292
7.50	510
7.75	804
8.00	1 213
8.25	1 700
8.50	2 288
8.75	2 896
9.00	3 531
9.25	4 082
9.50	4 553
9.75	4 830
10.00	4 949
10.25	4 830
10.50	4 553
10.75	4 082
11.00	3 531
11.25	2 896
11.50	2 288
11.75	1 700
12.00	1 213
12.25	804
12.50	510
12.75	292
13.00	159
13.25	74
13.50	33
13.75	10
14.00	3

The second factor that contributes to the sampling variance is the variance of the population itself. For example, if the results are reported out of a total score of 40 instead of 20, (*i.e.* the student results are all multiplied by two), then the mean of the student results is 20, the variance is 23.333 (*i.e.* four times 5.8333) and the standard deviation is equal to 4.83 (*i.e.* two times 2.415). The sampling variance from a sample of two students will be equal to 11.333 (*i.e.* four times 2.8333) and that the standard error of the mean will be equal to 3.3665 (*i.e.* two times 1.68).

The standard error of the mean is therefore proportional to the population variance. Based on these examples, it can be established that the sampling variance of the mean is equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$$

and the standard error of the sample mean is equal to:

$$\sigma_{(\hat{\mu})} = \sqrt{\sigma^2_{(\hat{\mu})}} = \frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}$$

where:

σ^2 = variance of the population,

σ = standard deviation of the population,

n = sample size,

N = population size.

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Let's check this formula with the example of two students selected:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right) = \frac{5.833}{2}\left(\frac{36-2}{36-1}\right) = 2.8333$$

As the size of the population increases, the ratio $\left(\frac{N-n}{N-1}\right)$ tends toward 1. In such cases, a close approximation of the sampling variance of the mean is given by:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2}{n}$$

However, in practice, the population variance is unknown and is estimated from a sample. The sampling variance estimate of the mean, just as a mean estimate, can vary depending on the sample. Therefore, being based on a sample, only an estimate of the sampling variance of the mean (or any other estimate) can be computed.

In the remainder of this manual, the concepts of sampling variance and estimations of the sampling variance will have the same symbol to simplify the text and the mathematical notations. That is, symbols depicting the estimates of sampling variance will not have a hat (^) to differentiate them from true values, but the fact that they are estimates is to be understood.

SAMPLING VARIANCE FOR TWO-STAGE SAMPLING

Education surveys and, more particularly, international surveys rarely sample students by simply selecting a random sample of students. Schools get selected first and, within each selected school, classes or students are randomly sampled.

One of the differences between simple random sampling and two-stage sampling is that for the latter, selected students attending the same school cannot be considered as independent observations. This is because students within a school will usually have more common characteristics than students from different educational institutions. For instance, they are offered the same school resources, may have the same teachers, and therefore are taught a common curriculum, and so on. Differences between students from different schools are also greater if different educational programmes are not available in all schools. For instance, one would expect to observe more differences between students from a vocational school and students from an academic school, than those that would be observed between students from two vocational schools.

Further, within a country, within subnational entities, and within cities, people tend to live in areas according to their financial resources. As children usually attend schools close to their homes, it is likely that students attending the same school come from similar socio-economic backgrounds.

A simple random sample of 4 000 students is thus likely to cover the diversity of the population better than a sample of 100 schools with 40 students observed within each school. It follows that the uncertainty associated with any population parameter estimate (*i.e.* standard error) will be greater for a two-stage sample than for a simple random sample of the same size.

The increase of the uncertainty due to the two-stage sample is directly proportional to the differences between the first-stage units, known as primary sampling units (PSUs), *i.e.* schools for education surveys. The consequences of this uncertainty are provided below for two extreme and fictitious situations:

- All students in the population are randomly assigned to schools. Therefore, there should not be any differences between schools. Randomly selecting 100 schools and then within the selected schools randomly drawing 40 students would be similar, from a statistical point of view, to directly randomly selecting 4 000 students as there are no differences between schools. The uncertainty associated with any population parameter estimate would be equal to the uncertainty obtained from a simple random sample of 4 000 students.

- All schools are different but within schools, all students are perfectly identical. Since within a particular school, all students are identical: observing only 1 student, or 40, would provide the same amount of information. Therefore, if 100 schools are selected and 40 students are observed per selected school, the effective sample size of this sample would be equal to 100. Therefore, the uncertainty associated with any population parameter estimate would be equal to the uncertainty obtained from a simple random sample of 100 students.

Of course, there is no education system in the world that can be identified with either of these extreme situations. Nevertheless, in some education systems, differences between schools appear to be very small, at least regarding the survey's measure, for example, of academic performance, while in some other educational systems, differences between schools can be quite substantial.

The academic performance of each student can be represented by a test score, or by the difference between his/her score and the country average score. In education research, it is common to split the difference between the student's score and the country average score into three parts: *(i)* the difference between the student's performance and the corresponding class mean; *(ii)* the difference between this class mean and the corresponding school mean; *(iii)* the difference between this school mean and the country mean. The first difference relates to the within-class variance (or the residual variance in terms of variance analysis). It indicates how much student scores can vary within a particular class. The second difference – the difference between the class mean and the school mean – is related to the between-classes-within-school variance. This difference reflects the range of differences between classes within schools. This between-classes-within-school variance might be substantial in educational institutions that offer both academic and vocational education. The third difference – the difference between the school average and the country average – is called the between-school variance. This difference indicates how much student performance varies among schools.

To obtain an estimate of these three components of the variance, it would be necessary to sample several schools, at least two classes per school and several students per class. PISA randomly selects 15-year-olds directly from student lists within the participating schools. Therefore, generally speaking, it is impossible to distinguish the between- and within-classes variances. PISA can only provide estimates of the between- and the within-school variances.

Table 4.4 provides the between-school and within-school variances on the mathematics scale for PISA 2003. In northern European countries, the between-school variance is very small compared to the within-school variance. In these countries, the student variance mainly lies at the within-school level. In terms of student achievement then, schools in such countries do not vary greatly. However, in Austria, Belgium, Germany and Hungary, for instance, more than 50% of differences in the student performance are accounted for at the school level. This means that the student performance differs substantially among schools. Therefore, the uncertainty associated with any population parameters will be larger for these countries when compared to the uncertainty for northern European countries, given a comparable sample size of schools and students.

As Kish (1987) noted:

> "Standard methods for statistical analysis have been developed on assumptions of simple random sampling. Assuming independence for individual elements (or observations) greatly facilitates the mathematics used for distribution theories of formulas for complex statistics. […] However, independent selection of elements is seldom realised in practice, because much research is actually and necessarily accomplished with complex sample designs. It is economical to select clusters that are natural grouping of elements, and these tend to be somewhat homogeneous for most characteristics. The assumptions may fail mildly or badly; hence standard statistical analysis tends to result in mild or bad underestimates in length of reported probability intervals. Overestimates are possible, but rare and mild."

Table 4.4
Between-school and within-school variances on the mathematics scale in PISA 2003

	Between-school variance	Within-school variance
AUS	1 919.11	7 169.09
AUT	5 296.65	4 299.71
BEL	7 328.47	5 738.33
CAN	1 261.58	6 250.12
CHE	3 092.60	6 198.65
CZE	4 972.45	4 557.50
DEU	6 206.92	4 498.70
DNK	1 109.45	7 357.14
ESP	1 476.85	6 081.74
FIN	336.24	6 664.98
FRA	3 822.62	4 536.22
GBR	1 881.09	6 338.25
GRC	3 387.52	5 991.75
HUN	5 688.56	4 034.66
IRL	1 246.70	6 110.71
ISL	337.56	7 849.99
ITA	4 922.84	4 426.67
JPN	5 387.17	4 668.82
KOR	3 531.75	5 011.56
LUX	2 596.36	5 806.97
MEX	2 476.01	3 916.46
NLD	5 528.99	3 326.09
NOR	599.49	7 986.58
NZL	1 740.61	7 969.97
POL	1 033.90	7 151.46
PRT	2 647.70	5 151.93
SVK	3 734.56	4 873.69
SWE	986.03	8 199.46
TUR	6 188.40	4 891.13
USA	2 395.38	6 731.45

Note: The results are based on the first plausible value for the mathematics scale, denoted PV1MATH in the PISA 2003 database (*www.pisa.oecd.org*).

Kish established a state-of-the-art knowledge of the sampling variance according to the type of estimator and the sampling design. The sampling variance distributions are well known for univariate and multivariate estimators for simple random samples. The use of stratification variables with a simple random sample still allows for the mathematical computation of the sampling variances, but with a substantial increase of complexity. As shown in Table 4.5, the computation of sampling variances for two-stage samples is available for some designs, but it becomes quite difficult to compute for multivariate indices.

Table 4.5
Current status of sampling errors

Selection methods	Means and total of entire samples	Subclass means and differences	Complex analytical statistics *e.g.* coefficients in regression
Simple random selection of elements	Known	Known	Known
Stratified selection of elements	Known	Available	Conjectured
Complex cluster sampling	Known for some sampling design	Available	Difficult

Note: Row 1 refers to standard statistical theory (Kish and Frankel, 1974).

Authors of sampling manuals usually distinguish two types of two-stage sampling (Cochran, 1977; Kish, 1995):

- two-stage sampling with first-stage units of equal sizes,
- two-stage sampling with first-stage units of unequal sizes.

Beyond this distinction, different characteristics of the population and of the sampling design need to be taken into account in the computation of the sampling variance, because they affect the sampling variance. Some of the factors to be considered are:

- Is the population finite or infinite?
- Was size a determining criterion in the selection of the first-stage units?
- Was a systematic procedure used for selecting first-stage or second-stage units?
- Does the sampling design include stratification variables?

The simplest two-stage sample design occurs with infinite populations of stage-one and stage-two units. As both stage units are infinite populations, PSUs are considered to be of equal sizes. If a simple random sample of PSUs is selected and if, within each selected PSU, a simple random sample of stage-two units is selected, then the sampling variance of the mean will be equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2_{between\_PSU}}{n_{PSU}} + \frac{\sigma^2_{within\_PSU}}{n_{PSU}\, n_{within}}$$

Let's apply this formula to an education survey and consider the population of schools as infinite and the population of students within each school as infinite. The computation of the sampling variance of the mean is therefore equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2_{between\_school}}{n_{school}} + \frac{\sigma^2_{within\_school}}{n_{students}}$$

Under these assumptions, the sampling variance of the mean and its square root, *i.e.* the standard error, in Denmark are computed as below. Table 4.6 presents the between-school and within-school variance as well as the numbers of participating schools and students in Denmark and Germany.

$$\sigma^2_{(\hat{\mu})} = \frac{1109.45}{206} + \frac{7357.14}{4218} = 5.39 + 1.74 = 7.13$$

$$\sigma_{(\hat{\mu})} = \sqrt{7.13} = 2.67$$

The sampling variance of the mean and its square root, *i.e.* the standard error, in Germany are equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{6206.92}{216} + \frac{4498.70}{4660} = 28.74 + 0.97 = 29.71$$

$$\sigma_{(\hat{\mu})} = \sqrt{29.71} = 5.45$$

If both samples were considered as simple random samples, then the standard error of the mean for Denmark and Germany would be respectively equal to 1.42 and 1.51.

Table 4.6

Between-school and within-school variances, number of participating schools and students in Denmark and Germany in PISA 2003

	Denmark	Germany
Between-school variance	1 109.45	6 206.92
Within-school variance	7 357.14	4 498.70
Number of participating schools	206	216
Number of participating students	4 218	4 660

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Based on these results, the following observations can be made:

- The standard error of the mean is larger for a two-stage sampling than for a simple random sampling. For example, in the case of Germany, the standard errors for simple random sampling and for two-stage sampling are 1.51 and 5.45, respectively. Considering a two-stage sample as a simple random sample will therefore substantially underestimate standard errors and consequently, confidence intervals will be too narrow. The confidence interval on the mathematic scale average, *i.e.* 503, would be equal to: [503 – (1.96*1.51);503 + (1.96*1.51)] = [500.05;505.96] in the case of a simple random sample, but equal to [503 – (1.96*5.45);503 + (1.96*5.45)] = [492.32; 513.68] in the case of a two-stage sample. This indicates that any estimated mean value between 492.32 and 500.05 and between 505.96 and 513.68 may or may not be considered as statistically different from the German average, depending on the standard error used.
- The sampling variance of the mean for two-stage samples is mainly dependent on the between-school variance and the number of participating schools. Indeed, the between-school variance accounts for 76% of the total sampling variance in Denmark, *i.e.* $\frac{5.39}{7.13} = 0.76$. In Germany, the between-school variance accounts for 97% of the total sampling variance, *i.e.* $\frac{28.74}{29.71} = 0.97$. Therefore, one should expect larger sampling variance in countries with larger between-school variance, such as Austria and Germany.

However, the PISA population cannot be considered as an infinite population of schools with an infinite population of students. Further:

- Schools have unequal sizes.
- The PISA sample is a sample without replacement, *i.e.* a school cannot be selected twice.
- Schools are selected proportionally to their sizes and according to a systematic procedure.
- Stratification variables are included in the sample design.

These characteristics of the sampling design will influence the sampling variance, so that the formula used above is also inappropriate. Indeed, *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004a) indicates that the standard errors for the mean performance in mathematics for Denmark and Germany are 2.7 and 3.3, respectively.

This shows that the PISA sample design is quite efficient in reducing the sampling variance. However, the design becomes so complex that there is no easy formula for computing the sampling variance or even mean.

Since the IEA 1990 Reading Literacy Study, replication or resampling methods have been used to compute estimates of the sampling variance for international education surveys. Even though these methods have been known since the late 1950s, they have not been used often as they require numerous computations. With the availability of powerful personal computers in the 1990s and the increased use of international databases by non-mathematicians, international co-ordinating centres were encouraged to use resampling methods for estimating sampling variances from complex sample designs.

According to Rust and Rao (1996):

> "The common principle that these methods have is to use computational intensity to overcome difficulties and inconveniences in utilizing an analytic solution to the problem at hand. Briefly, the replication approach consists of estimating the variance of a population parameter of interest by using a large number of somewhat different subsamples (or somewhat different sampling weights) to calculate the parameter of interest. The variability among the resulting estimates is used to estimate the true sampling error of the initial or full-sample estimate."

In the following sections, these methods will first be described for simple random samples and for two-stage samples. The PISA replication method will be presented subsequently.

REPLICATION METHODS FOR SIMPLE RANDOM SAMPLES

There are two main types of replication methods for simple random samples. These are known as the Jackknife and the Bootstrap. One of the most important differences between the Jackknife and the Bootstrap is related to the procedure used to produce the repeated subsamples or replicate samples. From a sample of n units, the Jackknife generates in a systematic way n replicate samples of $n-1$ units. The Bootstrap randomly generates a large number of repetitions of n units selected with replacement, with each unit having more than one chance of selection.

Since PISA does not use a Bootstrap replication method adapted to multi-stage sample designs, this section will only present the Jackknife method.

Suppose that a sample of ten students has been selected by simple random sampling. The Jackknife method will then generate ten subsamples, or replicate samples, each of nine students, as in Table 4.7.

Table 4.7
The Jackknife replicates and sample means

Student	1	2	3	4	5	6	7	8	9	10	Mean
Value	10	11	12	13	14	15	16	17	18	19	**14.50**
Replication 1	0	1	1	1	1	1	1	1	1	1	**15.00**
Replication 2	1	0	1	1	1	1	1	1	1	1	**14.88**
Replication 3	1	1	0	1	1	1	1	1	1	1	**14.77**
Replication 4	1	1	1	0	1	1	1	1	1	1	**14.66**
Replication 5	1	1	1	1	0	1	1	1	1	1	**14.55**
Replication 6	1	1	1	1	1	0	1	1	1	1	**14.44**
Replication 7	1	1	1	1	1	1	0	1	1	1	**14.33**
Replication 8	1	1	1	1	1	1	1	0	1	1	**14.22**
Replication 9	1	1	1	1	1	1	1	1	0	1	**14.11**
Replication 10	1	1	1	1	1	1	1	1	1	0	**14.00**

As shown in Table 4.7, the Jackknife generates ten replicate samples of nine students. The sample mean based on all ten students is equal to 14.5. For the first replicate sample, student 1 is not included in the calculation of the mean, and the mean of the nine students included in replicate sample 1 is 15.00. For the second replicate sample, the second student is not included and the mean of the other nine students is equal to 14.88, and so on.

The Jackknife estimate of sampling variance of the mean is equal to:

$$\sigma^2_{jack} = \frac{n-1}{n}\sum_{i=1}^{n}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

With $\hat{\theta}_{(i)}$ representing the statistic estimate for replicate sample i, and $\hat{\theta}$ representing the statistic estimate based on the whole sample.

Based on the data from Table 4.7, the Jackknife sampling variance of the mean is equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{9}{10}\left[(15.00-14.50)^2 + (14.88-14.50)^2 + ... + (14.11-14.50)^2 + (14.00-14.50)^2\right]$$

$$\sigma^2_{(\hat{\mu})} = \frac{9}{10}(1.018519) = 0.9167$$

The usual population variance estimator is equal to:

$$\sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \hat{\mu})^2 = \frac{1}{9}\left[(10-14.5)^2 + (11-14.5)^2 + ... + (18-14.5)^2 + (19-14.5)^2\right] = 9.17$$

Therefore, the sampling variance of the mean, estimated by the mathematical formula, is equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2}{n} = \frac{9.17}{10} = 0.917$$

As shown in this example, the Jackknife method and the mathematical formula provide identical estimation of the sampling variance. Rust (1996) mathematically demonstrates this equality.

$$\hat{\mu}_{(i)} - \hat{\mu} = \frac{\left[\left(\sum_{i=1}^{n} x_i\right) - x_i\right]}{n-1} - \frac{\left[\sum_{i=1}^{n} x_i\right]}{n} = -\frac{x_i}{n-1} + \left[\sum_{i=1}^{n} x_i\right]\left[\frac{1}{n-1} - \frac{1}{n}\right]$$

$$= -\frac{1}{(n-1)}\left[x_i - \left(\sum_{i=1}^{n} x_i\right)\left(1 - \frac{(n-1)}{n}\right)\right] = -\frac{1}{(n-1)}\left[x_i - \hat{\mu}(n-(n-1)\right] = -\frac{1}{(n-1)}(x_i - \hat{\mu})$$

Therefore,

$$\left(\hat{\mu}_{(i)} - \hat{\mu}\right)^2 = \frac{1}{(n-1)^2}(x_i - \hat{\mu})^2$$

$$\Rightarrow \sum_{i=1}^{n}(\hat{\mu}_{(i)} - \hat{\mu})^2 = \frac{1}{(n-1)^2}\sum_{i=1}^{n}(x_i - \hat{\mu})^2 = \frac{1}{(n-1)}\frac{\sum_{i=1}^{n}(x_i - \hat{\mu})^2}{(n-1)} = \frac{1}{(n-1)}\hat{\sigma}^2$$

$$\Rightarrow \sigma^2_{jack} = \frac{n-1}{n}\sum_{i=1}^{n}(\hat{\mu}_{(i)} - \hat{\mu})^2 = \frac{(n-1)}{n}\frac{1}{(n-1)}\hat{\sigma}^2 = \frac{\hat{\sigma}^2}{n}$$

The Jackknife method can also be applied to compute the sampling variance for other statistics, such as regression coefficients. As an example, in Table 4.8, the procedure consists of the computation of 11 regression coefficients: 1 based on the whole sample and 10 others based on one replicate sample. The comparison between the whole sample regression coefficient and each of the ten replicate regression coefficients will provide an estimate of the sampling variance of that statistic.

Table 4.8
Values on variables X and Y for a sample of ten students

Student	1	2	3	4	5	6	7	8	9	10
Value Y	10	11	12	13	14	15	16	17	18	19
Value X	10	13	14	19	11	12	16	17	18	15

The regression coefficient for the whole sample is equal to 0.53. The regression coefficients for ten replicate samples are shown in Table 4.9.

Table 4.9
Regression coefficients for each replicate sample

	Regression coefficient
Replicate 1	0.35
Replicate 2	0.55
Replicate 3	0.56
Replicate 4	0.64
Replicate 5	0.51
Replicate 6	0.55
Replicate 7	0.51
Replicate 8	0.48
Replicate 9	0.43
Replicate 10	0.68

The Jackknife formula, *i.e.* $\sigma^2_{jack} = \frac{n-1}{n}\sum_{i=1}^{n}(\hat{\theta}_{(i)} - \hat{\theta})^2$, can be applied to compute the sampling variance of the regression coefficient.

$$\sigma^2_{jack} = \frac{n-1}{n}\sum_{i=1}^{n}(\hat{\theta}_{(i)} - \hat{\theta})^2 = \frac{9}{10}\left[(0.35-0.53)^2 + (0.55-0.53)^2 + \ldots(0.68-0.53)^2\right] = 0.07$$

This result is identical to the result that the usual sampling variance formula for a regression coefficient would render.

REPLICATION METHODS FOR TWO-STAGE SAMPLES

There are three types of replication methods for two-stage samples:

1. the Jackknife, with two variants: one for unstratified samples and another one for stratified samples;
2. the Balanced Repeated Replication (BRR) and its variant, Fay's modification;
3. the Bootstrap.

PISA uses BRR with Fay's modification.[1]

The Jackknife for unstratified two-stage sample designs

If a simple random sample of PSUs is drawn without the use of any stratification variables, then it can be shown that the sampling variance of the mean obtained using the Jackknife method is mathematically equal to the formula provided earlier in this chapter, *i.e.:*

$$\sigma^2_{(\hat{\mu})} = \frac{\sigma^2_{between\_PSU}}{n_{PSU}} + \frac{\sigma^2_{within\_PSU}}{n_{PSU}\, n_{within}}$$

Consider a sample of ten schools and within selected schools, a simple random sample of students. The Jackknife method for an unstratified two-stage sample consists of generating ten replicates of nine schools. Each school is removed only once, in a systematic way.

For the first replicate, denoted R1, school 1 has been removed. As shown in Table 4.10, the weights of the other schools in the first replicate are adjusted by a factor of 1.11, *i.e.* $\frac{10}{9}$ or, as a general rule, by a factor of $\frac{G}{G-1}$, with *G* being the number of PSUs and the number of replicates in the sample. This adjustment factor is then applied when school replicate weights and within school replicate weights are combined to give the student replicate weights. For the second replicate, school 2 is removed and the weights in the remaining schools are adjusted by the same factor, and so on.

Table 4.10
The Jackknife replicates for unstratified two-stage sample designs

Replicate	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
School 1	0.00	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
School 2	1.11	0.00	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
School 3	1.11	1.11	0.00	1.11	1.11	1.11	1.11	1.11	1.11	1.11
School 4	1.11	1.11	1.11	0.00	1.11	1.11	1.11	1.11	1.11	1.11
School 5	1.11	1.11	1.11	1.11	0.00	1.11	1.11	1.11	1.11	1.11
School 6	1.11	1.11	1.11	1.11	1.11	0.00	1.11	1.11	1.11	1.11
School 7	1.11	1.11	1.11	1.11	1.11	1.11	0.00	1.11	1.11	1.11
School 8	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0.00	1.11	1.11
School 9	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0.00	1.11
School 10	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0.00

The statistic of interest is computed for the whole sample, and then again for each replicate. The replicate estimates are then compared to the whole sample estimate to obtain the sampling variance, as follows:

$$\sigma^2_{(\hat{\theta})} = \frac{(G-1)}{G}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

This formula is identical to the one used for a simple random sample, except that instead of using *n* replicates, *n* being the number of units in the sample, this formula uses *G* replicates, with *G* being the number of PSUs.

The Jackknife for stratified two-stage sample designs

As mentioned at the beginning of Chapter 3, two major principles underlie all sample designs. The first is the need to avoid bias in the selection procedure, the second to achieve maximum precision in view of the available financial resources.

To reduce the uncertainty, or to minimise the sampling variance without modifying the sample size, international and national education surveys usually implement the following procedures in the sampling design:

- PSUs are selected proportionally to their size and according to a systematic procedure. This procedure leads to an efficient student sampling procedure. Equal-sized samples of students can be selected from each school. At the same time, the overall selection probabilities (combining the school and student sampling components) do not vary much.
- PISA national centres are encouraged to identify stratification variables that are statistically associated with student performance. Characteristics, such as rural versus urban, academic versus vocational, private versus public, could be associated with student performance. The sampling variance reduction will be proportional to the explanatory power of these stratification variables on student performance.

The Jackknife for stratified two-stage samples allows the reduction of the sampling variance by taking both of these aspects into consideration. Failing to do so, would lead to a systematic overestimation of sampling variances.

Table 4.11
The Jackknife replicates for stratified two-stage sample designs

Pseudo-stratum	School	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
1	1	2	1	1	1	1	1	1	1	1	1
1	2	0	1	1	1	1	1	1	1	1	1
2	3	1	0	1	1	1	1	1	1	1	1
2	4	1	2	1	1	1	1	1	1	1	1
3	5	1	1	2	1	1	1	1	1	1	1
3	6	1	1	0	1	1	1	1	1	1	1
4	7	1	1	1	0	1	1	1	1	1	1
4	8	1	1	1	2	1	1	1	1	1	1
5	9	1	1	1	1	2	1	1	1	1	1
5	10	1	1	1	1	0	1	1	1	1	1
6	11	1	1	1	1	1	2	1	1	1	1
6	12	1	1	1	1	1	0	1	1	1	1
7	13	1	1	1	1	1	1	0	1	1	1
7	14	1	1	1	1	1	1	2	1	1	1
8	15	1	1	1	1	1	1	1	0	1	1
8	16	1	1	1	1	1	1	1	2	1	1
9	17	1	1	1	1	1	1	1	1	0	1
9	18	1	1	1	1	1	1	1	1	2	1
10	19	1	1	1	1	1	1	1	1	1	2
10	20	1	1	1	1	1	1	1	1	1	0

Suppose that the list of schools in the population is divided into two parts called strata: rural schools and urban schools. Further, within these two strata, schools are sorted by size. Within each stratum, ten schools are selected systematically and proportionally to their size.

The Jackknife method for stratified two-stage sample designs consists of systematically pairing sampled schools within each stratum in the order in which they were selected. Therefore, schools will be paired with other similar schools.

Table 4.11 shows how replicates are generated for this method. Schools 1 to 10 are in the stratum of "rural", and schools 11 to 20 are in the stratum of "urban". Within each stratum, there are therefore five school pairs, or pseudo-strata (also called variance strata).

The Jackknife for stratified two-stage samples will generate as many replicates as there are pairs or pseudo strata. In this example, ten replicates will therefore be generated. For each replicate sample, one school is randomly removed within a particular pseudo-stratum and the weight of the remaining school in the pseudo-stratum is doubled. For replicate 1, denoted R1, school 2 is removed and the weight of school 1 is doubled in the pseudo-stratum 1. For replicate 2, school 3 is removed and the weight of school 4 is doubled in the pseudo-stratum 2, and so on.

As previously mentioned, the statistic of interest is computed based on the whole sample and then again based on each replicate sample. The replicate estimates are then compared to the whole sample estimate to obtain the sampling variance, as follows:

$$\sigma^2_{(\hat{\theta})} = \sum_{i=1}^{G} (\hat{\theta}_{(i)} - \hat{\theta})^2$$

This replication method is now generally used in IEA studies.

The Balanced Repeated Replication method

While the Jackknife method consists of removing only one school for each replicate sample, the Balanced Repeated Replication (BRR) method proceeds by selecting at random one school within each pseudo-stratum to have its weight set to 0, and by doubling the weights of the remaining schools as shown in Table 4.12.

Table 4.12

Replicates with the Balanced Repeated Replication method

Pseudo-stratum	School	R1	R2	R3	R4	R5	R6	R7	R8	R9	R 10	R 11	R 12
1	1	2	0	0	2	0	0	0	2	2	2	0	2
1	2	0	2	2	0	2	2	2	0	0	0	2	0
2	3	2	2	0	0	2	0	0	0	2	2	2	0
2	4	0	0	2	2	0	2	2	2	0	0	0	2
3	5	2	0	2	0	0	2	0	0	0	2	2	2
3	6	0	2	0	2	2	0	2	2	2	0	0	0
4	7	2	2	0	2	0	0	2	0	0	0	2	2
4	8	0	0	2	0	2	2	0	2	2	2	0	0
5	9	2	2	2	0	2	0	0	2	0	0	0	2
5	10	0	0	0	2	0	2	2	0	2	2	2	0
6	11	2	2	2	2	0	2	0	0	2	0	0	0
6	12	0	0	0	0	2	0	2	2	0	2	2	2
7	13	2	0	2	2	2	0	2	0	0	2	0	0
7	14	0	2	0	0	0	2	0	2	2	0	2	2
8	15	2	0	0	2	2	2	0	2	0	0	2	0
8	16	0	2	2	0	0	0	2	0	2	2	0	2
9	17	2	0	0	0	2	2	2	0	2	0	0	2
9	18	0	2	2	2	0	0	0	2	0	2	2	0
10	19	2	2	0	0	0	2	2	2	0	2	0	0
10	20	0	0	2	2	2	0	0	0	2	0	2	2

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As this method results in a large set of possible replicates, a balanced set of replicate samples is generated according to Hadamard matrices in order to avoid lengthy computations. The number of replicates is the smallest multiple of four, greater than or equal to the number of pseudo-strata. In this example, as there are 10 pseudo-strata, 12 replicates will be generated.

The statistic of interest is again computed based on the whole sample, and then again for each replicate. The replicate estimates are then compared with the whole sample estimate to estimate the sampling variance, as follows:

$$\sigma^2_{(\hat{\theta})} = \frac{1}{G}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

With this replication method, each replicate sample only uses half of the available observations. This large reduction in sample might therefore become problematic for the estimation of a statistic on a rare subpopulation. Indeed, the number of remaining observations might be so small, even equal to 0, that the estimation of the population parameter for a particular replicate sample is impossible. To overcome this disadvantage, Fay developed a variant to the BRR method. Instead of multiplying the school weights by a factor of 0 or 2, Fay suggested multiplying the weights by a deflating factor *k* between 0 and 1, with the second inflating factor being equal to 2 minus *k*. For instance, if the deflating weight factor, denoted *k,* is equal to 0.6, then the inflating weight factor will be equal to $2-k$, *i.e.* $1-0.6=1.4$ (Judkins, 1990).

PISA uses the Fay method with a factor of 0.5. Table 4.13 describes how the replicate samples and weights are generated for this method.

Table 4.13

The Fay replicates

Pseudo-stratum	School	R1	R2	R3	R4	R5	R6	R7	R8	R9	R 10	R 11	R 12
1	1	1.5	0.5	0.5	1.5	0.5	0.5	0.5	1.5	1.5	1.5	0.5	1.5
1	2	0.5	1.5	1.5	0.5	1.5	1.5	1.5	0.5	0.5	0.5	1.5	0.5
2	3	1.5	1.5	0.5	0.5	1.5	0.5	0.5	0.5	1.5	1.5	1.5	0.5
2	4	0.5	0.5	1.5	1.5	0.5	1.5	1.5	1.5	0.5	0.5	0.5	1.5
3	5	1.5	0.5	1.5	0.5	0.5	1.5	0.5	0.5	0.5	1.5	1.5	1.5
3	6	0.5	1.5	0.5	1.5	1.5	0.5	1.5	1.5	1.5	0.5	0.5	0.5
4	7	1.5	1.5	0.5	1.5	0.5	0.5	1.5	0.5	0.5	0.5	1.5	1.5
4	8	0.5	0.5	1.5	0.5	1.5	1.5	0.5	1.5	1.5	1.5	0.5	0.5
5	9	1.5	1.5	1.5	0.5	1.5	0.5	0.5	1.5	0.5	0.5	0.5	1.5
5	10	0.5	0.5	0.5	1.5	0.5	1.5	1.5	0.5	1.5	1.5	1.5	0.5
6	11	1.5	1.5	1.5	1.5	0.5	1.5	0.5	0.5	1.5	0.5	0.5	0.5
6	12	0.5	0.5	0.5	0.5	1.5	0.5	1.5	1.5	0.5	1.5	1.5	1.5
7	13	1.5	0.5	1.5	1.5	1.5	0.5	1.5	0.5	0.5	1.5	0.5	0.5
7	14	0.5	1.5	0.5	0.5	0.5	1.5	0.5	1.5	1.5	0.5	1.5	1.5
8	15	1.5	0.5	0.5	1.5	1.5	1.5	0.5	1.5	0.5	0.5	1.5	0.5
8	16	0.5	1.5	1.5	0.5	0.5	0.5	1.5	0.5	1.5	1.5	0.5	1.5
9	17	1.5	0.5	0.5	0.5	1.5	1.5	1.5	0.5	1.5	0.5	0.5	1.5
9	18	0.5	1.5	1.5	1.5	0.5	0.5	0.5	1.5	0.5	1.5	1.5	0.5
10	19	1.5	1.5	0.5	0.5	0.5	1.5	1.5	1.5	0.5	1.5	0.5	0.5
10	20	0.5	0.5	1.5	1.5	1.5	0.5	0.5	0.5	1.5	0.5	1.5	1.5

As with all replication methods, the statistic of interest is computed based on the whole sample, and then again on each replicate. The replicate estimates are then compared to the whole sample estimate to get the sampling variance, as follows:

$$\sigma^2_{(\hat{\theta})} = \frac{1}{G(1-k)^2}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

In PISA, it was decided to generate 80 replicate samples and therefore 80 replicate weights. Therefore, the formula becomes:

$$\sigma^2_{(\hat{\theta})} = \frac{1}{G(1-k)^2}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2 = \frac{1}{80(1-0.5)^2}\sum_{i=1}^{80}(\hat{\theta}_{(i)} - \hat{\theta})^2 = \frac{1}{20}\sum_{i=1}^{80}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

OTHER PROCEDURES FOR ACCOUNTING FOR CLUSTERED SAMPLES

For the past two decades, multi-level models and software packages have been introduced in the education research field. There is no doubt that these models led to a breakthrough in the unravelling of education phenomena. Indeed, multi-level regression models offer the possibility of taking into account the fact that students are nested within classes and schools: each contributing factor can be evaluated when establishing the outcome measure.

Multi-level regression software packages, such as MLWin® or HLM®, just like any professional statistical package, provide an estimate of the standard error for each of the estimated population parameters. While SAS® and SPSS® consider the sample as a simple random sample of population elements, MLWin® and HLM® recognise the hierarchical structure of the data, but consider that the school sample is a simple random one. They therefore do not take into account the complementary sample design information used in PISA to reduce the sampling variance. Consequently, in PISA, the sampling variances estimated with multi-level models will always be greater than the sampling variances estimated with Fay replicate samples.

As these multi-level model packages do not incorporate the additional sample design information, their standard error estimates are similar to the Jackknife method for unstratified samples. For instance, the PISA 2003 data in Germany were analysed using the multi-level model proposed by SAS® and called PROC MIXED. The standard errors of the mean of the five plausible values[2] for the combined mathematical literacy scale were respectively 5.4565, 5.3900, 5.3911, 5.4692, and 5.3461. The average of these five standard errors is 5.41. Recall that the use of the formula assuming PSUs are selected as simple random sampling discussed above produces an estimate of the sampling variance equal to 5.45.

With multi-level software packages, using replicates cannot be avoided if unbiased estimates of the standard errors for the estimates need to be obtained.

CONCLUSION

Since international education surveys use a two-stage sample design most of the time, it would be inappropriate to apply the sampling distribution formulas developed for simple random sampling. Doing so would lead to an underestimation of the sampling variances.

Sampling designs in education surveys can be very intricate. As a result, sampling distributions might not be available or too complex even for simple estimators, such as means. Since the 1990 IEA Reading Literacy Study, sampling variances have been estimated through replication methods. These methods function by generating several subsamples, or replicate samples, from the whole sample. The statistic of interest is then estimated for each of these replicate samples and then compared to the whole sample estimate to provide an estimate of the sampling variance.

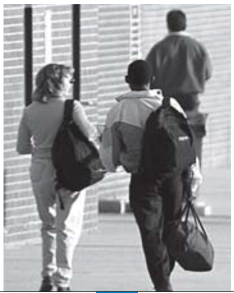
A replicate sample is formed simply through a transformation of the full sample weights according to an algorithm specific to the replication method. These methods therefore can be applied to any estimators[3] – means, medians, percentiles, correlations, regression coefficients, etc. – which can be easily computed thanks to advanced computing resources. Further, using these replicate weights does not require an extensive knowledge in statistics, since these procedures can be applied regardless of the statistic of interest.

Notes

1. See the reasons for this decision in the *PISA 2000 Technical Report* (OECD, 2002c).

2. See Chapter 6 for a description of plausible values.

3. Several empirical or theoretical studies have compared the different resampling methods for complex sampling design. As Rust and Krawchuk noted: "A benefit of both BRR and modified BRR over the Jackknife is that they have a sound theoretical basis for use with nonsmooth statistics, such as quantiles like the median. It has long been known that the Jackknife is inconsistent for estimating the variances of quantiles. That is, as the sample size increases for a given sample design, the estimation of the variances of quantiles does not necessarily become more precise when using the Jackknife." (Rust and Krawchuk, 2002).



5

The Rasch Model

INTRODUCTION

International surveys in education such as PISA are designed to estimate the performance in specific subject domains of various subgroups of students, at specific ages or grade levels.

For the surveys to be considered valid, many items need to be developed and included in the final tests. The OECD publications related to the assessment frameworks indicate the breadth and depth of the PISA domains, showing that many items are needed to assess a domain as broadly defined as, for example, mathematical literacy.[1]

At the same time, it is unreasonable and perhaps undesirable to assess each sampled student with the whole item battery because:

- After extended testing time, students' results start to be affected by fatigue and this can bias the outcomes of the surveys.
- School principals would refuse to free their students for the very long testing period that would be required. This would reduce the school participation rate, which in turn might substantially bias the outcomes of the results.

To overcome the conflicting demands of limited student-level testing time and broad coverage of the assessment domain, students are assigned a subset of the item pool. The result of this is that only certain subsamples of students respond to each item.

If the purpose of the survey is to estimate performance by reporting the percentage of correct answers for each item, it would not be necessary to report the performance of individual students. However, typically there is a need to summarise detailed item-level information for communicating the outcomes of the survey to the research community, to the public and also to policy makers. In addition, educational surveys aim to explain the difference in results between countries, between schools and between students. For instance, a researcher might be interested in the difference in performance between males and females.

HOW CAN THE INFORMATION BE SUMMARISED?

At the country level, the most straightforward procedure for summarising the item-level information would be to compute the average percentage of correct answers. This has been largely used in previous national and international surveys and is still used in some current international surveys, even when more complex models are implemented. These surveys may report the overall percentage of correct answers in reading, in mathematics and in science, as well as by content areas (for example, biology, physics, chemistry, earth sciences and so on). For instance, in mathematics, the overall percentage of correct answers for one country might be 54%, and for another, 65%.

The great advantage of this type of reporting is that it can be understood by everyone. Everybody can imagine a mathematics test and can envision what is represented by 54% and 65% of correct answers. These two numbers also give a sense of the difference between two countries.

Nevertheless, there are some weaknesses in this approach, because the percentage of correct answers depends on the difficulty of the test. The actual size of the difference in results between two countries depends on the difficulty of the test, which may lead to misinterpretation.

International surveys do not aim to just report an overall level of performance. Over the past few decades, policy makers have also largely been interested in equity indicators. They may also be interested in the amount of dispersion of results in their country. In some countries the results may be clustered around the mean and in other countries there may be large numbers of students scoring very high results and very low results.

It would be impossible to compute dispersion indices with only the difficulty indices, based on percentage of correct answers of all items. To do so, the information collected through the test need also be summarised at the student level.

To compare the results of two students assessed by two different tests, the tests must have exactly the same average difficulty. For PISA, as all items included in the main study are usually field trialled, test developers have some idea of the item difficulties and can therefore allocate the items to the different tests in such a way that the items in each test have more or less the same average difficulty. However, the two tests will never have exactly the same difficulty.

The distribution of the item difficulties will affect the distribution of the students' performance expressed as a raw score. For instance, a test with only items of medium difficulty will generate a different student score distribution than a test that consists of a large range of item difficulties.

This is complicated to a further degree in PISA as it assesses three or even four domains per cycle. This multiple assessment reduces the number of items available for each domain per test and it is easier to guarantee the comparability of two tests of 60 items than it is with, for example, 15 items.

If the different tests are randomly assigned to students, then the equality of the subpopulations in terms of mean score and variance of the student's performance can be assumed. In other words,

- The mean of the raw score should be identical for the different tests.
- The variance of the student raw scores should be identical for the different tests.

If this is not the case, then it would mean that the different tests do not have exactly the same psychometric properties. To overcome this problem of comparability of student performance between tests, the student's raw scores can be standardised per test. As the equality of the subpopulations can be assumed, differences in the results are due to differences in the test characteristics. The standardisation would then neutralise the effect of test differences on student's performance.

However, usually, only a sample of students from the different subpopulations is tested. As explained in Chapters 3 and 4, this sampling process generates an uncertainty around any population estimates. Therefore, even if different tests present exactly the same psychometric properties and are randomly assigned, the mean and standard deviation of the students' performance between the different tests can differ slightly. As the effect of the test characteristics and the sampling variability cannot be disentangled, the assumption cannot be made that the student raw scores obtained with different tests are fully comparable.

Other psychometric arguments can also be invoked against the use of raw scores based on the percentage of correct answers to assess student performance. Raw scores are on a ratio scale insofar as the interpretation of the results is limited to the number of correct answers. A student who gets a 0 on this scale did not provide any correct answers, but could not be considered as having no competencies, while a student who gets 10 has twice the number of correct answers as a student who gets 5, but does not necessarily have twice the competencies. Similarly, a student with a perfect score could not be considered as having all competencies (Wright and Stone, 1979).

THE RASCH MODEL FOR DICHOTOMOUS ITEMS

Introduction to the Rasch Model

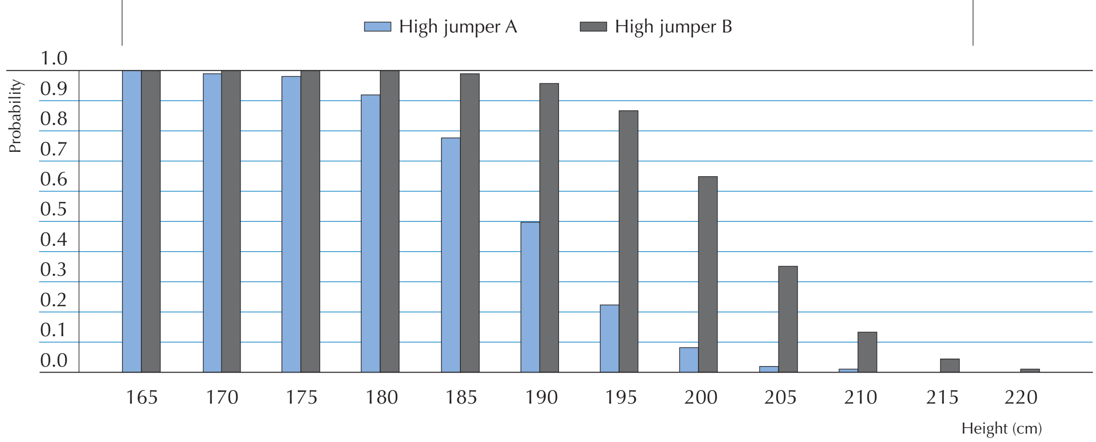
PISA applies the Rasch Model for scaling, in order to overcome challenges identified in the previous section. The following section provides a general introduction to the Rasch Model.

Let us suppose that someone wants to estimate the competence of a high jumper. It might be measured or expressed as his or her:

- individual record,
- individual record during an official and international event,
- mean performance during a particular period of time,
- most frequent performance during a particular period of time.

Figure 5.1 presents the probability of success for two high jumpers per height for the competitions in the previous year.

Figure 5.1
Probability of success for two high jumpers by height (dichotomous)



The two high jumpers always succeeded at 165 centimetres. Then the probability of success progressively decreases to reach 0 for both jumpers at 225 centimetres. While it starts to decrease at 170 centimetres for High jumper A, it starts to decrease at 185 for High jumper B.

These data can be depicted by a logistic regression model. This statistical analysis consists of explaining a dichotomous variable by a continuous variable. In this example, the continuous variable will explain the success or failure of a particular jumper by the height of the jump. The outcome of this analysis will allow the estimation of the probability of success, given any height. Figure 5.2 presents the probability of success for two high jumpers.

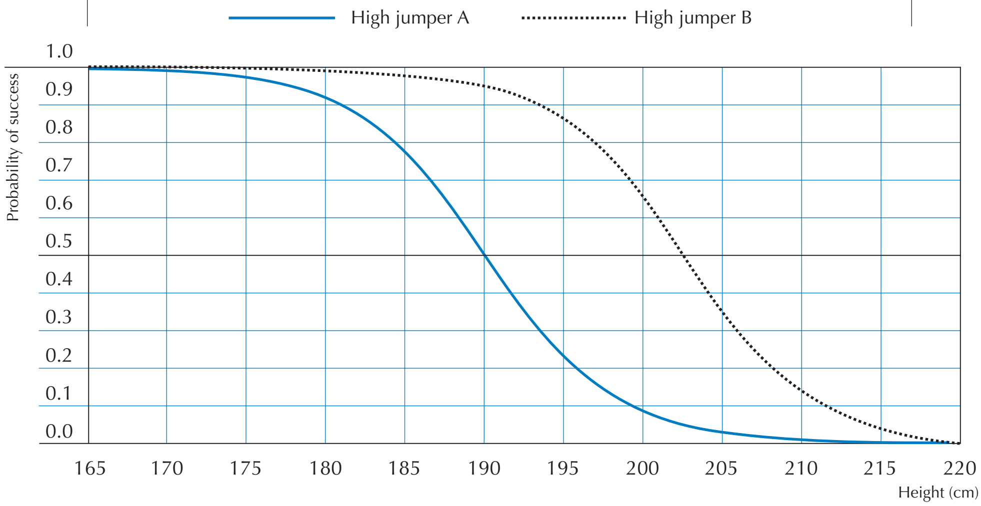
These two functions model the probability of success for the two high jumpers. The blue function represents the probability of success for High jumper A and the black function, the probability of success for High jumper B.

By convention,[2] the performance level would be defined as the height where the probability of success is equal to 0.50. This makes sense as below that level, the probability of success is lower than the probability of failure and beyond that level, it is the inverse.

In this particular example, the performance of the two high jumpers is respectively 190 and 202.5. Note that from Figure 5.1, the performance of High jumper A is directly observable whereas for High jumper B, it needs to be estimated from the model. A key property of this kind of approach is that the level (*i.e.* the height) of the crossbar and the performance of the high jumpers are expressed on the same metric or scale.

Figure 5.2

Probability of success for two high jumpers by height (continuous)

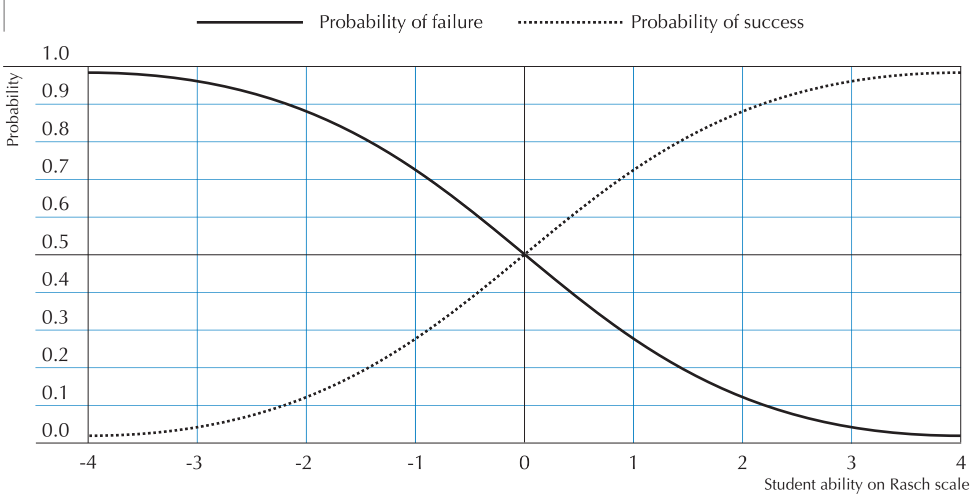


Scaling cognitive data according to the Rasch Model follows the same principle. The difficulty of the items is analogous to the difficulty of the jump based on the height of the crossbar. Further, just as a particular jump has two possible outcomes, *i.e.* success or failure, a student's answer to a particular question is either correct or incorrect. Finally, just as each jumper's performance was defined at the point where the probability of success was 0.5, the student's performance/ability is measured where the probability of success on an item equals 0.5.

One of the important features of the Rasch Model is that it will create a continuum on which both student performance and item difficulty will be located and a probabilistic function links these two components. Low ability students and easy items will be located on the left side of the continuum or scale, while high ability students and difficult items will be located on the right side of the continuum. Figure 5.3 represents the probability of success and the probability of failure for an item of difficulty zero.

Figure 5.3

Probability of success to an item of difficulty zero as a function of student ability



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As shown in Figure 5.3, a student with an ability of zero has a probability of 0.5 of success on an item of difficulty zero and a probability of 0.5 of failure. A student with an ability of –2 has a probability of a bit more than 0.10 of success and a probability of a bit less than 0.90 of failure on the same item of difficulty zero. But this student will have a probability of 0.5 of succeeding on an item of difficulty –2.

From a mathematical point of view, the probability that a student i, with an ability denoted β_i, provides a correct answer to item j of difficulty δ_j is equal to:

$$P(X_{ij}=1 \mid \beta_i, \delta_j) = \frac{\exp(\beta_i - \delta_j)}{1+\exp(\beta_i - \delta_j)}$$

Similarly, the probability of failure is equal to:

$$P(X_{ij}=0 \mid \beta_i, \delta_j) = \frac{1}{1+\exp(\beta_i - \delta_j)}$$

It can be easily shown that:

$$P(X_{ij}=1 \mid \beta_i, \delta_j) + P(X_{ij}=0 \mid \beta_i, \delta_j) = 1$$

In other words, the probability of success and the probability of failure always sum to one. Tables 5.1 to 5.5 present the probability of success for different student abilities and different item difficulties.

Table 5.1

Probability of success when student ability equals item difficulty

Student ability	Item difficulty	Probability of success
-2	-2	0.50
-1	-1	0.50
0	0	0.50
1	1	0.50
2	2	0.50

Table 5.2

Probability of success when student ability is less than the item difficulty by 1 unit

Student ability	Item difficulty	Probability of success
-2	-1	0.27
-1	0	0.27
0	1	0.27
1	2	0.27
2	3	0.27

Table 5.3

Probability of success when student ability is greater than the item difficulty by 1 unit

Student ability	Item difficulty	Probability of success
-2	-3	0.73
-1	-2	0.73
0	-1	0.73
1	0	0.73
2	3	0.73

Table 5.4

Probability of success when student ability is less than the item difficulty by 2 units

Student ability	Item difficulty	Probability of success
-2	0	0.12
-1	1	0.12
0	2	0.12
1	3	0.12
2	4	0.12

Table 5.5

Probability of success when student ability is greater than the item difficulty by 2 units

Student ability	Item difficulty	Probability of success
-2	-4	0.88
-1	-3	0.88
0	-2	0.88
1	-1	0.88
2	0	0.88

It can be observed that:

- When the student ability is equal to the item difficulty, the probability of success will always be equal to 0.50, regardless of the student ability and item difficulty locations on the continuum (Table 5.1).
- If the item difficulty exceeds the student ability by one Rasch unit, denoted as a logit, then the probability of success will always be equal to 0.27, regardless of the location of the student ability on the continuum (Table 5.2).
- If the student ability exceeds the item difficulty by one logit, the probability of success will always be equal to 0.73, regardless of the location of the student ability on the continuum (Table 5.3).
- If two units separate the student ability and the item difficulty, the probabilities of success will be 0.12 when the student ability is lower than the item difficulty and 0.88 when the student ability is higher than the item difficulty (Tables 5.4 and 5.5).

From these observations, it is evident that the only factor that influences the probability of success is the distance on the Rasch continuum between the student ability and the item difficulty.

These examples also illustrate the symmetry of the scale. If student ability is lower than item difficulty by one logit, then the probability of success will be 0.27, which is 0.23 lower than the probability of success when ability and difficulty are equal. If student ability is higher than item difficulty by one logit, the probability of success will be 0.73, which is 0.23 higher than the probability of success when ability and difficulty are equal. Similarly, a difference of two logits generates a change of 0.38 from the probability of success when ability and difficulty are equal.

Item calibration

Of course, in real settings a student's answer will either be correct or incorrect, so what then is the meaning of a probability of 0.5 of success in terms of correct or incorrect answers? In simple terms the following interpretations can be made:

- If 100 students each having an ability of 0 have to answer a item of difficulty 0, then the model will predict 50 students with correct answers and 50 students with incorrect answers.
- If a student with an ability of 0 has to answer 100 items, all of difficulty 0, then the model will predict 50 correct answers and 50 incorrect answers.

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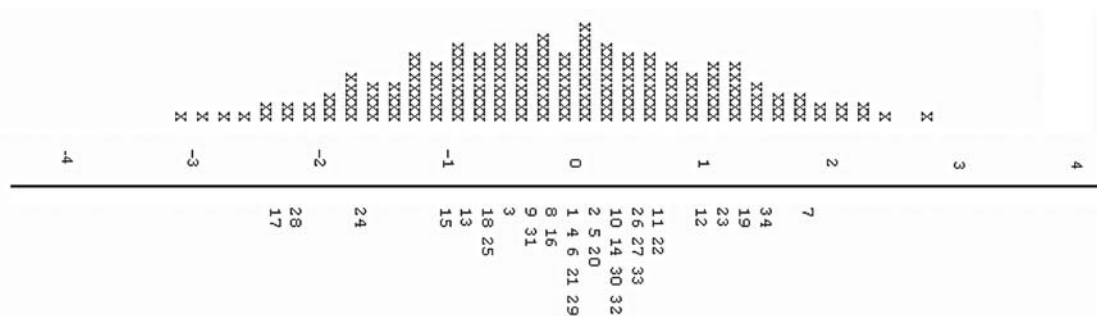
As described, the Rasch Model, through a probabilistic function, builds a relative continuum on which the item's difficulty and the student's ability are located. With the example of high jumpers, the continuum already exists, *i.e.* this is the physical continuum of the meter height. With cognitive data, the continuum has to be built. By analogy, this consists of building a continuum on which the unknown height of the crossbars, *i.e.* the difficulty of the items, will be located. The following three major principles underlie the construction of the Rasch continuum.

- The relative difficulty of an item results from the comparison of that item with all other items. Let us suppose that a test consists of only two items. Intuitively, the response pattern (0, 0) and (1, 1) (1 denotes a success and 0 denotes a failure), where the ordered pairs refer to the responses to items 1 and 2, respectively, is uninformative for comparing the two items. The responses in these patterns are identical. On the other hand, responses (1, 0) and (0, 1) are different and are informative on just that comparison. If 50 students have the (0, 1) response pattern and only 10 students have the (1, 0) response pattern, then the second item is substantially easier than the first item. Indeed, 50 students succeeded on the second item while failing the first one and only 10 students succeeded on the first item while failing the second. This means that if one person succeeds on one of these two items, the probability of succeeding on the second item is five times higher than the probability of succeeding on first item. It is, therefore, easier to succeed on the second than it is to succeed on the first. Note that the relative difficulty of the two items is independent of the student abilities.
- As difficulties are determined through comparison of items, this creates a relative scale, and therefore there are an infinite number of scale points. Broadly speaking, the process of overcoming this issue is comparable to the need to create anchor points on the temperature scale. For example, Celsius fixed two reference points: the temperature at which the water freezes and the temperature at which water boils. He labelled the first reference point as 0 and the second reference point at 100 and consequently defined the measurement unit as one-hundredth of the distance between the two reference points. In the case of the Rasch Model, the measurement unit is defined by the probabilistic function involving the item difficulty and student ability parameters. Therefore, only one reference point has to be defined. The most common reference point consists of centring the item difficulties on zero. However, other arbitrary reference points can be used, like centring the student's abilities on zero.
- This continuum allows the computation of the relative difficulty of items partly submitted to different subpopulations. Let us suppose that the first item was administered to all students and the second item was only administered to the low ability students. The comparison of items will only be performed on the subpopulation who was administered both items, *i.e.* the low ability student population. The relative difficulty of the two items will be based on this common subset of students.

Figure 5.4
Student score and item difficulty distributions on a Rasch continuum



Once the item difficulties have been placed on the Rasch continuum, the student scores can be computed. The line in Figure 5.4 represents a Rasch continuum. The item difficulties are located above that line and the item numbers are located below the line. For instance, item 7 represents a difficult item and item 17, an easy item. This test includes a few easy items, a large number of medium difficulty items and a few difficult items. The x symbols above the line represent the distribution of the student scores.

Computation of a student's score

Once the item difficulties have been located on the Rasch scale, student scores can be computed. As mentioned previously, the probability that a student *i*, with an ability denoted β_i, provides a correct answer to item *j* of difficulty δ_j is equal to:

$$P(X_{ij}=1 \mid \beta_i, \delta_j) = \frac{\exp(\beta_i - \delta_j)}{1+\exp(\beta_i - \delta_j)}$$

Similarly, the probability of failure is equal to:

$$P(X_{ij}=0 \mid \beta_i, \delta_j) = \frac{1}{1+\exp(\beta_i - \delta_j)}$$

The Rasch Model assumes the independence of the items, *i.e.* the probability of a correct answer does not depend on the responses given to the other items. Consequently, the probability of succeeding on two items is equal to the product of the two individual probabilities of success.

Let us consider a test of four items with the following items difficulties: –1, –0.5, 0.5 and 1. There are 16 possible responses patterns. These 16 patterns are presented in Table 5.6.

Table 5.6
Possible response pattern for a test of four items

Raw score	Response patterns
0	(0, 0, 0, 0)
1	(1, 0, 0, 0), (0, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1)
2	(1, 1, 0, 0), (1, 0, 1, 0), (1, 0, 0, 1), (0, 1, 1, 0), (0, 1, 0, 1), (0, 0, 1, 1)
3	(1, 1, 1, 0), (1, 1, 0, 1), (1, 0, 1, 1), (0, 1, 1, 1)
4	(1, 1, 1, 1)

For any student ability denoted β_i, it is possible to compute the probability of any response pattern. Let us compute the probability of the response pattern (1, 1, 0, 0) for three students with an ability of -1, 0, and 1.

Table 5.7
Probability for the response pattern (1, 1, 0, 0) for three student abilities

			$\beta_i = -1$	$\beta_i = 0$	$\beta_i = 1$
Item 1	$\delta_1 = -1$	Response = 1	0.50	0.73	0.88
Item 2	$\delta_2 = -0.5$	Response = 1	0.38	0.62	0.82
Item 3	$\delta_3 = 0.5$	Response = 0	0.82	0.62	0.38
Item 4	$\delta_4 = 1$	Response = 0	0.88	0.73	0.50
Probability of obtaining response pattern			**0.14**	**0.21**	**0.14**

The probability of success for the first student on the first item is equal to:

$$P(X_{ij}=1\,|\,\beta_i,\delta_j) = P(X_{1,1}=1\,|\,-1,-1)\,\frac{\exp(-1-(-1))}{1+\exp(-1-(-1))} = 0.5$$

The probability of success for the first student on the second item is equal to:

$$P(X_{ij}=1\,|\,\beta_i,\delta_j)=P(X_{1,2}=1\,|\,-1,-0.5)\,\frac{\exp(-1-(0.5))}{1+\exp(-1-(-0.5))} = 0.38$$

The probability of failure for the first student on the third item is equal to:

$$P(X_{ij}=0\,|\,\beta_i,\delta_j)= P(X_{1,3}=0\,|\,-1, 0.5)\,\frac{1}{1+\exp(-1-0.5)} = 0.82$$

The probability of failure for the first student on the fourth item is equal to:

$$P(X_{ij}=0\,|\,\beta_i,\delta_j)= P(X_{1,4}=0\,|\,-1, 1)\,\frac{1}{1+\exp(-1-1)} = 0.88$$

As these four items are considered as independent, the probability of the response pattern (1, 1, 0, 0) for a student with an ability $\beta_i = -1$ is equal to:

0.50*0.38*0.82*0.88 = 0.14

Given the item difficulties, a student with an ability $\beta_i = -1$ has 14 chances out of 100 to provide a correct answer to items 1 and 2 and to provide an incorrect answer to items 3 and 4. Similarly, a student with an ability of $\beta_i = 0$ has a probability of 0.21 to provide the same response pattern and a student with an ability of $\beta_i = 1$ has a probability of 0.14.

This process can be applied for a large range of student abilities and for all possible response patterns. Figure 5.5 presents the probability of observing the response pattern (1, 1, 0, 0) for all students' abilities between –6 and +6. As shown, the most likely value corresponds to a student ability of 0. Therefore, the Rasch Model will estimate the ability of any students with a response pattern (1, 1, 0, 0) to 0.

Figure 5.5

Response pattern probabilities for the response pattern (1, 1, 0, 0)

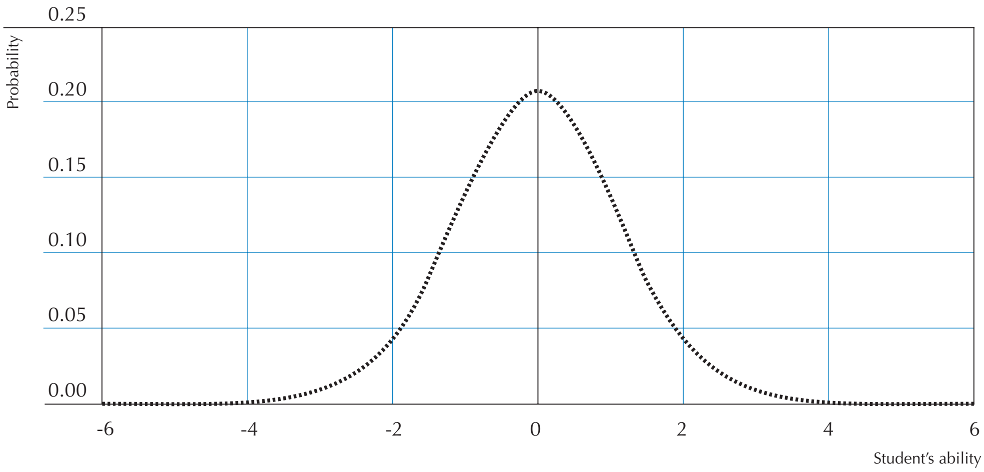


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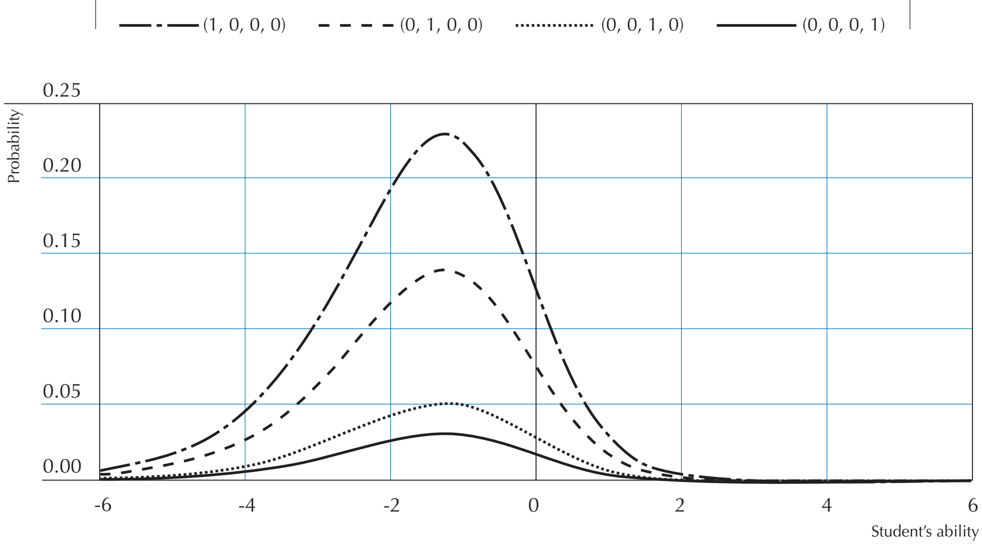
Figure 5.6 presents the distribution of the probabilities for all response patterns with only one correct item. As shown in Table 5.6, there are four responses patterns with only one correct item, *i.e.* (1, 0, 0, 0), (0, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1).

Figure 5.6 clearly shows that:

- The most likely response pattern for any students who succeed on only one item is (1, 0, 0, 0) and the most unlikely response pattern is (0, 0, 0, 1). When a student only provides one correct answer, it is expected that the correct answer was provided for the easiest item, *i.e.* item 1. It is also unexpected that this correct answer was provided for the most difficult item, *i.e.* item 4.
- Whatever the response pattern, the most likely value always corresponds to the same value for student ability. For instance, the most likely student ability for the response pattern (1, 0, 0, 0) is around –1.25. This is also the most likely student ability for the other response patterns.

The Rasch Model will therefore return the value –1.25 for any students who get only one correct answer, whichever item was answered correctly.

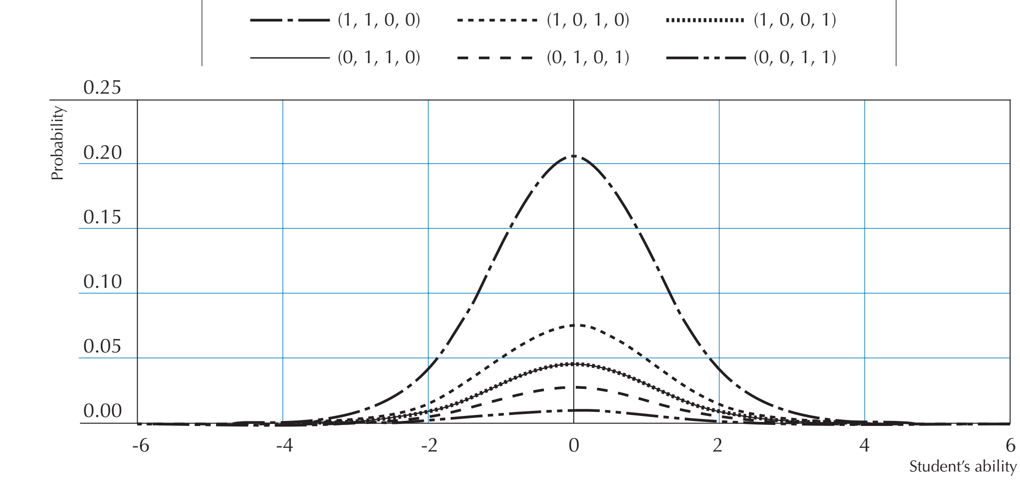
Figure 5.6
Response pattern probabilities for a raw score of 1



Similarly, as shown by Figure 5.7 and by Figure 5.8:

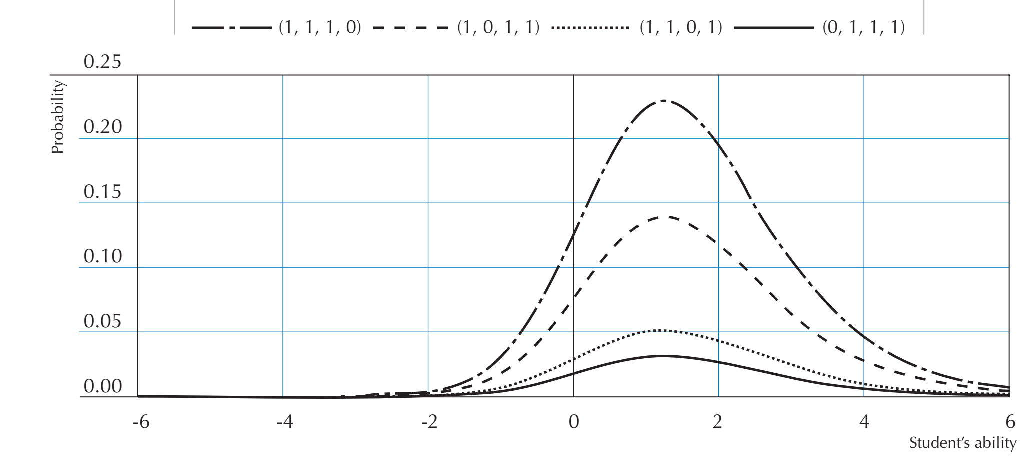
- The most likely response pattern with two correct items is (1, 1, 0, 0).
- The most likely student ability is always the same for any response pattern that includes two correct answers (student ability is 0 in this case).
- The most likely response pattern with three correct items is (1, 1, 1, 0).
- The most likely student ability is always the same for any response pattern that includes three correct answers (student ability is +1.25 in this case).

Figure 5.7
Response pattern probabilities for a raw score of 2[a]



a. In this example, since the likelihood function for the response pattern (1, 0, 0, 1) is perfectly similar to that for the response pattern (0, 1, 1, 0), these two lines overlap in the figure.

Figure 5.8
Response pattern probabilities for a raw score of 3



This type of Rasch ability estimate is usually denoted the maximum likelihood estimate (or MLE). As shown by these figures, per raw score, *i.e.* zero correct answers, one correct answer, two correct answers, and so on, the Rasch Model will return only one maximum likelihood estimate.

Warm has shown that this maximum likelihood estimate is biased and proposed to weight the contribution of each item by the information this item can provide (Warm, 1989). Warm estimates and MLEs are similar types of student individual ability estimates.

As the Warm estimate corrects the small bias in the MLE, it is usually preferred as the estimate of an individual's ability. Therefore, in PISA, weighted likelihood estimates (WLEs) are calculated by applying weights to MLE in order to account for the bias inherent in MLE as Warm proposed.

Computation of a student's score for incomplete designs

PISA uses a rotated booklet design for overcoming the conflicting demands of limited student-level testing time and the broad coverage of the assessment domain. A testing design where students are assigned a subset of items is denoted as an incomplete design. The principles for computing the student's individual ability estimate described in the previous section are also applicable for incomplete designs.

Let us suppose that two students with abilities of –1 and 1 have to answer two out of the four items presented in Table 5.8. The student with $\beta_1 = -1$ has to answer the first two items, *i.e.* the two easiest items and the student with $\beta_2 = 1$ has to answer the last two items, *i.e.* the two most difficult items. Both students succeed on their first item and fail on their second item.

Both patterns have a probability of 0.31 respectively for an ability of –1 and 1. As stated previously, these probabilities can be computed for a large range of student abilities. Figure 5.9 presents the (1, 0) response pattern probabilities for the easy test (solid line) and for the difficult test (dotted line).

Table 5.8

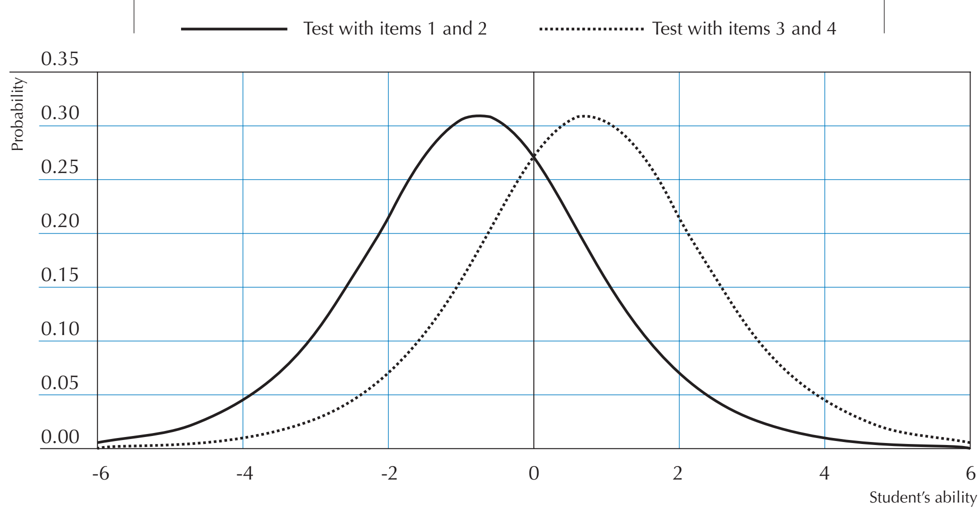
Probability for the response pattern (1, 0) for two students of different ability in an incomplete test design

			$\beta_i = -1$	$\beta_i = 0$
Item 1	$\delta_1 = -1$	Response = 1	0.50	
Item 2	$\delta_2 = -0.5$	Response = 0	0.62	
Item 3	$\delta_3 = 0.5$	Response = 1		0.62
Item 4	$\delta_4 = 1$	Response = 0		0.50
Response pattern			**0.31**	**0.31**

Figure 5.9 shows that for any student that succeeded on one item of the easy test, the model will estimate the student ability at –0.75, and that for any student that succeeded on one item of the difficult test, the model will estimate the student ability at 0.75. If raw scores were used as estimates of student ability, in both cases, we would get 1 out of 2, or 0.5.

Figure 5.9

Response pattern likelihood for an easy test and a difficult test



In summary, the raw score does not take into account the difficulty of the item for the estimation of the raw score and therefore, the interpretation of the raw score depends on the item difficulties. On the other hand, the Rasch Model uses the number of correct answers and the difficulties of the items administered to a particular student for his or her ability estimate. Therefore, a Rasch score can be interpreted independently of the item difficulties. As far as all items can be located on the same continuum, the Rasch model can return fully comparable student ability estimates, even if students were assessed with a different subset of items. Note, however, that valid ascertainment of the student's Rasch score depends on knowing the item difficulties.

Optimal conditions for linking items

Some conditions have to be satisfied when different tests are used. First of all, the data collected through these tests must be linked. Without any links, the data collected through two different tests cannot be reported on a single scale. Usually, tests are linked by having different students do common items or having the same students assessed with the different tests.

Let's suppose that a researcher wants to estimate the growth in reading performance between a population of grade 2 students and a population of grade 4 students. Two tests will be developed and both will be targeted at the expected proficiency level of both populations. To ensure that both tests can be scaled on the same continuum, a few difficult items from the grade 2 test will be included in the grade 4 test (let's say items 7, 34, 19, 23 and 12).

Figure 5.10
Rasch item anchoring

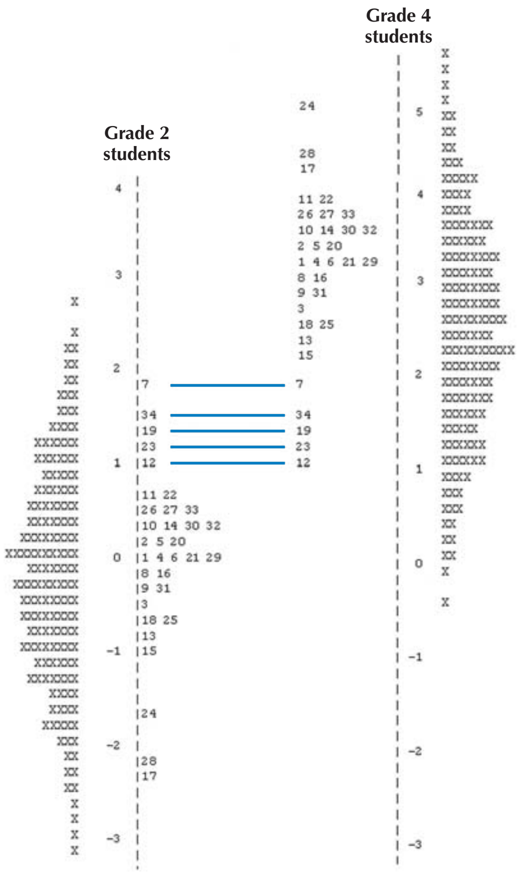


Figure 5.10 represents this item-anchoring process. The left part of Figure 5.10 presents the outputs of the scaling of the grade 2 test with items centred on zero. For the scaling of grade 4 data, the reference point will be the grade 2 difficulty of the anchoring items. Then the difficulty of the other grade 4 items will be fixed according to this reference point, as shown on the right side of Figure 5.10.

With this anchoring process, grade 2 and grade 4 item difficulties will be located on a single continuum. Therefore, the grade 2 and grade 4 students' ability estimates will also be located on the same continuum.

To accurately estimate the increase between grades 2 and 4, the researcher needs to ensure that the location of the anchor items is similar in both tests.

From a theoretical point of view, only one item is needed to link two different tests. However, this situation is far from being optimal. A balanced incomplete design presents the best guarantee for reporting the data of different tests on a single scale. This was adopted by PISA 2003 where the item pool was divided into 13 clusters of items. The item allocation to clusters takes into account the expected difficulty of the items and the expected time needed to answer the items. Table 5.9 presents the PISA 2003 test design. Thirteen clusters of items were denoted as C1 to C13 respectively. Thirteen booklets were developed and each of them has four parts, denoted as Block 1 to Block 4. Each booklet consists of four clusters. For instance, Booklet 1 consists of Cluster 1, Cluster 2, Cluster 4 and Cluster 10.

Table 5.9
PISA 2003 test design

	Block 1	Block 2	Block 3	Block 4
Booklet 1	C1	C2	C4	C10
Booklet 2	C2	C3	C5	C11
Booklet 3	C3	C4	C6	C12
Booklet 4	C4	C5	C7	C13
Booklet 5	C5	C6	C8	C1
Booklet 6	C6	C7	C9	C2
Booklet 7	C7	C8	C10	C3
Booklet 8	C8	C9	C11	C4
Booklet 9	C9	C10	C12	C5
Booklet 10	C10	C11	C13	C6
Booklet 11	C11	C12	C1	C7
Booklet 12	C12	C13	C2	C8
Booklet 13	C13	C1	C3	C9

With such design, each cluster appears four times, once in each position. Further, each pair of clusters appears once and only once.

This design should ensure that the link process will not be influenced by the respective location of the link items in the different booklets.

Extension of the Rasch Model

Wright and Masters have generalised the original Rasch Model to polytomous items, usually denoted as the partial credit model (Wright and Masters, 1982). With this model, items can be scored as incorrect, partially correct and correct. The PISA cognitive items were calibrated according to this model.

This polytomous items model can also be applied on Likert scale data. There is of course no correct or incorrect answer for such scales, but the basic principles are the same: the possible answers can be ordered. PISA questionnaire data are scaled with the one-parameter logistic model for polytomous items.

OTHER ITEM RESPONSE THEORY MODELS

A classical distinction between item response theory models concerns the number of parameters used to describe items. The Rasch Model is designated as a one-parameter model because item characteristic curves only depend on the item difficulty. In the three-parameter logistic model, the item characteristic curves depend on: *(i)* the item difficulty parameter; *(ii)* the item discrimination parameter; and *(iii)* what can be termed the "guessing" parameter. This last parameter accounts for the fact that, on a multiple choice test, all students have some chance of answering the item correctly, no matter how difficult the item is.

CONCLUSION

The Rasch Model was designed to build a symmetric continuum on which both item difficulty and student ability are located. The item difficulty and the student ability are linked by a logistic function. With this function, it is possible to compute the probability that a student succeeds on an item.

Further, due to this probabilistic link, it is not a requirement to administer the whole item battery to every student. If some link items are guaranteed, the Rasch Model will be able to create a scale on which every item and every student will be located. This last feature of the Rasch Model constitutes one of the major reasons why this model has become fundamental in educational surveys.

Notes

1. See *Measuring Student Knowledge and Skills – A New Framework for Assessment* (OECD, 1999a), *The PISA 2003 Assessment Framework – Mathematics, Reading, Science and Problem Solving Knowledge and Skills* (OECD, 2003b), and *Assessing Scientific, Reading and Mathematical Literacy – A Framework for PISA 2006* (OECD, 2006).

2. The probability of 0.5 was first used by psychophysics theories (Guilford, 1954).

6

Plausible Values

INDIVIDUAL ESTIMATES VERSUS POPULATION ESTIMATES

Education assessments can have two major purposes:

1. To measure the knowledge and skills of particular students. The performance of each student usually will have an impact on his or her future (school career, admission to post-secondary education, and so on). It is therefore particularly important to minimise the measurement error associated with each individual's estimate.
2. To assess the knowledge or skills of a population. The performance of individuals will have no impact on their school career or professional life. In such a case, the goal of reducing error in making inferences about the target population is more important than the goal of reducing errors at the individual level.

National and international education surveys belong to the second category.

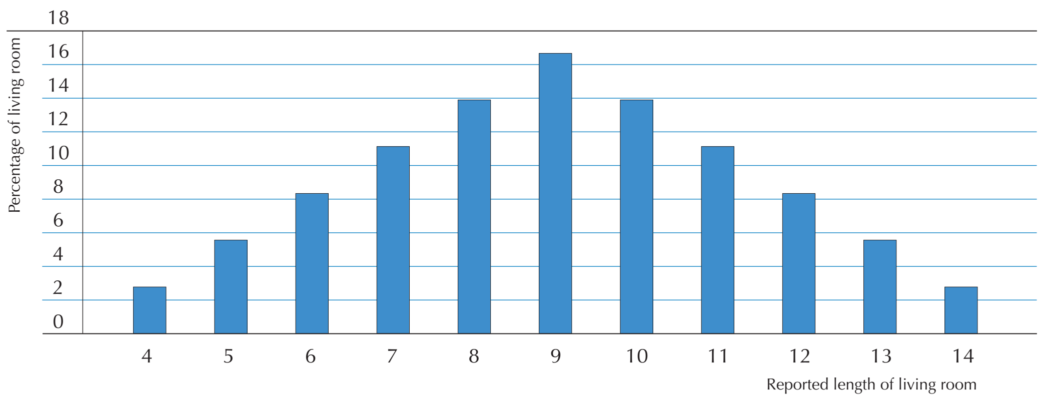
International surveys such as PISA report student performance through plausible values.[1] This chapter will explain the conceptual meaning of plausible values and the advantage of reporting with them. Individual estimators (such as the *weighted likelihood estimate* [WLE] defined in Chapter 5) will be compared with plausible values for the purposes of estimating a range of population statistics.

THE MEANING OF PLAUSIBLE VALUES (PVs)

An example taken from the physical sciences measurement area can help illustrate the complex concept of plausible values. Suppose that a city board decides to levy a new building tax to increase the city's revenue. This new tax will be proportional to the length of the family house living room. Inspectors visit all city houses to measure the length of the living rooms. They are given a measuring tape and are instructed to record the length in term of integers only, *i.e.* 1 metre, 2 metres, 3 metres, 4 metres and so on.

The results of this measure are shown in Figure 6.1. About 2% of the living rooms have a reported length of 4 metres; slightly over 16% of the living rooms have a reported length of 9 metres and so on.

Figure 6.1
Living room length expressed in integers



Of course, the reality is quite different, as length is a continuous variable. With a continuous variable, observations can take any value between the minimum and the maximum. On the other hand, with a discontinuous variable, observations can only take a predefined number of values. Figure 6.2 gives the length distribution of the living rooms per reported length.

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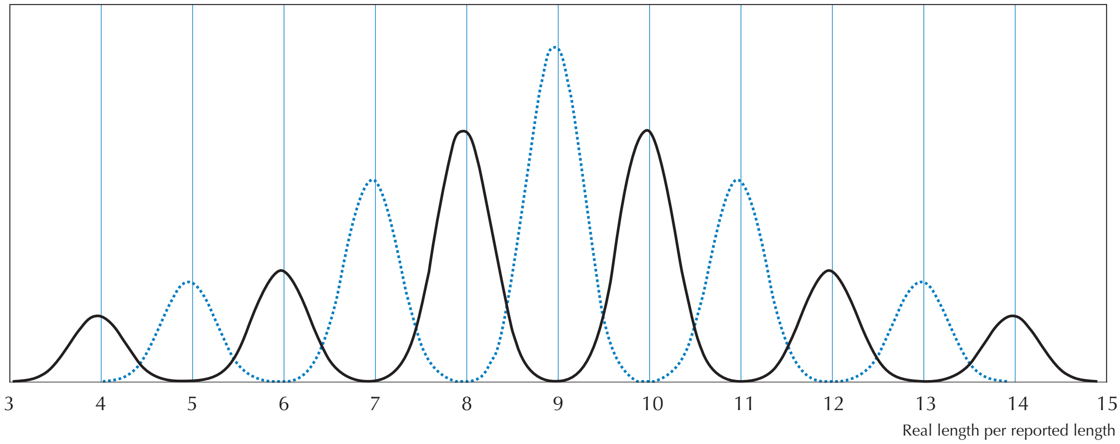
Figure 6.2
Real length per reported length



All living rooms with a reported length of 5 metres are not exactly 5 metres long. On average, they are 5 metres long, but their length varies around the mean. The difference between reported length and real length is due to the rounding process and measurement error. An inspector might incorrectly report 5 metres for a particular living room, when it really measures 4.15 metres. If the rounding process were the only source of error, then the reported length should be 4 metres. The second source of error, the error in measuring, explains the overlap in the distribution.

In this particular example, the lengths of the living rooms are normally distributed around the mean, which is also the reported length. If the difference between the length and the closest integer is small, then the probability of not reporting this length with the closest integer is very small. For instance, it is unlikely that a length of 4.15 be reported as 5 metres or 3 metres. However, as the distance between the real length and the closest integer increases, the probability of not reporting this length with the closest integer will also increase. For instance, it is likely that a length of 4.95 will be reported as 5 metres, whereas a length of 4.50 will be reported equally as many times as 4 metres as it is 5 metres.

The methodology of plausible values consists of:

- mathematically computing distributions (denoted as posterior distributions) around the reported values and the reported length in the example; and
- assigning to each observation a set of random values drawn from the posterior distributions.

Plausible values can therefore be defined as random values from the posterior distributions. In the example, a living room of 7.154 metres that was reported as 7 metres might be assigned any value from the normal distribution around the reported length of 7. It might be 7.45 as well as 6.55 or 6.95. Therefore, plausible values should not be used for individual estimation.

This fictitious example from the physical sciences can be translated successfully to the social sciences. For example, with a test of six dichotomous items, a continuous variable (*i.e.* mental ability) can be transformed into a discontinuous variable. The discontinuous variable will be the student raw score or the number of correct answers. The only possible scores are: 0, 1, 2, 3, 4, 5 and 6.

Contrary to most measures in the physical sciences, psychological or education measures encompass substantial measurement errors because:

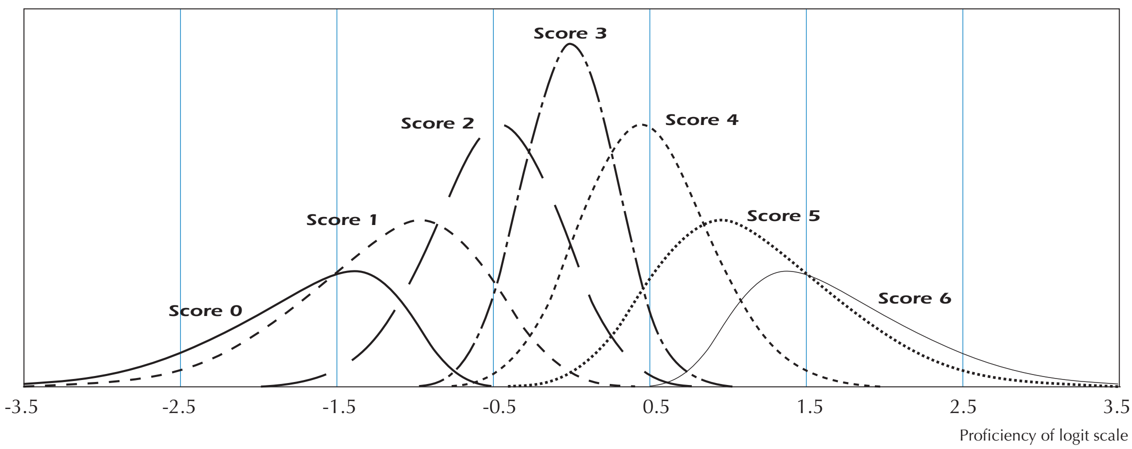
- The concept to be measured is broader.
- They might be affected by the mental and physical dispositions of the students on the day of the assessment.
- The conditions in which students are tested might also affect the results.

This means that there are large overlaps in the posterior distributions, as shown in Figure 6.3.

Further, with the example of the living room, the measurement error of the posterior distributions can be considered as independent of the living room.[2] In education, the measurement error is not always independent of the proficiency level of the students. It may be smaller for average students, and larger for low and high achievers, depending on the test average difficulty.

Further, in this particular example, the posterior distributions for score 0 and score 6 are substantially skewed, as the posterior distributions of the living rooms with a reported length of 4 and 14 metres would be, if all living rooms smaller than 4 metres were reported as 4, and if all living rooms longer than 14 metres were reported as 14. This means that the posterior distributions are not normally distributed, as shown in Figure 6.3.

Figure 6.3
A posterior distribution on a test of six items



Generating plausible values on an education test consists of drawing random numbers from the posterior distributions. This example clearly shows that plausible values should not be used for individual performance. Indeed, a student who scores 0 might get -3, but also -1. A student who scores 6 might get 3, but also 1.

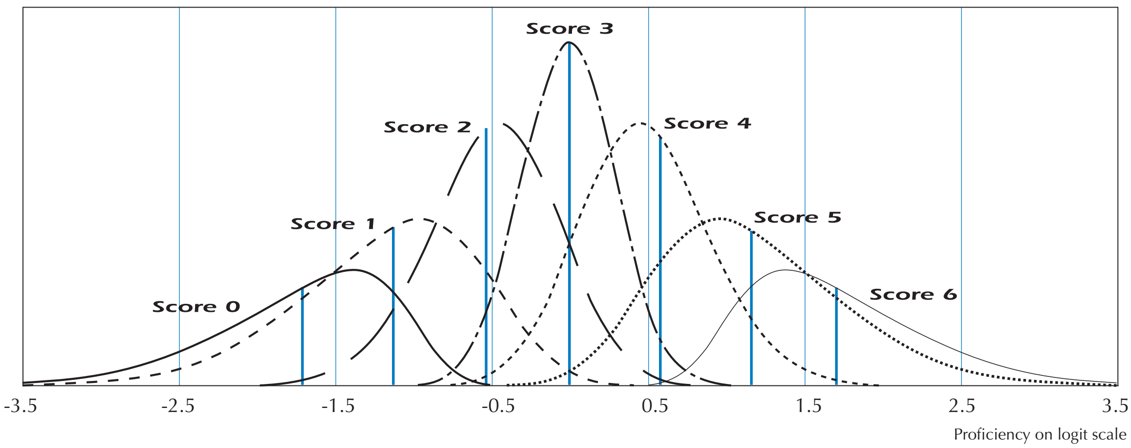
It has been noted that:

> "The simplest way to describe plausible values is to say that plausible values are a representation of the range of abilities that a student might reasonably have. […] Instead of directly estimating a student's ability θ, a probability distribution for a student's θ is estimated. That is, instead of obtaining a point estimate for θ, like a WLE, a range of possible values for a student's θ, with an associated probability for each of these values is estimated. Plausible values are random draws from this (estimated) distribution for a student's θ" (Wu and Adams, 2002).[3]

All this methodology aims at building a continuum from a collection of discontinuous variables (*i.e.* the test score). It is meant to prevent biased inferences occurring as a result of measuring an unobservable underlying ability through a test using a relatively small number of items.

Finally, an individual estimate of student ability can also be derived from the posterior distributions. This derived individual estimate is called the *expected a posteriori* estimator (EAP). Instead of assigning a set of random values from the posterior distributions, the mean of the posterior distributions is assigned. Therefore, the EAP can be considered as the mean of an infinite set of plausible values for a particular student. See Figure 6.4.

Figure 6.4
EAP estimators



As only one value is assigned per posterior distribution, the EAP estimator is also a discontinuous variable.[4] However, EAP estimates and WLEs differ as the former requires a population distribution assumption, which is not the case for the latter. Further, while any raw score for a particular test will always be associated with one and only one WLE, different EAP values can be associated with a particular raw score, depending on the regressors used as conditioning variables.

Researchers not used to working with plausible values might consider this apparent randomisation as a source of imprecision. The comparison of the different types of Rasch ability estimators (WLE, EAP and PV) through the estimation of population statistics will overcome this perception. The PISA database only includes PVs[5] for student performance but uses WLE for contextual indices derived from the student or school questionnaire. Although PISA does not include any EAP in its databases, the comparison will incorporate EAP estimates to show biases that occur when data analysts average the plausible values at the student levels to obtain one score value per student.

COMPARISON OF THE EFFICIENCY OF WLEs, EAP ESTIMATES AND PVs FOR THE ESTIMATION OF SOME POPULATION STATISTICS[6]

A comparison between different student ability estimators could be performed on real data. Such a comparison will outline differences, but it will not identify the best estimators for a particular population statistic. Therefore, a simulation will be used to illustrate and evaluate the differences in various estimators.

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The simulation consists of three major steps:

- The generation of a dataset including a continuous variable that represents the student abilities (*i.e.* denoted as the latent variable), some background variables including the gender and an index of social background, denoted HISEI, and a pattern of item responses coded 0 for an incorrect answer and 1 for a correct answer. The results presented hereafter are based on a fictitious test of 15 items.[7]
- The computation of the student ability estimator, in particular the WLEs, EAP estimates and PVs.[8]
- The estimation of some population parameters using the student ability (*i.e.* latent variable) and the different student ability estimators. A comparison will be made for:
  – mean, variance and percentiles,
  – correlation,
  – between- and within-school variance.

The dataset of this simulation contains 5 250 students distributed in 150 schools with 35 students per school. Table 6.1 presents the structure of the simulated dataset before the importation of the Rasch student ability estimators.

Table 6.1
Structure of the simulated data

School ID	Student ID	Sex	HISEI	Item 1	Item 2	…	Item 14	Item 15
001	01	1	32	1	1		0	0
001	02	0	45	1	0		1	0
…	…							
150	5 249	0	62	0	0		1	1
150	5 250	1	50	0	1		1	1

Table 6.2 presents the mean and the variance of the latent variable, the WLEs, the EAP estimates and the five plausible values. The average of the 5 PV mean is also included.

Table 6.2 shows that a good estimate of the population's mean (*i.e.* the latent variable estimate) is obtained regardless of the type of latent variable used (WLEs, EAP estimates or PVs). It can be empirically demonstrated that none of the estimates significantly differs from the expected mean, *i.e.* 0.00 in this particular case (Wu and Adams, 2002). Additionally, it can also be shown that the mean of the WLEs will not be biased if the test is well targeted, *i.e.* if the average of the item difficulties is around 0 on the Rasch scale (Wu and Adams, 2002). That is, on a well-targeted test, students will obtain a raw score of about 50% correct answers. If the test is too easy then the mean of the WLEs will be underestimated (this is called the ceiling effect), while if it is too difficult then the mean of the WLEs will be overestimated (this is called the floor effect).

Table 6.2
Means and variances for the latent variables and the different student ability estimators

	Mean	Variance
Latent variable	0.00	1.00
WLE	0.00	1.40
EAP	0.00	0.75
PV1	0.01	0.99
PV2	0.00	0.99
PV3	0.00	1.01
PV4	0.00	1.01
PV5	-0.01	0.00
Average of the 5 PV statistics	0.00	1.00

These last results explain why the mean of the WLEs provided in the PISA 2000 database differs from the mean of the plausible values, especially for the partner countries. For the reading/reflection and evaluation scale, the means obtained for Canada using WLEs and PVs are 538.4 and 542.5, respectively, which are very close. In contrast, the means obtained for Peru, using WLEs and PVs are 352.2 and 322.7, respectively, a difference of about 0.3 standard deviations. This shows that there is bias when WLEs are used to estimate the mean if the test is not well targeted.

For the population variance, Table 6.2 shows that PVs give estimates closest to the expected value, while WLEs overestimate it and the EAP underestimates it. These results are consistent with other simulation studies.

Table 6.3 presents some percentiles computed on the different ability estimators. For example, because the variance computed using plausible values is not biased, the percentiles based on PVs are also unbiased. However, because the EAP estimates and WLEs variances are biased, the percentiles, and in particular, extreme percentiles will also be biased. These results are consistent with other simulation studies previously cited.

Table 6.4 presents the correlation between the social background index (HISEI), gender and the latent variables and the different estimators of student abilities. The correlation coefficients with the WLEs are both underestimated, while the correlation coefficients with the EAP estimates are overestimated. Only the correlation coefficients with the plausible values are unbiased.[9]

It should be noted that the regression coefficients are all unbiased for the different types of estimators. Nevertheless, as variances are biased for some estimators, residual variances will also be biased. Therefore, the standard error on the regression coefficients will be biased in the case of the WLEs and the EAP estimates.

Table 6.3
Percentiles for the latent variables and the different student ability estimators

	P5	P10	P25	P50	P75	P90	P95
Latent variable	-1.61	-1.26	-0.66	0.01	0.65	1.26	1.59
WLE	-2.15	-1.65	-0.82	-0.1	0.61	1.38	1.81
EAP	-1.48	-1.14	-0.62	-0.02	0.55	1.08	1.37
PV1	-1.68	-1.29	-0.71	-0.03	0.64	1.22	1.59
PV2	-1.67	-1.31	-0.69	-0.03	0.62	1.22	1.58
PV3	-1.67	-1.32	-0.70	-0.02	0.64	1.21	1.56
PV4	-1.69	-1.32	-0.69	-0.03	0.63	1.23	1.55
PV5	-1.65	-1.3	-0.71	-0.02	0.62	1.2	1.55
Average of the 5 PV statistics	-1.67	-1.31	-0.70	-0.03	0.63	1.22	1.57

Table 6.4
Correlation between HISEI, gender and the latent variable, the different student ability estimators

	HISEI	GENDER
Latent variable	0.40	0.16
WLE	0.33	0.13
EAP	0.46	0.17
PV1	0.41	0.15
PV2	0.42	0.15
PV3	0.42	0.13
PV4	0.40	0.15
PV5	0.40	0.14
Average of the 5 PV statistics	0.41	0.14

Table 6.5
Between- and within-school variances

	Between-school variance	Within-school variance
Latent variable	0.33	0.62
WLE	0.34	1.02
EAP	0.35	0.38
PV1	0.35	0.61
PV2	0.36	0.60
PV3	0.36	0.61
PV4	0.35	0.61
PV5	0.35	0.61
Average of the 5 PV statistics	0.35	0.61

Finally, Table 6.5 presents the between- and within-school variances. Between-school variances for the different estimators do not differ from the expected value of 0.33. However, WLEs overestimate the within-school variance, while the EAP estimates underestimate it. These results are consistent with other simulation studies (Monseur and Adams, 2002).

As this example shows, plausible values provide unbiased estimates.

HOW TO PERFORM ANALYSES WITH PLAUSIBLE VALUES

As stated in the previous section, a set of plausible values, usually five, are drawn for each student for each scale or subscale. Population statistics should be estimated using each plausible value separately. The reported population statistic is then the average of each plausible value statistic. For instance, if one is interested in the correlation coefficient between the social index and the reading performance in PISA, then five correlation coefficients should be computed and then averaged.

Plausible values should never be averaged at the student level, *i.e.* by computing in the dataset the mean of the five plausible values at the student level and then computing the statistic of interest once using that average PV value. Doing so would be equivalent to an EAP estimate, with a bias as described in the previous section.

Mathematically, secondary analyses with plausible values can be described as follows. If θ is the population statistic and θ_i is the statistic of interest computed on one plausible value, then:

$$\theta = \frac{1}{M}\sum_{i=1}^{M}\theta_i$$

where M is the number of plausible values.

Plausible values also allow computing the uncertainty in the estimate of θ due to the lack of precision in the measurement test. If a perfect test could be developed, then the measurement error would be equal to zero and the five statistics from the plausible values would be exactly identical. Unfortunately, perfect tests do not exist and never will. This measurement variance, usually denoted imputation variance, is equal to:

$$B_M = \frac{1}{M-1}\sum_{i=1}^{M}(\theta_i - \theta)^2$$

It corresponds to the variance of the five plausible value statistics of interest. The final stage is to combine the sampling variance and the imputation variance as follows:

$$V = U + \left(1 + \frac{1}{M}\right)B_m$$

where U is the sampling variance.

Chapter 7 will demonstrate how to compute sampling variances and imputation variances and how to combine them, using the PISA databases.

CONCLUSION

This chapter was devoted to the meaning of plausible values and the steps required to analyse data with PVs. A comparison between PVs and alternate individual ability estimates was presented to demonstrate the superiority of this methodology for reporting population estimates.

Notes

1. The methodology of plausible values was first implemented in the National Assessment of Educational Progress (NAEP) studies. For more information, see Beaton (1987).

2. The measurement error will be independent of the length of the living rooms if the inspectors are using a measuring instrument that is at least 15 metres long (such as a measuring tape). If they are using a standard metre, then the overall measurement error will be proportional to the length of the living room.

3. The probability distribution for a student's θ can be based on the cognitive data only, *i.e.* the item response pattern, but can also include additional information, such as student gender, social background, and so on. The probability distribution becomes therefore conditioned by this additional information. A mathematical explanation of the model used for the scaling of the PISA 2000 scaling can be found in the PISA 2000 Technical Report (OECD, 2002c).

4. If several regressors are used as conditioning variables, then the EAP estimator tends to be a continuous variable.

5. PISA 2000 data files include both WLEs and PVs.

6. PV and EAP estimators can be computed with or without regressors. As the PVs in PISA were generated based on all variables collected through the student questionnaires, this comparison will only include PVs and EAP estimators with the use of regressors.

7. The data generation starts with a factorial analysis on a 3 by 3 squared correlation matrix. The correlation between the latent variable and gender was set at 0.20, the correlation between the latent variable and the social background indicator was set at 0.40 and the correlation between gender and the social background indicator was set at 0.00. Three random variables are drawn from normal distributions and combined according to the factorial regression coefficients to create the three variables of interest, *i.e.* reading, gender and social background. Based on the student score on the latent variable and a predefined set of 20 item difficulties; probabilities of success are computed according to the Rasch Model. These probabilities are then compared to uniform distribution and recoded into 0 and 1. Finally, gender is recoded into a dichotomous variable.

8. The estimators were computed with the Conquest Software® developed by M.L. Wu, R.J. Adams and M.R. Wilson.

9. The results on the EAP and PV correlation coefficients are observed when the probability distributions are generated with conditioning variables. Without the conditioning, the correlation with the plausible values would be underestimated.

7

Computation of Standard Errors

INTRODUCTION

As shown in Chapter 4, replicates have to be used for the computation of the standard error for any population estimate. This chapter will give examples of such computations.

For PISA, the Fay's variant of the Balanced Repeated Replication (BRR) is used. The general formula for computing the standard error with this method is:

$$\sigma^2_{(\hat{\theta})} = \frac{1}{G(1-k)^2}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

Since the PISA databases include 80 replicates and since the Fay coefficient was set to 0.5, the above formula can be simplified as follows:

$$\sigma^2_{(\hat{\theta})} = \frac{1}{G(1-k)^2}\sum_{i=1}^{G}(\hat{\theta}_{(i)} - \hat{\theta})^2 = \frac{1}{80(1-0.5)^2}\sum_{i=1}^{80}(\hat{\theta}_{(i)} - \hat{\theta})^2 = \frac{1}{20}\sum_{i=1}^{80}(\hat{\theta}_{(i)} - \hat{\theta})^2$$

THE STANDARD ERROR ON UNIVARIATE STATISTICS FOR NUMERICAL VARIABLES

To compute the mean and its respective standard error, it is necessary to first compute this statistic by weighting the data with the student final weight, *i.e.* `w_fstuwt`, and then to compute 80 other means, each of them by weighting the data with one of the 80 replicates, *i.e.* `w_fstr1` to `w_fstr80`.

Box 7.1 presents the SAS® syntax for computing these 81 means based on the social background index, denoted HISEI, for the PISA 2003 data for Germany. Table 7.1 presents the HISEI final estimates as well as the 80 replicate estimates.

Box 7.1 **SAS® syntax for computing 81 means (*e.g.* PISA 2003)**

```
data temp;
        set pisa2003.stud;
        if (cnt="DEU");
        keep cnt schoolid stidstd w_fstuwt w_fstr1-w_fstr80 hisei;
run;
proc means data=temp VARDEF=WGT;
        VAR hisei;
        WEIGHT w_fstuwt;
run;
proc means data=temp VARDEF=WGT;
        VAR hisei;
        WEIGHT w_fstr1;
run;
proc means data=temp VARDEF=WGT;
        VAR hisei;
        WEIGHT w_fstr2;
run;
.
.
.
proc means data=temp VARDEF=WGT;
        VAR hisei;
        WEIGHT w_fstr79;
run;
proc means data=temp VARDEF=WGT;
        VAR hisei;
        WEIGHT w_fstr80;
run;
```

Table 7.1
HISEI mean estimates

Weight	Mean estimate	Weight	Mean estimate
Final weight	**49.33**		
Replicate 1	49.44	Replicate 41	49.17
Replicate 2	49.18	Replicate 42	49.66
Replicate 3	49.12	Replicate 43	49.18
Replicate 4	49.46	Replicate 44	49.04
Replicate 5	49.24	Replicate 45	49.42
Replicate 6	49.34	Replicate 46	49.72
Replicate 7	49.13	Replicate 47	49.48
Replicate 8	49.08	Replicate 48	49.14
Replicate 9	49.54	Replicate 49	49.57
Replicate 10	49.20	Replicate 50	49.36
Replicate 11	49.22	Replicate 51	48.78
Replicate 12	49.12	Replicate 52	49.53
Replicate 13	49.33	Replicate 53	49.27
Replicate 14	49.47	Replicate 54	49.23
Replicate 15	49.40	Replicate 55	49.62
Replicate 16	49.30	Replicate 56	48.96
Replicate 17	49.24	Replicate 57	49.54
Replicate 18	48.85	Replicate 58	49.14
Replicate 19	49.41	Replicate 59	49.27
Replicate 20	48.82	Replicate 60	49.42
Replicate 21	49.46	Replicate 61	49.56
Replicate 22	49.37	Replicate 62	49.75
Replicate 23	49.39	Replicate 63	48.98
Replicate 24	49.23	Replicate 64	49.00
Replicate 25	49.47	Replicate 65	49.35
Replicate 26	49.51	Replicate 66	49.27
Replicate 27	49.35	Replicate 67	49.44
Replicate 28	48.89	Replicate 68	49.08
Replicate 29	49.44	Replicate 69	49.09
Replicate 30	49.34	Replicate 70	49.15
Replicate 31	49.41	Replicate 71	49.29
Replicate 32	49.18	Replicate 72	49.29
Replicate 33	49.50	Replicate 73	49.08
Replicate 34	49.12	Replicate 74	49.25
Replicate 35	49.05	Replicate 75	48.93
Replicate 36	49.40	Replicate 76	49.45
Replicate 37	49.20	Replicate 77	49.13
Replicate 38	49.54	Replicate 78	49.45
Replicate 39	49.32	Replicate 79	49.14
Replicate 40	49.35	Replicate 80	49.27

The mean that will be reported is equal to 49.33, *i.e.* the estimate obtained with the student final weight w_fstuwt. The 80 replicate estimates are just used to compute the standard error on the mean of 49.33.

There are three major steps for computing the standard error:

1. Each replicate estimate will be compared with the final estimate 49.33 and the difference will be squared. Mathematically, it corresponds to $(\hat{\theta}_{(i)} - \hat{\theta})^2$ or in this particular case, $(\hat{\mu}_{(i)} - \hat{\mu})^2$. For the first replicate, it will be equal to $(49.44 - 49.33)^2 = 0.0140$. For the second replicate, it corresponds to $(49.18 - 49.33)^2 = 0.0228$. Table 7.2 presents the squared differences.

2. The sum of the squared differences is computed, and then divided by 20. Mathematically, it corresponds to $\frac{1}{20}\sum_{i=1}^{80}(\hat{\mu}_{(i)} - \hat{\mu})^2$. In the example, the sum is equal to (0.0140 + 0.0228 + ... + 0.0354 + 0.0031- = 3.5195. The sum divided by 20 is therefore equal to $\frac{3.5195}{20} = 0.1760$. This value represents the sampling variance on the mean estimate for HISEI.

3. The standard error is equal to the square root of the sampling variance, *i.e.* $\sigma_{(\hat{\mu})} = \sqrt{\sigma^2_{(\hat{\mu})}} = \sqrt{0.1760} = 0.4195$.

This means that the sampling distribution on the HISEI mean for Germany has a standard error of 0.4195. This value also allows building a confidence interval around this mean. With a risk of type I error equal to 0.05, usually denoted α, the confidence interval will be equal to:

[49.33 – (1.96*0.4195);49.33 + (1.96*0.4195)]

[48.51;50.15]

In other words, there are 5 chances out of 100 that an interval formed in this way will fail to capture the population mean. It also means that the German population mean for HISEI is significantly different from, for example, a value of 51, as this number is not included in the confidence interval.

Chapter 11 will show how this standard error can be used for comparisons either between two or several countries, or between subpopulations within a particular country.

Table 7.2
Squared differences between replicate estimates and the final estimate

Weight	Squared difference	Weight	Squared difference
Replicate 1	0.0140	Replicate 41	0.0239
Replicate 2	0.0228	Replicate 42	0.1090
Replicate 3	0.0421	Replicate 43	0.0203
Replicate 4	0.0189	Replicate 44	0.0818
Replicate 5	0.0075	Replicate 45	0.0082
Replicate 6	0.0002	Replicate 46	0.1514
Replicate 7	0.0387	Replicate 47	0.0231
Replicate 8	0.0583	Replicate 48	0.0349
Replicate 9	0.0472	Replicate 49	0.0590
Replicate 10	0.0167	Replicate 50	0.0014
Replicate 11	0.0124	Replicate 51	0.3003
Replicate 12	0.0441	Replicate 52	0.0431
Replicate 13	0.0000	Replicate 53	0.0032
Replicate 14	0.0205	Replicate 54	0.0086
Replicate 15	0.0048	Replicate 55	0.0868
Replicate 16	0.0009	Replicate 56	0.1317
Replicate 17	0.0074	Replicate 57	0.0438
Replicate 18	0.2264	Replicate 58	0.0354
Replicate 19	0.0077	Replicate 59	0.0034
Replicate 20	0.2604	Replicate 60	0.0081
Replicate 21	0.0182	Replicate 61	0.0563
Replicate 22	0.0016	Replicate 62	0.1761
Replicate 23	0.0041	Replicate 63	0.1173
Replicate 24	0.0093	Replicate 64	0.1035
Replicate 25	0.0199	Replicate 65	0.0008
Replicate 26	0.0344	Replicate 66	0.0030
Replicate 27	0.0007	Replicate 67	0.0139
Replicate 28	0.1919	Replicate 68	0.0618
Replicate 29	0.0139	Replicate 69	0.0557
Replicate 30	0.0001	Replicate 70	0.0324
Replicate 31	0.0071	Replicate 71	0.0016
Replicate 32	0.0215	Replicate 72	0.0011
Replicate 33	0.0302	Replicate 73	0.0603
Replicate 34	0.0411	Replicate 74	0.0052
Replicate 35	0.0778	Replicate 75	0.1575
Replicate 36	0.0052	Replicate 76	0.0157
Replicate 37	0.0150	Replicate 77	0.0378
Replicate 38	0.0445	Replicate 78	0.0155
Replicate 39	0.0000	Replicate 79	0.0354
Replicate 40	0.0004	Replicate 80	0.0031
		Sum of squared differences	**3.5195**

THE SAS® MACRO FOR COMPUTING THE STANDARD ERROR ON A MEAN

Writing all the SAS® syntax to compute these 81 means and then transferring them into a Microsoft® Excel® spreadsheet to finally obtain the standard error would be very time consuming. Fortunately, SAS® macros simplify iterative computations. The software package will execute *N* times the commands included between the beginning command (DO I=1 TO N) and the ending command (END). Further, it also saves the results in a temporary file that can be used subsequently for the computation of the standard error.

Several SAS® macros have been written to simplify the main PISA computations as reported in the PISA initial reports. These macros have been saved in different files (with the extension .sas). Box 7.2 shows a SAS® syntax where a macro is called for computing the mean and standard error of the variable HISEI.

Box 7.2 **SAS® syntax for computing the mean of HISEI and its standard error (*e.g.* PISA 2003)**

```
libname PISA2003  "c:\pisa\2003\data\";
options nofmterr notes;
run;

%include "c:\pisa\macro\proc_means_no_pv.sas";

data temp1;
        set pisa2003.stud;
        if (cnt="DEU") ;
        w_fstr0=w_fstuwt;
        if (not missing (st03q01));
        keep  cnt schoolid stidstd hisei bsmj st01q01 st03q01
              w_fstr0-w_fstr80 ;
run;

%BRR_PROCMEAN(INFILE=temp1,
              REPLI_ROOT=w_fstr,
              BYVAR=cnt,
              VAR=hisei,
              STAT=mean,
              LIMIT=yes,
              LIMIT_CRITERIA=50 5 3 1,
              ID_SCHOOL=schoolid,
              OUTFILE=exercise1);
run;

proc print data=exercise1;
        var cnt stat sestat;
run;
```

After the definition of the SAS® library and a few options, the command (`%include "c:\pisa\macro\proc_means_no_pv.sas";`) will create and save a new procedure for later use.

The `"data"` statement will create a temporary file by selecting from the PISA 2003 student database, the data for Germany (`if (cnt="DEU")`). To facilitate the iterative process, the final weight, `w_fstuwt`, is recoded with the same replicate root, *i.e.* `w_fstr`. The number 0 is added after this root to avoid any possible confusion with the 80 replicates.

As these iterative computations might be central-processing-unit (CPU) consuming, it is advised to reduce the size of the input database by selecting the variables requested to perform a set of analyses. This can be easily done using the `"keep"` statement. In the example:

- the three international identification variables are kept, *i.e.*
  - CNT for the alphanumerical country code,
  - SCHOOLID for the alphanumerical school code,
  - STIDSTD for the alphanumerical student code;
- the socio-economic index, denoted HISEI;
- the 81 final and replicate weights;
- a few other variables that will be used later in this chapter.

To ensure their efficiency, all SAS® macros start by creating a temporary data file that only includes the variables requested by the macro.

The next nine lines call the macro. Nine pieces of information need to be provided:

- The input data file (`INFILE=temp`).
- The root of the final and replicate weights (`REPLI_ROOT=w_fstr`).
- One or several breakdown variables (`BYVAR=cnt`).
- The variable on which an estimate and its respective standard error will be computed (VAR=hisei).
- The requested statistic (`STAT=mean`).
- The request of flagging statistics for not reaching one of the sample size minimal requirements (`LIMIT=yes`). The other alternative is no. If no sample size requirements are set *i.e.* (`LIMIT=no`), no additional information are required for the next two arguments.
- The sample size minimal requirements per cell as defined by the BYVAR statement:[1]
  - The minimal number of students.
  - The minimal number of schools.
  - The minimal percentage of the population.
  - The *N* first variables of the `BYVAR` statement used for the computation of the percentages; it is recommended that the percentages are computed at the country level. For that purpose, the first variable included in the `BYVAR` statement will be CNT and the last component of the `LIMIT_CRITERIA` will be 1, indicating that only the first variable of the BYVAR statement will be used as a basis for the computation of the percentages.[2]
  - As a minimal sample size can be specified on the number of schools, it is necessary to indicate the variable name of the school identification (`ID_SCHOOL=schoolid`).
- The output data file in which the estimates and their respective standard errors will be stored (`OUTFILE=exercise1`).

From the temporary input data file denoted "`temp`", this macro will compute per country the mean of HISEI and its standard error by using the 81 final and replicate weights denoted w_fstr0 to w_fstr80. The results will be stored in a file that will be labelled "`exercise1`". This macro will return exactly the same values for the mean estimate and its respective standard error as the ones obtained through Table 7.1 and Table 7.2.

The structure of the output data file is presented in Table 7.3.

Table 7.3
Output data file exercise1 from Box 7.2

CNT	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
DEU	49.33	0.42	0	0	0

If the dataset had not been reduced to the data for Germany, then the number of rows in the output data file would be equal to the number of countries in the database.

As the three flags are equal to 0, the mean estimate has been computed on at least on 50 students, 5 schools and represents at least 3% of the population, *i.e.* Germany in this case. This last result is useless as the mean estimate was requested at the country level. These sample size requirements are more useful when statistics are requested at a subnational level. With a required percentage set at 95, the FLAG_PCT would be equal to 1. It would indicate in that particular case that more than 5% of the data for HISEI are missing.

There are a few restrictions, as well as a few options, with this macro:

- Only one input data file can be specified.
- The final and the replicate weights need to have the same root. The final weight will be assigned the number 0 while the 80 replicates, as already defined in the dataset, will range from 1 to 80.
- Several breakdown variables can be specified. For instance, if results per gender are needed, then the breakdown variables will be CNT and ST03Q01[3] (`BYVAR=cnt st03q01`).
- Only one numerical variable can be specified in the VAR statement.
- Only one statistic can be specified. The available statistics are presented in Table 7.4.
- Only one output data file can be specified.

Table 7.4
Available statistics with the PROC_MEANS_NO_PV macro[a]

Statistics available	Meaning
SUMWGT	Sum of the weight
MEAN	Mean
VAR	Variance
STD	Standard deviation
CV	Coefficient of variation
MEDIAN	Median
Q1	First quartile
Q3	Third quartile
QRANGE	Range between Q1 and Q3
Px	Percentile, with P1, P5, P10, P25, P50, P75, P90, P95 and P99

a. Some other statistics are also available through the PROC MEANS procedure in SAS®, such as the minimum, the maximum, the range, the number of observations, and so on. Nevertheless, they are not included in the table, either because it does not make sense to apply these statistics to the PISA data, or because Fay's method cannot be applied on these statistics. For instance, as no weights are set to 0 in any replicates, the minimum or maximum value for a particular variable will always be the same. Therefore, the macro will return the value of 0, which is meaningless.

Box 7.3 presents the syntax for computing the standard deviation per gender and Table 7.5 sets out the structure of the output data file. As sample size limits are not requested, the output data file will not include the three flagging variables.

Box 7.3 **SAS® syntax for computing the standard deviation of HISEI and its standard error by gender (*e.g.* PISA 2003)**

```
%BRR_PROCMEAN(INFILE=temp1,
              REPLI_ROOT=w_fstr,
              BYVAR=cnt st03q01,
              VAR=hisei,
              STAT=std,
              LIMIT=no,
              LIMIT_CRITERIA=,
              ID_SCHOOL=,
              OUTFILE=exercise2);
run;
```

Table 7.5
Output data file exercise2 from Box 7.3

CNT	ST03Q01	STAT	SESTAT
DEU	1	16.12	0.29
DEU	2	16.34	0.23

THE STANDARD ERROR ON PERCENTAGES

For variables such as gender, the statistic of interest is usually the percentage per category. The procedure for estimating the standard error is identical to the procedure used for the estimation of the standard error on a mean or a standard deviation, *i.e.* per category of the variable, 81 percentages have to be computed.

Box 7.4 presents the SAS® syntax for running the macro that will compute the percentages and their respective standard errors for each category of the gender variable. The structure of the output data file is presented in Table 7.6.

Box 7.4 **SAS® syntax for computing the percentages and their standard errors for gender (*e.g.* PISA 2003)**

```
%include "c:\pisa\macro\proc_freq_no_pv.sas";

%BRR_FREQ( INFILE=temp1,
          REPLI_ROOT=w_fstr,
          BYVAR=cnt,
          VAR=st03q01,
          LIMIT=yes,
          LIMIT_CRITERIA=100 10 5 1,
          ID_SCHOOL=schoolid,
          OUTFILE=exercise3);
run;
```

Table 7.6
Output data file exercise3 from Box 7.4

CNT	ST03Q01	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
DEU	1	49.66	1.04	0	0	0
DEU	2	50.34	1.04	0	0	0

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Table 7.7 presents the estimates of the percentage of females for the 81 weights and the squared differences. The percentage of females that will be reported is equal to 49.66, *i.e.* the percentage obtained with the final student weight.

As previously, there are three major steps for computing the standard error.

4. Each replicate estimate will be compared with the final estimate 49.66 and the difference will be squared. Mathematically, it corresponds to $(\hat{\pi}_{(i)} - \hat{\pi})^2$. For the first replicate, it will be equal to $(49.82 - 49.66)^2 = 0.0256$.

5. The sum of the squared differences is computed, and then divided by 20. Mathematically, it corresponds to $\frac{1}{20}\sum_{i=1}^{80}(\hat{\pi}_{(i)} - \hat{\pi})^2$. In the example, the sum is equal to (0.0252 + 0.1044 + ... + 0.3610 + 0.1313) = 21.4412. The sum divided by 20 is therefore equal to $\frac{21.4412}{20} = 1.07$. This value represents the sampling variance on the percentage estimate of females.

6. The standard error is equal to the square root of the sampling variance, *i.e.* $\sigma_{(\hat{\pi})} = \sqrt{\sigma^2_{(\hat{\pi})}} = \sqrt{1.07} = 1.035$.

Table 7.7
Percentage of girls for the final and replicate weights and squared differences

Weight	% estimate	Squared difference	Weight	% estimate	Squared difference
Final weight	**49.66**				
Replicate 1	49.82	0.03	Replicate 41	50.00	0.11
Replicate 2	49.98	0.10	Replicate 42	49.95	0.09
Replicate 3	49.44	0.05	Replicate 43	49.70	0.00
Replicate 4	49.32	0.11	Replicate 44	50.59	0.87
Replicate 5	49.39	0.07	Replicate 45	49.07	0.35
Replicate 6	49.06	0.36	Replicate 46	48.82	0.71
Replicate 7	48.59	1.14	Replicate 47	49.88	0.05
Replicate 8	48.85	0.66	Replicate 48	49.14	0.27
Replicate 9	49.06	0.36	Replicate 49	49.53	0.02
Replicate 10	49.72	0.00	Replicate 50	49.81	0.02
Replicate 11	50.05	0.15	Replicate 51	49.87	0.04
Replicate 12	49.31	0.13	Replicate 52	49.82	0.02
Replicate 13	49.29	0.13	Replicate 53	49.42	0.06
Replicate 14	49.47	0.04	Replicate 54	48.99	0.45
Replicate 15	49.90	0.06	Replicate 55	50.07	0.17
Replicate 16	50.82	1.35	Replicate 56	50.68	1.04
Replicate 17	49.11	0.30	Replicate 57	50.34	0.46
Replicate 18	49.51	0.02	Replicate 58	49.54	0.02
Replicate 19	49.79	0.02	Replicate 59	48.75	0.83
Replicate 20	50.75	1.18	Replicate 60	50.14	0.23
Replicate 21	50.24	0.33	Replicate 61	49.45	0.05
Replicate 22	49.79	0.02	Replicate 62	49.46	0.04
Replicate 23	49.87	0.04	Replicate 63	50.11	0.20
Replicate 24	49.37	0.08	Replicate 64	49.64	0.00
Replicate 25	49.50	0.02	Replicate 65	49.72	0.00
Replicate 26	49.82	0.02	Replicate 66	50.79	1.27
Replicate 27	49.92	0.07	Replicate 67	49.73	0.00
Replicate 28	49.55	0.01	Replicate 68	49.96	0.09
Replicate 29	50.22	0.31	Replicate 69	50.31	0.42
Replicate 30	49.16	0.25	Replicate 70	49.17	0.24
Replicate 31	50.51	0.73	Replicate 71	50.10	0.19
Replicate 32	49.98	0.10	Replicate 72	49.93	0.07
Replicate 33	50.67	1.02	Replicate 73	49.55	0.01
Replicate 34	49.29	0.13	Replicate 74	49.42	0.06
Replicate 35	48.96	0.49	Replicate 75	49.60	0.00
Replicate 36	49.98	0.10	Replicate 76	49.45	0.05
Replicate 37	50.23	0.33	Replicate 77	49.80	0.02
Replicate 38	48.25	1.99	Replicate 78	49.91	0.07
Replicate 39	49.56	0.01	Replicate 79	49.06	0.36
Replicate 40	49.66	0.00	Replicate 80	50.02	0.13
			Sum of squared differences		**21.44**

The same process can be used for the percentage of males. It should be noted that the standard error for males is equal to the one for females. Indeed, it can be mathematically shown that the standard error on π is equal to the standard error on 1-π, *i.e.* $\sigma_{(p)} = \sigma_{(1-p)}$. Nevertheless, if missing data for gender are kept in the data file, the standard error on the percentage of males can differ slightly from the standard error on the percentage of females.

Just as for the macro for numerical variables, more than one breakdown variable can be used. In PISA 2003, the first question in the student questionnaire provides the students' grade. German 15-year-olds are distributed from grade 7 to grade 11.

Box 7.5 presents the SAS® syntax for computing the percentage for each grade per gender and its standard error and Table 7.8 presents the output data file. The percentages within the VAR group variable add up to 100%. In this example, the percentages of pupils in grades 7 to 11 within gender and country add up to 100%.

Box 7.5 **SAS® syntax for computing the percentages and its standard errors for grades by gender (*e.g.* PISA 2003)**

```
%BRR_FREQ(  INFILE=temp1,
            REPLI_ROOT=w_fstr,
            BYVAR=cnt st03Q01,
            VAR=st01q01,
            LIMIT=yes,
            LIMIT_CRITERIA=100 10 5 1,
            ID_SCHOOL=schoolid,
            OUTFILE=exercise4);
run;
```

As shown in Table 7.8, more males tend to be in lower grades than females and more females tend to be in upper grades in Germany. A few rows are flagged in Table 7.8. Grade 7 and grade 11 count less that 100 males and less than 100 females. Further, these four subpopulations (males in grades 7 and11 and females in grades 7 and 11) each represent less than 5% of the German population. Finally, the computations in grade 11 are based on less than ten schools both for males and females.

Table 7.8
Output data file exercise4 from Box 7.5

CNT	ST03Q01	ST01Q01	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
DEU	1	7	1.15	0.26	1	0	1
DEU	1	8	13.09	0.83	0	0	0
DEU	1	9	59.33	1.00	0	0	0
DEU	1	10	26.28	1.08	0	0	0
DEU	1	11	0.17	0.08	1	1	1
DEU	2	7	2.28	0.45	1	0	1
DEU	2	8	16.92	1.04	0	0	0
DEU	2	9	60.32	1.06	0	0	0
DEU	2	10	20.41	0.79	0	0	0
DEU	2	11	0.08	0.05	1	1	1

THE STANDARD ERROR ON REGRESSION COEFFICIENTS

For any requested statistic, the computation of the estimate and its standard error will follow exactly the same procedure as the ones described for the mean of HISEI and for the percentages for gender. The remainder of this chapter will explain the use of two other SAS® macros developed for analysing PISA data.

The first macro is for simple linear regression analyses. Besides the seven arguments common to SAS® macros previously described in this manual, *i.e.* *(i)* INFILE=; *(ii)* REPLI_ROOT=; *(iii)* BYVAR=; *(iv)* OUTFILE=; *(v)* LIMIT=; *(vi)* LIMIT_CRITERIA=; and *(vii)* ID_SCHOOL=, two arguments need to be specified: the dependent variable and the independent variables. Only one dependent variable can be specified, whereas several independent variables can be specified.

Box 7.6 provides the syntax for running the simple linear regression macro. In this example, the dependent variable is the socio-economic index derived from the expected student job at the age of 30 (BSMJ) and the independent variables are the family socio-economic index (HISEI) and the student gender after recoding females into 1 and males into 0 (GENDER). Germany (DEU) and Austria (AUT) are selected.

Box 7.6 **SAS® syntax for computing regression coefficients, R^2 and its respective standard errors: Model 1 (*e.g.* PISA 2003)**

```
%include "c:\pisa\macro\proc_reg_no_pv.sas";
data temp2;
   set pisa2003.stud;
   if (cnt in ("DEU","AUT"));
   w_fstr0=w_fstuwt;
   if (st03q01=1) then gender=1;
   if (st03q01=2) then gender=0;
   if (not missing(st03q01));
run;
%BRR_REG(  INFILE=temp2,
           REPLI_ROOT=w_fstr,
           VARDEP=bsmj,
           EXPLICA=hisei gender,
           BYVAR=cnt ,
           LIMIT=yes,
           LIMIT_CRITERIA=100 10 5 1,
           ID_SCHOOL=schoolid,
           OUTFILE=exercise5);
run;
```

Table 7.9 presents the structure of the output data file of the regression analysis in Box 7.6.

Table 7.9
Output data file exercise5 from Box 7.6

CNT	CLASS	STAT	SESTAT
AUT	Intercept	32.25	1.20
AUT	HISEI	0.36	0.02
AUT	GENDER	3.99	0.98
AUT	_RSQ_	0.13	0.02
DEU	Intercept	32.9	1.29
DEU	HISEI	0.37	0.03
DEU	GENDER	2.07	0.62
DEU	_RSQ_	0.12	0.02

There are two ways to determine whether the regression coefficients are significantly different from 0. The first method consists of building a confidence interval around the estimated regression coefficient. The confidence interval for the GENDER regression coefficient on BSMJ in Germany can be computed for a value of α equal to 0.05 as: [2.07 – (1.96*0.62);2.07 + (1.96*0.62)] = [0.85;3.29].

As the value 0 is not included in this confidence interval, the regression coefficient is significantly different from 0. As the value 0 was assigned to males and the value 1 to females in the GENDER variable, it can be concluded that on average, females have significantly higher job expectations in Germany.

Another way to test the null hypothesis of the regression coefficient consists of dividing the regression coefficient by its standard error. This procedure will standardise the regression coefficient. It also means that the sampling distribution of the standardised regression coefficient, under the null hypothesis, has an expected mean of 0 and a standard deviation of 1. Therefore, if the ratio of the regression coefficient to its standard error is lower than –1.96 or higher than 1.96, it will be considered as significantly different from 0.

Table 7.9 also includes the R^2 of the regression and its standard error. As several rows are necessary for reporting the results of the regression analysis, the outcomes of sample size requirements are included in another output file, denoted in this example exercise5_criteria. This file includes, per subpopulation defined by the variables included in the BYVAR statement, a row with the three flagging variables.

It should be mentioned that exercise6 will provide different results from exercise5. In exercise5, GENDER is considered as an explanatory variable. With exercise6, GENDER is used as a breakdown variable. In the second model, there is only one explanatory variable, *i.e.* HISEI.

Box 7.7 **SAS® syntax for computing regression coefficients, R^2 and its respective standard errors: Model 2 (*e.g.* PISA 2003)**

```
%BRR_REG(  INFILE=temp2,
           REPLI_ROOT=w_fstr,
           VARDEP=bsmj,
           EXPLICA=hisei,
           BYVAR=cnt gender,
           LIMIT=yes,
           LIMIT_CRITERIA=100 10 5 1,
           ID_SCHOOL=schoolid,
           OUTFILE=exercise6);
run;
```

Table 7.10
Output data file exercise6 from Box 7.7

CNT	GENDER	CLASS	STAT	SESTAT
AUT	0	Intercept	32.00	1.64
AUT	0	HISEI	0.37	0.03
AUT	0	_RSQ_	0.12	0.02
AUT	1	Intercept	36.49	1.52
AUT	1	HISEI	0.36	0.03
AUT	1	_RSQ_	0.11	0.02
DEU	0	Intercept	32.54	1.44
DEU	0	HISEI	0.37	0.03
DEU	0	_RSQ_	0.13	0.02
DEU	1	Intercept	35.33	1.66
DEU	1	HISEI	0.36	0.03
DEU	1	_RSQ_	0.10	0.02

Table 7.11
Output data file exercise6_criteria from Box 7.7

CNT	GENDER	FLAG_STUD	FLAG_SCH	FLAG_PCT
AUT	0	0	0	0
AUT	1	0	0	0
DEU	0	0	0	0
DEU	1	0	0	0

Table 7.10 presents the structure of the output data file for the second model in Box 7.7 and Table 7.11 presents the structure of the output file devoted to the sampling requirements.

THE STANDARD ERROR ON CORRELATION COEFFICIENTS

Box 7.8 and Table 7.12 present, respectively, the SAS® syntax and the structure of the output data file for running the macro devoted to computing a correlation between two and only two variables.

Box 7.8 **SAS® syntax for computing correlation coefficients and its standard errors (*e.g.* PISA 2003)**

```
%include "c:\pisa\macro\proc_corr_no_pv.sas";

%BRR_CORR(  INFILE=temp2,
            REPLI_ROOT=w_fstr,
            BYVAR=cnt,
            VAR1=hisei,
            VAR2=bsmj,
            LIMIT=yes,
            LIMIT_CRITERIA=100 10 5 1,
            ID_SCHOOL=schoolid,
            OUTFILE=exercise7);
run;
```

Table 7.12
Output data file exercise7 from Box 7.8

CNT	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
AUT	0.34	0.02	0	0	0
DEU	0.34	0.02	0	0	0

CONCLUSION

This chapter described the computation of a standard error by using 80 replicates. For any given statistic, the procedure is the same.

Further, the SAS® syntax for running the SAS® macros, which were developed to facilitate the computation of the standard errors, has been provided in various examples.

However, all macros described in this chapter are for computing various statistics **without** using plausible values. Chapter 8 will describe how to conduct computation with plausible values.

Notes

1. The minimal numbers of students and schools are computed without weights and the minimal percentage of the population is computed with weights.

2. In general, PISA does not report estimates based on fewer than 30 students or less than 3% of students, unless otherwise stated.

3. In PISA 2006, the gender variable is ST04Q01.

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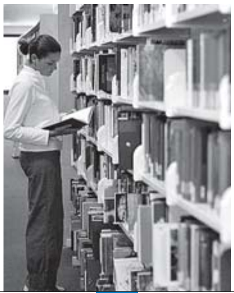

8

Analyses with Plausible Values

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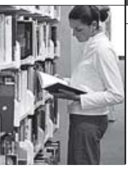

INTRODUCTION

As described in Chapters 5 and 6, the cognitive data in PISA are scaled with the Rasch Model and the performance of students is denoted with plausible values (PVs). For minor domains, only one scale is included in the international databases. For major domains,[1] a combined scale and several subscales are provided. For each scale and subscale, five plausible values per student are included in the international databases. This chapter describes how to perform analyses with plausible values.

Since plausible values are mainly used for reporting student performance on cognitive tests, this chapter is mainly useful when conducting analyses on achievement data and their relationships with student or school characteristics.

UNIVARIATE STATISTICS ON PLAUSIBLE VALUES

The computation of a statistic with plausible values always consists of six steps, regardless of the required statistic.

1. The required statistic and its respective standard error have to be computed for each plausible value. In Chapter 7, it was mentioned that 81 estimates were necessary to get the final estimate and its standard error. Therefore, any analysis that involves five plausible values will require 405 estimates. If a mean needs to be estimated, then 405 means will be calculated. The means estimated with the final weight are denoted $\hat{\mu}_1$, $\hat{\mu}_2$, $\hat{\mu}_3$, $\hat{\mu}_4$ and $\hat{\mu}_5$. From the 80 replicates applied on each of the five plausible values, five sampling variances are estimated, denoted respectively $\sigma^2_{(\hat{\mu}_1)}$, $\sigma^2_{(\hat{\mu}_2)}$, $\sigma^2_{(\hat{\mu}_3)}$, $\sigma^2_{(\hat{\mu}_4)}$ and $\sigma^2_{(\hat{\mu}_5)}$. These five mean estimates and their respective sampling variances are provided in Table 8.1.

Table 8.1
The 405 mean estimates

Weight	PV1	PV2	PV3	PV4	PV5
Final	$\hat{\mu}_1$	$\hat{\mu}_2$	$\hat{\mu}_3$	$\hat{\mu}_4$	$\hat{\mu}_5$
Replicate 1	$\hat{\mu}_{1\_1}$	$\hat{\mu}_{2\_1}$	$\hat{\mu}_{3\_1}$	$\hat{\mu}_{4\_1}$	$\hat{\mu}_{5\_1}$
Replicate 2	$\hat{\mu}_{1\_2}$	$\hat{\mu}_{2\_2}$	$\hat{\mu}_{3\_2}$	$\hat{\mu}_{4\_2}$	$\hat{\mu}_{5\_2}$
Replicate 3	$\hat{\mu}_{1\_3}$	$\hat{\mu}_{2\_3}$	$\hat{\mu}_{3\_3}$	$\hat{\mu}_{4\_3}$	$\hat{\mu}_{5\_3}$
....	....	....	....	....	....
....	....	....	....	....	....
Replicate 80	$\hat{\mu}_{1\_80}$	$\hat{\mu}_{2\_80}$	$\hat{\mu}_{3\_80}$	$\hat{\mu}_{4\_80}$	$\hat{\mu}_{5\_80}$
Sampling variance	$\sigma^2_{(\hat{\mu}_1)}$	$\sigma^2_{(\hat{\mu}_2)}$	$\sigma^2_{(\hat{\mu}_3)}$	$\sigma^2_{(\hat{\mu}_4)}$	$\sigma^2_{(\hat{\mu}_5)}$

2. The final mean estimate is equal to the average of the five mean estimates, *i.e.* $\hat{\mu} = \frac{1}{5}(\hat{\mu}_1 + \hat{\mu}_2 + \hat{\mu}_3 + \hat{\mu}_4 + \hat{\mu}_5)$.

3. The final sampling variance is equal to the average of the five sampling variances,
   i.e. $\sigma^2_{(\hat{\mu})} = \frac{1}{5}(\sigma^2_{(\hat{\mu}_1)} + \sigma^2_{(\hat{\mu}_2)} + \sigma^2_{(\hat{\mu}_3)} + \sigma^2_{(\hat{\mu}_4)} + \sigma^2_{(\hat{\mu}_5)})$

4. The imputation variance, also denoted measurement error variance, is computed as $\sigma^2_{(test)} = \frac{1}{4}\sum_{i=1}^{5}(\hat{\mu}_i - \hat{\mu})^2$. Indeed, as PISA returns five plausible values per scale, then $\sigma^2_{(test)} = \frac{1}{M-1}\sum_{i=1}^{M}(\hat{\mu}_i - \hat{\mu})^2 = \frac{1}{4}\sum_{i=1}^{5}(\hat{\mu}_i - \hat{\mu})^2$ with M being the number of plausible values. This formula is similar to the one used for the estimation of a population variance, except that in this particular case, observations are not compared with the population mean, but each PV mean is compared with the final mean estimate.

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5. The sampling variance and the imputation variance are combined to obtain the final error variance as $\sigma^2_{(error)} = \sigma^2_{(\hat{\mu})} + \left(1.2\sigma^2_{(test)}\right)$

Indeed, $\sigma^2_{(error)} = \sigma^2_{(\hat{\mu})} + \left(\left(1+\frac{1}{M}\right)\sigma^2_{(test)}\right) = \sigma^2_{(\hat{\mu})} + \left(\left(1+\frac{1}{5}\right)\sigma^2_{(test)}\right) = \sigma^2_{(\hat{\mu})} + \left((1.2)\sigma^2_{(test)}\right)$

6. The standard error is equal to the square root of the error variance.

The mean estimate on the science scale and its respective standard error for the PISA 2006 Belgian data can be computed. The macro described in Chapter 7 and labelled PROC_MEANS_NO_PV can be sequentially used five times, and the results can be combined in an Excel® spreadsheet. Table 8.2 presents the different PV means, their respective sampling variances, as well as the mean estimates on the first and last replicates.

Table 8.2

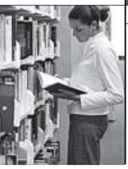
Mean estimates and their respective sampling variances on the science scale for Belgium (PISA 2006)

Weight	PV1	PV2	PV3	PV4	PV5
Final	510.18	510.58	510.36	510.62	510.09
Replicate 1	509.06	509.63	509.64	509.72	509.03
....	....	....	....	....	....
Replicate 80	511.38	512.03	511.63	512	511.28
Sampling variance	$(2.47)^2$	$(2.42)^2$	$(2.50)^2$	$(2.45)^2$	$(2.52)^2$

Box 8.1 presents the SAS® syntax for running sequentially the PROC_MEANS_NO_PV macro described in Chapter 7.

Box 8.1 **SAS® syntax for computing the mean on the science scale by using the PROC_MEANS_NO_PV macro (*e.g.* PISA 2006)**

```
libname PISA2003 "c:\pisa\2003\data\";
libname PISA2006 "c:\pisa\2006\data\";
options nofmterr notes;
run;
data temp1;
        set pisa2006.stu;
        if (cnt in ("BEL"));
        w_fstr0=w_fstuwt;
        science1=pv1scie;
        science2=pv2scie;
        science3=pv3scie;
        science4=pv4scie;
        science5=pv5scie;
        if (st04q01=1) then gender=1;
        if (st04q01=2) then gender=0;
        keep   cnt schoolid stidstd w_fstr0-w_fstr80 science1-science5
               st04q01 gender hisei bsmj;
run;
%include "c:\pisa\macro\proc_means_no_pv.sas";
%macro repeat;
%do kk=1 %to 5;
%BRR_PROCMEAN(INFILE=temp1,
              REPLI_ROOT =w_fstr,
              BYVAR=cnt,
              VAR=science&kk,
              STAT=mean,
               LIMIT=yes,
               LIMIT_CRITERIA=100 10 5 1,
               ID_SCHOOL=schoolid,
              OUTFILE =exercise&kk);
run;
%end;
%mend;
%repeat;
run;
```



With the results in the exercise1 to exercise5 files, the final mean estimate for Belgium on the combined science scale is computed as:

$$\hat{\mu} = \frac{1}{5}(\hat{\mu}_1 + \hat{\mu}_2 + \hat{\mu}_3 + \hat{\mu}_4 + \hat{\mu}_5), \textit{ i.e. } \hat{\mu} = \frac{(510.18 + 510.58 + 510.36 + 510.62 + 510.09)}{5} = 510.4$$

The final sampling variance on the mean estimate for the combined science literacy scale is equal to:

$$\sigma^2_{(\hat{\mu})} = \frac{1}{5}(\sigma^2_{(\hat{\mu}_1)} + \sigma^2_{(\hat{\mu}_2)} + \sigma^2_{(\hat{\mu}_3)} + \sigma^2_{(\hat{\mu}_4)} + \sigma^2_{(\hat{\mu}_5)}), \textit{ i.e. } \sigma^2_{(\hat{\mu})} = \frac{(2.47)^2 + (2.42)^2 + (2.50)^2 + (2.45)^2 + (2.52)^2}{5} = 6.11$$

The imputation variance is equal to:

$$\sigma^2_{(test)} = \frac{1}{4}\sum_{i=1}^{5}(\hat{\mu}_i - \hat{\mu})^2, \textit{ i.e. } \sigma^2_{(test)} = \frac{\left[(510.18 - 510.4)^2 + (510.58 - 510.4)^2 + \ldots + (510.09 - 510.4)^2\right]}{4} = 0.055$$

The final error variance is equal to:

$$\sigma^2_{(error)} = \sigma^2_{(\hat{\mu})} + \left(1.2\sigma^2_{(test)}\right), \textit{ i.e. } \sigma^2_{(error)} = 6.11 + (1.2 * 0.055) = 6.17$$

The final standard error is therefore equal to:

$$SE = \sqrt{\sigma^2_{(error)}} = \sqrt{6.17} = 2.48$$

Sequentially running the PROC_MEANS_NO_PV macro five times and combining the results can be avoided: a SAS® macro has been developed for dealing with plausible values (see Box 8.2). This macro also computes the:

- five mean estimates,
- five sampling variances,
- imputation variance,
- final standard error by combining the final sampling variance and the imputation variance.

Box 8.2 **SAS® syntax for computing the mean and its standard error on PVs (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_means_pv.sas";
%BRR_PROCMEAN_PV(INFILE=temp1,
                 REPLI_ROOT =w_fstr,
                 BYVAR=cnt,
                 PV_ROOT=science,
                 STAT=mean,
                 LIMIT=yes,
                 LIMIT_CRITERIA=100 10 5 1,
                 ID_SCHOOL=schoolid,
                 OUTFILE =exercise6);
run;
```

Besides the seven arguments common to all SAS® macros described in this manual, *i.e. (i)* INFILE=; *(ii)* REPLI_ROOT=; *(iii)* BYVAR=; *(iv)* OUTFILE=; *(v)* LIMIT=; *(vi)* LIMIT_CRITERIA=; and *(vii)* ID_SCHOOL=, two additional ones need to be defined:

- The root of the variable names for the five plausible values. In the PISA database, PV names are usually PV1READ, PV2READ, ..., PV1MATH, PV2MATH, …, PV1SCIE, PV2SCIE, … . These variable names cannot be used directly by the macro, as it will automatically add the numbers 1 to 5 at the end of the root variable name. Therefore, in the "data" statement in Box 8.1, new variables are created to fit the macro requirements. When calling the macro, the argument PV_ROOT will be equal to SCIENCE.
- The STAT argument to specify the requested statistics. Available statistics have been described in Chapter 7.

The structure of the output data file exercise6 is presented in Table 8.3.

Table 8.3
Output data file exercise6 from Box 8.2

CNT	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
BEL	510.4	2.48	0	0	0

Similar to the SAS® macros described in the previous chapter, more than one breakdown variable can be used. For instance, if one wants to determine whether the dispersion of the science performance is larger for females than for males, the macro BRR_PROCMEAN_PV can be used as shown in Box 8.3.

Box 8.3 **SAS® syntax for computing the standard deviation and its standard error on PVs by gender (*e.g.* PISA 2006)**

```
%BRR_PROCMEAN_PV( INFILE=temp1,
                  REPLI_ROOT=w_fstr,
                  BYVAR=cnt st04q01,
                  PV_ROOT=science,
                  STAT=std,
                  LIMIT=yes,
                  LIMIT_CRITERIA=100 10 5 1,
                  ID_SCHOOL=schoolid,
                  OUTFILE=exercise7);
run;
```

The structure of the output data file is presented in Table 8.4.

Table 8.4
Output data file exercise7 from Box 8.3

CNT	ST04Q01	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
BEL	1	96.1	2.23	0	0	0
BEL	2	102.9	2.50	0	0	0

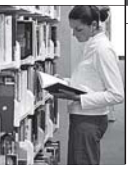
According to Table 8.4, the standard deviation (STAT) is larger for males than for females. Unfortunately, the information of the two standard errors in SESTAT is not enough to conduct a test of the equality for these two standard deviation coefficients since the standard deviation estimates for males and females may be correlated. The detail of the standard error on difference will be presented in Chapter 11.

THE STANDARD ERROR ON PERCENTAGES WITH PVS

The PROC_FREQ_NO_PV first presented in Chapter 7 was developed for the computation of percentages and their respective standard errors. Chapter 9 will deal with the application of this macro to plausible values: an entire chapter needs to be devoted to this type of analysis because of the issues involved.

THE STANDARD ERROR ON REGRESSION COEFFICIENTS WITH PVS

Suppose that the statistical effect of gender and student socio-economic background on the performance in science needs to be estimated. Just like estimating a mean, this question can be solved by sequentially applying five times the PROC_REG_NO_PV macro described in Chapter 7. Box 8.4 presents the SAS® syntax for such an approach.



Box 8.4 **SAS® syntax for computing regression coefficients and their standard errors on PVs by using the PROC_REG_NO_PV macro (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_reg_no_pv.sas";
%macro repeat;
%do kk=1 %to 5;
%BRR_REG( INFILE=temp1,
          REPLI_ROOT=w_fstr,
          BYVAR=cnt,
          VARDEP=science&kk,
          EXPLICA=hisei gender,
          LIMIT=yes,
          LIMIT_CRITERIA=100 10 5 1,
          ID_SCHOOL=schoolid,
          OUTFILE=exercise&kk);
run;
%end;
%mend;
%repeat;
run;
```

Just like the computation of a mean and its standard error, the computation of regression coefficients and their respective standard errors consists of six steps:

1. For each plausible value and for each explanatory variable, regression coefficients are computed with the final and the 80 replicate weights. Thus, 405 regression coefficients per explanatory variable will be computed. The PROC_REG_NO_PV macro applied sequentially five times will return, per explanatory variable, five estimates, denoted, $\hat{\beta}_1,\ldots,\ \hat{\beta}_5$ and five standard errors, denoted $\sigma_{(\hat{\beta}_1)},\ldots,\sigma_{(\hat{\beta}_5)}$. Table 8.5 presents the mathematical expression for these 405 estimates and Table 8.6 presents some of the values for the 405 regression coefficients obtained on the Belgian data for the HISEI (international socio-economic index of occupational status) variable.

2. The final regression coefficient estimate is equal to $\hat{\beta} = \dfrac{\hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4 + \hat{\beta}_5}{5}$

   i.e. for HISEI $\hat{\beta} = \dfrac{2.22+2.24+2.25+2.24+2.26}{5} = 2.24$

3. The final sampling variance estimate is equal to $\sigma^2_{(\hat{\beta})} = \dfrac{1}{5}\left(\sigma^2_{(\hat{\beta}_1)} + \sigma^2_{(\hat{\beta}_2)} + \sigma^2_{(\hat{\beta}_3)} + \sigma^2_{(\hat{\beta}_4)} + \sigma^2_{(\hat{\beta}_5)}\right)$

   i.e. for HISEI $\sigma^2_{(\hat{\beta})} = \dfrac{(0.09)^2 + (0.09)^2 + (0.09)^2 + (0.09)^2 + (0.09)^2}{5} = 0.0081$

4. The imputation variance is equal to $\sigma^2_{(test)} = \dfrac{1}{4}\sum_{i=1}^{5}(\hat{\beta}_i - \hat{\beta})^2$

   i.e. for HISEI $\sigma^2_{(test)} = \dfrac{(2.22-2.24)^2 + (2.24-2.24)^2 + \ldots + (2.26-2.24)^2}{4} = 0.0002$

5. The final error variance is equal to $\sigma^2_{(error)} = \sigma^2_{(\hat{\beta})} + \left(1.2\sigma^2_{(test)}\right)$

   i.e. for HISEI $\sigma^2_{(error)} = 0.0081 + (1.2*0.0002) = 0.0084$

6. The final standard error is equal to $SE = \sqrt{\sigma^2_{(error)}} = \sqrt{0.0084} = 0.10$

As 2.24 divided by 0.10 is about 22.4, the regression coefficient for HISEI is significantly different from 0.

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Table 8.5
The 450 regression coefficient estimates

Weight	PV1	PV2	PV3	PV4	PV5
Final	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_4$	$\hat{\beta}_5$
Replicate 1	$\hat{\beta}_{1\_1}$	$\hat{\beta}_{2\_1}$	$\hat{\beta}_{3\_1}$	$\hat{\beta}_{4\_1}$	$\hat{\beta}_{5\_1}$
Replicate 2	$\hat{\beta}_{1\_2}$	$\hat{\beta}_{2\_2}$	$\hat{\beta}_{3\_2}$	$\hat{\beta}_{4\_2}$	$\hat{\beta}_{5\_2}$
Replicate 3	$\hat{\beta}_{1\_3}$	$\hat{\beta}_{2\_3}$	$\hat{\beta}_{3\_3}$	$\hat{\beta}_{4\_3}$	$\hat{\beta}_{5\_3}$
....	....	....	....	....	....
....	....	....	....	....	....
Replicate 80	$\hat{\beta}_{1\_80}$	$\hat{\beta}_{2\_80}$	$\hat{\beta}_{3\_80}$	$\hat{\beta}_{4\_80}$	$\hat{\beta}_{5\_80}$
Sampling variance	$\sigma^2_{(\hat{\beta}_1)}$	$\sigma^2_{(\hat{\beta}_2)}$	$\sigma^2_{(\hat{\beta}_3)}$	$\sigma^2_{(\hat{\beta}_4)}$	$\sigma^2_{(\hat{\beta}_5)}$

Table 8.6
HISEI regression coefficient estimates and their respective sampling variance on the science scale in Belgium after accounting for gender (PISA 2006)

Weight	PV1	PV2	PV3	PV4	PV5
Final	2.22	2.24	2.25	2.24	2.26
Replicate 1	2.22	2.22	2.24	2.23	2.27
....	....	....	....	....	....
Replicate 80	2.14	2.16	2.18	2.18	2.18
Sampling variance	$(0.09)^2$	$(0.09)^2$	$(0.09)^2$	$(0.09)^2$	$(0.09)^2$

A SAS® macro PROC_REG_PV has also been developed for regression analyses with plausible values as dependent variables. The SAS® syntax is presented in Box 8.5.

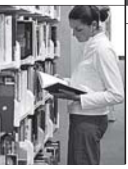
Box 8.5 **SAS® syntax for running the simple linear regression macro with PVs (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_reg_pv.sas";
%BRR_REG_PV(INFILE=temp1,
             REPLI_ROOT=w_fstr,
             EXPLICA=hisei gender,
             BYVAR=cnt,
             PV_ROOT=science,
             LIMIT=yes,
             LIMIT_CRITERIA=100 10 5 1,
             ID_SCHOOL=schoolid,
             OUTFILE=exercise8);
run;
```

Besides the arguments common to all macros, the root of the plausible value variable names has to be specified, in addition to the list of independent variables. The structure of the output data file is presented in Table 8.7.

Table 8.7
Output data file exercise8 from Box 8.5

CNT	CLASS	STAT	SESTAT
BEL	Intercept	403.39	5.74
BEL	HISEI	2.24	0.10
BEL	Gender	0.10	3.24
BEL	_RSQ_	0.15	0.01



A quick overview of these results shows that the intercept and the regression coefficient for HISEI are significantly different from 0. However, the regression coefficient for GENDER does not statistically differ from 0.

Similar to the PROC_REG_NO_PV macro, the PROC_REG_PV macro also returns the outcomes of the sampling size requirement analysis in a separate file. The file name consists of: *(i)* the name of the output files that contains the regression parameters; and *(ii)* the name of the output file followed with _CRITERIA.

THE STANDARD ERROR ON CORRELATION COEFFICIENTS WITH PVS

A SAS® macro has also been developed to compute the correlation between a set of plausible values and another variable. The SAS syntax for running this macro is presented in Box 8.6 and the structure of the output data file is presented in Table 8.8.

Box 8.6 **SAS® syntax for running the correlation macro with PVs (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_corr_pv.sas";

%BRR_CORR_PV( INFILE=temp1,
              REPLI_ROOT=w_fstr,
              BYVAR=cnt ,
              EXPLICA=hisei,
              PV_ROOT=science,
              LIMIT=yes,
              LIMIT_CRITERIA=100 10 5 1,
              ID_SCHOOL=schoolid,
              OUTFILE=exercise9);
run;
```

Table 8.8
Output data file exercise9 from Box 8.6

CNT	STAT	SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
BEL	0.38	0.02	0	0	0

CORRELATION BETWEEN TWO SETS OF PLAUSIBLE VALUES

Some researchers may be interested in the correlation between the different PISA domains and subdomains. For instance, some might want to compute the correlation between the reading subdomains or between the mathematics subdomains, or between reading and mathematics using the PISA 2000, PISA 2003 and PISA 2006 databases.

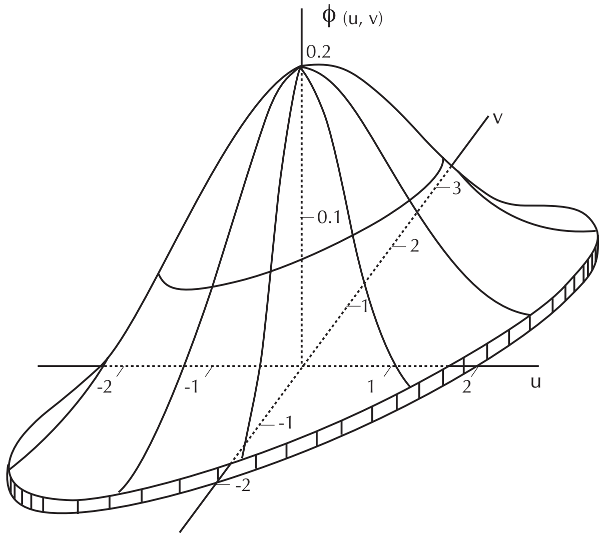
As described in Chapter 5, the PISA assessment used incomplete assessment designs, *i.e.* students are required to answer a subset of the item battery. Further, while all students were assessed in the major domain, only a subset of students was assessed in minor domains.

PISA 2000 included plausible values of a minor domain only for students who answered questions for that minor domain. Therefore, using the PISA 2000 database to compute the correlation between reading and mathematics, for example, would require working on a subset of students.[2]

To facilitate secondary analyses, PISA 2003 returned plausible values for all domains and for all students, regardless of whether they were actually assessed or not. Ignoring the assessment status is possible, because the cognitive data in PISA are scaled according to multi-dimensional models.

Since this is easier to illustrate graphically, let's suppose that only two domains were assessed, *i.e.* mathematics/quantity and mathematics/space and shape. If the mathematics/quantity and mathematics/space and shape materials were scaled independently, the correlation between the two subdomains would be largely underestimated. In order to avoid this problem, both materials are scaled together. The model will build a two-dimensional posterior distribution, instead of two one-dimensional posterior distributions as described in Chapter 6. Figure 8.1 graphically presents a two-dimensional normal distribution.

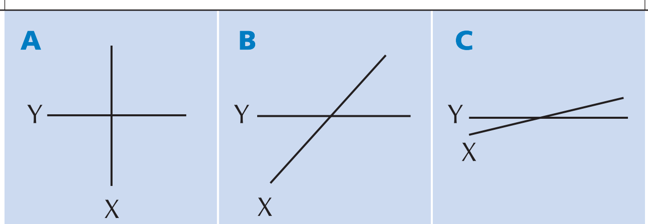
Figure 8.1
A two-dimensional distribution



To correctly describe such distributions, two means, two variances, and one correlation are needed. If the correlation is equal to 0, then the two axes will be orthogonal. As the absolute value of the correlation starts to increase, the angle formed by the two axes becomes less than 90 degrees (see Figure 8.2, part A).[3] Two axes perfectly overlapping would represent a correlation of 1.0 (or –1.0). These different cases are illustrated in Figure 8.2.

With a two-dimensional model, the first plausible value for mathematics/quantity will be drawn at the same time as the first plausible value for mathematics/space and shape. Per student, this will consist of randomly drawing one dot in the scatter plot. The values of the two plausible values will be the coordinates of the dot on the two axes. The same procedure is applied for the second, third, fourth, and fifth plausible values.

Figure 8.2
Axes for two-dimensional normal distributions



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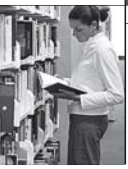

As the PISA domains and subdomains highly correlate, as shown by the graph on the far right in Figure 8.2, it is very unlikely for a student to get a high score for the first plausible value in mathematics/quantity (PV1MATH4) and a low score for the first plausible value in mathematics/space and shape (PV1MATH1). If plausible values were drawn independently for these two mathematics subdomains, such a case would be possible and therefore the correlation would be underestimated.

Since each draw is independent, to calculate the correlation between the two domains, the correlation between each set of plausible value, *i.e.* correlation between two plausible values with the same number, needs to be computed. In the PISA 2003 example of correlation between PV1MATH1 to PV5MATH1 and PV1MATH4 to PV5MATH4, the following values need to be computed:

- PV1MATH1 and PV1MATH4,
- PV2MATH1 and PV2MATH4,
- PV3MATH1 and PV3MATH4,
- PV4MATH1 and PV4MATH4,
- PV5MATH1 and PV5 MATH4.

Table 8.9 presents all possible 25 correlation coefficients between the 5 plausible values in mathematics/quantity (MATH4) and mathematics/space and shape (MATH1), respectively, for Germany in PISA 2003. As expected, the correlation coefficients on the diagonal of the square matrix are substantially higher than the other correlation coefficients. The final correlation estimate between these two mathematics subdomains will be the average of the five correlation coefficients on the diagonal.

Table 8.9
Correlation between the five plausible values for each domain, mathematics/quantity and mathematics/space and shape

	PV1MATH1	PV2MATH1	PV3MATH1	PV4MATH1	PV5MATH1
PV1MATH4	0.90	0.83	0.84	0.84	0.83
PV2MATH4	0.83	0.90	0.84	0.84	0.83
PV3MATH4	0.84	0.83	0.90	0.84	0.83
PV4MATH4	0.83	0.83	0.84	0.90	0.83
PV5MATH4	0.83	0.83	0.84	0.84	0.90

The standard error on this correlation estimate can be easily obtained by applying five times sequentially the PROC_CORR_NO_PV macro described in Chapter 7. The SAS® syntax is given in Box 8.7 and five correlation coefficients and respective sampling variances, produced by the syntax in Box 8.7 are presented in Table 8.10.

The final correlation estimate is equal to:

$$\hat{\rho} = \frac{\hat{\rho}_1 + \hat{\rho}_2 + \hat{\rho}_3 + \hat{\rho}_4 + \hat{\rho}_5}{5}, \; i.e. \; \hat{\rho} = \frac{0.8953 + 0.8964 + \ldots + 0.8958}{5} = 0.8970$$

The final sampling variance is equal to:

$$\sigma^2_{(\hat{\rho})} = \frac{\sum_{i=1}^{5} \sigma^2_{(\hat{\rho}_i)}}{5}, \; i.e. \; \sigma^2_{(\hat{\rho})} = \frac{(0.0040)^2 + (0.0033)^2 + \ldots + (0.0038)^2}{5} = 0.000013$$

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The measurement variance can be estimated as:

$$\sigma^2_{(test)} = \frac{1}{4}\sum_{i=1}^{5}(\hat{\rho}_i - \hat{\rho})^2 = 0.000003$$

The final variance is equal to:

$$\sigma^2_{(error)} = \sigma^2_{(\hat{\rho})} + \left(1.2\,\sigma^2_{(test)}\right) = 0.000017$$

The final standard error is equal to:

$$SE = \sqrt{\sigma^2_{(error)}} = \sqrt{0.000017} = 0.004116$$

Box 8.7 **SAS® syntax for the computation of the correlation between mathematics/quantity and mathematics/space and shape by using the PROC_CORR_NO_PV macro[a] (*e.g.* PISA 2003)**

```
data temp2;
        set pisa2003.stud;
        if (cnt="DEU") ;
        w_fstr0=w_fstuwt;
        keep   cnt schoolid stidstd w_fstr0-w_fstr80
               pv1math1 pv2math1 pv3math1 pv4math1 pv5math1
               pv1math4 pv2math4 pv3math4 pv4math4 pv5math4;
run;
%include "c:\pisa\macro\proc_corr_no_pv.sas";
%macro repeat;
%do kk=1 %to 5;
%BRR_CORR(     INFILE=temp2,
               REPLI_ROOT=w_fstr,
               BYVAR=cnt,
               VAR1=pv&kk.math1,
               VAR2=pv&kk.math4,
               LIMIT=no,
               LIMIT_CRITERIA=,
               ID_SCHOOL=,
               OUTFILE=exercise&kk);
run;
%end;
%mend;
%repeat;
run;
```

a. In the PROC_CORR_NO_PV macro, the statement of FORMAT STAT F5.2 should be changed to FORMAT STAT F8.4 to obtain the correlation coefficients with four decimal points.

Table 8.10

The five correlation estimates between mathematics/quantity and mathematics/space and shape and their respective sampling variance

	PV1	PV2	PV3	PV4	PV5
Correlation	0.8953	0.8964	0.8996	0.8978	0.8958
Sampling variance	$(0.0040)^2$	$(0.0033)^2$	$(0.0034)^2$	$(0.0037)^2$	$(0.0038)^2$

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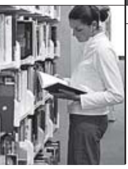


The computation of the correlation between two domains or between a subdomain and a domain might be problematic in some cases in the PISA databases. PISA 2000 used two scaling models:

- a three-dimensional model with mathematics, reading and science;
- a five-dimensional model with mathematics, reading/retrieving information, reading/interpreting texts, reading/reflection and evaluation, and science.

PISA 2003 also used two scaling models:

- a four-dimensional model with mathematics, problem solving, reading and science;
- a seven-dimensional model with mathematics/space and shape, mathematics/change and relationships, mathematics/uncertainty, mathematics/quantity, problem solving, reading and science.

PISA 2006 used two scaling models as well:

- a five-dimensional model with mathematics, reading, science and the two attitudinal scales;
- a five-dimensional model with mathematics, reading, and the three science scales (the identifying scientific issues scale, the explaining phenomena scientifically scale, and the using scientific evidence scale).

The PISA databases should contain two sets of plausible values for each of the minor domains. As this would be too confusing, only one set was provided. Therefore, the correlation coefficients are underestimated.

This can be confirmed by examining the data. In the case of a minor domain and a subscale of the major domain, the correlation coefficients on the diagonal do not differ from the other correlations, since these two sets of plausible values were generated by two different models.

In PISA 2006, as well as in PISA 2000 and in PISA 2003, the plausible values for the minor domains included in the databases were generated with the major domain as a combined scale. This means that:

- The correlation between a minor domain and the combined scale of the major domain can be computed.
- The correlation between two minor domains can be computed.
- The correlation between the subdomains can be computed.
- It is not possible to compute the correlation between minor domains and one of the subscales of the major domain.

A FATAL ERROR SHORTCUT

A common fatal error when analysing with plausible values involves computing the mean of the five plausible values, before further analysis.

In Chapter 6, the expected *a posteriori* (EAP) student performance estimator was described. As a reminder, the EAP estimator is equal to the mean of the posterior distribution. Therefore, computing the mean of the five plausible values at the student level is more or less equal to the EAP estimate.

In Chapter 6, the efficiency of the EAP estimator was also compared with the weighted likelihood estimate (WLE) and the plausible values for some statistics estimations. It was indicated that the EAP estimator:

- underestimates the standard deviation,
- overestimates the correlation between the student performance and some background variables,
- underestimates the within-school variance.

Therefore, computing the mean of the five plausible values and then computing statistics on this new score would bias the results just as the EAP does. Table 8.11 provides, per country, the standard deviation of the combined mathematics scale in PISA 2003 using the correct method, as described in this chapter, and the incorrect method of averaging the five plausible values at the student level and then computing the standard deviation on this new score. The result of the latter is denoted as pseudo-EAP.

As shown by Table 8.11, the pseudo-EAP underestimates the standard deviation.

Table 8.11

Standard deviations for mathematics scale using the correct method (plausible values) and by averaging the plausible values at the student level (pseudo-EAP) (PISA 2003)

	Plausible values	Pseudo-EAP
AUS	95.42	91.90
AUT	93.09	89.91
BEL	109.88	106.65
CAN	87.11	83.37
CHE	98.38	94.97
CZE	95.94	92.50
DEU	102.59	99.54
DNK	91.32	87.52
ESP	88.47	84.52
FIN	83.68	79.77
FRA	91.70	88.07
GBR	92.26	89.18
GRC	93.83	89.49
HUN	93.51	89.71
IRL	85.26	82.03
ISL	90.36	86.55
ITA	95.69	92.00
JPN	100.54	96.96
KOR	92.38	89.07
LUX	91.86	88.28
MEX	85.44	80.52
NLD	92.52	89.89
NOR	92.04	88.31
NZL	98.29	95.07
POL	90.24	86.49
PRT	87.63	83.91
SVK	93.31	89.86
SWE	94.75	91.07
TUR	104.74	100.79
USA	95.25	92.12

The analysis process should always aggregate the results of the five plausible values at the latest stage, *i.e.* the statistic that has to be reported is computed five times, then these five statistics are combined.

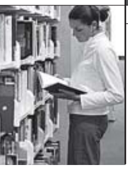
AN UNBIASED SHORTCUT

Table 8.1 and Table 8.5 respectively give the 405 mean and regression coefficient estimates needed for computing a mean or regression coefficient final estimate and the respective standard errors.

On average, analysing one plausible value instead of five plausible values provides unbiased population estimates as well as unbiased sampling variances on these estimates. It will not be possible to estimate the imputation variance using this method, however.

Therefore, an unbiased shortcut consists of:

- computing, using one of the five plausible values, the statistical estimate and its sampling variance by using the final student weight as well as the 80 replicate weights;
- computing the statistical estimate by using the final student weight on the four other plausible values;



- computing the final statistical estimate by averaging the plausible value statistical estimates;
- computing the imputation variance, as previously described;
- combining the imputation variance and the sampling variance, as previously described.

This unbiased shortcut is presented in Table 8.12 for the estimation of a mean and its standard error. This shortcut only requires the computation of 85 estimates instead of 405. The final estimate of this shortcut will be equal to the one obtained with the long procedure, but the standard error might differ slightly.

Table 8.12
Unbiased shortcut for a population estimate and its standard error

Weight	PV1	PV2	PV3	PV4	PV5
Final	$\hat{\mu}_1$	$\hat{\mu}_2$	$\hat{\mu}_3$	$\hat{\mu}_4$	$\hat{\mu}_5$
Replicate 1	μ_{1_1}				
Replicate 2	μ_{1_2}				
Replicate 3	μ_{1_3}				
....	....				
....	....				
Replicate 80	μ_{1_80}				
Sampling variance	$\sigma^2_{(\hat{\mu}_1)}$				

Table 8.13
Standard errors from the full and shortcut computation (PISA 2006)

	Mean estimate in science		Immigrant students mean estimate in science		
	Full computation	Shortcut computation	Full computation	Shortcut computation	
	S.E.	S.E.	S.E.	S.E.	Student flag (50)
AUS	2.26	2.21	5.75	5.77	0
AUT	3.92	3.98	10.92	11.00	0
BEL	2.48	2.49	8.34	8.65	0
CAN	2.03	2.00	5.24	5.25	0
CHE	3.16	3.25	6.94	7.13	0
CZE	3.48	3.40	15.89	15.48	0
DEU	3.80	3.80	8.80	8.62	0
DNK	3.11	3.06	8.05	8.06	0
ESP	2.57	2.60	7.23	7.43	0
FIN	2.02	2.05	16.28	15.76	0
FRA	3.36	3.34	10.05	9.94	0
GBR	2.29	2.23	14.74	15.07	0
GRC	3.23	3.29	10.33	10.73	0
HUN	2.68	2.63	14.57	13.15	0
IRL	3.19	3.18	14.56	13.95	0
ISL	1.64	1.59	13.94	13.73	0
ITA	2.02	2.02	8.18	8.30	0
JPN	3.37	3.45	36.57	37.54	1
KOR	3.36	3.41			
LUX	1.05	1.14	3.73	3.82	0
MEX	2.71	2.64	7.61	6.78	0
NLD	2.74	2.77	10.16	10.18	0
NOR	3.11	3.07	11.21	11.34	0
NZL	2.69	2.67	6.58	6.79	0
POL	2.34	2.37	53.97	49.11	1
PRT	3.02	3.02	11.09	10.64	0
SVK	2.59	2.57	47.09	49.10	1
SWE	2.37	2.28	8.09	8.29	0
TUR	3.84	3.82	18.20	18.18	1
USA	4.22	4.20	7.89	8.15	0

Table 8.13 presents the standard errors for the country mean estimate in student performance on the science scale (PISA 2006) as well as the immigrant subpopulations. Two standard errors are provided per estimate: the standard error that results from the strict application of the recommended procedure; and the standard errors using the described shortcut. In all or nearly all cases, the difference between the two standard error estimates is negligible, even based on less than 50 students.

CONCLUSION

This chapter described the different steps for analysing data with plausible values. It also provided some SAS® macros to facilitate the computations.

Attention was also drawn to a common error that consists of computing the average of the plausible values at the student level and adding this value to the database to be used as the student score in analyses. The correct method involves the averaging process which should always occur at the latest stage, that is on the statistic that will be reported.

The particular issue of analysing two sets of plausible values was also presented in the case of a correlation. The procedure that was applied can also be extended to other linear or non-linear modelling, such as a linear regression analysis.

Finally, an unbiased shortcut was described, one that is useful for time-consuming procedures, *e.g.* multilevel procedures.

Notes

1. Reading was the major domain in PISA 2000, mathematics in PISA 2003 and science in PISA 2006.

2. For more information, see the *Manual for the PISA 2000 Database* (OECD, 2002b).

3. A correlation coefficient can be expressed by the cosines of the angle formed by the two variables.

9

Use of Proficiency Levels

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INTRODUCTION

The values for student performance in reading, mathematics, and science literacy are usually considered as continuous latent variables. In order to facilitate the interpretation of the scores assigned to students, the reading, mathematics and science scales were designed to have an average score of 500 points and a standard deviation of 100 across OECD countries. This means that about two-thirds of the OECD member country students perform between 400 and 600 points.

In order to render PISA results more accessible to policy makers and educators, proficiency scales have been developed for the assessment domains. Since these scales are divided according to levels of difficulty and performance, both a ranking of student performance and a description of the skill associated with that proficiency level can be obtained. Each successive level is associated with tasks of increased difficulty.

In PISA 2000, five levels of reading proficiency were defined and reported in the PISA 2000 initial report *Knowledge and Skills for Life: First Results from PISA 2000* (OECD, 2001). In PISA 2003, six levels of mathematics proficiency levels were also defined and reported in the PISA 2003 initial report *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004a). In PISA 2006, six levels of science proficiency were defined and reported in the PISA 2006 initial report *Science Competencies for Tomorrow's World* (OECD, 2007a).

This chapter will show how to derive the proficiency levels from the PISA databases and how to use them.

GENERATION OF THE PROFICIENCY LEVELS

Proficiency levels are not included in the PISA databases, but they can be derived from the plausible values (PVs).

In PISA 2006, the cutpoints that frame the proficiency levels in science are 334.94, 409.54, 484.14, 558.73, 633.33 and 709.93.[1] While some researchers might understand that different possible scores can be assigned to a student, it is more difficult to understand that different levels can be assigned to a single student. Therefore, they might be tempted to compute the average of the five plausible values and then assign each student a proficiency level based on this average.

As discussed in Chapter 6 and Chapter 8, such a procedure is similar to assigning each student an expected *a posteriori* (EAP) score; the biases of such estimators are now well known. Since using EAP scores underestimates the standard deviation, the estimation of the percentages of students at each level of proficiency will consequently underestimate the percentages at the lowest and highest levels, and overestimate the percentages at the central levels.

As already stated, international education surveys do not aim to estimate the performance of particular students, but rather, they aim to describe population characteristics. Therefore, particular students can be allocated different proficiency levels for different plausible values. Thus, five plausible proficiency levels will be assigned to each student respectively according to their five plausible values. The SAS® syntax for the generation of the plausible proficiency levels in science is provided in Box 9.1.

The statement "array" allows the definition of a variable vector. In Box 9.1, two vectors are defined. The first, labelled SCIE, includes the five plausible values for the science combined scale (PV1SCIE to PV5SCIE) and the three science subscales (PV1EPS to PV5EPS, PV1ISI to PV5ISI, and PV1USE to PV5USE). The second, labelled LEVELSCIE, will create 20 new variables, labelled SCIELEV1 to SCIELEV5 for the science combined scale; EPSLEV1 to EPSLEV5 for the science/explaining phenomena scientifically subscale; ISILEV1 to ISILEV5 for the science/identifying scientific issues subscale; USELEV1 to USELEV1 to the science/use of scientific evidence subscale.

Box 9.1 **SAS® syntax for generating the proficiency levels in science (*e.g.* PISA 2006)**

```
libname PISA2003 "c:\pisa\2003\data";
libname PISA2006 "c:\pisa\2006\data";
options nofmterr notes;
run;
data temp1;
        set pisa2006.stu;
        if (cnt="DEU");
        array scie (20)
           pv1scie pv2scie pv3scie pv4scie pv5scie
           pv1eps pv2eps pv3eps pv4eps pv5eps
           pv1isi pv2isi pv3isi pv4isi pv5isi
           pv1use pv2use pv3use pv4use pv5use;
        array levelscie (20)
           scielev1-scielev5
           epslev1-epslev5
           isilev1-isilev5
           uselev1-uselev5;
        do i=1 to 20;
           if (scie(i)<=334.94) then levelscie(i)=0;
           if (scie(i)>334.94 and scie(i)<=409.54) then levelscie(i)=1;
           if (scie(i)>409.54 and scie(i)<=484.14) then levelscie(i)=2;
           if (scie(i)>484.14 and scie(i)<=558.73) then levelscie(i)=3;
           if (scie(i)>558.73 and scie(i)<=633.33) then levelscie(i)=4;
           if (scie(i)>633.33 and scie(i)<=707.93) then levelscie(i)=5;
           if (scie(i)>707.93) then levelscie(i)=6;
        end;
        w_fstr0=w_fstuwt;
run;
```

The iterative process will recode each plausible value variable into a new variable with seven categories labelled 0 to 6 for science.

The computation of the percentage of students at each proficiency level and its respective standard error is similar to the computation of a mean estimate and its standard error, as described in Chapter 8, *i.e.*:

- For each plausible value, the percentage of students at each proficiency level and its respective standard error have to be computed. Per proficiency level, five percentage estimates denoted $\hat{\pi}_1$, $\hat{\pi}_2$, $\hat{\pi}_3$, $\hat{\pi}_4$ and $\hat{\pi}_5$ will be obtained. Out of the 80 replicates applied on each of the 5 proficiency level variables, per level of proficiency, 5 sampling variances will be estimated, denoted respectively $\sigma^2_{(\hat{\pi}_1)}$, $\sigma^2_{(\hat{\pi}_2)}$, $\sigma^2_{(\hat{\pi}_3)}$, $\sigma^2_{(\hat{\pi}_4)}$ and $\sigma^2_{(\hat{\pi}_5)}$. These five percentage estimates and their respective sampling variances are given in Table 9.1.
- The final percentage estimate is equal to the average of the five percentage estimates, *i.e.* $\hat{\pi} = \frac{1}{5}(\hat{\pi}_1 + \hat{\pi}_2 + \hat{\pi}_3 + \hat{\pi}_4 + \hat{\pi}_5)$
- The final sampling variance is equal to the average of the five sampling variances, *i.e.* $\sigma^2_{(\hat{\pi})} = \frac{1}{5}(\sigma^2_{(\hat{\pi}_1)} + \sigma^2_{(\hat{\pi}_2)} + \sigma^2_{(\hat{\pi}_3)} + \sigma^2_{(\hat{\pi}_4)} + \sigma^2_{(\hat{\pi}_5)})$
- The imputation variance, also denoted measurement error variance, is computed[2] as $\sigma^2_{(test)} = \frac{1}{4}\sum_{i=1}^{5}(\hat{\pi}_i - \hat{\pi})^2$
- The sampling variance and the imputation variance are combined to obtain the final error variance as $\sigma^2_{(error)} = \sigma^2_{(\hat{\pi})} + (1.2\,\sigma^2_{(test)})$
- The standard error is equal to the square root of the error variance.

This process is repeated for each proficiency level.

Table 9.1
The 405 percentage estimates for a particular proficiency level

Weight	PV1	PV2	PV3	PV4	PV5
Final	$\hat{\pi}_1$	$\hat{\pi}_2$	$\hat{\pi}_3$	$\hat{\pi}_4$	$\hat{\pi}_5$
Replicate 1	$\hat{\pi}_{1\_1}$	$\hat{\pi}_{2\_1}$	$\hat{\pi}_{3\_1}$	$\hat{\pi}_{4\_1}$	$\hat{\pi}_{5\_1}$
Replicate 2	$\hat{\pi}_{1\_2}$	$\hat{\pi}_{2\_2}$	$\hat{\pi}_{3\_2}$	$\hat{\pi}_{4\_2}$	$\hat{\pi}_{5\_2}$
Replicate 3	$\hat{\pi}_{1\_3}$	$\hat{\pi}_{2\_3}$	$\hat{\pi}_{3\_3}$	$\hat{\pi}_{4\_3}$	$\hat{\pi}_{5\_3}$
....	....	....	....	....	....
....	....	....	....	....	....
Replicate 80	$\hat{\pi}_{1\_80}$	$\hat{\pi}_{2\_80}$	$\hat{\pi}_{3\_80}$	$\hat{\pi}_{4\_80}$	$\hat{\pi}_{5\_80}$
Sampling variance	$\sigma^2_{(\hat{\pi}_1)}$	$\sigma^2_{(\hat{\pi}_2)}$	$\sigma^2_{(\hat{\pi}_3)}$	$\sigma^2_{(\hat{\pi}_4)}$	$\sigma^2_{(\hat{\pi}_5)}$

In this way 405 percentages will be estimated per proficiency level. As there are 7 levels in science, 2 835 percentages will be estimated.

The seven proficiency levels in science are:
1. Below level 1,
2. Level 1,
3. Level 2,
4. Level 3,
5. Level 4,
6. Level 5,
7. Level 6.

Sequentially applying the PROC_FREQ_NO_PV macro five times, as described in Chapter 7, will return, per proficiency level, five percentage estimates and five standard error estimates that can be combined to get the final estimate and its standard error.

Box 9.2 presents the SAS® syntax for sequentially running the PROC_FREQ_NO_PV macro five times. Table 9.2 presents the five estimates and their respective sampling variances, per proficiency level.

Box 9.2 **SAS® syntax for computing the percentages of students by proficiency level in science and its standard errors by using the PROC_FREQ_NO_PV macro (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_freq_no_pv.sas";
%macro repeat;
%do kk=1 %to 5;
%BRR_FREQ( INFILE=temp1,
           REPLI_ROOT=w_fstr,
           BYVAR=cnt,
           VAR=scielev&kk,
           LIMIT=yes,
           LIMIT_CRITERIA=100 10 5 1,
           ID_SCHOOL=schoolid,
           OUTFILE=exercise&kk);
run;
%end;
%mend;
%repeat;
run;
```

To combine the results:

- Per proficiency level, the five percentage estimates are averaged.
- Per proficiency level, the five sampling variances are averaged.
- By comparing the final estimate and the five PV estimates, the imputation variance is computed.
- The final sampling variance and the imputation variance are combined as usual to get the final error variance.
- The standard error is obtained by taking the square root of the error variance.

Table 9.2
Estimates and sampling variances per proficiency level in science for Germany (PISA 2006)

Level		PV1	PV2	PV3	PV4	PV5
Below Level 1	$\hat{\pi}_i$	4.12	3.82	4.25	4.03	4.13
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.60)^2$	$(0.59)^2$	$(0.72)^2$	$(0.67)^2$	$(0.71)^2$
Level 1	$\hat{\pi}_i$	11.93	11.8	11.03	11.09	10.70
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.86)^2$	$(0.81)^2$	$(0.72)^2$	$(0.73)^2$	$(0.71)^2$
Level 2	$\hat{\pi}_i$	20.26	21.59	21.87	21.16	21.91
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.73)^2$	$(0.71)^2$	$(0.73)^2$	$(0.80)^2$	$(0.76)^2$
Level 3	$\hat{\pi}_i$	28.70	27.46	27.33	27.92	27.93
	$\sigma^2_{(\hat{\pi}_i)}$	$(1.00)^2$	$(0.94)^2$	$(0.69)^2$	$(0.91)^2$	$(0.92)^2$
Level 4	$\hat{\pi}_i$	23.39	23.45	23.57	23.66	23.77
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.91)^2$	$(0.93)^2$	$(0.92)^2$	$(0.92)^2$	$(0.96)^2$
Level 5	$\hat{\pi}_i$	9.82	10.07	10.14	10.24	9.69
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.61)^2$	$(0.53)^2$	$(0.53)^2$	$(0.64)^2$	$(0.49)^2$
Level 6	$\hat{\pi}_i$	1.79	1.81	1.82	1.89	1.87
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.25)^2$	$(0.28)^2$	$(0.23)^2$	$(0.20)^2$	$(0.21)^2$

The final results are presented in Table 9.3.

Table 9.3
Final estimates of the percentage of students, per proficiency level, in science and its standard errors for Germany (PISA 2006)

Proficiency level	%	S.E.
Below Level 1	4.07	0.68
Level 1	11.31	0.96
Level 2	21.36	1.06
Level 3	27.87	1.07
Level 4	23.57	0.95
Level 5	9.99	0.62
Level 6	1.84	0.24

A SAS® macro has been developed for computing the percentage of students at each proficiency level as well as its respective standard error in one run. Box 9.3 presents the SAS® syntax for running the macro and Table 9.4 presents the structure of the output data file.

Box 9.3 **SAS® syntax for computing the percentage of students by proficiency level in science and its standard errors by using the PROC_FREQ_PV macro (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_freq_pv.sas";

%BRR_FREQ_PV(  INFILE=temp1,
               REPLI_ROOT=w_fstr,
               BYVAR=cnt,
               PV_ROOT=scielev,
               LIMIT=yes,
               LIMIT_CRITERIA=100 10 5 1,
               ID_SCHOOL=schoolid,
               OUTFILE=exercise6);
run;
```

This macro has eight arguments. Besides the usual arguments, the root of the proficiency level variable names has to be specified. For the science scale, as specified in the data statement of Box 9.1, this will be set as SCIELEV. As indicated in Table 9.4, the number of cases at Level 6 is less than 100.

Table 9.4
Output data file exercise6 from Box 9.3

CNT	SCIELEV	STAT	SESTAT	STUD_FLAG	SCH_FLAG	PCT_FLAG
DEU	0	4.07	0.68	0	0	1
DEU	1	11.31	0.96	0	0	0
DEU	2	21.36	1.06	0	0	0
DEU	3	27.87	1.07	0	0	0
DEU	4	23.57	0.95	0	0	0
DEU	5	9.99	0.62	0	0	0
DEU	6	1.84	0.24	1	0	1

As before, several breakdown variables can be used. For instance, the distribution of students across proficiency levels per gender can be obtained, as in Box 9.4.

Box 9.4 **SAS® syntax for computing the percentage of students by proficiency level and its standard errors by gender (*e.g.* PISA 2006)**

```
%BRR_FREQ_PV(INFILE=temp1,
             REPLI_ROOT=w_fstr,
             BYVAR=cnt st04q01,
             PV_ROOT=scielev,
             LIMIT=yes,
             LIMIT_CRITERIA=100 10 5 1,
             ID_SCHOOL=schoolid,
             OUTFILE=exercise7);
run;
```

In this case, the sum of the percentages will be equal to 100 per country and per gender, as shown in Table 9.5.

Table 9.5
Output data file exercise7 from Box 9.4

CNT	ST04Q01	SCIELEV	STAT	SESTAT	STUD_FLAG	SCH_FLAG	PCT_FLAG
DEU	1	0	3.73	0.67	1	0	1
DEU	1	1	12.12	1.19	0	0	0
DEU	1	2	21.08	1.26	0	0	0
DEU	1	3	29.94	1.47	0	0	0
DEU	1	4	23.29	1.07	0	0	0
DEU	1	5	8.42	0.73	0	0	1
DEU	1	6	1.42	0.38	1	0	1
DEU	2	0	4.39	0.84	0	0	1
DEU	2	1	10.55	1.09	0	0	0
DEU	2	2	21.62	1.23	0	0	0
DEU	2	3	25.93	1.21	0	0	0
DEU	2	4	23.83	1.35	0	0	0
DEU	2	5	11.46	1.03	0	0	0
DEU	2	6	2.22	0.37	1	0	1

As shown in Table 9.5, the percentage of males at Level 5 and 6 is higher than the percentage of females at Level 5 and 6.

The statistical significance of these differences cannot be evaluated with this procedure, however. More details on this issue will be provided in Chapter 11.

OTHER ANALYSES WITH PROFICIENCY LEVELS

Proficiency levels constitute a powerful tool for communicating the results on the cognitive test. Researchers and/or policy makers might therefore be interested in estimating the influence of some variables (such as the social background or self-confidence measures) on the proficiency levels.

PISA 2003, for instance, constructed an index of mathematics self-efficacy, denoted MATHEFF.

Analysing the relationship between proficiency levels and mathematics self-efficacy is relevant, as there is probably a reciprocal relationship between these two concepts. Better self-perception in mathematics is thought to increase a student's proficiency in mathematics, but an increase in the latter might in return affect the former.

Suppose that the statistic of interest is the average self-efficacy per proficiency level. In statistical terms, mathematics self-efficacy is considered as the dependent variable and the level of proficiency, the independent variable. There is no macro that can directly compute the mean of a continuous variable per proficiency level. On the other hand, the PROC_MEAN_NO_PV macro described in Chapter 7 can be applied sequentially five times and the results could be combined in an Excel® spreadsheet for instance. This will be the case whenever proficiency levels are used as independent or as classification variables.

Box 9.5 presents SAS® syntax for preparing the PISA 2003 data file.

Box 9.5 **SAS® syntax for generating the proficiency levels in mathematics (*e.g.* PISA 2003)**

```
data temp2;
        set pisa2003.stud;
        if (cnt="DEU");
        array math (25)
           pv1math pv2math pv3math pv4math pv5math
           pv1math1 pv2math1 pv3math1 pv4math1 pv5math1
           pv1math2 pv2math2 pv3math2 pv4math2 pv5math2
           pv1math3 pv2math3 pv3math3 pv4math3 pv5math3
           pv1math4 pv2math4 pv3math4 pv4math4 pv5math4;
        array levelmat (25)
           mlev1-mlev5
           m1lev1-m1lev5
           m2lev1-m2lev5
           m3lev1-m3lev5
           m4lev1-m4lev5;
        do i=1 to 25;
           if (math(i)<=357.77) then levelmat(i)=0;
           if (math(i)>357.77 and math(i)<=420.07) then levelmat(i)=1;
           if (math(i)>420.07 and math(i)<=482.38) then levelmat(i)=2;
           if (math(i)>482.38 and math(i)<=544.68) then levelmat(i)=3;
           if (math(i)>544.68 and math(i)<=606.99) then levelmat(i)=4;
           if (math(i)>606.99 and math(i)<=669.30) then levelmat(i)=5;
           if (math(i)>669.30) then levelmat(i)=6;
        end;
        w_fstr0=w_fstuwt;
        keep   cnt schoolid stidstd
               w_fstr0-w_fstr80
               mlev1-mlev5
               m1lev1-m1lev5
               m2lev1-m2lev5
               m3lev1-m3lev5
               m4lev1-m4lev5
               st03q01 matheff;
run;
```

Box 9.6 presents SAS® syntax for computing the mean of student self-efficacy per proficiency level.

Box 9.6 SAS® syntax for computing the mean of self-efficacy in mathematics and its standard errors by proficiency level (*e.g.* PISA 2003)

```
%include "c:\pisa\macro\proc_means_no_pv.sas";
%macro repeat;
%do kk=1 %to 5;
%BRR_PROCMEAN(INFILE=temp2,
              REPLI_ROOT=w_fstr,
              BYVAR=cnt mlev&kk,
              VAR=matheff,
              STAT=mean,
              LIMIT=no,
              LIMIT_CRITERIA=,
              ID_SCHOOL=,
              OUTFILE=exercise&kk);
run;
data exercise&kk;
        set exercise&kk;
        stat&kk=stat;
        sestat&kk=sestat;
        mlev=mlev&kk;
        keep cnt mlev stat&kk sestat&kk;
run;
%end;
data exercise8;
        merge exercise1 exercise2 exercise3 exercise4 exercise5;
        by cnt mlev;
        stat=(stat1+stat2+stat3+stat4+stat5)/5;
        samp=  ((sestat1**2)+(sestat2**2)+(sestat3**2)+(sestat4**2)+
               (sestat5**2))/5;

        mesvar=(((stat1-stat)**2)+((stat2-stat)**2)+((stat3-stat)**2)+
                ((stat4-stat)**2)+((stat5-stat)**2))/4;

        sestat=(samp+(1.2*mesvar))**0.5;
        keep cnt mlev stat sestet stud_flag sch_flag pct_flag;
run;
%mend repeat;
```

Table 9.6 presents the mean estimates and standard errors for self-efficacy in mathematics per proficiency level.

To combine the results:

- Per proficiency level, the five mean estimates are averaged.
- Per proficiency level, the five sampling variances are averaged.
- By comparing the final estimate and the five PV estimates, the imputation variance is computed.
- The final sampling variance and the imputation variance are combined as usual to get the final error variance.
- The standard error is obtained by taking the square root of the error variance.

Final results are presented in Table 9.7. It shows that high self-efficacy in mathematics (STAT) is associated with higher proficiency levels (MLEV).

Table 9.6
Mean estimates and standard errors for self-efficacy in mathematics per proficiency level (PISA 2003)

Level		PV1	PV2	PV3	PV4	PV5
Below Level 1	$\hat{\mu}_i$	-0.68	-0.70	-0.74	-0.72	-0.77
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.06)^2$	$(0.06)^2$	$(0.06)^2$	$(0.05)^2$	$(0.06)^2$
Level 1	$\hat{\mu}_i$	-0.44	-0.45	-0.42	-0.43	-0.40
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.06)^2$	$(0.05)^2$	$(0.06)^2$	$(0.04)^2$	$(0.05)^2$
Level 2	$\hat{\mu}_i$	-0.18	-0.16	-0.17	-0.18	-0.18
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 3	$\hat{\mu}_i$	0.09	0.09	0.12	0.11	0.10
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 4	$\hat{\mu}_i$	0.43	0.45	0.41	0.45	0.44
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 5	$\hat{\mu}_i$	0.85	0.84	0.86	0.79	0.82
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.04)^2$	$(0.04)^2$	$(0.03)^2$	$(0.04)^2$	$(0.04)^2$
Level 6	$\hat{\mu}_i$	1.22	1.23	1.27	1.28	1.29
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.05)^2$	$(0.05)^2$	$(0.06)^2$	$(0.05)^2$	$(0.07)^2$

Table 9.7
Output data file exercise8 from Box 9.6

CNT	MLEV	STAT	SESTAT
DEU	0	-0.72	0.07
DEU	1	-0.43	0.06
DEU	2	-0.17	0.03
DEU	3	0.10	0.03
DEU	4	0.44	0.03
DEU	5	0.83	0.05
DEU	6	1.26	0.07

CONCLUSION

This chapter has shown how to compute the percentage of students per proficiency level and its standard errors. As shown, the algorithm is similar to the one used for other statistics.

The difficulty of conducting analyses using proficiency levels as the explanatory (independent) variables was also discussed.

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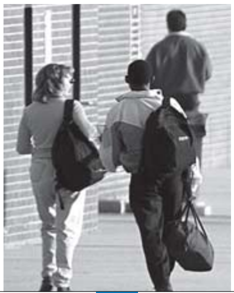
Notes

1. In PISA 2000, the cutpoints that frame the proficiency levels in reading are: 334.75, 407.47, 480.18, 552.89 and 625.61. In PISA 2003, the cutpoints that frame the proficiency levels in mathematics are: 357.77, 420.07, 482.38, 544.68, 606.99 and 669.3.

2. This formula is a simplification of the general formula provided in Chapter 5. M, denoting the number of plausible values, has been replaced by 5.



10

Analyses with School-Level Variables

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INTRODUCTION

The target population in PISA is 15-year-old students. This population was chosen because, at this age in most OECD countries, students are approaching the end of their compulsory schooling. Thus, PISA should be able to indicate the cumulative effect of a student's education.

As described in detail in Chapter 3, a two-stage sampling procedure is used in PISA. After the population is defined, school samples are selected with a probability proportional to size. Subsequently, 35 students are randomly selected from each school. As the target population is based on age, it is possible that students will come from a variety of grades.

Table 10.1 presents the distribution of 15-year-olds in each country, by grade and by the International Standard Classification of Education (ISCED) level in PISA 2006.

In a few countries, most of the 15-year-old population tends to be in a modal grade, whereas in others, the 15-year-old population is spread across several grades.

Table 10.1
Percentage of students per grade and ISCED level, by country (PISA 2006)

	Grade								
	7	8	9	10	11	12	13	ISCED 2	ISCED 3
AUS		0.1	9.2	70.8	19.8	0.1		80.1	19.9
AUT	0.3	6.4	44.6	48.7	0			6.7	93.3
BEL	0.4	4.4	31.1	63.2	1			6.8	93.2
CAN	0	1.7	13.3	83.8	1.2	0		15	85
CHE	0.8	16.1	62.6	20.3	0.3	0		82.8	17.2
CZE	0.6	3.5	44.3	51.5				50.4	49.6
DEU	1.6	12.3	56.5	29.3	0.3			97.3	2.7
DNK	0.2	12	85.3	1.4	1.1			98.9	1.1
ESP	0.1	7	33	59.8	0			100	0
FIN	0.2	11.7	88.1	0				100	0
FRA	0	5.2	34.8	57.5	2.4	0		40	60
GBR			0	0.9	98.4	0.7		0.5	99.5
GRC	0.5	2.1	5.3	78.8	13.3			8	92
HUN	2.2	5.5	65.7	26.6	0			7.7	92.3
IRL	0	2.7	58.5	21.2	17.5			61.3	38.7
ISL			0.2	99.2	0.6			99.4	0.6
ITA	0.3	1.5	15	80.4	2.8			1.7	98.3
JPN				100					100
KOR			2	97.3	0.7			2	98
LUX	0.2	11.8	53.4	34.4	0.1			64.2	35.8
MEX	2.3	8.1	33.5	48.9	5.1	2		44.5	55.5
NLD	0.1	3.7	44.9	50.7	0.4	0		73.5	26.5
NOR			0.5	99	0.5			99.5	0.5
NZL			0	6.2	89.4	4.4	0	6.2	93.8
POL	0.6	3.8	95	0.6				99.4	0.6
PRT	6.6	13.1	29.5	50.7	0.2			50.2	49.8
SVK	0.7	2.2	38.5	58.7				38.6	61.4
SWE		1.9	95.9	2.2				97.8	2.2
TUR	0.8	4.5	38.4	53.7	2.6			5.3	94.7
USA	0.8	1	10.7	70.9	16.5	0.1		12.4	87.6

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The PISA target population can be spread over several grades for different reasons:

- If the student does not pass a particular grade examination, he or she has to repeat the grade. For example in some countries there may be up to about 35% of students who have already repeated at least one grade.
- Even if grade retention is not used, the 15-year-old population might be separated at the time of testing into two grades. For logistical reasons, PISA testing takes place in a single calendar year. As the recommended testing window is around April (in the northern hemisphere), the PISA target population is defined as all students between 15 years and 3 months old and 16 years and 2 months old at the beginning of the testing period. If the entrance rules for compulsory education are defined in terms of complete calendar years, then the PISA target population will attend just one grade.

Further, in most countries, the PISA population is spread across the two levels of secondary education, *i.e.* lower secondary (ISCED 2) and upper secondary (ISCED 3).

As the 15-year-old population attends different grades in most OECD countries, the within-school samples can only consist of a random sample of students. Consequently, the PISA participating students are attending several grades and within a particular grade, are in several classes, depending on the school size. Largely because the PISA sample is not class-based, PISA collects data at the school level. This chapter describes how and why school-level data should be analysed.

Since the PISA target population attends several grades in most countries, it would be interesting to compute the average performance growth between two adjacent grades, so that performance differences between countries could be translated into school-year effect. However, this would certainly lead to an overestimation of the performance growth: 15-year-olds attending lower grades are either lower achievers or younger students, and 15-year-olds attending higher grades are either high achievers or older students. Therefore, caution is required in comparing subpopulations in different grades.

LIMITS OF THE PISA SCHOOL SAMPLES

As mentioned earlier, the following statement is valid for both PISA and other international studies:

> Although the student's samples were drawn from within a sample of schools, the school sample was designed to optimize the resulting sample of students, rather than to give an optimal sample of schools. For this reason, it is always preferable to analyse the school-level variables as attributes of students, rather than as elements in their own right. (Gonzalez and Kennedy, 2003)

This advice is particularly important in PISA as the target population is not defined as a grade, but as students of a particular age.

In some countries, lower secondary and upper secondary education are provided by the same school, whereas in others, this is not the case. In these countries, usually, the transition between lower and upper secondary education occurs around the age of 15, *i.e.* at the end of compulsory education (in most cases). As PISA focuses on the 15-year-old population, it means that one part of the target population is attending upper secondary education, while the other is attending lower secondary education (see Table 10.1 for the percentages of student by level of secondary education). Consequently, in several countries, 15-year-olds can be in different educational institutions.

As discussed in Chapter 3, schools are selected from the school sample frame by the probability proportional to size (PPS) sampling method, *i.e.* proportionally to the number of 15-year-olds attending the school.

This might mean, for example, that upper secondary schools only attended by students over the PISA age of 15 should not be included in the school sample frame. Similarly, lower secondary schools without any 15-year-olds should not be included in the school sample frame.

Thus, neither the lower secondary school population, nor the upper secondary school population represents the 15-year-old school population. In other words, the PISA school target population does not necessarily match the school population(s) within a particular country.

This lack of perfect match between the usual school population(s) and the PISA school population affects the way school data should be analysed. To avoid biases for the population estimates, school data have to be imported into the student data files and have to be analysed with the student final weight. This means, for example, that one will not estimate the percentage of public schools versus private schools, but will estimate the percentage of 15-year-olds attending private schools versus public schools. From a pedagogical and/or policy point of view, what is really important is not the percentage of schools that present such characteristics, but the percentage of students who are affected by these characteristics.

MERGING THE SCHOOL AND STUDENT DATA FILES

Box 10.1 provides the SAS® syntax for merging the student and school data files. Both files need first to be sorted by the identification variables, *i.e.* CNT, SCHOOLID and STIDSTD in the student data file and CNT and SCHOOLID in the school data file. Afterwards, the two sorted data files can be merged according to the common identification variables, *i.e.* CNT and SCHOOLID.

Box 10.1 **SAS® syntax for merging the student and school data files (*e.g.* PISA 2006)**

```
libname PISA2006 "c:\pisa\2006\data\";
options nofmterr notes;

data temp1;
        set pisa2006.stu;
run;
proc sort data=temp1;
        by cnt schoolid stidstd;
run;
data temp2;
        set pisa2006.sch;
run;
proc sort data = temp2;
        by cnt schoolid;
run;
data pisa2006.alldata;
        merge temp1 temp2;
        by cnt schoolid;
run;
```

ANALYSES OF THE SCHOOL VARIABLES

After merging the student and school data files, school data can be analysed as any student-level variables since the school-level variables are now considered as attributes of students. However, in this case, it is even more critical to use the replicate weights to compute sampling errors. Failure to do so would give a completely misleading inference.

The remainder of this chapter explains the methods for computing the percentage of students by school location, and their respective standard errors, as well as the student average performance in science, by school location.

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Box 10.2 sets out the school-location question found in the school questionnaire.

Box 10.2 **Question on school location in PISA 2006**

Q7 WHICH OF THE FOLLOWING BEST DESCRIBES THE COMMUNITY IN WHICH YOUR SCHOOL IS LOCATED?

Tick only one box in each row.

A <village, hamlet or rural area> (fewer than 3 000 people)	☐ 1
A <small town> (3 000 to about 15 000 people)	☐ 2
A <town> (15 000 to about 100 000 people)	☐ 3
A <city> (100 000 to about 1 000 000 people)	☐ 4
A large <city> with over 1 000 000 people	☐ 5

Box 10.3 provides the SAS® syntax for computing the percentage of students and the average performance in science, by school location. As previously indicated, the SAS® macro might be CPU-consuming; thus it is advised to keep only the variables indispensable for the analyses.

Box 10.3 **SAS® syntax for computing the percentage of students and the average performance in science, by school location (*e.g.* PISA 2006)**

```
data temp3;
   set pisa2006.alldata;
   if (cnt=“DEU”);
   if (not missing (sc07q01));
   w_fstr0=w_fstuwt;
   scie1=pv1scie;
   scie2=pv2scie;
   scie3=pv3scie;
   scie4=pv4scie;
   scie5=pv5scie;
   keep  cnt schoolid stidstd
         w_fstr0-w_fstr80 scie1-scie5 sc07q01;
run;
%include “c:\pisa\macro\proc_freq_no_pv.sas”;
%BRR_FREQ(   INFILE=temp3,
             REPLI_ROOT=w_fstr,
             BYVAR=cnt,
             VAR=sc07q01,
             LIMIT=no,
             LIMIT_CRITERIA=,
             ID_SCHOOL=,
             OUTFILE=exercise1);
run;
%include “c:\pisa\macro\proc_means_pv.sas”;
%BRR_PROCMEAN_PV(INFILE=temp3,
                 REPLI_ROOT=w_fstr,
                 BYVAR=cnt sc07Q01,
                 PV_ROOT=scie,
                 STAT=mean,
                 LIMIT=no,
                 LIMIT_CRITERIA=,
                 ID_SCHOOL=schoolid,
                 OUTFILE=exercise2);
run;
```

Table 10.2 and Table 10.3 present the structure of the output data files exercise1 and exercise2.

Table 10.2
Output data file exercise1 from Box 10.3

CNT	SC07Q01	STAT	SESTAT
DEU	1	3.8	1.1
DEU	2	27.6	2.9
DEU	3	45.0	3.5
DEU	4	15.7	2.6
DEU	5	7.9	1.6

Table 10.3
Output data file exercise2 from Box 10.3

CNT	SC07Q01	STAT	SESTAT
DEU	1	453.1	14.9
DEU	2	515.9	7.7
DEU	3	526.4	7.7
DEU	4	521.1	13.6
DEU	5	487.5	17.8

As a reminder, the school data was analysed at the student level and weighted by the student final weight. Therefore, results should be interpreted as: 27.6% of the 15-year-olds are attending a school located in a village with less than 3 000 people. The students attending a school located in a small village on average perform at 515.9.

As the percentages for some categories might be small, the standard error will be large for the mean estimates.

All the SAS® macros described in the previous chapters can be used on the school variables once they have been imported in the student data file.

CONCLUSION

For statistical and pedagogical reasons, the data collected through the school questionnaire, as well as the variables derived from that instrument, have to be analysed at the student level.

All the SAS® macros developed can be used without any modifications. The interpretation of the results should clearly state the analysis level, *i.e.* for instance the percentage of students attending a school located in a small village and not the percentage of schools located in a small village.

11

Standard Error on a Difference

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INTRODUCTION

This chapter will discuss the computation of standard errors on differences. Following a description of the statistical issues for such estimates, the different steps for computing such standard errors will be presented. Finally, the correction of the critical value for multiple comparisons will be discussed.

STATISTICAL ISSUES AND COMPUTING STANDARD ERRORS ON DIFFERENCES

Suppose that *X* represents the student score for a mathematics test and *Y* the student score for a science test for the same sample of students. To summarise the score distribution for both tests, one can compute:

- $\mu_{(X)}$, $\mu_{(Y)}$, representing respectively the mean of *X* and the mean of *Y*,
- $\sigma^2_{(X)}$, $\sigma^2_{(Y)}$, representing respectively the variance of *X* and the variance of *Y*.

It can be shown that:

$\mu_{(X+Y)} = \mu_{(X)} + \mu_{(Y)}$ and

$$\sigma^2_{(X+Y)} = \sigma^2_{(X)} + \sigma^2_{(Y)} + 2\,\mathrm{cov}(X,Y)$$

If a total score is computed by just adding the mathematics and science scores, then according to these two formulae, the mean of this total score will be the sum of the two initial means, and the variance of the total score will be equal to the sum of the variance of the two initial variables *X* and *Y* plus two times the covariance between *X* and *Y*. This covariance represents the relationship between *X* and *Y*. Usually, high performers in mathematics are also high performers in science; thus, one should expect a positive and high covariance in this particular example.

Similarly,

$\mu_{(X-Y)} = \mu_{(X)} - \mu_{(Y)}$ and

$$\sigma^2_{(X-Y)} = \sigma^2_{(X)} + \sigma^2_{(Y)} - 2\,\mathrm{cov}(X,Y)$$

In other words, the variance of a difference is equal to the sum of the variances of the two initial variables minus two times the covariance between the two initial variables.

As described in Chapter 4, a sampling distribution has the same characteristics as any distribution, except that units consist of sample estimates and not observations. Therefore,

$$\sigma^2_{(\hat{\mu}_X - \hat{\mu}_Y)} = \sigma^2_{(\hat{\mu}_X)} + \sigma^2_{(\hat{\mu}_Y)} - 2\,\mathrm{cov}(\hat{\mu}_X, \hat{\mu}_Y)$$

The sampling variance of a difference is equal to the sum of the two initial sampling variances minus two times the covariance between the two sampling distributions on the estimates.

Suppose that one wants to determine whether female performance is on average higher than male performance. As for all statistical analyses, the null hypothesis has to be tested. In this particular example, it will consist of computing the difference between the male performance mean and the female performance mean, or the inverse. The null hypothesis will be:

$$H_0 : \hat{\mu}_{(males)} - \hat{\mu}_{(females)} = 0$$

To test this null hypothesis, the standard error on this difference has to be computed and then compared to the observed difference. The respective standard errors on the mean estimate for males and for females ($\sigma_{(\hat{\mu}_{males})}$, $\sigma_{(\hat{\mu}_{females})}$) can be easily computed.

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What does the covariance between the two variables, *i.e.* $\hat{\mu}_{(males)}$, $\hat{\mu}_{(females)}$, tell us? A positive covariance means that if $\hat{\mu}_{(males)}$ increases, then $\hat{\mu}_{(females)}$ will also increase. A covariance equal or close to 0 means that $\hat{\mu}_{(males)}$ can increase or decrease with $\hat{\mu}_{(females)}$ remaining unchanged. Finally, a negative covariance means that if $\hat{\mu}_{(males)}$ increases, then $\hat{\mu}_{(females)}$ will decrease, and inversely.

How are $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ correlated? Suppose that in the school sample, a coeducational school attended by low performers is replaced by a coeducational school attended by high performers. The country mean will increase slightly, as well as the means for males and females. If the replacement process is continued, $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ will likely increase in a similar pattern. Indeed, a coeducational school attended by high-performing males is usually also attended by high-performing females. Therefore, the covariance between $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ will be positive.

Let us now suppose that all schools are single gender. A boys' school can replace a girls' school in the sample and therefore $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ will change. If gender is used as a stratification variable, *i.e.* all girls' schools are allocated to an explicit stratum and all boys' schools are allocated to another explicit stratum, then a girls' school can only be replaced by another girls' school. In this case, only $\hat{\mu}_{(females)}$ will change. As $\hat{\mu}_{(females)}$ might change without affecting $\hat{\mu}_{(males)}$, the expected value of the covariance between $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ is 0.

Finally, a negative covariance means that if a school is attended by high-performing males, then that school is also attended by low-performing females or the inverse. This situation is not likely.

In summary, the expected value of the covariance will be equal to 0 if the two subsamples are independent. If the two subsamples are not independent, then the expected value of the covariance might differ from 0.

In PISA, country samples are independent. Therefore, for any comparison between two countries, the expected value of the covariance will be equal to 0. The standard error on the estimate is:

$$\sigma_{(\hat{\theta}_i - \hat{\theta}_j)} = \sqrt{\sigma^2_{(\hat{\theta}_i)} + \sigma^2_{(\hat{\theta}_j)}} \text{, with } \quad \text{being any statistic.}$$

For instance, in PISA 2003, the mean score in mathematics is equal to 503 with a standard error of 3.3 in Germany, and the mean is equal to 529 with a standard error of 2.3 in Belgium. Therefore, the difference between Germany and Belgium is 529-503=26 and the standard error on this difference is:

$$\sigma_{(\hat{\theta}_i - \hat{\theta}_j)} = \sqrt{\sigma^2_{(\hat{\theta}_i)} + \sigma^2_{(\hat{\theta}_j)}} = \sqrt{(3.3)^2 + (2.3)^2} = \sqrt{10.89 + 5.29} = \sqrt{16.18} = 4.02$$

The difference divided by its standard error, *i.e.* $\frac{26}{4.02} = 6.46$, is greater than 1.96, which is significant. This means that the performance in Belgium is greater than the performance in Germany.

Similarly, the percentage of students below Level 1 in mathematics is equal to 9.2% in Germany (with a standard error of 0.8) and to 7.2% in Belgium (with a standard error of 0.6). The difference is equal to 9.2 – 7.2 = 2 and the standard error on this difference is equal to:

$$\sigma_{(\hat{\theta}_i - \hat{\theta}_j)} = \sqrt{\sigma^2_{(\hat{\theta}_i)} + \sigma^2_{(\hat{\theta}_j)}} = \sqrt{(0.8)^2 + (0.6)^2} = \sqrt{0.64 + 0.36} = \sqrt{1} = 1$$

The standardised difference is equal to 2 (*i.e.* $\frac{2}{1}$), which is significant. Thus the percentage of students below Level 1 is greater in Germany than in Belgium.

Finally, the regression coefficient of student socio-economic background index on the science performance in PISA 2006 is equal to 47.71 for Germany (with a standard error equal to 1.89), and 46.45 for Belgium

(with a standard error equal to 2.08). These two regression coefficients do not statistically differ as the standardised difference is equal to 0.44:

$$\frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{\sigma^2_{(\hat{\beta}_1)} + \sigma^2_{(\hat{\beta}_2)}}} = \frac{47.71 - 46.45}{\sqrt{(1.89)^2 + (2.08)^2}} = 0.44$$

While the covariance between two country estimates for any statistical parameter is expected to be 0, it differs from 0 between an OECD country and the OECD average or total, as any OECD country contributes to the computation of the OECD average or total parameter estimate. Chapter 12 will describe how the standard error on the difference between an OECD country and the OECD average can be computed.

Within a particular country, any subsamples will be considered as independent if the categorical variable used to define the subsamples was used as an explicit stratification variable. For instance, since Canada used the provinces as an explicit stratification variable, these subsamples are independent and any comparison between two provinces does not require the estimation of the covariance between the sampling distributions.

As a general rule, any comparison between countries does not require the estimation of the covariance, but it is strongly advised to estimate the covariance between the sampling distributions for within-country comparisons.

As described earlier in this section, the estimation of the covariance between, for instance, $\hat{\mu}_{(males)}$ and $\hat{\mu}_{(females)}$ would require the selection of several samples and then the analysis of the variation of $\hat{\mu}_{(males)}$ in conjunction with $\hat{\mu}_{(females)}$. Such procedure is, of course, unrealistic. Therefore, as for any computation of a standard error in PISA, replication methods using the supplied replicate weights will be used to estimate the standard error on a difference.

THE STANDARD ERROR ON A DIFFERENCE WITHOUT PLAUSIBLE VALUES

Let's suppose that a researcher wants to test whether females have higher job expectations than males in Germany.

As described in Chapter 7, the SAS® macro PROC_MEANS_NO_PV can be used to estimate the average job expectation for males and females respectively.

Box 11.1 **SAS® syntax for computing the mean of job expectations by gender (*e.g.* PISA 2003)**

```
libname PISA2003 "c:\pisa\2003\data\";
libname PISA2006 "c:\pisa\2006\data\";
options nofmterr notes;
run;
data temp1;
         set pisa2003.stud;
         if (cnt="DEU") ;
         w_fstr0=w_fstuwt;
         keep   cnt schoolid stidstd bsmj st03q01 w_fstr0-w_fstr80;
run;
%include "c:\pisa\macro\proc_means_no_pv.sas";
%BRR_PROCMEAN( INFILE=temp1,
                REPLI_ROOT=w_fstr,
                BYVAR=cnt st03q01,
                VAR=bsmj,
                STAT=mean,
                LIMIT=no,
                LIMIT_CRITERIA=,
                OUTFILE=exercise1);
run;
```

Box 11.1 presents the SAS® syntax for the computation of the mean for job expectations at the age of 30 (BSMJ) by gender. Table 11.1 presents the structure of the output data file as well as the results by gender.

Table 11.1
Output data file exercise1 from Box 11.1

CNT	ST03Q01	STAT	SESTAT
DEU	1	53.05	0.57
DEU	2	50.58	0.69

On average, job expectation is 53.05 for females and 50.58 for males. As German schools are usually coeducational and as gender is not used as an explicit stratification variable, the expected value of the covariance might differ from 0.

To compute the standard error by gender, it is necessary to compute the mean estimate for each of the 80 replicate weights. Table 11.2 presents the mean estimates by gender for 80 replicate weights.

Table 11.2
Mean estimates for the final and 80 replicate weights by gender (PISA 2003)

Weight	Mean estimate		Weight	Mean estimate	
	Females	Males		Females	Males
Final weight	**53.05**	**50.58**			
Replicate 1	53.29	50.69	Replicate 41	52.69	50.55
Replicate 2	53.16	50.53	Replicate 42	53.28	51.23
Replicate 3	53.16	50.45	Replicate 43	53.07	50.39
Replicate 4	53.30	50.70	Replicate 44	52.95	49.72
Replicate 5	52.79	50.28	Replicate 45	53.31	51.04
Replicate 6	53.14	50.76	Replicate 46	53.72	50.80
Replicate 7	53.04	50.36	Replicate 47	52.91	51.03
Replicate 8	52.97	50.11	Replicate 48	53.10	50.53
Replicate 9	53.28	51.37	Replicate 49	53.05	50.81
Replicate 10	53.01	50.55	Replicate 50	53.79	50.90
Replicate 11	53.26	50.70	Replicate 51	52.65	50.15
Replicate 12	53.16	49.86	Replicate 52	53.30	50.45
Replicate 13	52.81	50.94	Replicate 53	52.68	50.12
Replicate 14	53.21	50.71	Replicate 54	52.74	50.01
Replicate 15	53.39	50.23	Replicate 55	53.50	50.11
Replicate 16	53.06	50.46	Replicate 56	52.54	50.58
Replicate 17	53.34	50.48	Replicate 57	53.31	51.03
Replicate 18	52.71	50.42	Replicate 58	53.13	50.34
Replicate 19	53.18	50.87	Replicate 59	52.72	50.37
Replicate 20	52.82	50.44	Replicate 60	53.49	51.43
Replicate 21	53.36	50.74	Replicate 61	53.13	50.71
Replicate 22	53.15	50.72	Replicate 62	53.61	51.27
Replicate 23	53.24	50.65	Replicate 63	52.74	50.15
Replicate 24	52.68	50.51	Replicate 64	53.19	50.25
Replicate 25	52.76	50.44	Replicate 65	53.28	51.04
Replicate 26	52.79	50.43	Replicate 66	52.91	50.94
Replicate 27	53.01	50.58	Replicate 67	53.25	50.85
Replicate 28	53.24	50.12	Replicate 68	53.12	50.74
Replicate 29	52.86	50.68	Replicate 69	53.08	50.31
Replicate 30	52.85	50.02	Replicate 70	52.92	50.44
Replicate 31	52.90	50.85	Replicate 71	53.35	50.63
Replicate 32	53.25	50.60	Replicate 72	53.25	50.75
Replicate 33	53.32	50.54	Replicate 73	52.54	50.42
Replicate 34	52.42	50.55	Replicate 74	52.58	50.20
Replicate 35	52.91	50.72	Replicate 75	52.49	49.75
Replicate 36	53.06	50.36	Replicate 76	52.98	50.96
Replicate 37	52.67	50.73	Replicate 77	53.04	50.24
Replicate 38	53.36	50.16	Replicate 78	53.30	50.44
Replicate 39	52.57	50.36	Replicate 79	52.93	50.36
Replicate 40	53.07	50.58	Replicate 80	52.98	50.76

The final difference estimate will be the difference between the two final estimates, *i.e.* 53.05 – 50.58 = 2.47.

The procedure to estimate the final standard error is straightforward. It is similar to the procedure described in Chapter 7, except that is now a difference, and not a mean or a regression coefficient. The different steps are:

- The difference in the means between females and males is computed for each of the 80 replicates.
- Each of the 80 difference estimates is compared with the final difference estimate, then squared.
- The sum of the square is computed then divided by 20 to obtain the sampling variance on the difference.
- The standard error is the square root of the sampling variance.

These different steps can be summarised as:

$$\sigma_{(\hat{\theta})} = \sqrt{\frac{1}{20}\sum_{i=1}^{80}(\hat{\theta}_{(i)} - \hat{\theta})^2}$$ with being a difference.

Concretely:

- For the first replicate, the difference between the female mean estimate and the male mean estimate is equal to (53.29 – 50.69) = 2.60. For the second replicate, the difference estimate will be equal to (53.16 – 50.53) = 2.63 and so on for the 80 replicates. All these difference estimates are presented in Table 11.3.
- Each of the 80 replicate difference estimates is compared with the final difference estimate and this difference is squared. For the first replicate, it will be $(2.60 - 2.47)^2 = 0.0164$. For the second replicate, it will be $(2.63 - 2.47)^2 = 0.0258$. These squared differences are also presented in Table 11.3.
- These squared differences are summed. This sum is equal to (0.0164 + 0.0258 +….. + 0.0641) = 9.7360. The sampling variance on the difference is therefore equal to $\frac{9.7360}{20} = 0.4868$.
- The standard error is equal to the square root of 0.4868, *i.e.* 0.6977.

As $\frac{2.47}{0.6977}$ is greater than 1.96, job expectations for females are statistically greater than job expectations for males in Germany.

If the researcher had considered these two German subsamples as independent, then s/he would have obtained the following for the standard error on this difference

$$\sigma_{(\hat{\theta}_i - \hat{\theta}_j)} = \sqrt{\sigma^2_{(\hat{\theta}_i)} + \sigma^2_{(\hat{\theta}_j)}} = \sqrt{(0.57)^2 + (0.69)^2} = 0.895$$

In this particular case, the difference between the unbiased estimate of the standard error (*i.e.* 0.698) and the biased estimate of the standard error (*i.e.* 0.895) is quite small. The difference between the biased and unbiased estimates of the standard error, however, can be substantial, as shown later in this chapter.

A SAS® macro of PROC_DIF_NO_PV has been developed for the computation of standard errors on differences. Box 11.2 presents the SAS syntax for running this macro. Table 11.4 presents the structure of the output data file.

Table 11.3
Difference in estimates for the final weight and 80 replicate weights between females and males (PISA 2003)

Weight	Difference between females and males (females – males)	Squared difference between the replicate and the final estimates	Weight	Difference between females and males (females – males)	Squared difference between the replicate and the final estimates
Final weight	2.47				
Replicate 1	2.60	0.0164	Replicate 41	2.14	0.1079
Replicate 2	2.63	0.0258	Replicate 42	2.05	0.1789
Replicate 3	2.72	0.0599	Replicate 43	2.68	0.0440
Replicate 4	2.61	0.0180	Replicate 44	3.23	0.5727
Replicate 5	2.51	0.0011	Replicate 45	2.28	0.0373
Replicate 6	2.39	0.0067	Replicate 46	2.92	0.2038
Replicate 7	2.68	0.0450	Replicate 47	1.88	0.3488
Replicate 8	2.86	0.1483	Replicate 48	2.56	0.0084
Replicate 9	1.92	0.3085	Replicate 49	2.23	0.0567
Replicate 10	2.46	0.0002	Replicate 50	2.89	0.1768
Replicate 11	2.57	0.0089	Replicate 51	2.49	0.0004
Replicate 12	3.30	0.6832	Replicate 52	2.85	0.1440
Replicate 13	1.87	0.3620	Replicate 53	2.56	0.0072
Replicate 14	2.50	0.0009	Replicate 54	2.73	0.0667
Replicate 15	3.16	0.4756	Replicate 55	3.39	0.8520
Replicate 16	2.60	0.0173	Replicate 56	1.96	0.2631
Replicate 17	2.87	0.1577	Replicate 57	2.28	0.0351
Replicate 18	2.29	0.0327	Replicate 58	2.79	0.1017
Replicate 19	2.31	0.0269	Replicate 59	2.35	0.0158
Replicate 20	2.38	0.0078	Replicate 60	2.05	0.1749
Replicate 21	2.62	0.0221	Replicate 61	2.42	0.0027
Replicate 22	2.43	0.0014	Replicate 62	2.34	0.0164
Replicate 23	2.59	0.0142	Replicate 63	2.59	0.0137
Replicate 24	2.17	0.0901	Replicate 64	2.94	0.2230
Replicate 25	2.32	0.0227	Replicate 65	2.24	0.0539
Replicate 26	2.36	0.0132	Replicate 66	1.97	0.2524
Replicate 27	2.43	0.0015	Replicate 67	2.40	0.0050
Replicate 28	3.12	0.4225	Replicate 68	2.38	0.0089
Replicate 29	2.18	0.0844	Replicate 69	2.76	0.0848
Replicate 30	2.84	0.1333	Replicate 70	2.48	0.0002
Replicate 31	2.06	0.1709	Replicate 71	2.72	0.0609
Replicate 32	2.65	0.0312	Replicate 72	2.50	0.0006
Replicate 33	2.78	0.0970	Replicate 73	2.12	0.1217
Replicate 34	1.87	0.3611	Replicate 74	2.39	0.0073
Replicate 35	2.19	0.0809	Replicate 75	2.73	0.0693
Replicate 36	2.69	0.0490	Replicate 76	2.02	0.2031
Replicate 37	1.94	0.2825	Replicate 77	2.80	0.1058
Replicate 38	3.20	0.5355	Replicate 78	2.86	0.1519
Replicate 39	2.21	0.0683	Replicate 79	2.57	0.0091
Replicate 40	2.48	0.0001	Replicate 80	2.22	0.0641
			Sum of squared differences		9.736

Box 11.2 **SAS® macro for computing standard errors on differences (*e.g.* PISA 2003)**

```
%include "c:\pisa\macro\proc_dif_no_pv.sas";

%BRR_PROCMEAN_DIF(INFILE=temp1,
                  REPLI_ROOT=w_fstr,
                  BYVAR=cnt,
                  VAR=bsmj,
                  COMPARE=st03q01,
                  CATEGORY=1 2,
                  STAT=mean,
                  OUTFILE=exercise2);
run;
```

Beside the arguments common to all SAS® macros, four other arguments have to be specified:

1. The VAR argument informs the macro of the numerical variable on which a mean or a standard deviation will be computed per value of a categorical variable. In this example, VAR equals BSMJ.
2. The COMPARE argument specifies the categorical variables on which the contrasts will be based.
3. The CATEGORY argument specifies the values of the categorical variables for which contrasts are required. As gender has only two categories, denoted 1 and 2, CATEGORY is set as "1 2". If a categorical variable has four categories and if these four categories are specified in CATEGORY statement, then the macro will compute the standard error on the difference between:
   - category 1 and category 2;
   - category 1 and category 3;
   - category 1 and category 4;
   - category 2 and category 3;
   - category 2 and category 4;
   - category 3 and category 4.

   If only categories 1 and 2 are specified, then only the contrast between 1 and 2 will be computed, regardless of the number of categories for this categorical variable.
4. The STAT argument specifies the required statistic. See Chapter 7 for available statistics.

Table 11.4
Output data file exercise2 from Box 11.2

CNT	CONTRAST	STAT	SESTAT
DEU	1-2	2.47	0.6977

For dichotomous variables, the standard error on the difference can also be computed by a regression model. Box 11.3 presents the SAS® syntax to compute a gender difference in BSMJ and its standard error by using the PROC_REG_NO_PV macro. Before running the syntax in Box 11.3, the gender variable of ST03Q01 needs to be recoded into a new variable denoted FEMALE, with females being 1 and males being 0. Table 11.5 presents the structure of the output data file.

Box 11.3 **Alternative SAS® macro for computing the standard error on a difference for a dichotomous variable (*e.g.* PISA 2003)**

```
data temp2;
        set pisa2003.stud;
        if (cnt="DEU");
        if (st03q01=1) then female=1;
        if (st03q01=2) then female=0;
        w_fstr0=w_fstuwt;
        keep   cnt schoolid stidstd bsmj female w_fstr0-w_fstr80;
run;

%include "c:\pisa\macro\proc_reg_no_pv.sas";

%BRR_REG(   INFILE=temp2,
            REPLI_ROOT=w_fstr,
            VARDEP=bsmj,
            EXPLICA=female,
            BYVAR=cnt,
            LIMIT=no,
            LIMIT_CRITERIA=,
            ID_SCHOOL=,
            OUTFILE=exercise3);
run;
```

Table 11.5
Output data file exercise3 from Box 11.3

CNT	CLASS	STAT	SESTAT
DEU	Intercept	50.58	0.69
DEU	Female	2.47	0.70
DEU	_RSQ_	0.01	0.00

The difference estimate and its respective standard error are equal to the regression coefficient estimate and its standard error. For polytomous categorical variables, the use of the regression macro would require the recoding of the categorical variables into *h*-1 dichotomous variables, with *h* being equal to the number of categories. Further, the regression macro will compare each category with the reference category, while the macro PROC_DIF_NO_PV will provide all contrasts.

THE STANDARD ERROR ON A DIFFERENCE WITH PLAUSIBLE VALUES

The procedure for computing the standard error on a difference that involves plausible values consists of:

- Using each plausible value and for the final and 80 replicate weights, the requested statistic (*e.g.* a mean) has to be computed per value of the categorical variable.
- Computing, per contrast, per plausible value and per replicate weight, the difference between the two categories. There will be 405 difference estimates. Table 11.6 presents the structure of these 405 differences.
- A final difference estimate equal to the average of the five difference estimates.
- Computing, per plausible value, the sampling variance by comparing the final difference estimate with the 80 replicate estimates.
- A final sampling variance being equal to the average of the five sampling variances.
- Computing imputation variance, also denoted measurement error variance.
- Combining the sampling variance and the imputation variance to obtain the final error variance.
- A standard error being equal to the square root of the error variance.

Table 11.6
Gender difference estimates and their respective sampling variances on the mathematics scale (PISA 2003)

Weight	PV1	PV2	PV3	PV4	PV5
Final	**-8.94**	**-9.40**	**-8.96**	**-7.46**	**-10.12**
Replicate 1	-9.64	-10.05	-10.29	-8.74	-11.45
....	....	....	....	....	....
....	....	....	....	....	....
Replicate 80	-8.56	-8.52	-8.85	-7.70	-9.84
Sampling variance	$(4.11)^2$	$(4.36)^2$	$(4.10)^2$	$(4.31)^2$	$(4.28)^2$

Note: PV = plausible value.

A SAS® macro has been developed to compute standard errors on differences that involve plausible values. Box 11.4 provides the SAS® syntax. In this example, the standard error on the difference in performance in mathematics between males and females is computed. Table 11.7 presents the structure of the output data file.

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Box 11.4 **SAS® syntax for computing standard errors on differences which involve PVs (*e.g.* PISA 2003)**

```
data temp3;
       set pisa2003.stud;
       if (cnt="DEU");
       mcomb1=pv1math;
       mcomb2=pv2math;
       mcomb3=pv3math;
       mcomb4=pv4math;
       mcomb5=pv5math;
       w_fstr0=w_fstuwt;
       keep cnt schoolid stidstd bsmj st03q01
       mcomb1-mcomb5 w_fstr0-w_fstr80;
run;

%include "c:\pisa\macro\proc_dif_pv.sas";

%BRR_PROCMEAN_DIF_PV(INFILE=temp3,
                     REPLI_ROOT=w_fstr,
                     BYVAR=cnt,
                     PV_ROOT=mcomb,
                     COMPARE=st03q01,
                     CATEGORY=1 2,
                     STAT=mean,
                     OUTFILE=exercise4);
run;
```

In comparison with the previous SAS® macro, the VARDEP argument is replaced by the PV_ROOT argument.

As the absolute value of the ratio between the difference estimate and its respective standard error is greater than 1.96, the null hypothesis is rejected. Thus females perform on average lower than males in Germany in mathematics. These results might also be obtained through the regression macro for plausible values.

Table 11.7
Output data file exercise4 from Box 11.4

CNT	CONTRAST	STAT	SESTAT
DEU	1-2	–8.98	4.37

Table 11.8 presents the gender difference in mean performance in mathematics for all OECD countries in PISA 2003, as well as the unbiased standard errors and the biased standard errors.

In nearly all countries, the unbiased standard error is smaller than the biased standard error, reflecting a positive covariance between the two sampling distributions. In a few countries, the difference between the two standard errors is small, but it is substantial for some other countries, such as Greece and Turkey.

The PROC_DIF macros can also be used for other statistical parameters, such as percentiles, variances or standard deviations. Table 11.9 presents the gender difference in the mean science performance and in the standard deviation for science performance in PISA 2006.

Surprisingly, males and females perform differently in only 8 countries out of 30. In two countries, *i.e.* Turkey and Greece, females outperform males while in Denmark, Luxembourg, Mexico, Netherlands, Switzerland and the United Kingdom, males outperforms females. On the other hand, in 23 countries, the standard deviation of the science performance for females is significantly smaller than the standard deviation of the science performance for males.

Table 11.8
Gender differences on the mathematics scale, unbiased standard errors and biased standard errors (PISA 2003)

Country	Mean difference (females – males)	Unbiased standard error	Biased standard error
AUS	-5.34	3.75	4.04
AUT	-7.57	4.40	5.59
BEL	-7.51	4.81	4.69
CAN	-11.17	2.13	2.78
CHE	-16.63	4.87	5.98
CZE	-14.97	5.08	6.11
DEU	-8.98	4.37	5.59
DNK	-16.58	3.20	4.50
ESP	-8.86	2.98	4.02
FIN	-7.41	2.67	3.24
FRA	-8.51	4.15	4.60
GBR	-6.66	4.90	4.84
GRC	-19.40	3.63	6.11
HUN	-7.79	3.54	4.69
IRL	-14.81	4.19	4.54
ISL	15.41	3.46	3.15
ITA	-17.83	5.89	5.96
JPN	-8.42	5.89	7.04
KOR	-23.41	6.77	6.90
LUX	-17.17	2.81	2.40
MEX	-10.90	3.94	5.91
NLD	-5.12	4.29	5.36
NOR	-6.22	3.21	4.04
NZL	-14.48	3.90	4.23
POL	-5.59	3.14	4.18
PRT	-12.25	3.31	5.41
SVK	-18.66	3.65	5.30
SWE	-6.53	3.27	4.30
TUR	-15.13	6.16	10.33
USA	-6.25	2.89	4.65

Table 11.9
Gender differences in mean science performance and in standard deviation for science performance (PISA 2006)

	Difference in mean (females – males)		Difference in standard deviation (females – males)	
	Difference	S.E.	Difference	S.E.
AUS	-0.05	3.76	-7.29	1.85
AUT	-7.53	4.91	0.40	3.56
BEL	-0.75	4.13	-6.81	2.54
CAN	-4.07	2.19	-5.90	1.62
CHE	-5.56	2.67	-0.67	1.67
CZE	-4.82	5.64	4.09	2.79
DEU	-7.14	3.71	-5.92	2.22
DNK	-8.93	3.24	-2.89	2.04
ESP	-4.36	2.36	-6.13	1.66
FIN	3.10	2.88	-7.87	1.93
FRA	-2.64	4.03	-8.87	2.72
GBR	-10.06	3.44	-9.45	2.19
GRC	11.41	4.68	-12.93	2.92
HUN	-6.48	4.17	-8.45	2.88
IRL	0.40	4.31	-7.07	2.12
ISL	6.17	3.44	-7.46	2.24
ITA	-3.05	3.53	-9.00	2.11
JPN	-3.26	7.40	-8.74	3.26
KOR	1.86	5.55	-7.43	2.67
LUX	-9.34	2.93	-8.71	2.15
MEX	-6.66	2.19	-3.14	1.76
NLD	-7.20	3.03	-2.80	2.35
NOR	4.37	3.39	-9.31	2.36
NZL	3.75	5.22	-8.57	2.42
POL	-3.38	2.48	-7.00	1.77
PRT	-5.04	3.33	-4.89	2.06
SVK	-6.23	4.73	-6.07	2.87
SWE	-1.28	2.97	-4.93	2.86
TUR	11.93	4.12	-4.64	2.25
USA	-0.58	3.51	-7.13	2.44

Comparisons of regression coefficients might also interest researchers or policy makers. For instance, does the influence of a student's socio-economic background on his/her performance depend on a student's gender? A regression model on the male subsample and another one on the female subsample will provide the regression coefficients but it will be impossible to compute the significance level of their difference, as the two samples are not independent. This test can, however, be easily implemented by modelling an interaction. Box 11.5 presents the SAS® syntax for testing this interaction.

Question ST04Q01 is recoded into a new variable denoted MALE, with males being 1 and females being 0. A second variable, denoted INTER, is computed by multiplying MALE with HISEI. The INTER variable will be equal to 0 for all females and to HISEI for all males.

Box 11.5 **SAS® syntax for computing standard errors on differences that involve PVs (*e.g.* PISA 2006)**

```
data temp4;
       set pisa2006.stu;
       w_fstr0=w_fstuwt;
       scie1=pv1scie;
       scie2=pv2scie;
       scie3=pv3scie;
       scie4=pv4scie;
       scie5=pv5scie;
       if (st04Q01=1) then male=0;
       if (st04Q01=2) then male=1;
       inter=hisei*males;
       if (cnt in (“BEL”));
run;
%include “c:\pisa\macro\proc_reg_pv.sas”;
%BRR_REG_PV(INFILE=temp4,
            REPLI_ROOT=w_fstr,
            EXPLICA= hisei,
            BYVAR=cnt male,
            PV_ROOT=scie,
            LIMIT=no,
            LIMIT_CRITERIA=,
            ID_SCHOOL=,
            OUTFILE=exercise5);
run;
%BRR_REG_PV(INFILE=temp4,
            REPLI_ROOT=w_fstr,
            EXPLICA=male hisei inter,
            BYVAR=cnt,
            PV_ROOT=scie,
            LIMIT=no,
            LIMIT_CRITERIA=,
            ID_SCHOOL=,
            OUTFILE=exercise6);
run;
```

Table 11.10 presents the regression coefficients for the male subsample regression and the female subsample regression (*e.g.* exercise5) as well as the regression coefficients for the model including males and females altogether with the interaction (*e.g.* exercise6). Standard errors are also provided.

The model with the interaction returns values for the intercept and for the HISEI regression coefficient that are identical to the corresponding estimates on the subsample of females. The regression coefficient of INTER is equal to the difference between the two HISEI regression coefficients computed on both subsamples. The standard error for the INTER regression coefficient indicates that the null hypothesis cannot be rejected.

Table 11.10
Regression coefficient of HISEI on the science performance for different models (PISA 2006)

Models	Sample	Variables	Estimates	S.E.
exercise5	Females	Intercept	405.13	7.32
		HISEI	2.21	0.13
	Males	Intercept	401.90	5.89
		HISEI	2.27	0.12
exercise6	All	Intercept	405.13	7.32
		MALE	-3.23	7.46
		HISEI	2.21	0.13
		INTER	0.06	0.15

Therefore, the influence of a student's social background on his/her performance does not depend on student gender.

MULTIPLE COMPARISONS

In Chapter 4, it was noted that every statistical inference is associated with what is usually called a type I error. This error represents the risk of rejecting a null hypothesis that is true.

Let's suppose that at the population level, there is no difference in the mathematics performance between males and females. A sample is drawn and the gender difference in mathematics performance is computed. As this difference is based on a sample, a standard error on the difference has to be computed. If the standardised difference (*i.e.* the gender difference divided by its standard error) is less than –1.96 or greater than 1.96, that difference would be reported as significant. In fact, there are 5 chances out of 100 to observe a standardised difference lower than –1.96 or higher than 1.96 and still have the null hypothesis true. In other words, there are 5 chances out of 100 to reject the null hypothesis, when there is no true gender difference in the population.

If 100 countries are participating in the international survey and if the gender difference is computed for each of them, then it is statistically expected to report 5 of the 100 gender differences as significant, when there are no true differences at the population level.

For every country, the type I error is set at 0.05. For two countries, as countries are independent samples, the probability of not making a type I error, *i.e.* accepting both null hypotheses, is equal to 0.9025 (0.95 times 0.95) (Table 11.11).

Table 11.11
Cross tabulation of the different probabilities

		Country A	
		0.05	0.95
Country B	0.05	0.0025	0.0475
	0.95	0.0475	0.9025

This statistical issue is even more amplified for tables of multiple comparisons of achievement. Suppose that the means of three countries need to be compared. This will involve three tests: Country A versus Country B; Country A versus Country C; and Country B versus Country C. The probability of not making a type I error is therefore equal to:

$$(1-\alpha)(1-\alpha)(1-\alpha) = (1-\alpha)^3$$

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Broadly speaking, if X comparisons are tested, then the probability of not making a type I error is equal to $(1-\alpha)^X$.

Dunn (1961) developed a general procedure that is appropriate for testing a set of *a priori* hypotheses, while controlling the probability of making a type I error. It consists of adjusting the value . Precisely, the value is divided by the number of comparisons and then its respective critical value is used.

In the case of three comparisons, the critical value for an = 0.05 will therefore be equal to 2.24 instead of 1.96. Indeed,

$$\frac{0.05}{3} = 0.01666$$

As the risk is shared by both tails of the sampling distribution, one has to find the z score that corresponds to the cumulative proportion of 0.008333. Consulting the cumulative function of the standardised normal distribution will return the value –2.24.

Nevertheless, the researcher still has to decide how many comparisons are involved. In PISA, it was decided that no correction of the critical value would be applied, except on multiple comparison tables.[1] Indeed, in many cases, readers are primarily interested in finding out whether a given value in a particular country is different from a second value in the same or another country, *e.g.* whether females in a country perform better than males in the same country. Therefore, as only one test is performed at a time, then no adjustment is required.

On the other hand, with multiple comparison tables, if the reader is interested in comparing the performance of one country with all other countries, the adjustment is required. For example, if one wants to compare the performance of Country 1 with all other countries, we will have the following comparisons: Country 1 versus Country 2; Country 1 versus Country 3; and Country 1 versus Country L. Therefore, the adjustment will be based on L-1 comparisons.

CONCLUSION

This chapter was devoted to the computation of standard errors on differences. After a description of the statistical issues for such estimates, the different steps for computing such standard errors were presented. The SAS® macros to facilitate such computations were also described.

It was clearly stated that any comparison between countries does not require the estimation of the covariance. However, it is strongly advised that the covariance between the sampling distributions for any within-country comparisons should be estimated.

The two SAS® macros can however be used for between-country comparisons. As the expected value of the covariance is equal to 0, in a particular case, one might get a small positive or negative estimated covariance. Therefore, the standard error returned by the SAS® macro might be slightly different from the standard errors based only on the initial standard errors.

Finally, the correction of the critical value for multiple comparisons was discussed.

Note

1. The Bonferroni adjustment was not presented in the PISA 2006 multiple comparison tables (OECD, 2007).

12

OECD Total and OECD Average

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INTRODUCTION

The PISA initial and thematic reports present results for each country and two additional aggregated estimates: the OECD total and the OECD average.

The OECD total considers all the OECD countries as a single entity, to which each country contributes proportionally to the number of 15-year-olds enrolled in its schools. To compute an OECD total estimate, data have to be weighted by the student final weight, *i.e.* W_FSTUWT.

On the contrary, the OECD average does not take into account the absolute size of the population in each country; each country contributes equally to the OECD average. The contribution of the smallest OECD country, *i.e.* Luxembourg, is equivalent to one of the largest countries, *i.e.* the United States.

In the PISA publications, the OECD total is generally used when references are made to the overall situation in the OECD area; the OECD average is used when the focus is on comparing performance across education systems.

In the case of some countries, data may not be available for specific indicators, or specific categories may not apply. Researchers should, therefore, keep in mind that the terms OECD average and OECD total refer to the OECD countries included in the respective comparisons for each cycle and for a particular comparison.

There are two approaches to compute the OECD total and the OECD average.

- One way is to compute them based on the pooled samples of the OECD countries with specific weights. To compute the pooled OECD total estimate, data will be weighted by the student final weight, *i.e.* W_FSTUWT. The computation of the pooled OECD average estimates will require the transformation of the student final weights and replicates so that their sum per country is a constant. These transformed weights are usually denoted as SENAT weights.
- The other way is to compute them directly from the country estimates. The arithmetic OECD total is the weighted average of the country estimates and the arithmetic OECD average is the unweighted average of the country estimates.

The arithmetic OECD total estimate and its respective sampling variance are equal to:

$$\hat{\theta} = \frac{\sum_{i=1}^{C} w_i \hat{\theta}_i}{\sum_{i=1}^{C} w_i} \quad \text{and} \quad SE^2 = \frac{\sum_{i=1}^{C} w_i^2 SE_i^2}{\left[\sum_{i=1}^{C} w_i\right]^2}$$

with any statistics, SE^2 its respective sampling variance and w_i being the sum of the student final weights for a particular country, C being the number of OECD countries that participated.

The arithmetic OECD average estimate and its respective sampling variance are equal to:

$$\hat{\theta} = \frac{\sum_{i=1}^{C} \hat{\theta}_i}{C} \quad \text{and} \quad SE^2 = \frac{\sum_{i=1}^{C} SE_i^2}{C^2}$$

with C being the number of OECD countries that participated.

For example, if the statistic is a mean, the arithmetic OECD total mean and its respective sampling variance are equal to:

$$\hat{\mu} = \frac{\sum_{i=1}^{C} w_i \hat{\mu}_i}{\sum_{i=1}^{C} w_i} \quad \text{and ,} \quad \sigma^2_{(\hat{\mu})} = \frac{\sum_{i=1}^{C} w_i^2 \sigma^2_{(\hat{\mu}_i)}}{\left[\sum_{i=1}^{C} w_i\right]^2}$$

with w_i being the sum of the student final weights for a particular country.

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The arithmetic OECD average mean and its respective sampling variance are equal to:

$$\hat{\mu} = \frac{\sum_{i=1}^{C} \hat{\mu}_i}{C} \quad \text{and} \quad \sigma^2_{(\hat{\mu})} = \frac{\sum_{i=1}^{C} \sigma^2_{(\hat{\mu}_i)}}{C^2}$$

with C being the number of OECD countries that participated.

For simple statistics such as a mean or a percentage, the pooled OECD total estimate is mathematically equal to the arithmetic OECD total estimate, and the pooled OECD average estimate is equal to the arithmetic OECD average, respectively, if no data are missing.

If the percentage of missing data varies between countries, however, then these two estimates are not equal anymore, unless a weight adjustment for missing data is applied to W_FSTUWT and SENAT weights. For instance, in PISA 2000, about 60% of the Japanese students did not have information on their parent's main occupation. The data for Japan therefore contribute substantially less than it should for the computation of the pooled OECD average estimate.

Furthermore, "pooled" estimates and "arithmetic" estimates are not equal for the estimates which include the notion of variation (such as standard deviation) and the notion of relationship (such as regression coefficients or correlation). For instance, the pooled OECD average for standard deviation for the student performance, *i.e.* 100, is not equal to the average of country standard deviation. Also the pooled OECD average for a regression coefficient is not equal to the arithmetic OECD average for a regression coefficient and the pooled OECD total for a regression coefficient is not equal to the arithmetic OECD total for a regression coefficient.

Table 12.1

Regression coefficients of the index of instrumental motivation in mathematics on mathematic performance in OECD countries (PISA 2003)

	Change in the mathematics score per unit of this index	
	Effect	S.E.
AUS	16.88	0.91
AUT	-3.70	1.60
BEL	11.03	1.63
CAN	19.78	0.96
CHE	-2.39	1.62
CZE	10.73	1.82
DEU	1.11	1.93
DNK	20.89	1.77
ESP	19.41	1.39
FIN	26.89	1.70
FRA	13.72	1.61
GBR	10.39	1.48
GRC	14.89	1.76
HUN	7.86	1.90
IRL	7.66	1.45
ISL	17.73	1.72
ITA	8.45	1.58
JPN	23.92	2.25
KOR	32.81	1.77
LUX	-0.01	1.35
MEX	5.37	2.44
NLD	6.14	2.00
NOR	28.49	1.49
NZL	15.63	1.81
POL	16.97	1.82
PRT	17.35	2.04
SVK	6.29	1.98
SWE	22.98	2.00
TUR	12.89	2.39
USA	13.58	1.52
Pooled OECD average	**8.52**	**0.41**
Arithmetic OECD average	**13.46**	**0.32**

The example presented in Table 12.1, which presents the mathematic score per unit of the index of instrumental motivation in mathematics in PISA 2003, illustrates the distinction between the pooled OECD average and the arithmetic OECD average. The arithmetic OECD average for a regression coefficient, *i.e.* the average of the country regression coefficients, differs from the pooled OECD average in Table 12.1

In the PISA 2000 and 2003 initial and thematic reports published before 2005, the pooled OECD total and the pooled OECD average were reported as the OECD total and the OECD average. In the PISA publication after 2005, in general, the OECD total corresponds to the pooled OECD total, while the OECD average corresponds to the arithmetic OECD average, unless otherwise stated.

RECODING OF THE DATABASE TO ESTIMATE THE POOLED OECD TOTAL AND THE POOLED OECD AVERAGE

As stated in Chapter 4, the sum of the student final weights per country is an estimate of the 15-year-old population in that country. Therefore, the OECD total statistic can easily be obtained by deleting the partner country data. Then the statistic is computed, without using the country breakdown variable (CNT). The standard error is obtained as usual by using the 80 replicates. Box 12.1 provides the SAS® syntax for computing the pooled OECD total for the mathematics performance by gender in PISA 2003 and Table 12.2 provides the results of the procedure.

Box 12.1 **SAS® syntax for computing the pooled OECD total for the mathematics performance by gender (*e.g.* PISA 2003)**

```
libname PISA2003 "c:\pisa\2003\data\";
options nofmterr notes;
run;
data temp1;
       set pisa2003.stud;
       if (cnt in ('AUS','AUT','BEL','CAN','CZE','DNK','FIN','FRA',
       'DEU','GBR','GRC','HUN','ISL','IRL','ITA','JPN',
       'KOR','LUX','MEX','NLD','NZL','NOR','POL','PRT',
       'SVK','ESP','SWE','CHE','TUR','USA'));
       pv1=pv1math;
       pv2=pv2math;
       pv3=pv3math;
       pv4=pv4math;
       pv5=pv5math;
       w_fstr0=w_fstuwt;
       if (not missing (st03q01));
       keep cnt schoolid stidstd pv1-pv5 w_fstr0-w_fstr80 st03q01;
run;
%include "c:\pisa\macro\proc_means_pv.sas";
%BRR_PROCMEAN_PV(     INFILE=temp1,
                      REPLI_ROOT=w_fstr,
                      BYVAR=st03q01,
                      PV_ROOT=pv,
                      STAT=mean,
                      LIMIT=no,
                      LIMIT_CRITERIA=,
                      ID_SCHOOL=,
                      OUTFILE=exercise1);
```

Table 12.2
Output data file exercise1 from Box 12.1

ST03Q01	STAT	SESTAT
1	483.93	1.25
2	494.04	1.32

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Computing the pooled OECD average requires an additional step. The student final weights need to be recoded, so that the sum of the student final weights per country is equal to a constant, *e.g.* 1 000. This can easily be implemented with the PROC UNIVARIATE procedure, as described in Box 12.2. Table 12.3 presents the results of the procedure.

Box 12.2 **SAS® syntax for the pooled OECD average for the mathematics performance by gender (*e.g.* PISA 2003)**

```
data temp2;
        set pisa2003.stud;
        if (cnt in (‘AUS’,‘AUT’,‘BEL’,‘CAN’,‘CZE’,‘DNK’,‘FIN’,‘FRA’,
        ‘DEU’,‘GRC’,‘GBR’,‘HUN’,‘ISL’,‘IRL’,‘ITA’,‘JPN’,
        ‘KOR’,‘LUX’,‘MEX’,‘NLD’,‘NZL’,‘NOR’,‘POL’,‘PRT’,
        ‘SVK’,‘ESP’,‘SWE’,‘CHE’,‘TUR’,‘USA’));
        pv1=pv1math;
        pv2=pv2math;
        pv3=pv3math;
        pv4=pv4math;
        pv5=pv5math;
        w_fstr0=w_fstuwt;
        keep cnt schoolid stidstd pv1-pv5 w_fstr0-w_fstr80 st03q01;
run;
proc sort data=temp2;
        by cnt schoolid stidstd;
run;
proc univariate data=temp2;
        var w_fstr0;
        by cnt;
        output out=cntwgt1 sum=sumwgt;
run;
data temp3;
        merge temp2 cntwgt1;
        by cnt;
        array wgt (81)
           w_fstr0-w_fstr80;
        do i=1 to 81;
           wgt(i)=(1000*wgt(i))/sumwgt;
        end;
        if (not missing (st03q01));
run;
%BRR_PROCMEAN_PV(  INFILE=temp3,
                   REPLI_ROOT=w_fstr,
                   BYVAR=st03q01,
                   PV_ROOT=pv,
                   STAT=mean,
                   LIMIT=no,
                   LIMIT_CRITERIA=,
                   ID_SCHOOL=,
                   OUTFILE=exercise2);
run;
```

It is worth noting that the standard error is higher for the pooled OECD total than it is for the pooled OECD average. In the case of the pooled OECD total, 40% of the data come from just two countries (*i.e.* Japan and the United States), and these two countries do not have large sample sizes compared to the other OECD countries.

Table 12.3
Output data file exercise2 from Box 12.2

ST03Q01	STAT	SESTAT
1	494.41	0.76
2	505.53	0.75

DUPLICATION OF THE DATA TO AVOID RUNNING THE PROCEDURE THREE TIMES

If a researcher is interested in the country estimates as well as the pooled OECD total and the pooled OECD average, then three runs of the procedure are needed: one for the country estimates, one for the pooled OECD total estimate and one for the pooled OECD average estimate.

In order to avoid such repetitions, it is possible to duplicate three times the data for the OECD countries in such a way that the procedure directly provides the estimates for each country, as well as the pooled OECD total and the pooled OECD average estimates.

Box 12.3 **SAS® syntax for the creation of a larger dataset that will allow the computation of the pooled OECD total and the pooled OECD average in one run (*e.g.* PISA 2003)**

```
data temp4;
        set pisa2003.stud;
        if (cnt in (‘AUS’,‘AUT’,‘BEL’,‘CAN’,‘CZE’,‘DNK’,‘FIN’,‘FRA’,
        ‘DEU’,‘GRC’,‘GBR’,‘HUN’,‘ISL’,‘IRL’,‘ITA’,‘JPN’,
        ‘KOR’,‘LUX’,‘MEX’,‘NLD’,‘NZL’,‘NOR’,‘POL’,‘PRT’,
        ‘SVK’,‘ESP’,‘SWE’,‘CHE’,‘TUR’,‘USA’))
        then oecd=1;;
        if (cnt in ( ‘BRA’,‘HKG’,‘IDN’,‘LVA’,‘LIE’,‘MAC’,
                     ‘RUS’,‘YUG’,‘THA’,‘TUN’,‘URY’))
        then oecd=4;
        country=cnt;
run;
proc sort data=temp4;
        by oecd cnt schoolid stidstd;;
run;
data temp5;
        set temp4;
        if (oecd=1);
        country=“TOT”;
        oecd=2;
run;
proc univariate data=temp5 noprint;
        var w_fstuwt;
        by cnt;
        output out=cntwgt2 sum=sumwgt;
run;
data temp6;
        merge temp5 cntwgt2;
        by cnt;
        array wgt (81)
           w_fstuwt w_fstr1-w_fstr80;
        do i=1 to 81;
           wgt(i)=(1000*wgt(i))/sumwgt;
        end;
        country=“AVE”;
        oecd=3;
run;
proc sort data=temp5;
        by oecd cnt schoolid stidstd;
run;
proc sort data=temp6;
        by oecd cnt schoolid stidstd;
run;
data pisa2003.student;
        merge temp4 temp5 temp6;
        by oecd cnt schoolid stidstd;
run;
```


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Box 12.3 presents the SAS® syntax for the generation of such datasets. It consists of the following steps:

- Create a temporary file (TEMP4) with a new categorical variable, denoted OECD, which separates OECD and the partner countries; a value of 1 for OECD countries, a value of 4 for the partner countries. Also, create an alphanumerical variable, denoted COUNTRY, and set it as CNT.
- After sorting the temporary file (TEMP4), select only OECD countries, set the variable OECD as 2, set the COUNTRY variable as TOT, and save in another temporary file (TEMP5).
- In the TEMP5 file, compute the sum of the student final weights by country through the PROC UNIVARIATE procedure and save the results in a temporary file named CNTWGT2.
- Merge the TEMP5 file with the CNTWGT2 file, and transform the final student weights in such a way that the sum per country is equal to 1 000. Apply the same linear transformation to the 80 replicates. Set the COUNTRY variable as AVE and the OECD variable as 3. Then, save these new data into TEMP6.
- After sorting TEMP5 and TEM6, merge the TEMP4, TEMP5 and TEMP6 files and save in a final SAS® data file.

SAS® macros presented in the previous chapters can be applied to this new data file. The breakdown variables are now OECD and COUNTRY instead of CNT. The output data file will contain two additional rows for the pooled OECD average and the pooled OECD total. The first 30 rows will be the results of OECD countries. The next two rows will present the pooled OECD total and the pooled OECD average estimates. Finally, the last rows will present the estimates for the partner countries.

With the increasing numbers of partner countries and of countries that are oversampling for subnational adjudication, the file with duplicates might contain more than 500 000 records. In terms of computing time, this procedure might become less efficient than estimating separately the pooled OECD total and the pooled OECD average. However, creating a file with duplicates might be required if the difference between an OECD country and the pooled OECD total or the pooled OECD average need to be statistically tested.

COMPARISONS BETWEEN THE POOLED OECD TOTAL OR POOLED OECD AVERAGE ESTIMATES AND A COUNTRY ESTIMATE

As a reminder, only OECD countries that are fully adjudicated contribute to the OECD average and the OECD total estimates and their respective standard errors. Therefore, the expected value of the covariance between a country sampling variance and the OECD aggregate sampling variance will differ from 0 if the country's values are included in the OECD aggregate values, because the two are not independent. Indeed, if the sampling variance of one country increases, then the OECD aggregate sampling variance will also increase.

If a researcher wants to test the null hypothesis between an OECD country and the OECD aggregate estimate, then the covariance should be estimated, as explained in Chapter 11. Since the covariance is expected to be positive, then the correct standard error estimate should be smaller than the standard error obtained from the formulae.

Since partner countries do not contribute at all to the OECD aggregate estimates, estimating the covariance is not necessary. The standard error on the difference can be directly obtained from the country standard error and the aggregate standard error.

Table 12.4 provides:

- the country mean performance in mathematics as well as the pooled OECD total and the pooled OECD average in PISA 2003;
- the standard error on these mean estimates;
- the difference between the country mean and the pooled OECD total;
- the standard error on this difference, using the formula provided in Chapter 10, *i.e.* without an estimation of the covariance;
- the standard error on this difference, using the replicates, *i.e.* with an estimation of the covariance;
- the difference between the country mean and the pooled OECD average;
- the standard error on this difference, using the formula provided in Chapter 10, *i.e.* without an estimation of the covariance;
- the standard error on this difference, using the replicates, *i.e.* with an estimation of the covariance.

Table 12.4

Difference between the country mean scores in mathematics and the OECD total and average (PISA 2003)

		Mean score		Difference from the OECD total			Difference from the OECD average		
		Mean	S.E.	Dif.	S.E. without the covariance estimates	S.E. with the covariance estimates	Dif.	S.E. without the covariance estimates	S.E. with the covariance estimates
OECD	Australia	524	2.2	35	2.4	**2.1**	24	2.2	**2.0**
	Austria	506	3.3	17	3.4	**3.5**	6	3.3	**3.3**
	Belgium	529	2.3	40	2.5	**2.4**	29	2.4	**2.2**
	Canada	532	1.8	43	2.1	**2.1**	32	1.9	**2.0**
	Czech Republic	516	3.6	27	3.7	**3.9**	16	3.6	**3.5**
	Denmark	514	2.7	25	3.0	**3.0**	14	2.8	**2.7**
	Finland	544	1.9	55	2.2	**2.1**	44	2.0	**1.9**
	France	511	2.5	22	2.7	**2.5**	11	2.6	**2.5**
	Germany	503	3.3	14	3.5	**3.4**	3	3.4	**3.3**
	Greece	445	3.9	-44	4.1	**3.9**	-55	4.0	**3.8**
	Hungary	490	2.8	1	3.0	**3.2**	-10	2.9	**3.0**
	Iceland	515	1.4	26	1.8	**1.8**	15	1.6	**1.5**
	Ireland	503	2.5	14	2.7	**2.6**	3	2.5	**2.4**
	Italy	466	3.1	-23	3.3	**3.1**	-34	3.1	**3.0**
	Japan	534	4.0	45	4.2	**3.9**	34	4.1	**3.9**
	Korea	542	3.2	53	3.4	**3.3**	42	3.3	**3.2**
	Luxembourg	493	1.0	4	1.5	**1.5**	-7	1.2	**1.2**
	Mexico	385	3.6	-104	3.8	**3.6**	-115	3.7	**3.6**
	Netherlands	538	3.1	49	3.3	**3.2**	38	3.2	**3.1**
	New Zealand	523	2.3	34	2.5	**2.4**	23	2.3	**2.3**
	Norway	495	2.4	6	2.6	**2.7**	-5	2.5	**2.4**
	Poland	490	2.5	1	2.7	**2.8**	-10	2.6	**2.5**
	Portugal	466	3.4	-23	3.6	**3.3**	-34	3.5	**3.2**
	Slovak Republic	498	3.4	9	3.5	**3.5**	-2	3.4	**3.3**
	Spain	485	2.4	-4	2.6	**2.6**	-15	2.5	**2.5**
	Sweden	509	2.6	20	2.8	**2.5**	9	2.6	**2.4**
	Switzerland	527	3.4	38	3.6	**3.5**	27	3.4	**3.4**
	Turkey	423	6.7	-66	6.8	**6.5**	-77	6.8	**6.5**
	United Kingdom	508	2.4	19	2.7	**2.4**	8	2.5	**2.4**
	United States	483	3.0	-6	3.1	**2.4**	-17	3.0	**2.9**
	OECD total	**489**	**1.1**						
	OECD average	**500**	**0.6**						
Partners	Brazil	356	4.8	-133	**5.0**	4.9	-144	**4.9**	4.8
	Hong Kong-China	550	4.5	61	**4.7**	4.8	50	**4.6**	4.7
	Indonesia	360	3.9	-129	**4.1**	4.0	-140	**4.0**	3.9
	Latvia	483	3.7	-6	**3.8**	3.9	-17	**3.7**	3.8
	Liechtenstein	536	4.1	47	**4.3**	4.2	36	**4.2**	4.1
	Macao-China	527	2.9	38	**3.1**	3.1	27	**3.0**	2.9
	Russian Federation	468	4.2	-21	**4.3**	4.5	-32	**4.2**	4.3
	Serbia	437	3.8	-52	**3.9**	3.9	-63	**3.8**	3.8
	Thailand	417	3.0	-72	**3.2**	3.4	-83	**3.1**	3.2
	Tunisia	359	2.5	-130	**2.8**	2.6	-141	**2.6**	2.6
	Uruguay	422	3.3	-67	**3.5**	3.4	-78	**3.4**	3.3

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The correct standard error estimates are in bold in Table 12.4. The differences between the biased and unbiased estimates for OECD countries are not very large.

The differences for partner countries are not very large either. As the expected covariance for partner countries are 0, both standard errors are on average unbiased. However, it is recommended to use the standard error directly obtained with the formula.

COMPARISONS BETWEEN THE ARITHMETIC OECD TOTAL OR ARITHMETIC OECD AVERAGE ESTIMATES AND A COUNTRY ESTIMATE

The standard error on a difference between the arithmetic OECD total and an OECD country estimate can be mathematically computed as follows:[1]

$$SE^2_{(OECD\_TOT-J)} = \frac{\sum_{i=1}^{C} w_i^2\, SE_i^2 + \left[\left(\sum_{i=1}^{C} w_i - w_j\right)^2 - w_j^2\right] SE_j^2}{\left[\sum_{i=1}^{C} w_i\right]^2}$$

with C being the number of OECD countries, SE_j being the standard error for country j parameter estimate, w_i being the sum of the student final weights for a particular country i and w_j being the sum of the student final weights for a particular country j.

In this formula, it can be observed that the first block on the right side of the equation, *i.e.* $\frac{\sum_{i=1}^{C} w_i^2 SE_i^2}{\left[\sum_{i=1}^{C} w_i\right]^2}$, is equivalent to the equation for the sampling variance for the arithmetic OECD total presented at the beginning of this chapter.

The standard error on a difference between the arithmetic OECD average and an OECD country estimate can be mathematically computed as follows (Gonzalez, 2003):

$$SE^2_{(OECD\_AV-J)} = \frac{\sum_{i=1}^{C} SE_i^2 + \left[(C-1)^2 - 1\right] SE_j^2}{C^2}$$

with C being the number of OECD countries and SE_j being the standard error for country j parameter estimate.

In this formula, it can be observed that the first block on the right side of the equation, *i.e.* $\frac{\sum_{i=1}^{C} SE_i^2}{C^2}$, is equivalent to the equation for the sampling variance for the arithmetic OECD average presented at the beginning of this chapter.

CONCLUSION

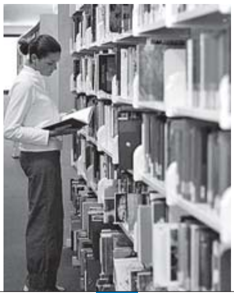
This chapter discussed the concepts of OECD total and OECD average. First, the pooled OECD total and the arithmetic OECD total as well as the pooled OECD average and the arithmetic OECD average were introduced. The "pooled" and "arithmetic" estimates should be the same, as far as no data are missing, for the simple statistics such as mean and percentage, but these are different for the statistics which involves the notion of variation or relationship (*e.g.* standard deviation and correlation coefficient).

The second section presented the recoding of the database in order to estimate the pooled OECD total and the pooled OECD average. The SAS® syntax for creating a larger dataset was also provided.

Finally, following the issues raised in the previous chapter devoted to comparisons, any comparison that involves a particular country and an OECD aggregate estimate was discussed.

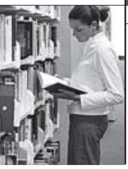
Note

1. The derivation assumes that the population size is known, which is not the case in PISA. However, this variance is a "second order" contribution to the standard error that it is estimating and can therefore be ignored.



13

Trends



INTRODUCTION

Policy makers and researchers require information on how indicators change over time. An analysis of the impact of reforms on the education system, would be an example, where policy makers would seek to measure changes in the targeted area to gauge the effectiveness of their policies. In the early 1960s, for example, most OECD countries implemented education reforms to facilitate access to tertiary education, mainly through financial help. One indicator of the impact of these reforms would be to calculate the percentage of the population with a tertiary qualification for several years to show how this has evolved. Computing this trend indicator is a straightforward statistical manipulation, since the measure (*i.e.* whether or not an individual has completed tertiary education) is objective and available at the population level, in most cases. Nevertheless, such measures can be slightly biased by, for example, differing levels of immigration over a period of time, student exchange programmes, and so on.

Trends over time on a particular indicator do require careful interpretation. Policy makers also need to take into account changes to the economic context of a country, such as rising unemployment rates. Further, when comparing trend indicators across countries, it is important to consider how comparable the definition of the indicator is from country to country, *e.g.* tertiary education might mean something different in each country.

PISA offers a unique opportunity to extend the computation of trend indicators on educational outcomes by looking at student performance in reading, mathematical and scientific literacy.

For the trend measures to be reliable, the comparability of the target population, the data collection procedures, and the assessment framework need to be consistent over time. Being able to use the results from PISA as trend indicators is one of its major aims.

Since its inception, PISA has maintained a consistent methodology of data collection. A few small methodological changes have been introduced, however: *(i)* limitation of the target population to 15-year-olds attending grade 7 or above;[1] *(ii)* modification of the student non-response adjustment for counterbalancing gender and grade differential participation rates; *(iii)* revision of the test design between 2000 and 2003.

Other changes were planned when PISA was designed: *(i)* shifts between major/minor domains; and *(ii)* revision/broadening of the assessment framework for the major domain. The changes made in the assessment frameworks have limited the use and the interpretation of the trend indicators in mathematics between 2000 and 2003 and in science between 2003 and 2006.

Figure 13.1 summarises the available trend indicators on student performance for the first three data collections. In reading literacy, the combined scale was constructed in PISA 2000 and later reading assessments were reported on this scale in PISA 2003 and PISA 2006. In PISA 2003 mathematics was the major domain, and the mathematics assessment framework was broadened from two overarching ideas included in PISA 2000 to four overarching ideas.[2] A new combined mathematic scale was constructed in PISA 2003 and two trends scales, provided in a separate database, were computed for the two overarching ideas assessed in both PISA 2000 and PISA 2003. Mathematics reporting scales are directly comparable for PISA 2003 and PISA 2006. For science, a new metric was established in PISA 2006. As mentioned in the *PISA 2006 Technical Report* (OECD, forthcoming), a science link was prepared to permit a comparison of the PISA 2006 science results with the science results in previous data collections. The science link scale provides the results for PISA 2003 and PISA 2006 using only those items that were common to the two PISA studies.

In Figure 13.1, black arrows indicate the data that are on a common scale. For instance, the plausible values for reading literacy, denoted PV1READ to PV5READ in the three international databases, are on a common scale. Trends can therefore be computed directly. Blue arrows indicate the data that are not on a common scale. For instance, the plausible values for science denoted PV1SCIE to PV5SCIE in the PISA 2003

and in the PISA 2006 databases, are not on a common scale. However, the PISA 2000 and the PISA 2003 science plausible values are on a common scale. Trends can therefore be computed in science between PISA 2000 and PISA 2003 without any precautions.

Figure 13.1
Trend indicators in PISA 2000, PISA 2003 and PISA 2006

↑ Black arrows indicate the data that are on a common scale
↑ Blue arrows indicate the data that are not on a common scale

	Reading literacy	Mathematic literacy	Science literacy
PISA 2000	**Major domain**	Minor domain	Minor domain
PISA 2003	Minor domain	**Major domain**	Minor domain
PISA 2006	Minor domain	Minor domain	**Major domain**

Behind these preliminary precautions, the computation of trend indicators in PISA raises two statistical issues:

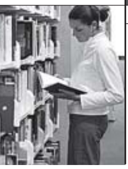
1. PISA collects data on a sample and therefore any statistic has to be associated with a sampling error. The next section will discuss how to compute such sampling error on a trend indicator.
2. As implicitly represented in Figure 13.1, there are three test-design contexts for trend indicators: *(i)* the *major domain – minor domain* context; *(ii)* the *minor domain – minor domain* context; and *(iii)* the *major domain – minor domain* context. As described previously, with the last context, scales are not on the same metrics and additional data are required for the computation of trends. With the first context, *i.e. major domain – minor domain*, only a subset of items is included to ensure a psychometric link while usually the same anchor items are used in the second context, *i.e. minor domain – minor domain*. As one can easily imagine, selecting other anchor items would have returned slightly different results on the trend performance indicators. It follows that any comparison between two PISA cycles in the student performance will require an addition of another error component, *i.e.* the item sampling error.

THE COMPUTATION OF THE STANDARD ERROR FOR TREND INDICATORS ON VARIABLES OTHER THAN PERFORMANCE

For any country, the PISA samples of two cycles are independent. Therefore, the standard error on any trend indicator not involving achievement variables can be computed as follows:

$$\sigma_{(\hat{t}_{2003}-\hat{t}_{2000})}=\sqrt{\sigma^2_{(\hat{t}_{2003})}+\sigma^2_{(\hat{t}_{2000})}}$$, with representing any statistic.

However, the computation of a difference between two PISA cycles and its standard error are relevant only if the two measures are identical. For instance, in the PISA databases, there are several indices derived from the student questionnaires with exactly the same variable names (for instance, HEDRES for Home Educational Resources, BELONG for the student's sense of belonging to the school, and so on). The questions that were used to derive these indices have not changed, but as the scaling was done independently, there is no guarantee that the PISA 2000, PISA 2003 and PISA 2006 metrics are comparable. Further, these indices were standardised at the OECD level to get a mean of 0 and a standard deviation of 1. The standardisation differs between cycles. It is therefore not recommended to compute trend indicators on contextual questionnaire-derived indices.



The Highest International Social and Economic Index (denoted HISEI in the databases) satisfies all the conditions for the computation of trend indicators. Indeed, the questions were not changed and the transformation used on the International Standard Classification of Occupations (ISCO) categories has been implemented without any modification in the three cycles.

Table 13.1 presents, by country, the mean estimate of HISEI and its standard error for PISA 2000 and PISA 2003, as well as the difference between the two estimates, the standard error of this difference and the standardised difference, *i.e.* the difference divided by its standard error.

For Germany (DEU), the means for HISEI in PISA 2000 and PISA 2003 are equal to 48.85 and 49.33 respectively. The difference between these two data collections is therefore equal to:

$$49.33 - 48.55 = 0.48$$

The standard errors on these mean estimates are equal to 0.32 and 0.42. The standard error on the difference estimate is equal to:

$$\sigma_{(\hat{l}_{2003} - \hat{l}_{2000})} = \sqrt{\sigma^2_{(\hat{l}_{2000})} + \sigma^2_{(\hat{l}_{2003})}} = \sqrt{(0.32)^2 + (0.42)^2} = 0.53$$

The standardised difference, *i.e.* the difference estimate divided by its standard error, is equal to:

$$\frac{0.48}{0.53} = 0.91$$

Table 13.1

Trend indicators between PISA 2000 and PISA 2003 for HISEI, by country

	PISA 2000		PISA 2003		Difference between PISA 2003 and PISA 2000		
	Mean	S.E.	Mean	S.E.	Dif.	S.E.	STD difference
AUS	52.25	(0.50)	52.59	(0.30)	0.34	(0.58)	0.59
AUT	49.72	(0.29)	47.06	(0.52)	-2.66	(0.59)	-4.49
BEL	48.95	(0.39)	50.59	(0.38)	1.65	(0.54)	3.05
CAN	52.83	(0.22)	52.58	(0.27)	-0.25	(0.35)	-0.73
CHE	49.21	(0.53)	49.30	(0.43)	0.09	(0.68)	0.13
CZE	48.31	(0.27)	50.05	(0.34)	1.74	(0.44)	3.98
DEU	48.85	(0.32)	49.33	(0.42)	0.48	(0.53)	0.91
DNK	49.73	(0.43)	49.26	(0.45)	-0.47	(0.63)	-0.75
ESP	44.99	(0.62)	44.29	(0.58)	-0.70	(0.85)	-0.83
FIN	50.00	(0.40)	50.23	(0.36)	0.23	(0.54)	0.42
FRA	48.27	(0.44)	48.66	(0.47)	0.39	(0.64)	0.61
GBR	51.26	(0.35)	49.65	(0.39)	-1.61	(0.52)	-3.07
GRC	47.76	(0.60)	46.94	(0.72)	-0.83	(0.93)	-0.88
HUN	49.53	(0.47)	48.58	(0.33)	-0.95	(0.57)	-1.65
IRL	48.43	(0.48)	48.34	(0.49)	-0.09	(0.69)	-0.13
ISL	52.73	(0.28)	53.72	(0.26)	0.99	(0.38)	2.62
ITA	47.08	(0.31)	46.83	(0.38)	-0.24	(0.49)	-0.50
JPN	50.54	(0.62)	49.98	(0.31)	-0.56	(0.69)	-0.80
KOR	42.80	(0.42)	46.32	(0.36)	3.52	(0.55)	6.36
LUX	44.79	(0.27)	48.17	(0.22)	3.38	(0.35)	9.76
MEX	42.48	(0.68)	40.12	(0.68)	-2.37	(0.96)	-2.46
NLD	50.85	(0.47)	51.26	(0.38)	0.42	(0.61)	0.68
NOR	53.91	(0.38)	54.63	(0.39)	0.72	(0.54)	1.33
NZL	52.20	(0.37)	51.46	(0.36)	-0.74	(0.51)	-1.45
POL	46.03	(0.47)	44.96	(0.34)	-1.07	(0.58)	-1.85
PRT	43.85	(0.60)	43.10	(0.54)	-0.75	(0.81)	-0.92
SWE	50.57	(0.39)	50.64	(0.38)	0.07	(0.55)	0.12
USA	52.40	(0.79)	54.55	(0.37)	2.15	(0.87)	2.47

As the standardised difference is included in the interval [-1.96; 1.96], the difference on the mean estimate for HISEI between PISA 2000 and PISA 2003 is not statistically different from 0 with a type I error of 0.05.

Table 13.1 shows that the difference is statistically different from 0 in nine countries: Austria, Belgium, the Czech Republic, Iceland, Korea, Luxembourg, Mexico, the United Kingdom and the United States.

It would be unrealistic to consider these differences as simply a reflection of social and economic changes in these nine countries. Over a period of three years, some changes can occur, but these could not explain by themselves the size of the observed increases or decreases.

It is also possible that the quality of the samples might explain some of the differences. As the student propensity to participate positively correlate with his/her academic records and as on average low performers come from lower social background variables than high performers, an increase or a decrease in the student participation rates might affect the HISEI mean.

A change in the percentage of missing data for the HISEI variable would be another explanation that can be easily verified. On average, students who do not provide their parents' occupations are lower performers. Therefore, one should expect low socio-economic background characteristics, so that an increase of missing data could be associated with an increase of the HISEI mean, and the inverse.

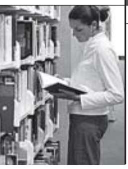
In summary, changes in the school or student participation rates and in the distribution of missing data might sometimes increase the type I error, *i.e.* rejecting the null hypothesis while it is true. It is therefore recommended to implement some verification before trying to interpret calculated differences as a real change in the population characteristics.

THE COMPUTATION OF THE STANDARD ERROR FOR TREND INDICATORS ON PERFORMANCE VARIABLES

The Technical Reports of the PISA surveys (OECD, 2002; 2005; forthcoming) provide detailed information on the equating methods. These equating methods are usually based on a linear transformation. Such transformations that equate new data with previous data depend upon the change in the difficulty of each of the individual link items, and as a consequence, the sample of link items that have been chosen will influence the choice of the transformation. With an alternative set of link items, the transformation would be slightly different. The consequence is an uncertainty in the transformation due to the sampling of the link items. This uncertainty is referred to as the linking error and this error must be taken into account when making certain comparisons between the results from different PISA data collections.

Similar to the sampling error, the linking error can only be estimated. As the PISA items are clustered in units, mathematical developments for the computation of the linking error estimates are complex. The underlying rationale will therefore be presented on a fictitious example with independent items. Readers interested in the details of the linking error in PISA should consult the *PISA Technical Reports* (OECD, 2002; 2005; forthcoming).

An equating process supposes two data collections and a set of link items. For each link item, we have two item parameter estimates that are, after the application of the linear transformation, on the same metric. Some of these link items might show an increase of the relative difficulty, some might show a decrease, but on average, the difference is equal to 0. This means that some items seem more difficult in one data collection than they were in the other data collection, or the inverse.



Let $\hat{\delta}_i^1$ be the estimated difficulty of link *i* for the first data collection and let $\hat{\delta}_i^2$ be the estimated difficulty of link *i* for the second data collection, where the mean of the two sets difficulty estimates for all of the link items for a domain is set at 0. We now define the value:

$$c_i = \hat{\delta}_i^1 - \hat{\delta}_i^2$$

The value c_i is the amount by which item *i* deviates from the average of all link items in terms of the transformation that is required to align the two scales. If the link items are assumed to be a random sample of all possible link items and each of the items is counted equally, then the link error can be estimated as follows:

$$Link\_error = \sqrt{\frac{1}{L}\sum_{i=1}^{L} c_i^2}$$

where the summation is over the link items for the domain and *L* is the number of link items.

Mathematically, this formula is equal to the one used for computing the sampling error on a population mean estimate.

If the item parameters from one calibration perfectly match the item parameters from the other calibration, then the relative difficulty of the link items would not have changed. All the differences between the relative difficulties would be equal to 0 and therefore, the linking error would be equal to 0.

As the differences in the item parameters increase, the variance of these differences will increase and consequently the linking error will increase. It makes sense for the uncertainty around the trend to be proportional to the changes in the item parameters.

Also, the uncertainty around the trend indicators is inversely proportional to the number of link items. From a theoretical point of view, only one item is needed to measure a trend, but with only one item, the uncertainty will be very large. If the number of link items increases, the uncertainty will decrease.

Table 13.2 presents the linking error estimates by subject domains and by comparison between data collections.

Table 13.2
Linking error estimates

Scales	Compared data collections	Linking errors
Reading combined scale	PISA 2000 - PISA 2003	5.307
	PISA 2000 - PISA 2006	4.976
	PISA 2003 - PISA 2006	4.474
Mathematics combined scale	PISA 2003 - PISA 2006	1.382
Interim science scale	PISA 2000 - PISA 2003	3.112
Science scale	PISA 2003 - PISA 2006	4.963

A common transformation has been estimated from the link items, and this transformation is applied to all participating countries. It follows that any uncertainty that is introduced through the linking is common to all students and all countries. Thus, for example, suppose that the linking error between PISA 2000 and PISA 2003 in reading resulted in an overestimation of student scores by two points on the PISA 2000 scale. It follows that every student's score would be overestimated by two score points. This overestimation will have effects on certain, but not all, summary statistics computed from the PISA 2003 data. For example, consider the following:

- Each country's mean would be overestimated by an amount equal to the link error, in our example this is two score points;
- The mean performance of any subgroup would be overestimated by an amount equal to the linking error, in our example this is two score points;
- The standard deviation of student scores would not be affected because the over-estimation of each student by a common error does not change the standard deviation;
- The difference between the mean scores of two countries in PISA 2003 would not be influenced because the over-estimation of each student by a common error would have distorted each country's mean by the same amount;
- The difference between the mean scores of two groups (*e.g.* males and females) in PISA 2003 would not be influenced, because the overestimation of each student by a common error would have distorted each group's mean by the same amount;
- The difference between the performance of a group of students (*e.g.* a country) between PISA 2000 and PISA 2003 would be influenced because each student's score in PISA 2003 would be influenced by the error; and
- A change in the difference between two groups from PISA 2000 to PISA 2003 would not be influenced. This is because neither of the components of this comparison, which are differences in scores in PISA 2000 and PISA 2003 respectively, is influenced by a common error that is added to all student scores in PISA 2003.

In general terms, the linking error need only be considered when comparisons are being made between results from different data collections, and then usually when group means are being compared.

The most obvious example of a situation where there is a need to use the linking error is in the comparison of the mean performance for a country between two data collections.

In PISA 2000, the mean in reading literacy for Germany is equal to 483.99 with a standard error of 2.47. In PISA 2003, the mean for Germany is equal to 491.36 and the standard error is equal to 3.39. The difference between PISA 2003 and PISA 2000 is therefore equal to 491.36-483.99=7.37. The average performance of German students has therefore increased by 7.37 scores on the PISA 2000 reading scale from PISA 2000 to PISA 2003.

The standard error on this difference, as mentioned previously, is influenced by the linking error. The standard error is therefore equal to:

$$SE = \sqrt{\sigma^2_{(\hat{\mu}_{2000})} + \sigma^2_{(\hat{\mu}_{2003})} + \sigma^2_{(linking\_error)}}$$

$$SE = \sqrt{(2.47)^2 + (3.39)^2 + (5.31)^2} = 6.77$$

As the standardised difference between PISA 2000 and PISA 2003, *i.e.* 7.37/6.77, is included in the interval [-1.96; 1.96], the null hypothesis of no difference is not rejected. In other words, Germany's performance in reading has not changed between PISA 2000 and PISA 2003.

Table 13.3 provides the estimates of the reading performance in Germany by gender in PISA 2000 and PISA 2003, with their respective standard errors, as well as the difference in the mean performance and their respective standard errors.

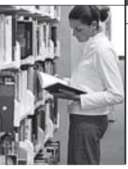


Table 13.3
Mean performance in reading by gender in Germany

		Performance in reading	S.E.
PISA 2003	Females	512.93	3.91
	Males	470.80	4.23
	Difference	42.13	4.62
PISA 2000	Females	502.20	3.87
	Males	467.55	3.17
	Difference	34.65	5.21

As the comparison for a particular country between PISA 2000 and PISA 2003 is affected by the linking error, the comparison for a particular subgroup between PISA 2000 and PISA 2003 is also affected by the linking error. Therefore, the standard error has to include the linking error.

The trend indicators for males and females in Germany are, respectively, equal to:

$$Trends_{females} = 512.93 - 502.20 = 10.73$$

$$SE_{females} = \sqrt{(3.91)^2 + (3.87)^2 + (5.31)^2} = 7.65$$

$$Trends_{males} = 470.80 - 467.55 = 3.25$$

$$SE_{males} = \sqrt{(4.23)^2 + (3.17)^2 + (5.31)^2} = 7.49$$

Both differences are not statistically different from 0.

On the other hand, the gender difference in PISA 2003 is not affected by the linking error. Indeed, both subgroup estimates will be underestimated or overestimated by the same amount and therefore the computation of the difference will neutralise this difference. Consequently, the trend indicator on the gender difference and its standard error will be equal to:

$$Trends_{Gender\_dif} = 42.13 - 34.65 = 7.43$$

$$SE_{Gender\_dif} = \sqrt{(4.62)^2 + (5.21)^2} = 6.96$$

This means that the change in gender difference in Germany for reading between PISA 2000 and PISA 2003 was not statistically significant, even though it appears from Table 13.3 to have widened considerably.

In the PISA initial reports, student performance is also reported by proficiency levels (see Chapter 9). As the linking error affects the country mean estimates, the percentages of students at each level will also be affected. However, an overestimation or an underestimation of the results of *X* points on one PISA scale will have a different impact on the percentages of students at each proficiency level for each country. If the percentage is small, then the impact will be small. If the percentage is large, then the impact will be larger. It would have been too complex to provide a linking error for each country and for each proficiency level. It was therefore decided not to take into account the linking error for the comparison of percentages of students at each proficiency level between two PISA data collections. This means that the standard errors on the difference between 2000 and 2003 are underestimated.

CONCLUSION

This chapter was devoted to the computation of the standard error on trend indicators. The comparison of any variable other than performance variables is straightforward as the national PISA samples for two cycles are independent. However, such comparisons are only relevant if the measures are comparable from one cycle to another.

The comparison of performance mean estimates is more complex as it might require the inclusion of the linking error in the standard error depending on the statistic. For instance, Table 2.1.d in the PISA 2003 initial report (OECD, 2004) presents the trends in mathematics/space and shape average performance between PISA 2000 and PISA 2003. The trend indicator has integrated the linking error in its standard error. However, Figure 2.6c in the PISA 2003 initial report (OECD, 2004) presents the trends between PISA 2000 and PISA 2003 on the 5th, 10th, 25th, 75th, 90th and 95th percentiles. As mentioned previously, it would require a specific linking error for each percentile and for each country. For that reason, the linking error was not integrated in the standard error of these trends.

Due to the growing interest in trend indicators and their political impacts, it is essential to interpret significant changes with caution. A significant change might simply be due to a difference in the school or student participation rate, in the pattern of missing data or in the composition of the test. For instance, changing the repartition of item types (multiple choice versus open-ended items) might have an impact on the gender difference estimates.

Notes

1. This was introduced from PISA 2003. In PISA 2000, only a very small percentage of 15-year-olds were attending grade 5 or grade 6 (Austria: 0.03%; Canada: 0.03%; Czech Republic: 0.06%; Germany: 0.02%; Hungary: 0.59%; Latvia: 0.27%; Portugal: 1.25%; and Russia: 0.04%). Therefore, except for Portugal, the change in the target population should not significantly affect trend indicators.

2. Four overarching ideas consist of *space and shape*; *change and relationships*; *quantity*; and *uncertainty*. *Space* and *shape* and *change and relationships* were covered in PISA 2000.

14

Studying the Relationship between Student Performance and Indices Derived from Contextual Questionnaires

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INTRODUCTION

The PISA initial reports have used the following tools to describe the relationship between student performance and questionnaire indices: *(i)* dividing the questionnaire indices into quarters and then reporting the mean performance by quarter; *(ii)* the relative risk; *(iii)* the effect size; and *(iv)* the linear regression. This chapter discusses technical issues related to these four tools and presents some SAS® macros that facilitate their computation.

ANALYSES BY QUARTERS

As described in Chapter 5, the indices derived from questionnaire data were generated with the Rasch Model, and students' estimates were reported with the *weighted likelihood estimates* (WLEs). As previously mentioned, WLE individual estimates constitute a discontinuous variable. Indeed, with the Rasch Model, the raw score is a sufficient statistic.

Table 14.1 presents the distribution of the questionnaire index of **cultural possessions at home** from the PISA 2006 data in Luxembourg. This table shows the discontinuous character of the variable.

Table 14.1
Distribution of the questionnaire index of cultural possession at home in Luxembourg (PISA 2006)

WLE	%
-1.60	17.52
-1.57	0.13
-1.49	0.10
-0.93	0.13
-0.84	0.02
-0.58	24.53
-0.50	0.27
-0.23	0.02
-0.20	0.15
-0.16	0.38
0.13	0.14
0.21	23.74
0.50	0.07
0.58	0.82
1.11	0.09
1.19	0.05
1.23	31.84

The cultural-possession-at-home scale consists of three dichotomous items. There are therefore four possible scores, ranging from 0 to 3. Thus, 98% of the students (17.52 + 24.53 + 23.74 + 31.84) are distributed among four WLEs. All the other WLEs, with negligible percentages, represent response patterns with at least one missing value.

How can this distribution be divided into four quarters, especially given that approximately 32% of the students have the highest WLE?

There are two ways of recoding the data:
1. smaller versus equal and greater;
2. smaller and equal versus greater.

Depending on the procedure adopted, the percentages of students in the bottom quarter, second quarter, third quarter, and top quarter will vary. Further, neither of these two procedures generate four equal quarters of 25% students each. Since the percentages of students in each quarter can vary among countries, no international comparisons can be made.

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It is therefore necessary to distribute the students with a WLE equal to one of the three cutpoint percentiles into the two respective adjacent quarters. For instance, if 31.84% of the students get a score equal to percentile 75, it is then necessary to sample 6.84% of these students who will be allocated to the third quarter. The remaining 25% will be allocated to the fourth quarter.

This random subsampling process is implemented by adding a small random variable to the questionnaire index. That random noise will in a sense transform this discontinuous variable into a pseudo-continuous variable. The three new percentiles on this pseudo-continuous variable will divide the index variable into quarters, each including exactly 25% of the students.

This random allocation of some parts of the population to one of the four quarters adds an error component to the standard error. Indeed, in the example, the composition of the 6.84% of the students allocated to the third quarter is likely to differ between two runs of the procedure.

To account for this new error component, the statistical approach adopted for the analyses of plausible values can be implemented. It will therefore consist of:

- computing a set of five plausible quarters for each student;
- computing the required statistic and its respective sampling variance by using the final and 80 replicate weights, per plausible quarter;
- averaging the five estimates and their respective sampling variances;
- computing the imputation variance;
- combining the sampling variance and the imputation variance to obtain the final error variance.

As the dependent variable is exclusively, or nearly exclusively, a set of plausible values, the procedure described in Chapter 8 will be used, except that each plausible value will be analysed with a different plausible quarter.

Box 14.1 **SAS® syntax for the quarter analysis (*e.g.* PISA 2006)**

```
libname PISA2006  “c:\pisa\2006\data\”;
options nofmterr notes;
run;
data temp1;
   set pisa2006.stu;
   if (cnt=“LUX”);
   scie1=pv1scie;
   scie2=pv2scie;
   scie3=pv3scie;
   scie4=pv4scie;
   scie5=pv5scie;
   w_fstr0=w_fstuwt;
   keep cnt schoolid stidstd scie1-scie5 w_fstr0-w_fstr80 cultposs;
run;
%include “c:\pisa\macro\quartile_pv.sas”;
%QUARTILE_PV(INFILE=temp1,
             REPLI_ROOT=w_fstr,
             BYVAR =cnt ,
             PV_ROOT =scie,
             INDEX =cultposs,
             LIMIT=yes,
             LIMIT_CRITERIA=100 20 20 1,
             ID_SCHOOL=schoolid,
             OUTFILE =exercise1);
```

A SAS® macro was developed to facilitate these computations, as largely used in the three PISA initial reports. Box 14.1 presents the SAS® syntax and Table 14.2 the output data file.

The nine arguments of the quarter SAS® macro have been extensively described in other chapters. The output data file contains: *(i)* the mean of the contextual index (the independent variable) per quartile and its corresponding standard error; and *(ii)* the average performance in science (the dependent variable) and its standard errors.

Table 14.2
Output data file exercise1 from Box 14.1

CNT	CAT	INDEX_STAT	INDEX_SESTAT	PV_STAT	PV_SESTAT	FLAG_STUD	FLAG_SCH	FLAG_PCT
LUX	1	-1.31	0.01	451.40	3.09	0	0	0
LUX	2	-0.35	0.01	471.64	3.37	0	0	0
LUX	3	0.51	0.01	494.24	3.00	0	0	0
LUX	4	1.23	0.00	531.71	3.52	0	0	0

THE CONCEPT OF RELATIVE RISK

The notion of relative risk is a measure of association between an antecedent factor and an outcome factor (Cornfield, 1951). The relative risk is simply the ratio of two risks, *i.e.* the risk of observing the outcome when the antecedent is present, and the risk of observing the outcome when the antecedent is not present.

Table 14.3 presents the notation that will be used.

$p_{..}$ is equal to $\frac{n_{..}}{n_{..}}$, with $n_{..}$ the total number of students and $p_{..}$ is therefore equal to 1; $p_{i.}$, $p_{.j}$ respectively represent the marginal probabilities for each row and for each column. The marginal probabilities are equal to the marginal frequencies divided by the total number of students. Finally, the p_{ij} values represent the probabilities for each cell and are equal to the number of observations in a particular cell divided by the total number of observations.

Table 14.3
Labels used in a two-way table

		Outcome measure		
		Yes	No	Total
Antecedent measure	Yes	p_{11}	p_{12}	$p_{1.}$
	No	p_{21}	p_{22}	$p_{2.}$
	Total	$p_{.1}$	$p_{.2}$	$p_{..}$

In this chapter, the conventions for the two-way table are:

- The rows represent the antecedent factor with:
  - the first row having the antecedent; and
  - the second row not having the antecedent.
- The columns represent the outcome with:
  - the first column having the outcome; and
  - the second column not having the outcome.

With these conditions, the relative risk is equal to:

$$RR = \frac{(p_{11}/p_{1.})}{(p_{21}/p_{2.})}$$

Let's suppose that a psychologist wants to analyse the risk of a student repeating a grade if the parents recently divorced. The psychologist draws a simple random sample of students in grade 10. In this example, the outcome variable is present if the child is repeating grade 10 and the antecedent factor is considered present if the student's parents divorced in the past two years. The results are found in Table 14.4 and Table 14.5.

Table 14.4

Distribution of 100 students by parents' marital status and grade repetition

	Repeat the grade	Does not repeat the grade	Total
Parents divorced	10	10	20
Parents not divorced	5	75	80
Total	15	85	100

Table 14.5

Probabilities by parents' marital status and grade repetition

	Repeat the grade	Does not repeat the grade	Total
Parents divorced	0.10	0.10	0.20
Parents not divorced	0.05	0.75	0.80
Total	0.15	0.85	1.00

The relative risk is therefore equal to:

$$RR = \frac{(p_{11}/p_{1.})}{(p_{21}/p_{2.})} = \frac{(0.10/0.20)}{(0.05/0.80)} = \frac{0.5}{0.0625} = 8$$

This means that the probability of repeating grade 10 is eight times greater if the parents recently divorced than if they had stayed together.

Instability of the relative risk

The relative risk was developed for dichotomous variables. More and more often, this coefficient is extended and is used with continuous variables. However, to apply the coefficient to continuous variables, a cutpoint needs to be set for each variable and the continuous variables need to be dichotomised.

It is important to recognise that when applied to dichotomised variables, the computed values of the relative risk will depend on the value of the chosen cutpoint.

Table 14.6

Relative risk for different cutpoints

Percentile	Relative risk
10	2.64
15	2.32
20	1.90
25	1.73
30	1.63

To demonstrate the influence of the cutpoint on the relative risk, two random variables were generated with a correlation of 0.30. These two variables were then transformed into dichotomous variables by using the 10^{th}, 15^{th}, 20^{th}, 25^{th} and 30^{th} percentiles respectively as cutpoints. Table 14.6 presents the relative risk for a range of choices for the cutpoints.

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Table 14.6 shows that the relative risk coefficient is dependent on the setting of the cutpoints; thus, the values should be interpreted in light of this.

Such a comparison of the relative risks was computed for the PISA 2000 data to identify the changes depending on the cutpoint location. The antecedent factor was the mother's educational level and the outcome variable was student performance in reading. Low reading performance was successively defined within countries as being below the 10^{th}, 15^{th}, 20^{th}, 25^{th}, 30^{th} and 35^{th} percentiles.

In PISA 2000, the relative risks for these different cutpoints are on average (across OECD countries) equal to 2.20, 1.92, 1.75, 1.62, 1.53, and 1.46, respectively. In PISA, it was decided to use the 25^{th} percentile as the cutpoint for continuous variables when calculating the relative risk.

Computation of the relative risk

Depending on the variables involved in the computation of the relative risk, the procedure might differ. Indeed, the relative risk concept requires as input two dichotomous variables, such as gender.

However, most of the variables in the PISA databases are not dichotomous; they are categorical or continuous variables.

The recoding of a categorical into a dichotomous variable does not raise any specific issues. From a theoretical point of view, the purpose of the comparison needs to be decided; the recoding will follow. For instance, in PISA 2003, the education levels of the parents are reported by using the ISCED classification (OECD, 1999b). If the comparison is based on the distinction between tertiary versus non-tertiary education, then the categorical variable can be recoded into a dichotomous variable.

Numerical variables also have to be recoded into dichotomous variables. As stated earlier, the OECD has decided to divide numerical variables based on the 25^{th} percentile.

If plausible values are involved as outcome measures, after the recoding of the five estimates of the student performance into dichotomous variables, five relative risks will be computed and then combined.

In the PISA databases however, most numerical variables are discontinuous variables. To ensure that the 25^{th} percentile will divide the variables into two categories that will include 25% and 75% respectively, a random component has to be added to the initial variable, as described in the previous section on analyses per quarter. Five relative risk estimates are computed and then combined.

Box 14.2 presents the SAS® syntax for computing the increased likelihood of the students in the bottom quarter of HISEI (international socio-economic index of occupational status) scoring the bottom quarter of the science performance distribution, with the PISA 2006 data in France. As HISEI is a discontinuous variable with a limited number of values, it is necessary to add a random component. This example therefore has five antecedent variables and five outcome variables.

The first macro devoted to the computation of the relative risk requires five dummy variables as antecedents and five dummy variables as outcomes. Value 1 will be assigned if the risk is present; otherwise the assigned value will be 0. Value 1 will also be assigned if the outcome is present; otherwise it will be 0. It is of prime importance to respect these application conditions. Inverting the values will not stop the macro running, but it will change the meaning of the results.

Table 14.7 shows that a student in the bottom quarter of the international socio-economic index of occupational status has 2.38 times more chance of appearing in the bottom quarter of the science performance distribution.

Box 14.2 **SAS® syntax for computing the relative risk with five antecedent variables and five outcome variables (*e.g.* PISA 2006)**

```
data temp2;
    set pisa2006.stu;
    w_fstr0=w_fstuwt;
    if (cnt in (“FRA”));
    array a1 (5) scie1-scie5;
    array a2 (5) level1-level5;

    if (st04q01=1) then gender=0;
    if (st04q01=2) then gender=1;

    if (intscie <= 0) then int=1;
    if (intscie > 0 ) then int=0;
    if (intscie in (.,.I,.M,.N)) then int=.;

    ses1=hisei+(0.01*normal(-12));
    ses2=hisei+(0.01*normal(-23));
    ses3=hisei+(0.01*normal(-34));
    ses4=hisei+(0.01*normal(-45));
    ses5=hisei+(0.01*normal(-56));

    if (escs in (.,.I,.M,.N)) then delete;
run;
proc means data=temp2 vardef=wgt noprint;
    var ses1-ses5 pv1scie pv2scie pv3scie pv4scie pv5scie;
    by cnt;
    weight w_fstr0;
    output out=temp3 p25=ses25_1-ses25_5 pv25_1-pv25_5;
run;
data temp4;
    merge temp2 temp3;
    by cnt;
    array a1 (5) ses1-ses5;
    array a2 (5) ses25_1-ses25_5 ;
    array a3 (5) ses_risk1-ses_risk5;
    array a4 (5)  pv1scie pv2scie pv3scie pv4scie pv5scie;
    array a5 (5) pv25_1-pv25_5;
    array a6 (5) pv_out1-pv_out5;
    do i=1 to 5;
       if (a1(i) <= a2(i)) then a3(i)=1;
       if (a1(i) > a2(i)) then a3(i)=0;
       if (a1(i) in (.,.M,.I,.N)) then a3(i)=.;
    end;
    do i=1 to 5;
       if (a4(i) <= a5(i)) then a6(i)=1;
       if (a4(i) > a5(i)) then a6(i)=0;
       if (a4(i) in (.,.M,.I,.N)) then a6(i)=.;
    end;
run;
%include “c:\pisa\macro\relative_risk_no_pv.sas”;
%include “c:\pisa\macro\relative_risk_pv.sas”;
%BRR_RR_PV(INFILE=temp4,
           REPLI_ROOT=w_fstr,
           BYVAR=cnt,
           ANTECEDENT_ROOT=ses_risk,
           OUTCOME_ROOT=pv_out,
           LIMIT=no,
           LIMIT_CRITERIA= ,
           ID_SCHOOL=schoolid,
           OUTFILE=exercise2);
run;
```

Table 14.7
Output data file exercise2 from Box 14.2

CNT	STAT	SESTAT
FRA	2.38	0.19

A second macro presented in Box 14.3 has been developed for analyses that involve only one antecedent variable and one outcome variable.

Box 14.3 **SAS® syntax for computing the relative risk with one antecedent variable and one outcome variable (*e.g.* PISA 2006)**

```
%BRR_RR(INFILE=temp4,
         REPLI_ROOT=w_fstr,
         BYVAR=cnt,
         ANTECEDENT=gender,
         OUTCOME=int,
         LIMIT=no,
         LIMIT_CRITERIA=,
         ID_SCHOOL=schoolid,
         OUTFILE=exercise3);
run;
```

No macro has been developed for analyses that involve one antecedent variable and five outcome variables. However, Box 14.4 presents the SAS® syntax for computing the relative risk in that case. It consists of running the macro for relative risk without plausible values five times and then, as usual, combining the results.

Box 14.4 **SAS® syntax for computing the relative risk with one antecedent variable and five outcome variables (*e.g.* PISA 2006)**

```
data temp5;
         set temp4;
         array a1 (5) pv1scie pv2scie pv3scie pv4scie pv5scie;
         array a2 (5) low1-low5;
         do i=1 to 5;
            if (a1(i) > 409.5) then a2(i)=0;
            if (a1(i) < 409.5) then a2(i)=1;
         end;
run;
%macro rr;
%do rr=1 %to 5;
%BRR_RR(INFILE=temp5,
            REPLI_ROOT=w_fstr,
            BYVAR=cnt,
            ANTECEDENT=gender,
            OUTCOME=low&rr,
            LIMIT=no,
            LIMIT_CRITERIA=,
            ID_SCHOOL=schoolid,
            OUTFILE=out&rr);
run;
data out&rr;
         set out&rr;
         stat&rr=stat;
         se&rr=sestat;
         keep cnt stat&rr se&rr;
run;
%end;
data out;
         merge out1 out2 out3 out4 out5;
         stat=(stat1+stat2+stat3+stat4+stat5)/5;
         mesvar= (((stat1-stat)**2)+((stat2-stat)**2)+((stat3-stat)**2)+
                 ((stat4-stat)**2)+((stat5-stat)**2))/4;
         sampvar=((se1**2)+(se1**2)+(se1**2)+(se1**2)+(se1**2))/5;
         var=sampvar+(1.2*mesvar);
         se=var**0.5;
         keep cnt stat se;
run;
%mend;
%rr;
run;
```

EFFECT SIZE

An effect size is a measure of the strength of the relationship between two variables. PISA requires sampling a substantial number of students from each participating country. As standard errors are inversely proportional to the number of observations, small differences will be statistically different from 0. It is therefore recommended to analyse the strength of a relationship that is statistically significant. In other words, the effect size helps researchers decide whether a statistically significant difference is of practical concern.

The term effect size is commonly used to refer to standardised differences. Standardising a difference is useful when the metric has no intrinsic meaning. With variables that have an intrinsic meaning, it is preferable to use non-standardised differences. For instance, the differences between male and female averages of height or weight are more meaningful if they are expressed in metres or kilos than if they are expressed in standardised differences.

Mathematically, the effect size is equal to:

$$\frac{\hat{\mu}_1 - \hat{\mu}_2}{\sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}}$$

$\hat{\mu}_1$ and $\hat{\mu}_2$ respectively represent the mean estimates for groups 1 and 2 and σ_1^2, σ_2^2 their variance.

Effect sizes are particularly interesting in PISA. Firstly, as differences are also compared across countries, using the difference or using the effect size might change the interpretation of the results. Differences will mainly affect countries with large or small standard deviations. For instance, the mean and the standard deviation of the student performance in reading for males and for females are presented in Table 14.8.

Table 14.8
Mean and standard deviation for the student performance in reading by gender, gender difference and effect size (PISA 2006)

	Performance in reading							
	Mean		Standard deviation		Difference in means between females and males			
	Females	Males	Females	Males	Dif.	Effect size	Rank of the difference	Rank of the effect size
AUS	531.8	494.9	86.9	96.5	36.9	0.40	14	16
AUT	512.9	468.3	102.8	108.8	44.6	0.42	24	22
BEL	521.7	482.0	102.1	113.5	39.7	0.37	17	12
CAN	543.0	511.1	90.7	98.9	31.9	0.34	7	6
CHE	515.2	484.4	91.2	94.3	30.8	0.33	5	5
CZE	508.6	462.8	107.5	110.0	45.8	0.42	25	21
DEU	516.6	474.6	105.6	113.9	42.0	0.38	22	14
DNK	509.3	479.5	86.0	90.0	29.8	0.34	3	8
ESP	478.7	443.3	82.4	91.4	35.4	0.41	13	19
FIN	572.0	521.4	73.4	80.9	50.6	0.66	28	29
FRA	504.6	469.8	97.1	107.9	34.9	0.34	11	9
GBR	509.5	480.4	95.3	106.3	29.2	0.29	2	2
GRC	488.1	431.6	87.9	108.3	56.6	0.57	29	28
HUN	503.0	463.4	87.1	96.8	39.6	0.43	16	24
IRL	534.0	500.2	87.0	94.7	33.8	0.37	10	13
ISL	508.9	460.4	87.6	99.8	48.5	0.52	27	27
ITA	489.0	447.7	100.6	112.8	41.3	0.39	20	15
JPN	513.3	482.7	95.0	107.1	30.6	0.30	4	3
KOR	573.8	538.8	82.4	90.4	35.0	0.41	12	18
LUX	495.4	463.7	95.2	102.5	31.7	0.32	6	4
MEX	426.7	393.1	91.7	96.8	33.6	0.36	9	10
NLD	519.0	494.9	93.1	98.4	24.2	0.25	1	1
NOR	508.0	462.1	95.5	108.8	45.9	0.45	26	25
NZL	539.1	501.7	99.2	107.9	37.4	0.36	15	11
POL	527.6	487.4	92.6	103.5	40.1	0.41	18	20
PRT	488.2	455.3	94.1	100.8	32.8	0.34	8	7
SVK	487.8	446.1	98.5	107.0	41.7	0.40	21	17
SWE	528.1	487.6	92.6	99.3	40.5	0.42	19	23
TUR	471.0	427.3	84.6	94.8	43.7	0.49	23	26

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The differences and the effect sizes have been sorted and ranked. In most cases, the two rankings presented in the two last columns of Table 14.8 are equal or close. However, for some countries, they differ substantially. For instance, Germany is ranked 22 in the difference, and 14 in the effect size; Hungary ranks 16 and 24, respectively. The German and Hungarian researchers and policy makers would certainly interpret the results differently if their analyses were based on the absolute difference or on the effect size.

An effect size also allows a comparison of differences across measures that differ in their metric. For example, it is possible to compare effect sizes between the PISA indices and the PISA test scores, as for example, gender differences in performance in science compared to gender differences in several indices.

Two SAS® macros have been developed for the computation of the effect size, depending on whether the independent variables consist of plausible values or not. Box 14.5 presents the SAS® syntax for running effect size analyses.

Box 14.5 **SAS® syntax for computing effect size (*e.g.* PISA 2006)**

```
data temp6;
        set pisa2006.stu;
        w_fstr0=w_fstuwt;
        scie1=pv1scie;
        scie2=pv2scie;
        scie3=pv3scie;
        scie4=pv4scie;
        scie5=pv5scie;
        if(cnt in ("AUT"));
run;
%include "c:\pisa\macro\effect_size_no_pv.sas";
%include "c:\pisa\macro\effect_size_pv.sas";
%BRR_EFFECT_PV(INFILE=temp6,
               REPLI_ROOT=w_fstr,
               BYVAR=cnt,
               PV_ROOT=scie,
               EFFECT=st04Q01 1 2,
               OUTFILE=exercise4);
run;
%BRR_EFFECT(INFILE=temp6,
            REPLI_ROOT=w_fstr,
            BYVAR=cnt,
            VAR=instscie,
            EFFECT=st04q01 1 2,
            OUTFILE=exercise5);
run;
```

The dependent variable is listed in the PV_ROOT or VAR argument and the independent variable is listed in the EFFECT argument. The two values that define the two subgroups follow the name of the independent variable in the EFFECT argument. The order of two values is important: with `st04q01 1 2`, the effect size will be equal to:

$$\frac{\hat{\mu}_1 - \hat{\mu}_2}{\sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}}$$

With `st04q01 2 1`, the effect size will be equal to:

$$\frac{\hat{\mu}_2 - \hat{\mu}_1}{\sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}}$$

Table 14.9 and Table 14.10 present the structure of the exercise4 and exercise5 output data files.

Table 14.9
Output data file exercise4 from Box 14.5

CNT	STAT	SESTAT
AUT	-0.08	0.05

Table 14.10
Output data file exercise5 from Box 14.5

CNT	STAT	SESTAT
AUT	-0.21	0.04

LINEAR REGRESSION AND RESIDUAL ANALYSIS

This section is devoted to linear regression analyses. As it will be demonstrated, such models can be used, even if there is some dependency between the errors within schools. Further, analyses of regression residuals might also provide researchers an opportunity to investigate composition effects outside complex multilevel modelling, for instance.

Independence of errors

As expressed by P. Bressoux (2008), "*qui se ressemble s'assemble mais aussi qui s'assemble tend à se ressembler*" (all that appear similar, group together; but also, all that group together tend to appear similar).

Selected students that attend the same school cannot be considered as independent observations as they are usually more similar to each other than students that attend different schools. This assumption of independence of errors can also be translated as a requirement of the absence of intraclass correlation. The PISA initial and thematic reports have reported the school variances and the intraclass correlation coefficients. In some countries such as Austria, Belgium or Germany, more than 50% of the variance is accounted for by the schools. The assumption of independence between errors cannot be maintained.

The violation of this assumption does not bias the regression coefficient estimates, but underestimates its standard error, which leads to an increase of type I error (Bressoux, 2008, p. 108). Fortunately, standard errors in PISA are estimated by replication techniques and are therefore unbiased.

The PISA initial and thematic reports have extensively used the linear regression, mainly for reporting the change in the student performance score per unit of indices derived from contextual questionnaires. The detailed description of conducting linear regression analysis with using replicates and plausible values is presented in Chapters 7 and 8.

This section will describe an alternative use of the linear regression. It consists of analysing the residual according to a particular criterion. An illustration from Monseur and Crahay (forthcoming) is also provided to show the potential of such analyses.

The underlying hypothesis of the illustration relates to the impact of social segregation in schools on student performance. Typically, this hypothesis should be tested with a multilevel regression analysis. However, such models are quite complex and their results are not always easy to explain.

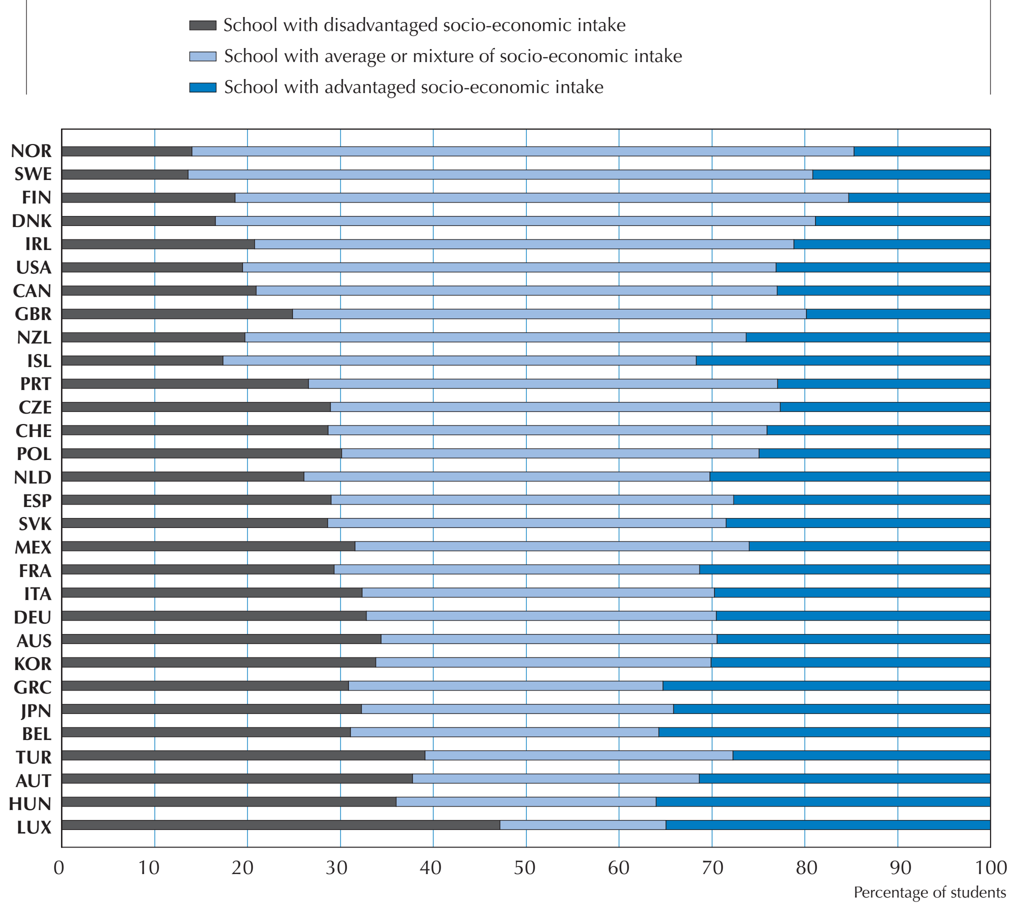
The first step implemented by Monseur and Crahay (forthcoming) was to allocate schools to one of the three following groups: *(i)* schools mainly attended by students with disadvantaged socio-economic backgrounds; *(ii)* schools mainly attended by students with average socio-economic backgrounds, or students with a mixture of disadvantaged and advantaged socio-economic backgrounds; and *(iii)* schools mainly attended by students with advantaged socio-economic backgrounds.

As the within-school samples are simple random samples, the standard error of the school average of the student socio-economic background can be estimated only with the student final weights without replicates. Then, the difference of a school average and the country average is statistically tested. If the null hypothesis is accepted, the school is allocated to the second group, *i.e.* the average or mixed schools; otherwise, the school is allocated to the first or to the third group, depending on whether the difference is negative or positive.

Figure 14.1 presents the percentage of students by the three school groups in PISA 2003.

Northern European countries, and to a lesser extent English-speaking countries, tend to have a large percentage of mixed schools. Highly tracked educational systems, such as Belgium or Germany, present small percentages of the average or mixed schools.

Figure 14.1
Percentage of schools by three school groups (PISA 2003)



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The mathematics performance of the students was predicted by the PISA index of economic, social and cultural status (ESCS) of the student. The residuals were then saved and their means were computed by school categories and by the national quartiles of ESCS. Table 14.11 presents the average residual for the students in the bottom quarter of ESCS and for the students in the top quarter of ESCS, by the three school groups.

Table 14.11

Mean of the residuals in mathematics performance for the bottom and top quarters of the PISA index of economic, social and cultural status, by school group (PISA 2003)

	(i) School with disadvantaged socio-economic intake				*(ii)* School with average or mixture of socio-economic intake				*(iii)* School with advantaged socio-economic intake			
	Students in the bottom quarter of ESCS		Students in the top quarter of ESCS		Students in the bottom quarter of ESCS		Students in the top quarter of ESCS		Students in the bottom quarter of ESCS		Students in the top quarter of ESCS	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
AUS	-12.7	(5.4)	-32.5	(7.9)	10.3	(6.4)	-13.3	(4.4)	47.7	(11.6)	18.6	(4.1)
AUT	-20.1	(5.3)	-79.3	(8.6)	25.5	(7.7)	-25.5	(8.0)	87.3	(11.9)	20.4	(4.9)
BEL	-30.3	(4.4)	-71.9	(8.6)	22.2	(4.7)	-18.9	(5.0)	97.3	(5.7)	15.3	(3.5)
CAN	-8.5	(3.6)	-19.2	(5.9)	4.0	(2.7)	-9.5	(3.0)	23.9	(7.7)	17.1	(4.2)
CHE	-13.9	(6.3)	-43.3	(11.6)	-0.3	(4.7)	-24.6	(5.1)	72.1	(17.1)	21.9	(5.2)
CZE	-23.2	(5.5)	-71.8	(11.8)	6.6	(4.0)	-32.0	(4.4)	78.6	(15.1)	29.4	(5.4)
DEU	-30.2	(5.2)	-85.1	(9.2)	25.8	(5.8)	-32.0	(7.3)	109.3	(9.8)	24.9	(3.4)
DNK	-15.6	(7.6)	-18.5	(14.7)	2.5	(4.0)	-1.6	(3.8)	19.8	(13.7)	9.2	(5.7)
ESP	-7.2	(5.4)	-31.9	(9.3)	9.8	(4.5)	-9.8	(4.2)	43.0	(8.9)	13.8	(3.7)
FIN	1.6	(4.2)	-7.5	(7.5)	-0.3	(3.2)	-0.1	(3.8)	-15.8	(12.7)	1.6	(5.9)
FRA	-29.7	(5.2)	-70.8	(15.9)	27.4	(6.6)	-8.5	(7.0)	69.6	(7.7)	9.7	(5.2)
GBR	-12.4	(4.0)	-30.0	(8.0)	11.0	(4.3)	-10.9	(3.8)	47.5	(11.3)	25.9	(5.3)
GRC	-16.3	(5.5)	-63.8	(11.4)	21.3	(6.9)	-10.4	(5.6)	57.6	(9.4)	14.0	(4.8)
HUN	-21.2	(4.8)	-84.6	(10.2)	36.7	(5.8)	-37.0	(8.2)	76.8	(11.8)	14.4	(4.3)
IRL	-22.3	(5.7)	-38.8	(12.1)	10.0	(3.8)	-9.2	(4.0)	25.9	(11.3)	9.2	(5.7)
ISL	2.5	(4.9)	-0.2	(15.9)	-0.4	(3.8)	4.9	(4.5)	-1.1	(9.6)	0.9	(3.7)
ITA	-27.5	(5.6)	-71.9	(7.4)	24.2	(7.3)	-22.7	(6.9)	71.1	(12.4)	12.5	(5.9)
JPN	-27.7	(7.6)	-75.4	(11.0)	19.1	(7.9)	-41.1	(6.8)	78.3	(11.0)	26.6	(8.7)
KOR	-25.0	(5.5)	-79.8	(10.5)	41.8	(6.2)	-9.6	(5.1)	59.3	(9.5)	20.1	(8.4)
LUX	-9.4	(2.7)	-51.2	(6.3)	14.7	(6.6)	0.0	(8.2)	73.9	(8.1)	25.3	(3.0)
MEX	-13.9	(4.7)	-56.8	(9.3)	20.8	(5.2)	-30.5	(5.2)	71.7	(7.1)	22.4	(4.5)
NLD	-30.3	(6.1)	-87.7	(8.4)	15.1	(7.8)	-28.3	(6.2)	105.3	(7.5)	34.0	(5.0)
NOR	-0.5	(7.2)	-14.2	(15.3)	-1.4	(3.3)	-2.1	(4.3)	-11.4	(15.8)	5.6	(5.1)
NZL	-19.1	(6.3)	-45.0	(12.8)	7.7	(4.0)	-2.3	(4.1)	30.9	(10.6)	19.2	(3.9)
POL	-8.3	(5.0)	-19.5	(7.9)	0.7	(4.8)	-4.2	(4.7)	23.4	(14.2)	4.8	(3.8)
PRT	-22.3	(5.5)	-20.1	(11.3)	20.0	(6.4)	-5.4	(5.8)	58.6	(12.8)	15.1	(3.8)
SVK	-28.6	(4.9)	-75.2	(12.2)	10.3	(5.3)	-27.8	(6.3)	59.0	(9.1)	18.2	(5.2)
SWE	-12.4	(8.6)	-24.4	(12.5)	6.4	(3.5)	-2.4	(4.0)	15.7	(10.3)	9.5	(7.0)
TUR	0.6	(5.0)	-79.3	(10.2)	30.0	(7.0)	-38.7	(5.4)	94.4	(13.6)	38.1	(13.2)
USA	-22.3	(6.0)	-53.5	(12.5)	13.2	(3.6)	-1.6	(3.6)	27.3	(10.5)	15.3	(4.2)

In all countries with significant differences:

- Students attending schools with disadvantaged socio-economic intake perform on average lower than what would be predicted based on their socio-economic background.
- Students attending schools with advantaged socio-economic intake perform on average higher than what would be predicted based on their socio-economic background.
- Students attending schools with average or a mixture of socio-economic intake and from the bottom quarter of ESCS on average perform higher than what would be predicted based on their socio-economic background; the reverse is observed for students from the top quarter.

These results confirm a school socio-economic composition effect on student performance in mathematics. These composition effects appear small in northern European countries but large in countries such as Belgium, Czech Republic and Germany and the Netherlands.

As stated previously, composition effect can be estimated by multilevel regression modelling. Such modelling does not require allocating schools to some groups. On the other hand, residual analyses can easily be explained to policy makers.

STATISTICAL PROCEDURE

Box 14.6 presents the SAS® syntax for running a residual analysis that involves plausible values. First, five regression models need to be computed, each of them on one of the five plausible values. These five regressions can be run via a short SAS® macro. The regression residuals are saved and then combined with the original database. These five regression residuals are then analysed according to a similar procedure as any plausible values.

Box 14.6 [1/2] **SAS® syntax for residual analyses (*e.g.* PISA 2003)**

```
data temp7;
       set pisa2003.stud;
       if (cnt in
       (‘AUS’,‘AUT’,‘BEL’,‘CAN’,‘CZE’,‘DNK’,‘FIN’,‘FRA’,‘DEU’,
       ‘GRC’,‘HUN’,‘ISL’,‘IRL’,‘ITA’,‘JPN’,‘KOR’,‘LUX’,‘MEX’,
       ‘NLD’,‘NZL’,‘NOR’,‘POL’,‘PRT’,‘SVK’,‘ESP’,‘SWE’,‘CHE’,
       ‘TUR’,‘GBR’,‘USA’));
       w_fstr0=w_fstuwt;
       math1=pv1math;
       math2=pv2math;
       math3=pv3math;
       math4=pv4math;
       math5=pv5math;
       keep cnt schoolid stidstd w_fstr0-w_fstr80 math1-math5 escs;
run;
proc sort data=temp7;
       by cnt schoolid;
run;
proc means data=temp7 noprint vardef=wgt;
       var escs;
       by cnt schoolid;
       weight w_fstr0;
       output out=school1 mean=mu_escs;
run;
proc means data=temp7 noprint ;
       var escs;
       by cnt schoolid;
       output out=school2 stderr=err_escs;
run;
data school3;
       merge school1 school2;
       by cnt schoolid;
       drop _type_ _freq_;
run;
proc means data=temp7 noprint vardef=wgt;
       var escs;
       by cnt ;
       weight w_fstr0;
       output out=cnt mean=cnt_escs p25=per25 p75=per75 ;
run;
data school4;
       merge school3 cnt;
       by cnt;
       if ( err_escs > 0) then do;
       t=(mu_escs-cnt_escs)/err_escs;
       end;
       if (t <= -1.96) then schl_type=1;
       if (t > -1.96 and t < 1.96) then schl_type=3;
       if (t >= 1.96) then schl_type=3;
       if (t=. ) then schl_type=.;
       keep cnt schoolid schl_type per25 per75;
run;
data temp8;
       merge temp7 school4;
       by cnt schoolid;
       if (escs <= per25) then statut=1;
       if (escs > per25 and escs <= per75) then statut=2;
       if (escs > per75) then statut=3;
       if (escs in (.,.I,.M,.N)) then statut=.;
run;
```

Box 14.6 [2/2] **SAS® syntax for residual analyses (*e.g.* PISA 2003)**

```
%include "c:\pisa\macro\proc_freq_no_pv.sas";
%BRR_FREQ(INFILE=temp8,
          REPLI_ROOT=w_fstr,
          BYVAR=cnt,
          VAR=schl_type,
          LIMIT=no,
          LIMIT_CRITERIA=,
          ID_SCHOOL=,
          OUTFILE=exercise6);
run;
%macro residuals;
%do i=1 %to 5;
        proc reg data=temp8 noprint;
           model math&i=escs;
           by cnt;
           weight w_fstr0;
           output out=out&i r=res&i;
        run;

        data out&i;
           set out&i;
           keep cnt schoolid stidstd res&i;
        run;
%end;
data temp9;
        merge temp8 out1 out2 out3 out4 out5;
        by cnt schoolid stidstd;
run;
%mend;
%residuals;
run;
%include "c:\pisa\macro\proc_means_pv.sas";
%BRR_PROCMEAN_PV(INFILE=temp9,
                 REPLI_ROOT=w_fstr,
                 BYVAR=cnt schl_type statut,
                 PV_ROOT=res,
                 STAT=mean,
                 LIMIT=yes,
                 LIMIT_CRITERIA=100 10 5 1,
                 ID_SCHOOL=schoolid,
                 OUTFILE=exercise7);
run;
```

CONCLUSION

This chapter was devoted to some statistical issues related to the way the OECD reported the relationship between questionnaire indices and student performance in the initial reports.

The PISA initial and thematic reports extensively use the linear regression, in particular for estimating the impact of contextual indices on student performance. An alternative use of the linear regression that consists of analysing the residuals was also presented.

15

Multilevel Analyses

INTRODUCTION

Over the last 20 years, education survey data have been increasingly analysed with multilevel models. Indeed, since simple linear regression models without taking into account the potential effects that may arise from the way in which students are assigned to schools or to classes within schools,[1] they may provide an incomplete or misleading representation of efficiency in education systems. In some countries, for instance, the socio-economic background of a student may partly determine the type of school that he or she attends and there may be little variation in the socio-economic background of students within each school. In other countries or systems, schools may draw on students from a wide range of socio-economic backgrounds, but within the school, the socio-economic background of the student impacts the type of class he or she is allocated to and, as a result, the within-school variance is affected. A linear regression model that does not take into account the hierarchical structure of the data will thus not differentiate between these two systems.

The use of multilevel models (Goldstein, 1995), also called hierarchical linear models (Bryk and Raudenbush, 1992), acknowledges the fact that students are nested within classes and schools. The relative variation in the outcome measures, between students within the same school and between schools can therefore be evaluated.

Figure 15.1 shows four graphs that highlight the distinction between a simple linear regression and a multilevel linear regression model. These four graphs represent the relationship between student socio-economic backgrounds and performance estimates in different countries; let's say for mathematics.

The thick black line represents the simple regression line when the hierarchical structure of the data is **not** taken into account. The thin blue lines represent the relationship between these two variables within particular schools. For each school, there is a regression line (the blue line in this example). The larger black dot on the simple linear regression lines (black) represents the point with the mean of *X* and *Y* as coordinates, ($_{x}$, $_{y}$), and the blue point on the multilevel regression lines represents the point with the school mean of *X* and *Y* as coordinates, ($_{xi}$, $_{yi}$).

The simple linear regression analysis, graphically represented by the black lines, shows that the expected score of a student from a higher socio-economic background is considerably higher than the expected score of a student from a lower socio-economic background. The comparison between the black lines on these four graphs shows the similarity of the relationship between the student's socio-economic background and student performance between countries. Based on simple linear regression analyses, therefore, the conclusion could be that the relationship between socio-economic background and student performance is identical in different countries.

However, the multilevel regression analyses clearly distinguish the relationship between students' socio-economic backgrounds and their performance in the four countries.

In Country 1, the multilevel regression lines are similar and close to the simple linear regression line. This means that:

- Regarding the socio-economic background of the student (*X* axis):
  - The different schools are attended by students from a wide range of socio-economic backgrounds. All the within-school regression lines cover the whole range of values on the *X* axis.
  - The schools have the same socio-economic intake, *i.e.* the mean of the student socio-economic background. Indeed, the projections of the blue dots on the *X* axis are very close to each other.
  - In summary, there is no social segregation.

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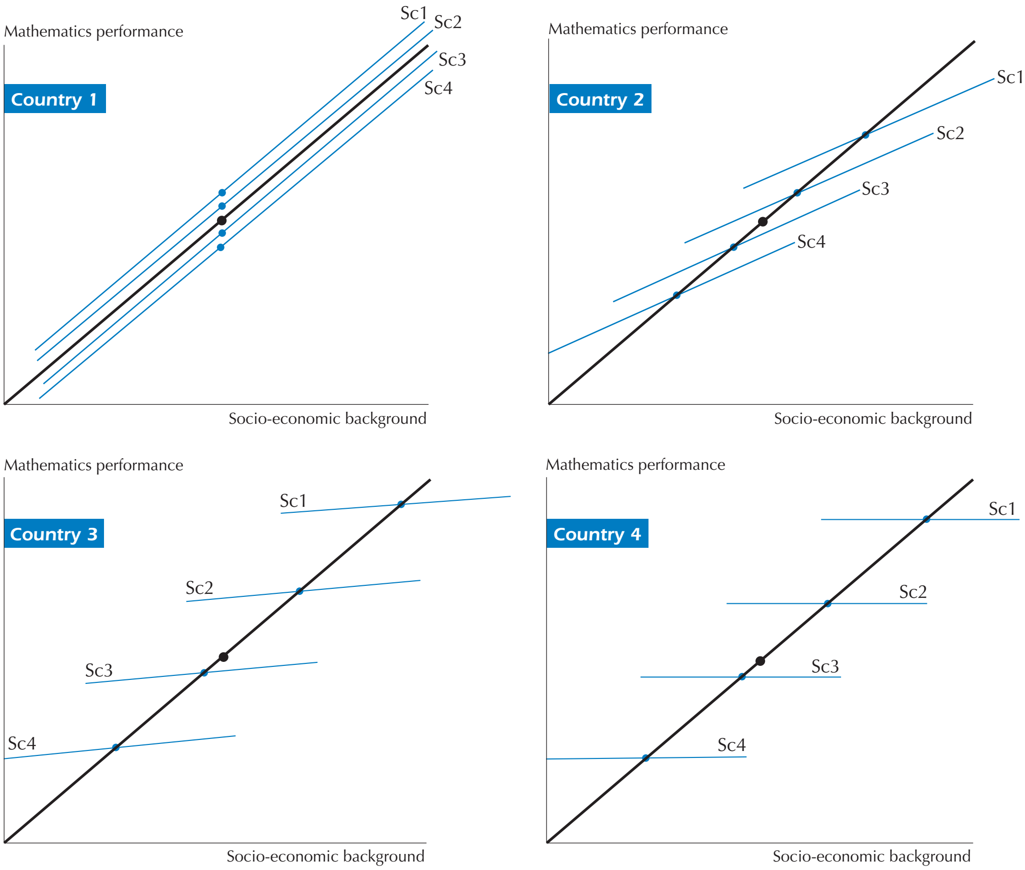
- Regarding the student performance in mathematics (*Y* axis):
  - In each school, there are low, medium, and high achievers. All the within-school regression lines cover the *Y* axis.
  - On average, the schools have a similar level of performance. Indeed, the projections of the blue dots on the *Y* axis are very close to each other. It also means that the school variance is quite small.
  - In summary, there is no academic segregation.
- Regarding the relationship between the socio-economic background and mathematics performance:
  - In each school, there is a positive relationship between the socio-economic background and achievement.
  - Within all schools, disadvantaged socio-economic background students perform well below students with advantaged socio-economic background students. The steep slope of the within-school regression line indicates that there is a relationship between students' socio-economic background and their performance.

Figure 15.1
Simple linear regression analysis versus multilevel regression analysis



Each school in Country 1 can therefore be considered as a simple random sample of the population and each school reflects the relationships that exist at the population level. Northern European countries tend generally to behave as the fictitious case of Country 1.

The opposite case of Country 1 is graphically represented by Country 4. The multilevel regression lines differ considerably from the simple linear regression line. In this case, it means that:

- Regarding the socio-economic background of the student (*X* axis):
  - The schools do not cover the range of socio-economic backgrounds that exist at the population level. School 1 is mainly attended by advantaged socio-economic background students while School 4 is mainly attended by disadvantaged socio-economic background students.
  - The schools have therefore different socio-economic intakes as the projections of the blue dots on the *X* axis show.
  - In summary, there is a significant social segregation at the school level.
- Regarding the student performance in mathematics (*Y* axis):
  - The schools do not cover the range of the student performance that exists at the population level. School 1 is mainly attended by high achievers and School 4 is mainly attended by low achievers.
  - Schools largely differ in their average performance level, as the projections of the blue dots on the *Y* axis show. In Country 4, the school performance variance is therefore very important.
  - In summary, there is a high academic segregation.
- Regarding the relationship between the socio-economic background and mathematics performance:
  - In each school, there is no relationship between socio-economic background and achievement.
  - What does matter is the school the student will attend knowing that the socio-economic background of the student will determine this school.

Countries 2 and 3 present intermediate situations between these two extreme examples.

TWO-LEVEL MODELLING WITH SAS®

Usually, two types of indices are relevant in multilevel analyses: *(i)* the regression coefficients, usually denoted as the fixed parameters of the model; and *(ii)* the variance estimates, usually denoted as the random parameters of the model. Any multilevel regression analysis should always begin with the computation of the Level 1 and Level 2 variance estimates for the dependent variable.

Decomposition of the variance in the empty model

The first recommended step in multilevel regression analysis consists of a decomposition of the variance of the dependent variable into the different levels. Here, as an example, the variance of the student performance in science will be decomposed into two components: the within-school variance and the between-school variance.

These two variance components can be obtained with an Mixed ANOVA (analysis of variance) model, as well as with a multilevel regression. The multilevel regression equation is equal to:

$$Y_{ij} = {}_{0j} + {}_{ij}$$

$${}_{0j} = \gamma_{00} + U_{0j}$$

with Y_{ij} representing the reading performance of student *i* in school *j*, β_{0j} the intercept for school *j*, ε_{ij} the student residual, γ_{00} the overall intercept and U_{0j} the school departure from the overall intercept. This model simply predicts the student performance by the average performance of his/her school and the school performance is predicted by the grand mean. Indeed, as the regression model has no predictors, the school intercepts, *i.e.* β_{0j} will therefore be equal or close to the school means. The variance of U_{0j}, usually denoted τ_{00} or τ_0^2, will be equal to the between-school variance. As each student will be assigned his/her school mean as predicted score, the variance of ε_{ij}, usually denoted σ^2, will be equal to the within-school variance.

The SAS® PROC MIXED procedure is devoted to multilevel regressions. However, it requires the normalisation of the weights, *i.e.* the sum of the weights is equal to the number of students in the dataset.[2] If the BY statement is used, then the normalisation will be done by category of the breakdown variable.

Box 15.1 provides the SAS® syntax for this normalisation, as well as a short checking procedure.

Box 15.1 **Normalisation of the final student weights (*e.g.* PISA 2006)**

```
libname PISA2006  "c:\pisa\2006\data\";
options nofmterr notes;
run;
data temp1;
        set pisa2006.stu;
        keep cnt schoolid stidstd w_fstuwt pv1scie;
run;
proc sort data=temp1;
        by cnt;
run;
proc univariate data=temp1 noprint;
        var w_fstuwt;
        by cnt;
        output out=temp2 sum=wgt N=nbre;
run;
data temp3;
        merge temp1 temp2;
        by cnt;
        std_wgt=(w_fstuwt*nbre)/wgt;
run;

/* VERIFICATION */

proc means data=temp3 noprint;
        var std_wgt;
        by cnt;
        output out=cnt N=nbstud sum=wgtsum;
run;
proc print data=cnt;
        var nbstud wgtsum;
run;
```

Box 15.2 provides the SAS® syntax for a multilevel regression model as well as the SAS® syntax for the computation of the intraclass correlation.

Box 15.2 **SAS® syntax for the decomposition of the variance in student performance in science (*e.g.* PISA 2006)**

```
proc mixed data= temp3 method=ml;
        class schoolid;
        model pv1scie = /solution;
        random intercept/subject=schoolid solution;
        weight std_wgt;
        by cnt;
        ods output covparms=decompvar solutionf=fixparm solutionr=ranparm;
run;
proc transpose data=decompvar out=rho;
        var estimate;
        by cnt;
        id covparm;
run;
data rho;
        set rho;
        rho=intercept/(intercept+residual);
        keep cnt intercept residual rho;
run;
proc print data=rho;
run;
```

The **`class`** statement defines the second level of the analyses. Similar to all linear models, the **`model`** statement specifies the dependent and independent variables. In this particular example, there is no predictor. Therefore the between-school and within-school residual variances will be equal to the between-school and within-school variance estimates. The **`random`** statement distinguishes between fixed and random predictors, as explained in the previous section. It should be noted that **`"intercept"`** always needs to be mentioned. The **`weight`** and the **`by`** statements are self-explanatory. Finally, the **`ods`** statement will save the results in three data files. The variance estimates will be saved in the file **`"decompvar"`**, the fixed parameters will be saved in the file **`"fixparm"`** and the random parameters will be saved in the file **`"ranparm"`**.

Table 15.1 provides the between-school and within-school variance estimates and the intraclass correlation. These variance estimates were saved in the file **`"decompvar"`**. As shown in Box 15.2, the intraclass correlation is equal to:

$$\rho = \frac{\sigma^2_{between\text{-}school}}{\sigma^2_{between\text{-}school} + \sigma^2_{within\text{-}school}} = \frac{\tau^2_0}{\tau^2_0 + \sigma^2}$$

with $\sigma^2_{between\text{-}school}$ or τ^2_0 the between-school variance and $\sigma^2_{within\text{-}school}$ or ^{2} the within-school variance.

In Australia, the between-school variance is equal to 1 793 and the within-school variance is equal to 8 263. In Australia, the intraclass correlation is therefore equal to 1 793/(1 793 + 8 263) = 0.18. The intraclass correlation is the percentage of the total variance that is accounted for by the school. It reflects how schools differ in their student average performance. The estimate of the intraclass correlation ranges among countries from 0.06 in Finland to 0.61 in Hungary.

If the Level 2 variance is equal to 0, a multilevel regression would be mathematically equal to a linear regression. As the between-school variance becomes larger, the differences between these two regression models increase. Knowing the intraclass correlation will therefore help the researcher correctly interpret the results.

Table 15.1
Between- and within-school variance estimates and intraclass correlation (PISA 2006)

Country	Between-school variance	Within-school variance	rho (intraclass correlation)
AUS	1 793.90	8 263.15	0.18
AUT	5 417.72	4 487.38	0.55
BEL	5 128.06	4 776.88	0.52
CAN	1 659.45	7 121.52	0.19
CHE	3 341.69	5 900.62	0.36
CZE	5 576.30	5 068.80	0.52
DEU	5 979.48	4 483.83	0.57
DNK	1 411.05	7 313.88	0.16
ESP	1 131.29	6 663.92	0.15
FIN	424.32	6 958.82	0.06
FRA	5 547.85	4 711.89	0.54
GBR	2 169.93	8 925.47	0.20
GRC	4 467.86	5 054.07	0.47
HUN	5 450.09	3 461.37	0.61
IRL	1 496.87	7 551.06	0.17
ISL	887.96	8 641.69	0.09
ITA	4 803.95	4 657.73	0.51
JPN	4 769.06	5 326.91	0.47
KOR	2 881.59	5 353.91	0.35
LUX	2 752.47	6 584.74	0.29
MEX	2 281.54	3 462.17	0.40
NLD	5 343.29	3 525.86	0.60
NOR	947.58	8 338.64	0.10
NZL	1 913.37	9 702.39	0.16
POL	1 113.91	7 107.97	0.14
PRT	2 480.24	5 234.37	0.32
SVK	3 644.47	5 059.48	0.42
SWE	1 034.22	7 863.48	0.12
TUR	3 702.19	3 199.89	0.54
USA	2 610.97	8 529.74	0.23

Models with only random intercepts

The following examples are based on the PISA 2006 data in Belgium.

In the PISA databases, there are no missing data for the final weight and for the student performance estimates. However, contextual variables that might be used as predictors in a multilevel regression model usually have missing data. These missing data generate two major issues:

- The sum of the weights will slightly differ from the number of cases that will be used by the regression models. Note that cases with missing values are usually dropped from regression models.[3]
- The school and student variances from different models cannot be compared as missing values are not always random. For instance, disadvantaged socio-economic background students are usually less likely to provide answers about their mother's and/or father's occupations.

To avoid these two problems, it is recommended to delete any cases with missing data for the different predictors that will be used in the regression models before normalising the weights.

At the student level, different variables were included in the temporary file:

- The variable of ST01Q01 indicates students' grades.

- The variable of GENDER indicates students' gender derived from ST04Q01:
  – Value 0 is assigned to males.
  – Value 1 is assigned to females.
- The variable of IMIG indicates students' immigrant status derived from ST11Q01 to 03:
  – Value 1 is assigned to a student whose parents were born in a country other than Belgium.
  – Value 0 if the student was born in Belgium and at least one of the parents was also born in Belgium.
- The variable of ESCS indicates the PISA index of economic, social and cultural status for students.
- The variable of VOCATION indicates students' programme orientation derived from ISCEDO:
  – Value 0 is assigned to students enrolled in academic programmes.
  – Value 1 is assigned to students enrolled in pre-vocational and vocational programmes.

At the school level, three variables were derived:

- The variable of MU_ESCS indicates schools' socio-economic intake measured by the school average ESCS.
- The variable of PPCT_IM indicates the proportion of students with an immigrant background in the school.
- The variable of TYPE indicates the school type:
  – Value 1 is assigned to schools that propose only academic programmes.
  – Value 0 is assigned to schools that propose pre-vocational or vocational programs.

Box 15.3 presents the SAS® syntax for the preparation of the data file.

As mentioned earlier in this chapter, the first step in multilevel modelling consists of running a regression without any independent variables. This model will return the estimate of the between-school and within-school variances. In Belgium, the between-school variance is equal to 5 010 and the within-school variance is equal to 4 656, as saved in the **"decompvar1"** file. It should be noted that the variance estimates have to be computed after the deletion of cases with missing data. Indeed, as residual variances will be compared between different regressions, it is of prime importance that the different models be computed exactly on the same dataset.

The **"fixparm1"** file contains the fixed parameters. With an empty model, it presents γ_{00}, *i.e.* 510.78 for the data in Belgium.

The **"ranparm1"** file lists the random parameters. With an empty model, only the school departure U_{0j} will be listed. Table 15.2 is a printout of the **"ranparm1"** file for the first ten cases. It contains:

- the breakdown variables used in the model, *i.e.* CNT;
- the effect, *i.e.* the intercept or as it will be shown later, the random predictor, the estimate;
- the class variable, *i.e.* the SCHOOLID;
- the estimate;
- the standard error on the estimate;
- the number of degrees of freedom (the number of students minus the number of schools);
- the *t* statistic;
- the probability that the estimates differ from 0.

Box 15.3 [1/2] **SAS® syntax for normalising PISA 2006 final student weights with deletion of cases with missing values and syntax for variance decomposition (*e.g.* PISA 2006)**

```
data temp4;
      set  pisa2006.stu;
      if (cnt="BEL");

      if (st01Q01 not in (7,8,9,10,11,12,13,14)) then st01Q01=.;

      gender=.;
      if (st04q01 in (1)) then gender=1;
      if (st04q01 in (2)) then gender=0;

      if (st11q01 in (.,.M,.N,.I)) then st11q01=9;
      if (st11q02 in (.,.M,.N,.I)) then st11q02=9;
      if (st11q03 in (.,.M,.N,.I)) then st11q03=9;
      immig=(100*st11q01)+(10*st11q02)+(st11q03);

      img=.;
      if (immig in (111,121,112)) then img=0;
      if (immig in (122,222)) then img=1;

      vocation=.;
      if (iscedo in (1)) then vocation=0;
      if (iscedo in (2,3)) then vocation=1;

      nbmis=0;
      array vecmis (5) vocation st04q01 st01Q01 escs img;
      do i=1 to 5;
      if (vecmis(i) in (.,.N,.I,.M)) then nbmis=nbmis+1;
      end;

      if (nbmis=0);

      scie1=pv1scie;
      scie2=pv2scie;
      scie3=pv3scie;
      scie4=pv4scie;
      scie5=pv5scie;
      w_fstr0=w_fstuwt;
      keep  CNT SCHOOLID stidstd
            scie1-scie5  w_fstr0-w_fstr80
               vocation gender st01Q01 escs img;
run;

proc sort data=temp4;
      by cnt schoolid stidstd;
run;

proc univariate data=temp4 noprint;
      var w_fstr0;
      by cnt;
      output out=temp5 sum=somwgt n=nbre;
run;
```

For instance, the departure of the school 2 from the overall intercept is 45.27. This departure statistically differs from 0, as shown by the *t* statistic and its associated probability value. In other words, the intercept of school 2 is significantly different from the overall intercept. On the other hand, the intercept of school 1 is not significantly different from the overall intercept.

Box 15.3 [2/2] **SAS® syntax for normalising PISA 2006 final student weights with deletion of cases with missing values and syntax for variance decomposition (*e.g.* PISA 2006)**

```
data temp6;
      merge temp4 temp5;
      by cnt;
          array wgt (81) w_fstr0-w_fstr80;
          do i=1 to 81;
            wgt(i) =(wgt(i)/somwgt)*nbre;
      end;
run;
proc univariate data=temp6 noprint vardef=wgt;
      weight w_fstr0;
      by cnt schoolid;
      var img escs;
      output out=temp7 mean=pct_im mu_escs;
run;
proc freq data=temp6 noprint;
      table vocation/out=temp8;
      by cnt schoolid;
run;
proc transpose data=temp8 out=temp9;
      var count;
      by cnt schoolid;
      id vocation;
run;
data temp10;
      set temp9;
      if (_0=.)then _0=0;
      if (_1=.)then _1=0;
      type=0;
      if (_1>0) then type=1;
      keep cnt schoolid type;
run;
data temp11;
      merge temp7 temp10;
      by cnt schoolid;
run;
data temp12;
        merge temp6 temp11;
        by cnt schoolid;
run;
/*Variance decomposition*/
proc mixed data=temp12 method=ml;
        class schoolid;
        model scie1=/solution;
        random intercept/subject=schoolid solution;
        weight w_fstr0;
        by cnt;
        ods output covparms=decompvar1 solutionf=fixparm1 solutionr=ranparm1;
run;
```

Table 15.2
Output data file "ranparm1" from Box 15.3

CNT	Effect	SCHOOLID	Estimate	StdErrPred	Degrees of freedom	tValue	Probability
BEL	Intercept	1	-32.3468	27.5127	8113	-1.18	0.2397
BEL	Intercept	2	45.2674	11.9007	8113	3.80	0.0001
BEL	Intercept	3	16.2277	13.9353	8113	1.16	0.2443
BEL	Intercept	4	-13.7326	12.4275	8113	-1.11	0.2692
BEL	Intercept	5	31.4794	11.6458	8113	2.70	0.0069
BEL	Intercept	6	25.2378	13.1742	8113	1.92	0.0554
BEL	Intercept	7	111.2300	12.7806	8113	8.70	<.0001
BEL	Intercept	8	-20.3494	15.1814	8113	-1.34	0.1801
BEL	Intercept	9	69.3355	10.1656	8113	6.82	<.0001
BEL	Intercept	10	16.7966	12.2150	8113	1.38	0.1691

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Shrinkage factor

In the case of an empty model, it might be considered that the sum of the overall intercept γ_{00} and a particular school departure U_{0j} should be perfectly equal to the school performance mean.

Multilevel models shrink the school departures. To illustrate this shrinkage process, let's suppose that we have an educational system with 100 schools and that the school performance means are perfectly identical. In other words, the school variance is equal to 0. If 20 students are tested within each school, it is expected that school mean estimates will differ slightly from the school means. Indeed, within particular schools, predominantly high performers or low performers may be sampled so that the school mean is respectively overestimated or underestimated. As the number of sampled students within schools increases, the difference between the school mean and its estimate is likely to decrease. Therefore, the shrinkage factor is inversely proportional to the number of sampled students within schools.

The shrinkage factor is equal to:

$$\frac{n_j \sigma^2_{between\text{-}school}}{n_j \sigma^2_{between\text{-}school} + \sigma^2_{within\text{-}school}}$$

with n_j being the number of students in school j in the sample (Goldstein, 1997).

This shrinkage factor ranges from 0 to 1. As it multiplies the school departure, the shrinkage will:

- depend on the ratio between between-school and within-school variance ;
- be proportional to the school departure, *i.e.* the shrinkage factor mainly affects low and high performing schools;
- be inversely proportional to the number of observed students in the school.

The between-school variance can also be estimated with an ANOVA. Mathematically, the between-school variance will be equal to:

$$\sigma^2_{between\text{-}school} = \frac{MS_{between\text{-}school} - MS_{within\text{-}school}}{n_j}$$

As it can be depicted from the ANOVA formula for estimating the between-school variance, the correction is also proportional to the within unit variance and inversely proportional to the number of cases sampled from each unit.

Models with random intercepts and fixed slopes

With the introduction of the student-level variable ESCS as a fixed effect, the equation can be written as:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(ESCS)_{ij} + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + U_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

This model has two random components, *i.e.* *(i)* the variance of ε_{ij}, denoted ^{2}; and *(ii)* the variance of U_{0j}, denoted τ_{00}; and two fixed parameters, *i.e.* γ_{00} and γ_{10}. The SAS® syntax for this model is presented in Box 15.4 and parts of the SAS® output are presented in Box 15.5.

Box 15.4 **SAS® syntax for a multilevel regression model with random intercepts and fixed slopes (*e.g.* PISA 2006)**

```
proc mixed data= temp12 method=ml;
        class schoolid;
        model scie1 = escs/solution;
        random intercept/subject=schoolid solution;
        weight w_fstr0;
        by cnt;
        ods output covparms=decompvar2 solutionf=fixparm2 solutionr=ranparm2;
run;
```

Box 15.5 **SAS® output for the multilevel model in Box 15.4**

```
                     Covariance parameter estimates
                 Cov parm        Subject        Estimate
                 Intercept       SCHOOLID       3 971.20
                 Residual                       4 475.09

                        Solution for fixed effects
      Effect      Estimate    Standard error     DF       t Value    Pr>|t|
      Intercept    507.90        3.9345          268       129.09    <.0001
      ESCS        18.9064        0.9502         8112        19.90    <.0001
```

Only one change has been introduced in comparison with the syntax presented at the end of Box 15.3. The name ESCS has been added to the model statement.

The overall intercept γ_{00} is now equal to 507.90 and the within-school regression coefficient γ_{10} is equal to 18.9064. This means that, within a particular school, an increase of one unit on the ESCS index will be associated with an increase of 18.9064 on the science scale. By comparison, the linear regression coefficient of ESCS on the science performance is equal to 47.38.[4] It appears that the education system in Belgium behaves in a similar manner to fictional Country 3 presented in Figure 15.2.

The between-school and within-school residual variable estimates, respectively denoted τ_{00} and ^{2}, are equal to 3 971 and 4 475. In the empty model, the between-school variance is 5010 and the within-school variance is 4656.

The percentage of variance explained by the ESCS variable can be computed as:

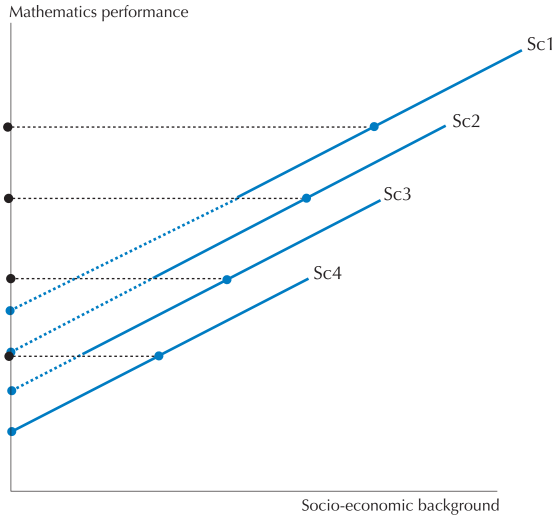
$1-\frac{3971}{5010}=0.21$ at the school level, and

$1-\frac{4475}{4656}=0.04$ at the student level.

How can a student-level variable explain about 21% of the between-school variance and only 4% of the within-school variance? This mainly reflects the school socio-economic background segregation. Some of the schools are mainly attended by advantaged socio-economic background students, while other schools are mainly attended by disadvantaged socio-economic background students.

Figure 15.2 provides a graphical explanation of this phenomenon. In any case, the between-school variance can be graphically represented by the variability of the school intercepts on the *Y* axis. In the case of an empty model, the intercept is close to the orthogonal projection of the school performance average on the *Y* axis, as shown by the black line in Figure 15.2. As explained in the previous section, the difference between the school mean and the intercept results from the application of the shrinkage factor.

Figure 15.2
Graphical representation of the between-school variance reduction



The between-school residual variance can be obtained by the extension of the regression line on the *Y* axis, as shown by the blue discontinuous line in Figure 15.2. As shown, the range of the black intercepts is larger than the range of the blue intercepts.

Broadly speaking, a student-level variable will have an impact on the between-school variance if:

- Schools differ in the mean and range of students with regard to the student-level variable (see Countries 2, 3 and 4 in Figure 15.1).
- The within-school regression coefficient of the student-level variable differs from 0. Country 4 in Figure 15.1 illustrates a case where using the ESCS variable at the student level in the model will not reduce the between-school variance. On the other hand, the introduction of the school socio-economic intake, *i.e.* the school ESCS mean, will have a substantial impact on the between-school variance.

Models with random intercepts and random slopes

In the cases examined so far, the within-school regression lines were all parallel, but multilevel regression analyses also allowed the regression slopes to vary. In the former, the effect, *i.e.* the *X* effect, will be considered as fixed, while in the latter, the effect will be considered as random. Figure 15.3 presents a case with a random effect.

Usually, empirical data should better fit a model that does not force the parallelism of the within-school regression lines. On the other hand, it implies that more parameters have to be estimated and that therefore convergence might not be reached.

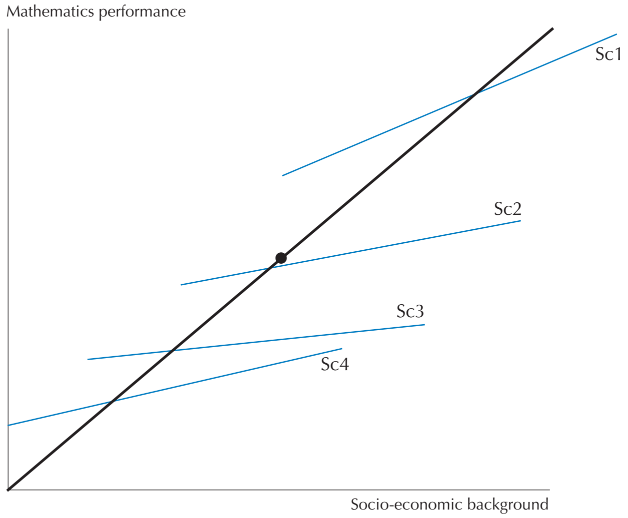
As demonstrated in the previous section, the student performance within a particular school is influenced by his/her socio-economic background. Schools may thus not be considered as equitable as expected by educational policies. One might further investigate if schools differ in terms of inequity. Are there schools that appear to be more equitable than others? This question can be answered by considering the ESCS slope as random and then testing if its variance significantly differs from 0. With the ESCS slope as random, the equation can be written as:

$$Y_{ij} = \alpha_j + \beta_{1j}\,(ESCS)_{ij} + \varepsilon_{ij}$$

$$\alpha_j = \gamma_{00} + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + U_{1j}$$

Figure 15.3
A random multilevel model



Box 15.6 sets out the SAS® syntax for a multilevel regression model.

Box 15.6 **SAS® syntax for a multilevel regression model (*e.g.* PISA 2006)**

```
proc mixed data= temp12 method=ml cl covtest;
   class schoolid;
   model scie1 = escs/solution;
   random intercept escs/subject=schoolid solution ;
   weight w_fstr0;
   by cnt;
   ods output covparms=decompvar3 solutionf=fixparm3 solutionr=ranparm3;
run;
```

The variable ESCS has been added to the random statement. The standard error and a confidence interval for random parameters can be obtained by adding two options in the **proc mixed** statement: **cl** and **covtest**.

The fixed parameter file contains the overall intercept γ_{00} and the ESCS overall regression coefficient γ_{10}. Similar to the school intercepts which are divided into two parts – an overall intercept and a school departure – the within-school regression coefficient is divided into two parts: an overall regression coefficient (the fixed part, denoted γ_{10}) and a school regression coefficient departure (the random part, denoted U_{1j}).

The overall intercept and regression coefficient are presented in Table 15.3. The overall intercept is equal to 508.05 and the overall ESCS regression coefficient is equal to 18.718. As shown by the *t* statistic and its associated probability, both parameters are significantly different from 0.

Table 15.3
Output data file "fixparm3" from Box 15.6

CNT	Effect	Estimate	S.E.	Degrees of freedom	tValue	Probability
BEL	Intercept	508.05	3.9602	268	128.29	<.0001
BEL	ESCS	18.719	1.1499	268	16.28	<.0001

The random parameter file lists the school departures:

- U_{0j} from the intercept γ_{00}, *i.e.* 508.05,
- U_{1j} from the ESCS regression coefficient γ_{10}, *i.e.* 18.72.

Table 15.4 presents the school departure from the overall ESCS regression coefficient for the first ten schools.

Table 15.4
Output data file "ranparm3" from Box 15.6

CNT	Effect	SCHOOL	Estimate	StdErrPred	Degrees of freedom	tValue	Probability
BEL	ESCS	1	0.3412	9.7250	7844	0.04	0.9720
BEL	ESCS	2	0.2670	8.1305	7844	0.03	0.9738
BEL	ESCS	3	-1.6771	9.1097	7844	-0.18	0.8539
BEL	ESCS	4	-8.1808	8.3040	7844	-0.99	0.3246
BEL	ESCS	5	0.6080	7.7785	7844	0.08	0.9377
BEL	ESCS	6	-2.0933	8.7431	7844	-0.24	0.8108
BEL	ESCS	7	-0.2759	8.6122	7844	-0.03	0.9744
BEL	ESCS	8	2.8939	9.0724	7844	0.32	0.7498
BEL	ESCS	9	-0.4817	8.1833	7844	-0.06	0.9531
BEL	ESCS	10	-1.1952	8.3590	7844	-0.14	0.8863

The ESCS regression coefficient for school 1 is equal to 18.718 + 0.267 = 18.985, but it cannot be considered as significantly different from the overall intercept. Of the 269 schools, only 2 schools present a regression coefficient that significantly differs from the overall coefficient.

SAS® now provides three variance estimates. Box 15.7 presents these estimates and their related information.

- the between-school residual variance τ_0^2, *i.e.* 4 009;
- the within-school residual variance ^{2}, *i.e.* 4 411;
- the variance of ESCS regression coefficients τ_1^2, *i.e.* 99.

Box 15.7 **SAS® output for the multilevel model in Box 15.6**

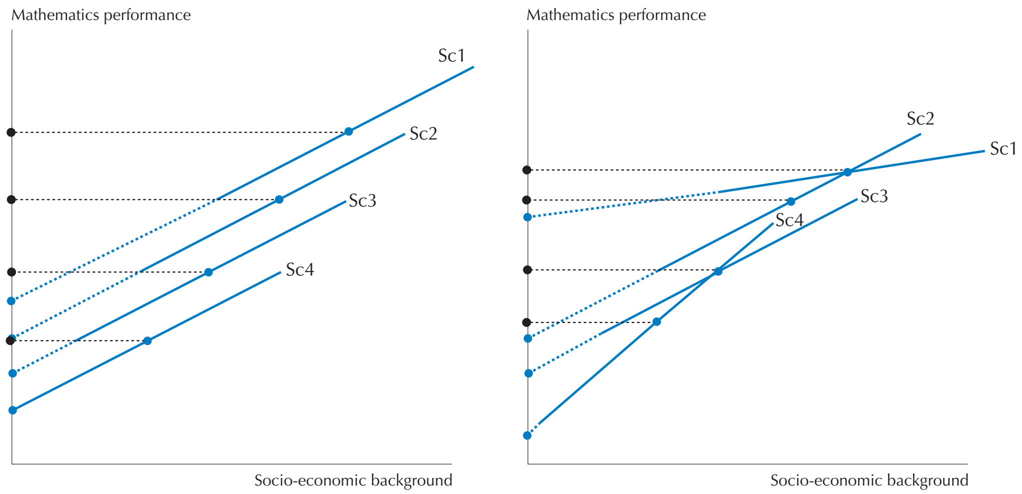
```
                      Covariance parameter estimates

                                  Standard
Cov parm  Subject   Estimate    error    Z Value    Pr Z    Alpha    Lower     Upper
Intercept SCHOOLID  4 009.43   366.99    10.93    <.0001    0.05  3 377.22 4 838.43
ESCS      SCHOOLID   99.0653  27.3568     3.62    0.0001    0.05   61.5503   185.47
Residual            4 411.33  70.2516    62.79    <.0001    0.05  4 276.81 4 552.32
```

As variance parameters have a default lower boundary constraint of 0, their confidence intervals are not symmetric. The ESCS confidence interval does not include 0; the null hypothesis can therefore be rejected with a type I error risk of 0.05.

In comparison with previous results, the between-school residual variance has slightly increased (from 3 971 to 4 009) and the within-school residual variance has decreased slightly (from 4 475 to 4 411). The reduction of the within-school variance is not surprising as the random effect can only better fit the data. The increase in the school variance in this particular example is negligible, but in some cases it might be substantial. Figure 15.4 helps to understand and interpret a substantial increase of the between-school residual variance, by showing that the range of the projections of the red lines on the *Y* axis varies more in the random slope model than in the fixed slope model. The school intercepts and the school slopes might correlate. In Figure 15.4, the correlation between intercepts and slopes is negative: lower performing schools have deeper slopes and higher performing schools have flatter slopes. This would mean that higher performing schools are more equitable. The correlation between the intercept and the slope could also be positive: in that case, this would mean that lower performing schools are more equitable.

Figure 15.4
Change in the between-school residual variance for a fixed and a random model



The SAS® option **`type=un`** in the **`random`** statement will return estimates of the covariance between random parameters. Box 15.8 presents the SAS® output. Without **`type=UN`**, the covariance between random parameters is set to 0.

Box 15.8 **SAS® output for the multilevel model with covariance between random parameters**

```
                    Covariance parameter estimates

                                  Standard
Cov parm   Subject    Estimate     error    Z Value    Pr Z     Alpha     Lower      Upper
UN(1,1)    SCHOOLID  4 005.67    366.39     10.93    <.0001    0.05   3 374.43  4 833.23
UN(2,1)    SCHOOLID   -0.5365   73.8023     -0.01    0.9942    0.05    -145.19    144.11
UN(2,2)    SCHOOLID   99.0195   27.3829      3.62    0.0001    0.05    61.4854    185.57
Residual             4 411.48   70.2542     62.79    <.0001    0.05    4276.96  4 552.48
```

UN(1,1) corresponds to the intercept variance, **UN(2,2)** corresponds to the ESCS regression coefficient slope variance and **UN(2,1)** corresponds to the covariance between the intercepts and the slopes. In this example, 0 is included in the confidence interval for **UN(2,1)** and therefore the null hypothesis cannot be rejected.

Suppose that the regression lines in Figure 15.4 are moved 5 cm on the right. The variance of the intercept will be unchanged for the fixed model, but will increase for the random model. Broadly speaking, as the mean of the independent variable differs from 0, the impact of considering it as random on the school variance will increase. Centring the independent variables on 0 limits the changes in the between-school variance estimates. Table 15.5 presents the variance/covariance estimates on the international socio-economic index of occupational status (HISEI) for Belgium. As a reminder, HISEI averages around 50 and has a standard deviation of 15. The left part of Table 15.5 presents the estimates before centring, the right part, after centring on 0. Three models were implemented: *(i)* HISEI as a fixed factor in Model 1; *(ii)* HISEI as a random factor, but no estimation of the covariance in Model 2; and *(iii)* HISEI as a random factor and estimation of the covariance in Model 3.

As illustrated by Table 15.5, centring the independent variable limits changes in the school variance estimates.

Table 15.5
Variance/covariance estimates before and after centering

Estimate		Before centering			After centering		
		Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept variance	τ_{00}	4 112	3 920	4 653	4 112	4 114	4 109
HISEI regression coefficient slope variance	τ_{11}		0.13	0.22		0.22	0.22
Covariance between the intercepts and the slopes	τ_{10}			-10.80			-0.04
Residual	2	4 506	4 472	4 457	4 506	4 457	4 457

Bryk and Raudenbush (1992) distinguish three main locations for the Level 1 independent variables:

- **The natural X metric**: it can only be meaningful if cases with the value 0 on the *X* variable can be observed. Otherwise, the intercept that represents the score on *Y* for a subject with 0 on the *X* variables will be meaningless.
- **Centring around the grand mean**: it consists of transforming the original variables so that their means will be equal to 0. The intercepts will therefore represent the score on *Y* for a subject whose values on the *X* variable are equal to the grand mean.
- **Centring around the Level 2 mean (group-mean centring)**: it consists of transforming the original variables so that their means will be equal to 0 for each school. With this approach, the introduction of Level 1 variables does not affect the between-school variance. For instance, the introduction of the ESCS variable as a fixed effect in the model decreases the between-school variance by around 20%. It reflects a segregation effect of the students based on their economic, social and cultural status. Such effect cannot be observed if Level 1 independent variables are group-mean centred.

In the following model, the student gender, denoted GENDER with males being 0 and females being 1 in the PISA 2006 database, is added as a random factor to the previous model. The equation can be written as:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(ESCS)_{ij} + \beta_{2j}\,(GENDER)_{ij}$$

$$\beta_{0j} = \gamma_{00} + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + U_{1j}$$

$$\beta_{2j} = \gamma_{20} + U_{2j}$$

The fixed parameters are respectively equal to 514.53 for the overall intercept γ_{00}, 18.06 for the overall ESCS regression coefficient γ_{10} and –13.01 for the overall gender coefficient γ_{20}.

The between-school residual variance τ_{00} is equal to 4 144 and the within-school residual variance ^{2} is equal to 4 344. Finally, the variance of the school ESCS regression coefficient τ_{11} is equal to 102 and the variance of the school GENDER regression coefficient τ_{22} is equal to 140. All these variance estimates differ statistically from 0.

The gender regression coefficient of –13.01 reflects the expected gender difference within any school, after controlling for ESCS.

Box 15.9 **Interpretation of the within-school regression coefficient**

The expected within-school gender difference can differ greatly from the overall gender difference, especially in a highly tracked system. It appears that girls are more likely to attend an academic track while boys are more likely to attend a vocational track. The linear regression coefficient of gender on the student performance provides an estimates of the overall gender difference, while a multilevel regression model estimates gender difference after accounting for the differential attendance to school. Therefore, the gender multilevel regression coefficient will substantially differ from the linear regression coefficient. The table below provides the linear and multilevel regression coefficients for gender on the data from Germany.

At the population level, males outperform females by 6.2 in science while females outperform males by 42.6 in reading. But within a particular school, the expected differences in science and reading are respectively equal to 16.6 and 31.9.

Gender differences in Germany (females – males)

	Science	Reading	Mathematics
Linear regression	–6.2	42.6	–18.8
Multilevel regression	–16.6	31.9	–28.9

Models with Level 2 independent variables

The last equation was $Y_{ij} = \beta_{0j} + \beta_{1j}\,(ESCS)_{ij} + \beta_{2j}\,(GENDER)_{ij} + \varepsilon_{ij}$. This equation mainly models the student performance variability within schools by introducing student-level predictors. However, due to the segregation effect, these student-level predictors can explain some of the between-school variance. It is also possible to introduce school-level predictors.

First, it is important to understand why some schools perform well and others less so. One usually predicts the school intercept by the school socio-economic intake, *i.e.* the mean of the student economical, social and cultural status. The impact of school socio-economic intake is usually denoted *peer effect* or *school composition effect*. A student's social and academic context may influence his/her behaviour. In a school where most of the students spend hours working on homework, it is likely s/he will work hard. Conversely, s/he will probably not work hard in a school where most of the students skip class.

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Mathematically, testing the influence of the school socio-economic intake can be written as:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(ESCS)_{ij} + \beta_{2j}(GENDER)_{ij} + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(mu\_ESCS)_j + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + U_{1j}$$

$$\beta_{2j} = \gamma_{20} + U_{2j}$$

with mu_ESCS representing the school average of the PISA index of economic, social and cultural status for a student. The SAS® syntax is presented in Box 15.10.

Box 15.10 **SAS® syntax for a multilevel regression model with a school-level variable (*e.g.* PISA 2006)**

```
proc mixed data= temp12 method=ml cl covtest;
        class schoolid;
        model scie1 = escs gender mu_escs/solution;
        random intercept escs gender/subject=schoolid solution ;
        weight w_fstr0;
        by cnt;
        ods output covparms=decompvar4 solutionf=fixparm4 solutionr=ranparm4;
run;
```

Table 15.6 presents the results for the fixed parameters.

Table 15.6
Output data file of the fixed parameters file

CNT	Effect	Estimate	S.E.	Degrees of freedom	tValue	Probability
BEL	Intercept	498.31	2.7255	267	182.83	<.0001
BEL	ESCS	16.48	1.1612	268	14.19	<.0001
BEL	gender	-12.87	1.8127	244	-7.10	<.0001
BEL	mu_escs	105.89	5.1549	7 599	20.54	<.0001

As shown in Table 15.6, the regression coefficient of the school socio-economic intake is highly significant. For two students with a similar ESCS background but attending two schools that differ by one index point in the average ESCS, their performance will differ by 106 points.

It might be useful to understand why some schools appear to be more equitable, *i.e.* schools with lower ESCS and/or GENDER regression coefficients, and why some other schools appear to be more inequitable, *i.e.* with higher ESCS and/or GENDER regression coefficients.

In this example, the impact of the school socio-economic intake and the school type will be tested. Mathematically, the model can be written as:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(ESCS)_{ij} + \beta_{2j}(ST03Q01)_{ij} + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(TYPE)_j + \gamma_{02}(mu\_ESCS)_j + U_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(TYPE)_j + \gamma_{12}(mu\_ESCS)_j + U_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(TYPE)_j + \gamma_{22}(mu\_ESCS)_j + U_{2j}$$

Box 15.11 presents the SAS® syntax for running this model. Testing the influence of the school type on the ESCS regression coefficients requires modelling the interaction between these two variables. Usually, this interaction is denoted a cross-level interaction. Box 15.12 presents the SAS® output.

Box 15.11 **SAS® syntax for a multilevel regression model with interaction (*e.g.* PISA 2006)**

```
proc mixed data= temp12 method=ml cl covtest;
        class schoolid;
        model scie1 = escs gender
                    type mu_escs
                    escs*type escs*mu_escs
                    gender*type gender*mu_escs /solution;
        random intercept escs gender /subject=schoolid   ;
        weight w_fstr0;
        by cnt;
        ods output covparms=decompvar5 solutionf=fixparm5 solutionr=ranparm5;
run;
```

Box 15.12 **SAS® output for the multilevel model in Box 15.11**

Covariance parameter estimates

Cov parm	Subject	Estimate	Standard error	Z Value	Pr Z	Alpha	Lower	Upper
Intercept	SCHOOLID	1 338.93	134.27	9.97	<.0001	0.05	1 110.32	1 646.60
ESCS	SCHOOLID	89.9421	26.0773	3.45	0.0003	0.05	54.7338	174.65
gender	SCHOOLID	87.6427	58.2604	1.50	0.0662	0.05	32.9396	602.44
Residual		4 348.94	70.2643	61.89	<.0001	0.05	4 214.45	4 490.01

Solution for fixed effects

Effect	Estimate	Standard error	DF	t Value	Pr>|t|
Intercept	522.37	6.2466	266	83.62	<.0001
ESCS	10.6204	2.6153	266	4.06	<.0001
gender	-16.1028	3.9816	242	-4.04	<.0001
type	-30.8790	7.0795	7 599	-4.36	<.0001
mu_escs	94.3191	6.6287	7 599	14.23	<.0001
ESCS*type	8.4097	3.0270	7 599	2.78	0.0055
ESCS*mu_escs	0.07536	2.7466	7 599	0.03	0.9781
gender*type	7.4455	4.5563	7 599	1.63	0.1023
gender*mu_escs	-6.5241	4.4320	7 599	-1.47	0.1411

Only one cross-level interaction is significant, *i.e.* ESCS*type. As the value of 0 is assigned to schools that only propose an academic education and the value of 1 is assigned to schools that provide vocational education, the value of 8.41 for γ_{11} means that the ESCS regression coefficient is equal to 10.62 in academic schools and to 10.62 + 8.41, *i.e.* 19.03 in vocational schools. This result is not surprising as the student population is less diverse in terms of socio-economic background and academic performance in academic schools.

It should be noted that any Level 2 predictors used for testing a cross-level interaction should also be included in the regression of the school intercept. Indeed, the estimation of an interaction requires modelling the main effects.

To demonstrate this, let's suppose the following: Students are distributed according to their immigrant status (native versus immigrant) and according to the type of school (academic versus vocational). Table 15.7 presents the performance average, as well as the percentage of students.

Table 15.7
Average performance and percentage of students by student immigrant status and by type of school

		Native students (0)	Students with an immigrant background (1)
Academic schools (0)	Average performance	650	450
	Percentage of students	25%	25%
Vocational schools (1)	Average performance	500	400
	Percentage of students	25%	25%

Table 15.8 presents the variables for the four groups of students.

Table 15.8
Variables for the four groups of students

	School type	Student immigrant status	Interaction
Academic schools – Native students	0	0	0
Vocational schools – Native students	1	0	0
Academic schools – Students with an immigrant background	0	1	0
Vocational schools – Students with an immigrant background	1	1	1

In a regression model, the reference category will be the native students attending an academic school (0,0,0). Therefore, β_0 will be equal to 650. If the two main dichotomous effects and the interaction are included in the model, it would correspond to three dummies differentiating four categories, as illustrated by Table 15.8. The "school type" main effect will compare the native students in academic schools with the native students in a vocational school. The regression coefficient will therefore be equal to –150. The "student immigrant status" main effect will differentiate student according to their immigrant status within academic schools. The regression coefficient will therefore be equal to –200. Finally, the interaction will compare, for the students with an immigrant background in a vocational school, their expected score based on the main effect and the observed score. The expected score will be 650-150-200, *i.e.* 300. As the average performance is 400, the interaction will therefore be equal to 100.

Let's suppose that the school type is not included as a main effect, but only the immigrant status and the interaction. The reference category (0,0) will be the native students, so β_0 will be equal to 575, the average performance of native students across school types. The "student immigrant status" main effect will be computed by comparing the reference categories with the students with an immigrant background in academic schools and, therefore, the regression coefficient will be equal to –125. Finally, the interaction, as previously, will compare the expected and observed means. The interaction regression coefficient will therefore be equal to the difference between 575 – 125 = 450 and 400. The interaction will be equal to -50.

This fictitious example illustrates that any cross-level interaction should not be tested without the inclusion of the main effect. In terms of multilevel modelling, it means that any variable used for explaining the variability of a Level 1 regression coefficient should also be included in the intercept equation.

Computation of final estimates and their respective standard errors

As described in the previous chapters, the final estimates of a multilevel regression analysis should be also computed for each of five plausible values, with the replicates.

Two SAS® macros have been developed for multilevel regression analyses: one for plausible values as a dependent variable, and the other for non-plausible values as a dependent variable.

Two subroutines are embedded in these two macros:

- The first subroutine deletes any cases with at least one missing value.
- The second subroutine normalises the weight and replicates.

Box 15.13 presents the SAS® syntax for running the macro.

Box 15.13 **SAS® syntax for using the multilevel regression macro (*e.g.* PISA 2006)**

```
%include "c:\pisa\macro\proc_mixed_pv.sas";

%BRR_MIXED_PV(INFILE=temp12,
              REPLI_ROOT=w_fstr,
              PV_ROOT=scie,
              FIXEF=escs vocation st01Q01 type mu_escs pct_im,
              RANEF=img,
              BYVAR=cnt,
              LEVEL2=schoolid,
              OUTSCREEN="c:\ml.out",
              OUTFILE=out);
run;
```

The macro devoted to plausible values has nine arguments. The INFILE, REPLI_ROOT, PV_ROOT, BYVAR and OUTFILE arguments have already been largely described in previous chapters. In the FIXEF and RANEF arguments, the variables considered as fixed and random effects are listed respectively. It should be noted that any cross-level interaction needs to be computed in the data file and the resulting variable should be included in the FIXEF argument.

The Level 2 identification variable (SCHOOLID in the PISA databases) has to be listed in the LEVEL2 argument. Finally, as limited control is provided on the SAS® output, the results are sent to an external file to avoid SAS® stopping due to a lack of memory. The name of the file and its location must be between brackets.

The macro will store the results in four different files with the out-file name specified in the OUTFILE argument, *e.g.* out, followed by the extensions presented in the brackets below:

- a file with the regression coefficients and their standard errors (**out_fixe**),
- a file with the variance estimates and their standard errors (**out_variance**),
- a file with the intraclass correlation and its standard error (**out_intraclass**),
- a file with the percentage of subjects deleted due to missing data (**out_deletion**).

Table 15.9

Comparison of the regression coefficient estimates and their standard errors in Belgium (PISA 2006)

	Using macro		Using PROC MIXED	
Effect	**STAT**	**S.E.**	**STAT**	**S.E.**
ESCS	10.6	1.07	10.3	0.88
Intercept	104.0	17.09	99.5	13.80
st01q01	45.5	1.73	45.8	1.33
img	-24.0	2.61	-23.8	3.07
mu_escs	43.5	2.18	43.9	5.30
pct_im	-52.4	4.91	-53.6	11.41
type	-0.3	1.93	0.6	5.19
vocation	-56.8	2.72	-56.3	2.23

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Table 15.9 presents the regression coefficient estimates and their standard errors computed with the macro or just with SAS® PROC MIXED on the first plausible value.

Regression coefficient estimates differ slightly depending on how they are computed. But the most important differences concern the standard errors. Multilevel regression models assume schools were selected according to a simple random procedure. In PISA, explicit and implicit stratification variables improve the efficiency of the sampling design and therefore standard errors are usually smaller than the standard errors obtained from a simple random sample of schools.

From an educational policy perspective, these results show that the percentage of immigrants in a school and the school socio-economic intake do impact the school intercept in Belgium.

As shown in Table 15.10, the macro returns a larger standard error for τ_{11} (variance for the regression coefficient of the variable IMG) because for three out of the five plausible values, the variance estimate was equal to 0.

Table 15.10

Comparison of the variance estimates and their respective standard errors in Belgium (PISA 2006)

	Using macro		Using PROC MIXED	
Cov parm	**STAT**	**S.E.**	**STAT**	**S.E.**
Intercept	738.5	65.39	706.6	73.73
Residual	3619.7	85.63	3599.4	56.99
Img	450.8	237.7	517.5	149.82

These results show the importance of using the 5 plausible values and the 80 replicates to compute the final estimates and their respective standard errors. The use of the replicates is particularly recommended in countries that organised a census of their students (*e.g.* Iceland, Luxembourg).

THREE-LEVEL MODELLING

Three-level regression analyses (*i.e.* Level 1 being the student level, Level 2 the school level and Level 3 the country level) can also be implemented with SAS®. However, even a simple model on the PISA data will run for hours. It is therefore recommended to use specialised software packages such as HLM®. This section shows a simple example of a three-level regression. The detailed example of the preparation for the data files and three-level regression analysis with HLM® applied in the Chapter 5 of the PISA 2006 initial report (OECD, 2007) are presented in Appendix 1.

Three-level modelling requires precaution mainly because removing or adding countries might have a substantial impact on the results at Level 3. For instance, Figure 2.12a of the PISA 2006 initial report (OECD, 2007) presents the relationship between student performance in science and national income. The correlation between these two variables is equal to 0.53. Adding the partner countries would certainly strengthen the relationship.

The following example is based solely on data from OECD countries, since it is less likely that including, or not including, one or a subset of OECD countries will substantially change the results.

First of all, the final student weights need to be normalised. The weight transformation makes: *(i)* the sum of the weight across the countries equal to the number of cases in the databases; and *(ii)* the sum of the weights per country is constant and equal to the total number of cases divided by the number of countries. Box 15.14 presents the SAS® syntax for normalising the weights for a three-level model.

Box 15.14 **SAS® syntax for normalising the weights for a three-level model (*e.g.* PISA 2006)**

```
data temp13;
    set pisa2006.stu;
    if (escs in (.,.N,.I,.M)) then delete;
    oecd=1;
    if (cnt in ("AUS","AUT","BEL","CAN","CZE","DNK","FIN","FRA","DEU","GRC",
            "HUN","ISL","IRL","ITA","JPN","KOR","LUX","MEX","NLD","NZL",
            "NOR","POL","PRT","SVK","ESP","SWE","CHE","TUR","GBR","USA"));
    keep cnt schoolid stidstd
        w_fstuwt pv1scie escs oecd;
run;
proc sort data=temp13;
    by cnt;
run;
proc univariate data=temp13 noprint;
    var w_fstuwt;
    by oecd cnt;
    output out=temp14 sum=sum_wgt n=cnt_cases;
run;

data temp15;
    merge temp13 temp14;
    by oecd cnt;
    std_wgt=(w_fstuwt/sum_wgt)*cnt_cases;
run;

proc univariate data=temp14 noprint;
    var cnt_cases;
    by oecd;
    output out=temp16 sum=tot_cases n=n_cnt;
run;
data temp17;
    merge temp15 temp16;
    by oecd;
    final_wgt=std_wgt * ((tot_cases/ n_cnt)/cnt_cases);
    keep cnt schoolid stidstd pv1scie escs final_wgt;
run;
```

The dependent variable is the performance of the student in science. At Level 1, *i.e.* the student level, the only independent variable included in the model is the PISA index of economic, social and cultural status for students. At Level 2, *i.e.* the school level, two variables are included in the model: *(i)* the school socio-economic intake (the school average of the student ESCS index); and *(ii)* the school socio-economic mix (the standard deviation of the student ESCS index).

Table 15.11

Three-level regression analyses

	Model 1	Model 2	Model 3	Model 4
	Fixed parameters			
γ_{000}				501.43
γ_{010}			67.15	68.23
γ_{020}				-7.30
γ_{100}		21.96	19.67	12.34
γ_{110}				0.16
γ_{120}				9.14
	Random parameters			
ε_{ijk}	5 777	5 467	5 469	5 470
U_{0jk}	3 464	2 685	1 244	1 241
U_{00k}	1 037	763	399	397
U_{1jk}		37	37	35
U_{10k}		66	86	89
U_{01k}			1 157	1 138

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Table 15.11 shows the results from four different three-level models using HLM®. Model 1 is the empty model, without any independent variables. Model 2 has one independent variable (ESCS) at Level 1 as random slopes at Level 2 and Level 3. Model 3 has one independent variable (MU_ESCS) at Level 2 as random slopes at Level 3 in addition to Model 2. Model 4 has one more independent variable (STD_ESCS) at Level 2 as a fixed slope in addition to Model 3.

The equations for Model 4 are presented below. With only one independent variable at Level 1 and two independent variables at Level 2, a three-level regression model becomes quickly complex, especially when random slopes are modelled.

$$SCIE_{ijk} = \beta_{0jk} + \beta_{1jk}(ESCS)_{ijk} + \varepsilon_{ijk}$$

$$\beta_{0jk} = \beta_{00k} + \beta_{01k}(MU\_ESCS)_{jk} + \beta_{02k}(STD\_ESCS)_{jk} + U_{0jk}$$
$$\beta_{1jk} = \beta_{10k} + \beta_{11k}(MU\_ESCS)_{jk} + \beta_{12k}(STD\_ESCS)_{jk} + U_{1jk}$$

$$\beta_{00k} = \gamma_{000} + U_{00k}$$
$$\beta_{01k} = \gamma_{010} + U_{01k}$$
$$\beta_{02k} = \gamma_{020}$$
$$\beta_{10k} = \gamma_{100} + U_{10k}$$
$$\beta_{11k} = \gamma_{110}$$
$$\beta_{12k} = \gamma_{120}$$

The decomposition of the variance, *i.e.* Model 1, shows that 56% of the variance lies within schools, 34% between schools within countries and only 10% between countries. Model 2 indicates that the national variability of the ESCS regression coefficients (37) is about the same as its international counterpart (66). In other words, the differences in the ESCS regression coefficient between the most equitable schools and the most inequitable schools in a country are similar to the difference between the most equitable countries and the most inequitable countries.

Model 3 demonstrates that the impact of the school socio-economic intake is substantially higher than the impact of the PISA index of economic, social and cultural status of students. Further, the variability of the school social intake regressions (1 157) is higher than the variability of the ESCS regression coefficients. It does mean that countries differs more by the impact of the school socio-economic intake than by the impact of the student socio-economic background.

Finally, Model 4 indicates that the ESCS slope of a particular school is positively correlated with the school socio-economic mix (9.14). A school with a greater socio-economic diversity will have a higher ESCS regression coefficient.

This short example illustrates the potential of three-level regression modelling. However, such models become rapidly complex and their results might be sensitive to which countries are included in the analyses.

LIMITATIONS OF THE MULTILEVEL MODEL IN THE PISA CONTEXT

This section aims to alert PISA data users to some limitations of applying multilevel models in the PISA context.

As PISA draws, per participating school, a random sample of an age population across grades and across classes, it allows the decomposition of the variance into two levels: a between-school variance and a within-school variance. Therefore, the overall variance is expected to be larger with an age-based sample than with a grade sample, unless the age population is attending a single grade, as in Iceland or Japan.

To allow for meaningful international comparisons, these types of indicators require a school definition common to each country. While there are no major differences in definition of what a student is, there are, from one country to another, important differences about what a school is.

International surveys in education are primarily interested in the student sample and therefore one might consider the school sample as a necessary step to draw an efficient sample of students that minimises the cost of testing. In this context, the definition of what a school is, does not present any major issues. However, the increasing importance and popularity of multilevel analyses calls for more attention to the definition issue.

PISA's emphasis in the sampling procedures is on developing a list of units that would guarantee full coverage of the enrolled 15-year-old population and that would additionally give acceptable response rates. Once a "school" was selected, it also had to be practical to sample 35 students from that school to assess them. Thus, the school frame was constructed with issues of student coverage and practical implementation of PISA administration in mind, rather than analytic considerations. Therefore, in the PISA databases, it is possible that the school identification represents different educational institutions that may not be comparable without any restriction. For instance, in some PISA countries, schools were defined as administrative units that may consist of several buildings not necessarily located close to each other. Other countries used the "building" as the school sampling unit and finally, a few countries defined a school as a track within a particular building. It is likely that the larger these aggregates are, the smaller the differences between these aggregates will be and the larger the differences within these aggregates will be. In this context, one would expect to observe high intraclass correlations in these countries and a non-significant within-school regression coefficient for the student socio-economic background (OECD, 2002d).

Besides this problem of an international definition of a school, data users should be aware of the following issues:

- The choice of a school definition in a particular country may be dictated by the availability of the data. Indeed, the national centres have to include a measure of size of the 15-year-old population in the school sample frame (see Chapter 3). This information may be available at the administrative unit level, but not at the "building" level. In federal countries that count several educational systems, the available data might differ from one system to another, so that the concept of a school might differ even within a particular country.
- For practical or operational reasons, the concept of schools might differ between two PISA data collections. For instance, some countries used the administrative units in the PISA 2000 school sample frame and the "building" units in the PISA 2003 school sample frame. Such changes were implemented to increase the school participation rate. These conceptual changes will influence the results of any variance decomposition and might also affect the outcomes of multilevel models. Moving from an administrative definition to a "building" definition will increase the intraclass correlation and should decrease the slope of the within-school regression coefficient. The changes in any trends on variance decomposition or multilevel regressions require careful examination and interpretation.

In summary, multilevel analyses and variance decomposition analyses need to be interpreted in light of the structure of the educational systems and the school definition used in the school sample frame.

CONCLUSION

This chapter described the concept of multilevel analyses and how to perform such models with SAS®. It started with the simplest model, denoted the empty model, and then progressively added complexity by

adding variables. This was followed by a description of the SAS® macro to compute standard errors using five plausible values and replicates.

An example of a three-level regression was then presented.

Finally, in the PISA context, important methodological issues that limit the international comparability of the results were discussed.

Notes

1. While simple linear regression models do not recognize hierarchical structure of data, it is possible to account for some hierarchical aspects of the PISA data in the survey regression models. In many software packages it is also straightforward to correct standard errors in the linear regression by using BRR weights or cluster-robust estimators. These models can adjust for clustering of students within schools and other aspects of survey design.

2. PISA has been using normalised student final weights at the student level for multilevel analyses. But, it is important to note that technical discussion is currently under way regarding the use of separate weights at the different levels.

3. A correlation matrix computed with the pairwise deletion option can however be used as input for a linear regression analysis.

4. This is based on PV1SCIE.

16

PISA and Policy Relevance – Three Examples of Analyses

INTRODUCTION

This chapter will provide three examples of possible analyses with PISA data. The examples will begin with a concrete policy question which will be followed by a step-by-step analysis:

1. how to translate a policy question into a working hypothesis;
2. how to choose the most appropriate approach to answer the hypothesis;
3. how to compute, referring to the relevant chapters in this manual on technical matters;
4. how to interpret the results;
5. how to draw policy recommendations.

The first example will investigate how to determine which student population should be targeted by an educational reform designed to reduce the gender gap in reading. As it will be demonstrated, the male student distribution differs from the female student distribution, not only by their mean but also by their standard deviation.

The second example will scrutinise the school composition effect in a particular country, *i.e.* Belgium. In addition to the potential efficiency of promoting socio-economic diversity within schools, this example also illustrates the usefulness of the PISA data for answering a policy question in a specific national context.

The last example will explore the influence of some characteristics at the educational system level on the students' expected occupational status at age 30. It will be extended to the issue of segregation in academic performance.

EXAMPLE 1: GENDER DIFFERENCES IN PERFORMANCE

It is current practice to build efficiency and equity indicators of educational systems based on national or international surveys. International agencies, including the OECD, regularly release updated sets of indicators (*e.g.* OECD's *Education at a Glance*). Among equity indicators, differences of achievement in various domains (mainly reading, mathematics and science) between males and females are often presented. Computing these indicators does not raise technical problems and there is relative consensus among modern democratic societies that the gender gap in performance should be reduced. Until recently, the major concern was to improve females' achievement in scientific domains; but, currently, there is a growing concern about males' underachievement in reading literacy.

Lietz (2006) conducted a meta-analysis of gender differences in reading at the secondary education level. Results indicated that: *(i)* gender differences existed across the 139 studies under review that were not due to chance; and *(ii)* slightly over half of these differences could be explained by differences in the design of some of the large-scale assessment programmes included in the meta-analysis and the basis of calculating effect size. Further, the reason for greater gender differences in more recent assessment programmes which could, for example, be related to item selection procedures, contextual changes surrounding reading in society and at school, or the scaling of reading scores, warrant further scrutiny (Lietz, 2006, pp. 336-337).

Lafontaine and Monseur (forthcoming) has explored the impact of some of the test characteristics – especially the question format, the reading process and the type of texts – on gender equity indicators in reading literacy. They concluded that:

the variance analysis clearly shows that the reading aspect has a larger impact (24% of variance explained) than item format on the difference in reading achievement between males and females. But item format also makes a striking difference (16% of variance explained). The type of text appears to be one of the major

factors contributing to gender differences. This result is not surprising and can be related to the differences in written material regularly read by males and females respectively.

In summary, PISA and other large-scale assessments have shown the evidence of females outperforming males in reading and recent methodological investigations have pointed out the influence of item format, type of texts and reading aspects on the size of the gender gap.

However, few recommendations are provided to policy makers to reduce these gender differences. Should remediation programmes designed to reduce the gender gap in reading target all male students or primarily male low performers? In other words, is the gender difference constant or variable across the ability range? According to Wagemaker (1996, p. 42) based on the IEA Reading Literacy Study, "in some countries, it is evident that disparity between boys and girls is not uniformly systematic across the ability distribution." PISA offers a unique opportunity to test the hypothesis of a larger distribution for males. Indeed, data are collected every three years in three domains, *i.e.* reading literacy, mathematics literacy and science literacy.

As a starting point, the hypothesis can be translated as follows: there is no statistical difference between the standard deviation computed on the male population and the standard deviation computed on the female population. Mathematically, the null hypothesis can be written as:

$$H_0 : {}_{males} - {}_{females} = 0$$

The standard deviations for each domain and on the first three data collections have been computed for males and for females and then compared. However, as illustrated in Chapter 11, the two standard deviation estimates are not independent. Therefore, the significance test for the gender difference in standard deviation requires the use of the PROC_DIF_PV macro. Box 16.1 presents the syntax for testing the similarity of the standard deviations.

Box 16.1 **SAS® syntax for testing the gender difference in standard deviations of reading performance (*e.g.* PISA 2000)**

```
libname PISA2000  "c:\pisa\2000\data\";
libname PISA2006  "c:\pisa\2006\data\";
options nofmterr notes;
run;

data temp1;
         set pisa2000.intread;
         if (cnt in ('AUS','AUT','BEL','CAN','CZE','DNK','FIN','FRA','DEU','GRC',
                     'HUN','ISL','IRL','ITA','JPN','KOR','LUX','MEX','NLD','NZL',
                     'NOR','POL','PRT','SVK','ESP','SWE','CHE','TUR','GBR','USA'));
         w_fstr0=w_fstuwt;
         read1=pv1read;
         read2=pv2read;
         read3=pv3read;
         read4=pv4read;
         read5=pv5read;
         keep cnt schoolid stidstd read1-read5 w_fstr0-w_fstr80 st03Q01;
run;

%include "c:\pisa\macro\proc_dif_pv.sas";

%BRR_PROCMEAN_DIF_PV(INFILE=temp1,
                     REPLI_ROOT=w_fstr,
                     BYVAR=cnt ,
                     PV_ROOT=read,
                     COMPARE=st03Q01,
                     CATEGORY=2 1,
                     STAT=std,
                     OUTFILE=exercise1);
run;
```

Table 16.1 presents the differences in the standard deviations between males and females by domain and by country in PISA 2000. For instance, in Australia, the difference in the standard deviation between males and females is equal to 6.94 with a standard error of 2.48. As (6.94/2.48) is greater than 1.96, this difference is significant. The standard deviation of the male student performance in reading is higher by 6.94 than the standard deviation of the female student performance in reading. In other words, the performance of males varies more than the performance of females.

Table 16.1
Differences between males and females in the standard deviation of student performance (PISA 2000)

	Reading		Mathematics		Science	
	Difference (males – females)	S.E.	Difference (males – females)	S.E.	Difference (males – females)	S.E.
AUS	**6.94**	(2.48)	3.45	(3.31)	**6.58**	(2.98)
AUT	4.12	(2.74)	**6.75**	(3.23)	4.06	(2.99)
BEL	**8.16**	(3.44)	**7.24**	(3.25)	**10.66**	(4.81)
CAN	**5.22**	(1.10)	**5.16**	(1.33)	**4.65**	(1.44)
CHE	3.44	(2.26)	3.47	(3.68)	4.02	(3.07)
CZE	**11.92**	(4.14)	**8.01**	(3.38)	**7.9**	(3.87)
DEU	5.58	(5.23)	0.93	(3.76)	1.67	(3.74)
DNK	**6.68**	(3.16)	4.3	(3.56)	6.5	(3.73)
ESP	**9.33**	(2.32)	**7.01**	(2.70)	**8.83**	(2.74)
FIN	6.21	(3.19)	1.41	(2.79)	**8.52**	(2.65)
FRA	**8.19**	(2.35)	**5.82**	(2.42)	5.91	(3.27)
GBR	**5.71**	(2.43)	**7.06**	(3.12)	4.02	(3.55)
GRC	**10.09**	(3.28)	**9.55**	(4.78)	**8.11**	(3.98)
HUN	2.54	(2.81)	1.44	(3.85)	3.01	(3.22)
IRL	4.35	(2.87)	3.27	(3.65)	3.55	(3.28)
ISL	**8.72**	(2.32)	4.77	(3.44)	**6.03**	(3.07)
ITA	**9.75**	(4.19)	5.92	(4.16)	**9.81**	(4.56)
JPN	**11.19**	(3.34)	**11.64**	(5.24)	**12.74**	(4.07)
KOR	3.84	(2.79)	2.21	(4.09)	2.31	(3.45)
LUX	5.45	(3.28)	7.02	(4.08)	**9.81**	(4.19)
MEX	3.69	(2.49)	**6.32**	(3.03)	5.73	(3.10)
NOR	**12.42**	(2.62)	**9.58**	(3.20)	**11.27**	(3.74)
NZL	**9.04**	(3.06)	**9.82**	(3.54)	**7.77**	(3.50)
POL	**10.25**	(3.69)	**11.83**	(4.48)	6.59	(3.82)
PRT	**6.96**	(2.64)	1.41	(4.17)	4.7	(3.08)
SVK		(0.00)		(0.00)		(0.00)
SWE	**5.84**	(2.40)	2.7	(3.46)	6.43	(3.63)
TUR		(0.00)		(0.00)		(0.00)
USA	**12.89**	(3.24)	**9.15**	(2.64)	**12.27**	(4.40)

Note: Differences that statistically differ from 0 are in bold.

Table 16.2 provides a summary of gender differences in standard deviation for reading, mathematics and science performance in PISA 2000, PISA 2003 and PISA 2006. Of the 260 comparisons, only 6 are negative, meaning that the standard deviation for females is higher than the standard deviation for males. Further, 177 differences, *i.e.* 68%, are positive and differ significantly from 0, which means that the distribution of the male performance is more widespread than the distribution of the female performance.

Table 16.2
Distribution of the gender differences (males – females) in the standard deviation of the student performance

	Domain	Negative non-significant difference	Positive non-significant difference	Positive significant difference
PISA 2000	Reading	0	9	18
	Mathematics	0	13	14
	Science	0	13	14
PISA 2003	Reading	0	8	22
	Mathematics	2	7	21
	Science	0	12	18
PISA 2006	Reading	0	4	25
	Mathematics	2	6	22
	Science	2	5	23

To better understand why the standard deviation is higher for males than for females, 5th, 10th, 90th and 95th percentiles are computed by gender on the combined reading scale in PISA 2000. Table 16.3 presents the differences between males and females in these percentiles. Box 16.2 presents the SAS® syntax for computing the difference for the 5th percentile.

Table 16.3
Gender difference on the PISA combined reading scale for the 5th, 10th, 90th and 95th percentiles (PISA 2000)

	Gender difference (males – females) in percentiles of the reading performance distribution							
	5th		10th		90th		95th	
	Difference	S.E.	Difference	S.E.	Difference	S.E.	Difference	S.E.
AUS	-44.5	(11.4)	-40.5	(8.5)	-21.6	(8.1)	-20.3	(8.6)
AUT	-38.5	(11.0)	-35.1	(8.5)	-19.1	(6.1)	-18.8	(8.8)
BEL	-38.8	(12.8)	-43.4	(12.7)	-16.4	(5.7)	-14.1	(5.6)
CAN	-42.8	(4.2)	-41.3	(3.6)	-25.3	(3.6)	-22.9	(3.5)
CHE	-24.5	(10.1)	-24.4	(8.4)	-20.6	(6.6)	-17.6	(5.7)
CZE	-68.2	(18.1)	-56.6	(11.8)	-21.5	(5.6)	-20.3	(6.6)
DEU	-56.1	(20.8)	-45.2	(12.2)	-25.4	(7.2)	-21.6	(5.9)
DNK	-41.0	(7.9)	-35.9	(7.2)	-16.4	(4.7)	-14.5	(7.3)
ESP	-37.3	(6.5)	-37.0	(6.7)	-11.1	(5.5)	-8.5	(6.0)
FIN	-65.4	(8.8)	-68.1	(5.5)	-40.0	(4.9)	-39.8	(5.9)
FRA	-46.5	(9.6)	-44.5	(6.7)	-20.1	(4.3)	-18.4	(6.1)
GBR	-38.6	(8.8)	-32.2	(7.5)	-17.9	(6.8)	-14.1	(8.7)
GRC	-52.3	(12.8)	-53.9	(8.5)	-23.4	(6.9)	-22.5	(7.8)
HUN	-34.0	(9.4)	-34.1	(8.6)	-26.1	(6.9)	-23.9	(6.5)
IRL	-30.6	(10.9)	-32.4	(9.9)	-20.0	(6.7)	-19.0	(8.6)
ISL	-54.8	(8.6)	-56.3	(7.2)	-26.1	(5.0)	-23.4	(7.9)
ITA	-54.2	(12.5)	-49.0	(12.0)	-23.4	(6.2)	-22.2	(6.6)
JPN	-56.7	(12.8)	-49.4	(12.4)	-18.5	(5.9)	-17.3	(7.4)
KOR	-28.0	(10.1)	-21.1	(9.1)	-13.3	(5.2)	-13.3	(5.2)
LUX	-34.7	(12.6)	-35.0	(9.0)	-19.6	(5.4)	-14.6	(8.6)
MEX	-21.6	(9.0)	-22.8	(6.2)	-13.2	(7.0)	-11.5	(9.1)
NOR	-61.0	(13.2)	-62.4	(8.1)	-28.7	(5.8)	-25.3	(6.9)
NZL	-68.0	(12.2)	-61.7	(9.3)	-34.0	(8.5)	-33.9	(14.0)
POL	-49.4	(12.3)	-53.3	(10.4)	-24.5	(7.3)	-22.5	(9.6)
PRT	-29.3	(10.0)	-33.4	(7.3)	-9.6	(4.9)	-6.7	(5.6)
SWE	-43.8	(7.6)	-49.5	(6.4)	-29.6	(6.3)	-27.7	(6.1)
USA	-52.4	(10.1)	-52.2	(9.1)	-11.1	(7.9)	-7.7	(11.4)
OECD average	**-44.9**	**(2.2)**	**-43.4**	**(1.7)**	**-21.4**	**(1.2)**	**-19.3**	**(1.5)**

Box 16.2 **SAS® syntax for testing the gender difference in the 5th percentile of the reading performance (*e.g.* PISA 2000)**

```
%BRR_PROCMEAN_DIF_PV(INFILE=temp1,
                     REPLI_ROOT=w_fstr,
                     BYVAR=cnt ,
                     PV_ROOT=read,
                     COMPARE=st03Q01,
                     CATEGORY=2 1,
                     STAT=p5,
                     OUTFILE=exercise2);
run;
```

On average, across OECD countries, the gender differences are equal to -45, -43, -21 and -19 for the 5th, 10th, 90th and 95th percentiles respectively. It therefore appears that the gender gap varies according to the level of proficiency, the difference in performance between males and females being greater for low achievers than it is for high achievers.

Next, let's examine whether the gender difference is constant or not according to the different types of items. Two new reading scales are computed: the first scale is based on multiple-choice items and the second scale is based on open-ended items. Table 16.4 presents the difference between the standard deviation for males and the standard deviation for females. On average, the standard deviation for males is greater than females by 3.8 on the multiple-choice item scale, and by 8.2 on the open-ended item scale.

Table 16.4

Gender difference in the standard deviation for the two different item format scales in reading (PISA 2000)

	Scale of multiple-choice items		Scale of open-ended items	
	Difference (males – females) in the standard deviation	S.E.	Difference (males – females) in the standard deviation	S.E.
AUS	4.7	(3.1)	8.8	(3.1)
AUT	1.2	(2.5)	4.4	(3.0)
BEL	3.3	(3.0)	7.9	(3.2)
CAN	3.7	(1.4)	6.5	(1.5)
CHE	3.1	(2.7)	4.6	(3.1)
CZE	2.0	(2.6)	8.2	(3.1)
DEU	-1.2	(3.7)	4.7	(3.6)
DNK	2.5	(2.7)	6.8	(3.3)
ESP	4.3	(2.1)	10.8	(2.1)
FIN	6.1	(3.0)	9.2	(2.3)
FRA	4.2	(2.6)	8.6	(2.6)
GBR	2.5	(3.1)	5.4	(2.8)
GRC	4.7	(3.4)	13.6	(3.5)
HUN	-0.7	(3.3)	3.7	(3.2)
IRL	2.9	(3.0)	6.4	(2.8)
ISL	7.7	(3.6)	12.1	(3.0)
ITA	1.7	(2.9)	9.2	(3.6)
JPN	4.3	(3.1)	13.4	(3.6)
KOR	1.8	(3.0)	5.2	(2.1)
LUX	3.7	(3.4)	5.4	(3.6)
MEX	2.8	(2.6)	3.5	(3.5)
NOR	8.0	(3.1)	12.8	(3.7)
NZL	6.6	(3.6)	9.0	(4.3)
POL	6.0	(3.7)	12.5	(3.7)
PRT	4.6	(2.7)	8.1	(2.8)
SWE	5.4	(2.3)	6.2	(2.7)
USA	6.9	(3.2)	14.5	(3.4)
OECD average	**3.8**	**(0.6)**	**8.2**	**(0.6)**

The item format is therefore related to the gender difference in the performance distribution. Increasing the proportion of multiple-choice items will minimise the difference between males and females in performance dispersion. As the proportion of open-ended items increase, the difference between males and females in performance distribution will increase.

In conclusion, the results suggest that any strategies aimed at reducing the gender gap should target male low performers. The consistent findings of the wider gender gap for students at the lower end of performance, in conjunction with the impact of item format on the standard deviation, might also suggest a tendency of male low performers to invest less in schoolwork than female low performers. Even if some studies demonstrate that reading disabilities are more frequent in males than in females (Rutter *et al.*, 2004), remedial strategies will have to take into account student motivation and behaviour in school.

EXAMPLE 2: PROMOTING SOCIO-ECONOMIC DIVERSITY WITHIN SCHOOL?

A few decades ago, some OECD countries set up a school catchment area that obliges students to attend their local schools. Countries with such a school attendance policy usually present small between-school variance (i.e., intraclass correlation coefficients) in students' performance and students' socio-economic background indicator. Every school, in some sense, has students who represent the population in the area that the school is located in.

In other countries, parents are free to select the school their children attend. This freedom generally tends to be related to an increase between-school variance in students' performance and students' socio-economic background. The PISA initial reports have extensively discussed such equity issues and equity in educational opportunity is an important issue that policy makers can no longer ignore (OECD, 2004, 2007). Belgium is one of the countries which show large between-school variance in student performance in science and the majority of which are explained by the student and school socio-economic background, together with other OECD countries including Austria, Czech Republic, Germany, Hungary and the Netherlands (OECD, 2007, Table 4.1a). For these countries, what would be the best strategy to provide students with equal educational opportunity regardless of their socio-economic background? The following section will examine this issue, taking Belgium as an example.

As illustrated in Figure 1.1 in Chapter 1 of this manual, between-school variance in performance (i.e. academic segregation) and between-school variance in students' socio-economic background (i.e. social segregation) are closely intertwined. Unfortunately, it is not easy to know whether social segregation is an antecedent or a consequence of academic segregation. For example, in countries with a substantial proportion of students enrolled in private schools with admission fees, one might suspect that academic segregation is partly a consequence of social segregation. In some other countries where students are grouped at an early age according to their performance, social segregation may be a consequence of academic segregation.

Before adopting a specific educational reform, it is important to disentangle the relationship between social segregation and academic segregations and help policy makers know where to target a reform. For example, even if a reform is designed to decrease the difference in school socio-economic intake, the reform would fail when social segregation is simply the consequence of academic segregation.

In this example, the PISA index of economic, social and cultural status (ESCS) is used as an indicator of the student socio-economic background. As described in Chapter 15, estimating the importance of the school socio-economic composition effect on student performance requires the computation of the school average PISA index of economic, social and cultural status (ESCS) of student. The composition effect, then, can be estimated with the following multilevel model:

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(ESCS) + \varepsilon_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(MU\_ESCS) + U_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

In the educational system in Belgium, the school socio-economic composition has an important impact on student performance, as illustrated in Model 2 in Table 16.5. The SAS® macro PROC_MIXED_PV was used to obtain unbiased estimates of the standard errors.

Table 16.5

Random and fixed parameters in the multilevel model with student and school socio-economic background

	Model 1		Model 2	
	Estimate	S.E.	Estimate	S.E.
τ_0^2	5113.8	(142.5)	1456.7	(88.8)
^{2}	4750.7	(126.7)	4568.4	(118.1)
Intercept	509.9	(0.3)	491.3	(0.5)
ESCS			17.3	(1.2)
MU_ESCS			102.6	(1.5)

An increase of 1 point on the school socio-economic intake variable (*i.e.* school average ESCS) is associated with an increase of 102.6 points in science. As the school socio-economic intake in Belgium ranges from -1.73 to 1.63, the difference in science performance between the most disadvantaged and the most advantaged schools in Belgium is more than 300 score points.

It should also be noted that the student socio-economic background and the school socio-economic background explain about 72% of the school variance, *i.e.* (5 113.8-1 456.7)/5 113.8.

In Belgium, the educational system consists of three types of secondary schools: *(i)* schools that provide general education only; *(ii)* schools that provide vocational education only; *(iii)* schools that provide both general and vocational education.

Before starting the multilevel analysis, a data file is prepared, as shown in Box 16.3. Two dummy variables are created to differentiate the three types of schools: GEN for the schools that provide only general education and VOC for the schools that provide only vocational education. The detailed description for the variable REPEAT and MU_REPEAT is provided later in this section.

Box 16.3 [1/2] **SAS® syntax for preparing a data file for the multilevel analysis**

```
data temp2;
      set pisa2006.stu;
      if (cnt="BEL");
      if (st01Q01 in (10,11,12)) then repeat=0;
      if (st01Q01=9) then repeat=1;
      if (st01Q01=8) then repeat=2;
      if (st01Q01=7) then repeat=3;
      if (repeat = .) then delete;
run;
proc sort data=temp2;
      by cnt schoolid stidstd;
run;
proc means data=temp2 vardef=wgt noprint;
      var escs repeat;
      by schoolid;
      weight w_fstuwt;
      output out=temp3 mean=mu_escs mu_repeat;
run;
data temp4;
      merge temp2 temp3;
      by schoolid;
run;
proc freq data=temp2 noprint;
      table schoolid * iscedo / out=temp5;
run;
proc transpose data=temp5 out=temp6;
      var count;
      by schoolid;
      id iscedo;
run;
data temp7;
      set temp6;
      if (_1 = .) then _1=0;
      if (_3 = .) then _3=0;
    gen=0;
      voc=0;
      if (_3=0) then gen=1;
      if (_1=0) then voc=1;
      keep schoolid gen voc;
run;
```

Box 16.3 [2/2] **SAS® syntax for preparing a data file for the multilevel analysis**

```
data temp8;
       merge temp4 temp7 ;
       by schoolid;
       nbmis=0;
       array mis (6) escs mu_escs repeat mu_repeat gen voc;
       do i=1 to 6;
             if (mis(i) in (.,.N,.M,.I)) then nbmis=nbmis+1;
       end;
       if (nbmis=0);
       w_fstr0=w_fstuwt;
run;
proc univariate data=temp8 noprint;
       var w_fstr0;
       by cnt;
       output out=temp9 sum=somme n=nombre;
run;
data temp10;
       merge temp8 temp9;
       by cnt;
       array aaa (81) w_fstr0-w_fstr80;
       do j=1 to 81;
             aaa(j)=(aaa(j)/somme)*nombre;
       end;
       pv1=pv1scie;
       pv2=pv2scie;
       pv3=pv3scie;
       pv4=pv4scie;
       pv5=pv5scie;
run;
```

As a first step, preliminary analysis is conducted, using only one plausible value without replicates, to examine if the school composition effect differs according to school type. Box 16.4 presents the SAS® syntax for this preliminary analysis and Box 16.5 presents the SAS® output of this model. As shown in Box 16.4, analysing the variability of the school composition effect according to school type can be modelled by Level 2 interactions (*i.e.* mu_escs*gen and mu_escs*voc). It is also necessary, as described in Chapter 15, to include them (*i.e.* gen and voc) as the main effects.

Box 16.4 **SAS® syntax for running a preliminary multilevel analysis with one PV**

```
proc mixed data= temp10 noclprint  noitprint noinfo method=ml;
           class schoolid;
           model pv1= escs mu_escs gen voc mu_escs*gen mu_escs*voc
            /solution;
           random intercept /subject=schoolid ;
                  weight w_fstr0;
run;
```

Box 16.5 **SAS® output for fixed parameters in the multilevel model**

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	485.19	3.2541	263	149.10	<.0001
ESCS	17.0069	0.9346	8506	18.20	<.0001
mu_escs	120.78	8.6052	8506	14.04	<.0001
gen	54.3207	8.9145	8506	6.09	<.0001
voc	1.2123	6.0937	8506	0.20	0.8423
mu_escs*gen	-77.8060	14.2017	8506	-5.48	<.0001
mu_escs*voc	-40.9547	13.9624	8506	-2.93	0.0034

The school composition effect shown in Box 16.4 is the effect compared with a reference group, *i.e.* schools providing both general and vocational education. The school composition effect for schools providing general education only is equal to 43, *i.e.* 120.78-77.80, and the school composition effect for schools providing vocational education only is equal to 80, *i.e.* 120.78-40.95. However, these results were obtained by using only one plausible value and the macro was not used so that standard errors are not unbiased.

According to *Les indicateurs de l'enseignement* (2007, p. 35), a student who has to repeat a grade in secondary education is two or three times more likely to move to another school than to repeat the grade in the same school in the French-speaking community in Belgium. Further, usually, the student will move to a school that has a lower socio-economic intake.

The grade repetition information was therefore added to the previous model both at the student and school levels. The proportion of grade repetition at the school level is a proxy of academic segregation. In Belgium, as compulsory education is dictated by the calendar year of birth and as the PISA target population is also defined in term of the calendar year, it is straightforward to determine if a student is in the expected grade or not. The difference in years between the expected grade and the actual grade is computed at the student level (*i.e.* REPEAT) and the school average of these differences is also computed at the school level (*i.e.* MU_REPEAT), as seen in Box 16.3. These variables are included as independent variables.

It is also possible to model cross-level interactions for analysing the differences between the three types of schools as shown in the model in Box 16.3. Here, however, in order to facilitate the readability of the results, a multilevel model is run separately for each of the three school types. The final model can be written as:

$$y_{ij} = \beta_{0j} + \beta_{1j}\,(ESCS) + \beta_{2j}\,(REPEAT)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{10}\,(MU\_ESCS) + \gamma_{20}\,(MU\_REPEAT)$$

$$\beta_{10} = \gamma_{10}$$

$$\beta_{20} = \gamma_{20}$$

If the school socio-economic composition effect decreases substantially by introducing the grade repetition variables, this means that social segregation is mainly a result of academic segregation in Belgium.

Table 16.6 presents the fixed and random parameters estimates of the final model as well as two previous models, *i.e.* the empty model (Model 1) and the model with student and school socio-economic background (Model 2). Estimates and their respective standard errors were obtained with the PROC_MIXED_PV macro as shown in Box 16.6.

The intraclass correlation on the whole population is equal to 0.52. It is respectively equal to 0.42, 0.26 and 0.42 for schools providing both general and vocational education, for schools providing general education only, and for schools providing vocational education only. Therefore, in Belgium, differences between schools in performance are small for the schools providing general education only, but large for schools providing vocational education or schools providing both general and vocational education.

The results of Model 2 indicate that the school socio-economic composition effects are important for students in schools providing both general and vocational education and to a lesser extent for students in schools providing vocational education only. On the other hand, the school socio-economic composition effect is small for students in schools providing general education. The percentage of school variance explained by the student socio-economic background and the school socio-economic intake are respectively equal to 66%, 38% and 58% for population in schools providing both general and vocation education, in schools providing general education only and in schools providing vocational education only.

Table 16.6
Random and fixed parameters in the multilevel model with socio-economic background and grade retention at the student and school levels

Schools providing both general and vocational education

	Model 1		Model 2		Model 3	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
τ_0^2	4115.4	(149.8)	1400.4	(96.5)	666.9	(90.4)
^{2}	5582.0	(335.5)	5271.2	(310.0)	4516.3	(256.9)
Intercept	486.9	(0.5)	485.3	(0.6)	539.9	(3.4)
ESCS			22.0	(1.6)	18.6	(1.6)
MU_ESCS			114.9	(2.5)	57.6	(4.7)
REPEAT					-49.0	(2.0)
MU_REPEAT					-55.8	(7.1)

Schools providing general education only

	Model 1		Model 2		Model 3	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
τ_0^2	1350.2	(105.7)	842.4	(91.3)	377.6	(50.0)
^{2}	3740.9	(299.8)	3663.3	(290.3)	3326.4	(235.3)
Intercept	578.1	(0.6)	539.8	(1.6)	587.5	(2.3)
ESCS			12.1	(2.1)	9.6	(2.0)
MU_ESCS			48.3	(3.0)	15.1	(3.0)
REPEAT					-45.2	(3.7)
MU_REPEAT					-90.3	(6.9)

School providing vocational education only

	Model 1		Model 2		Model 3	
	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
τ_0^2	3185.9	(251.6)	1346.1	(144.4)	569.9	(127.4)
^{2}	4363.0	(437.2)	4251.6	(438.2)	3924.5	(403.2)
Intercept	468.6	(1.0)	486.0	(0.8)	531.8	(1.9)
ESCS			13.1	(2.6)	11.1	(2.5)
MU_ESCS			86.0	(4.0)	12.7	(5.7)
REPEAT					-38.9	(5.6)
MU_REPEAT					-78.1	(7.9)

The results of Model 3 illustrate the importance of the academic segregation in Belgium, even within school types. Indeed, the introduction of the grade repetition information substantially reduces the school composition effect. For instance, in schools providing general education only, this effect changes from 48.3 to 15.1 and from 86.0 to 12.7 for schools providing vocational education only. This reduction also reflects the high correlation between the school socio-economic intake and the percentage of over-aged students.

In conclusion, these results indicate that social segregation in the Belgian educational system is mainly an outcome of academic segregation. Thus, promoting social diversity within each school, without taking into account academic segregation, will not substantially reduce educational inequities.

Box 16.6 **SAS® syntax for running multilevel models with the PROC_MIXED_PV macro**

```
%include "c:\pisa\macro\proc_mixed_pv.sas";

/*Model 1*/
%BRR_MIXED_PV(INFILE=temp10,
                   REPLI_ROOT=w_fstr,
                   PV_ROOT=pv,
                   FIXEF=,
                   RANEF=,
                   BYVAR=cnt gen voc,
                   LEVEL2=schoolid,
                   OUTSCREEN="c:\ml.out",
                   OUTFILE=exercise3);
run;

/*Model 2*/
%BRR_MIXED_PV(INFILE=temp10,
                   REPLI_ROOT=w_fstr,
                   PV_ROOT=pv,
                   FIXEF=escs mu_escs,
                   RANEF=,
                   BYVAR=cnt gen voc,
                   LEVEL2=schoolid,
                   OUTSCREEN="c:\ml.out",
                   OUTFILE=exercise4);
run;

/*Model 3*/
%BRR_MIXED_PV(INFILE=temp10,
                   REPLI_ROOT=w_fstr,
                   PV_ROOT=pv,
                   FIXEF=escs mu_escs retard mu_retard,
                   RANEF=,
                   BYVAR=cnt gen voc,
                   LEVEL2=schoolid,
                   OUTSCREEN="c:\ml.out",
                   OUTFILE=exercise5);
run;
```

EXAMPLE 3: THE INFLUENCE OF AN EDUCATIONAL SYSTEM ON THE EXPECTED OCCUPATIONAL STATUS OF STUDENTS AT AGE 30

This section examines the influence of an educational system on the expected occupational status of students at age 30. In PISA 2000 and PISA 2006 students were asked to report on their expected occupation at the age of 30. The open-ended responses for occupations were coded in accordance with the International Standard Classification of Occupations (ISCO 1988), to derive students' expected occupational status mapped to the International Socio-Economic Index of Occupational Status (ISEI) (Ganzebom *et al.*, 1992).

The structure of the educational system was assessed through the academic segregation and social segregation coefficients, as described in Chapter 1. By way of reminder, the two SAS® macros devoted to multilevel modelling return the intraclass correlation and its standard error. In Chapter 1, some of the consequences of social and/or academic segregations have been listed. Monseur and Crahay (forthcoming) demonstrated that as social and academic segregations increase, *(i)* the difference between low performers and high performers increases; *(ii)* the difference between disadvantaged and advantaged socio-economic backgrounds of students increases; and *(iii)* the correlation between the student socio-economic background and his/her performance in reading increases.

Three other indicators were computed for assessing the influence of the educational system on the index of expected occupational status of students:

1. the percentage of variance in students' expected occupational status that lies between schools;
2. the correlation between students' expected occupational status and student performance;
3. the correlation between students' expected occupational status and the international socio-economic index of occupational status (HISEI) for parents.

It is assumed that in highly tracked or segregated educational systems:

1. the intraclass correlation for students' expected occupational status will be higher,
2. the correlation between students' expected occupational status and student performance will be higher,
3. the correlation between students' expected occupational status and the international socio-economic index of occupational status (HISEI) for parents will be higher.

Table 16.7 and Table 16.8 present these five indicators respectively for PISA 2000 data and for PISA 2006. These five indicators include: the segregation indices (*i.e.* intraclass correlation coefficients) of student performance; international socio-economic index of occupational status (HISEI); and students' expected occupational status; as well as the correlation coefficients between student performance and students' expected occupational status; and between HISEI and students' expected occupational status.

Table 16.7
Segregation indices and correlation coefficients by country (PISA 2000)

	Segregation indices (intraclass correlation coefficient)						Correlation between:			
	Student performance in reading		International socio-economic index of occupational status (HISEI)		Students' expected occupational status		Student performance in reading and students' expected occupational status		International socio-economic index of occupational status (HISEI) and students' expected occupational status	
	rho	S.E.	rho	S.E.	rho	S.E.	Coefficient	S.E.	Coefficient	S.E.
AUS	0.18	(0.01)	0.17	(0.01)	0.09	(0.01)	0.41	(0.02)	0.24	(0.02)
AUT	0.60	(0.02)	0.23	(0.01)	0.42	(0.02)	0.42	(0.02)	0.34	(0.02)
BEL	0.60	(0.01)	0.24	(0.01)	0.38	(0.01)	0.51	(0.02)	0.37	(0.02)
CAN	0.18	(0.01)	0.12	(0.00)	0.07	(0.00)	0.30	(0.01)	0.17	(0.01)
CHE	0.43	(0.02)	0.18	(0.01)	0.26	(0.02)	0.45	(0.02)	0.37	(0.02)
CZE	0.53	(0.01)	0.20	(0.02)	0.38	(0.02)	0.52	(0.01)	0.35	(0.02)
DEU	0.59	(0.01)	0.21	(0.01)	0.31	(0.02)	0.46	(0.02)	0.30	(0.02)
DNK	0.19	(0.03)	0.13	(0.02)	0.10	(0.03)	0.42	(0.02)	0.31	(0.03)
ESP	0.20	(0.01)	0.26	(0.02)	0.08	(0.01)	0.41	(0.01)	0.26	(0.02)
FIN	0.12	(0.04)	0.13	(0.01)	0.05	(0.01)	0.38	(0.02)	0.26	(0.02)
FRA	0.50	(0.01)	0.20	(0.01)	0.28	(0.01)	0.46	(0.01)	0.31	(0.02)
GBR	0.22	(0.01)	0.16	(0.01)	0.08	(0.01)	0.41	(0.01)	0.27	(0.02)
GRC	0.51	(0.02)	0.22	(0.02)	0.22	(0.02)	0.40	(0.02)	0.28	(0.02)
HUN	0.67	(0.01)	0.30	(0.01)	0.40	(0.02)	0.51	(0.02)	0.36	(0.02)
IRL	0.18	(0.02)	0.13	(0.01)	0.05	(0.01)	0.42	(0.02)	0.24	(0.02)
ISL	0.08	(0.02)	0.15	(0.03)	0.04	(0.03)	0.34	(0.02)	0.22	(0.02)
ITA	0.55	(0.02)	0.22	(0.01)	0.38	(0.02)	0.31	(0.02)	0.31	(0.02)
JPN	0.46	(0.01)	0.06	(0.01)	0.09	(0.02)	0.18	(0.03)	0.13	(0.03)
KOR	0.37	(0.01)	0.19	(0.01)	0.18	(0.01)	0.29	(0.02)	0.21	(0.02)
LUX	0.31	(0.01)	0.20	(0.01)	0.20	(0.02)	0.29	(0.02)	0.23	(0.02)
MEX	0.53	(0.01)	0.33	(0.02)	0.13	(0.02)	0.20	(0.02)	0.18	(0.02)
NLD	0.50	(0.02)	0.13	(0.02)	0.19	(0.02)	0.45	(0.02)	0.25	(0.03)
NOR	0.10	(0.02)	0.09	(0.01)	0.07	(0.01)	0.42	(0.02)	0.31	(0.02)
NZL	0.16	(0.01)	0.12	(0.01)	0.06	(0.01)	0.38	(0.02)	0.25	(0.02)
POL	0.62	(0.01)	0.24	(0.01)	0.53	(0.02)	0.54	(0.02)	0.34	(0.02)
PRT	0.37	(0.02)	0.23	(0.01)	0.09	(0.01)	0.41	(0.02)	0.29	(0.02)
SWE	0.09	(0.01)	0.12	(0.01)	0.05	(0.01)	0.36	(0.02)	0.24	(0.02)
USA	0.29	(0.02)	0.15	(0.01)	0.05	(0.01)	0.27	(0.02)	0.14	(0.02)

Table 16.8
Segregation indices and correlation coefficients by country (PISA 2006)

	Segregation indices (intraclass correlation coefficient)						Correlation between:			
	Student performance in science		International socio-economic index of occupational status (HISEI)		Students' expected occupational status		Student performance in science and students' expected occupational status		International socio-economic index of occupational status (HISEI) and students' expected occupational status	
	rho	S.E.	rho	S.E.	rho	S.E.	Coefficient	S.E.	Coefficient	S.E.
AUS	0.18	(0.01)	0.16	(0.01)	0.08	(0.01)	0.39	(0.01)	0.22	(0.01)
AUT	0.55	(0.01)	0.26	(0.01)	0.46	(0.01)	0.39	(0.04)	0.36	(0.02)
BEL	0.52	(0.01)	0.22	(0.01)	0.36	(0.01)	0.48	(0.02)	0.33	(0.02)
CAN	0.19	(0.01)	0.12	(0.00)	0.08	(0.00)	0.28	(0.01)	0.20	(0.01)
CHE	0.36	(0.01)	0.15	(0.01)	0.17	(0.01)	0.30	(0.02)	0.25	(0.01)
CZE	0.53	(0.02)	0.26	(0.02)	0.34	(0.02)	0.50	(0.02)	0.35	(0.02)
DEU	0.57	(0.01)	0.21	(0.01)	0.29	(0.02)	0.43	(0.02)	0.34	(0.02)
DNK	0.16	(0.02)	0.10	(0.01)	0.07	(0.01)	0.41	(0.02)	0.27	(0.02)
ESP	0.15	(0.01)	0.21	(0.01)	0.06	(0.00)	0.42	(0.02)	0.25	(0.01)
FIN	0.06	(0.01)	0.10	(0.01)	0.05	(0.01)	0.39	(0.02)	0.28	(0.02)
FRA	0.54	(0.01)	0.28	(0.02)	0.31	(0.02)	0.43	(0.02)	0.33	(0.02)
GBR	0.20	(0.01)	0.13	(0.01)	0.08	(0.00)	0.42	(0.02)	0.26	(0.01)
GRC	0.47	(0.02)	0.29	(0.02)	0.30	(0.02)	0.45	(0.02)	0.26	(0.02)
HUN	0.61	(0.02)	0.28	(0.02)	0.41	(0.02)	0.45	(0.02)	0.30	(0.02)
IRL	0.17	(0.02)	0.17	(0.01)	0.07	(0.01)	0.42	(0.02)	0.26	(0.02)
ISL	0.09	(0.03)	0.13	(0.03)	0.07	(0.03)	0.34	(0.02)	0.22	(0.02)
ITA	0.50	(0.01)	0.20	(0.01)	0.36	(0.01)	0.31	(0.02)	0.28	(0.01)
JPN	0.47	(0.01)	0.10	(0.01)	0.16	(0.01)	0.26	(0.03)	0.17	(0.02)
KOR	0.35	(0.01)	0.13	(0.01)	0.11	(0.01)	0.35	(0.02)	0.13	(0.02)
LUX	0.30	(0.01)	0.24	(0.01)	0.26	(0.02)	0.42	(0.02)	0.30	(0.02)
MEX	0.40	(0.04)	0.25	(0.01)	0.08	(0.01)	0.13	(0.02)	0.12	(0.01)
NLD	0.60	(0.01)	0.18	(0.01)	0.32	(0.01)	0.49	(0.01)	0.29	(0.02)
NOR	0.11	(0.01)	0.12	(0.01)	0.05	(0.01)	0.37	(0.02)	0.25	(0.02)
NZL	0.17	(0.01)	0.12	(0.01)	0.07	(0.01)	0.35	(0.02)	0.23	(0.02)
POL	0.14	(0.01)	0.19	(0.01)	0.05	(0.01)	0.43	(0.01)	0.29	(0.01)
PRT	0.32	(0.01)	0.26	(0.01)	0.10	(0.01)	0.41	(0.02)	0.29	(0.02)
SVK	0.42	(0.02)	0.23	(0.02)	0.31	(0.02)	0.44	(0.02)	0.32	(0.02)
SWE	0.12	(0.02)	0.12	(0.01)	0.07	(0.01)	0.31	(0.02)	0.23	(0.01)
TUR	0.53	(0.02)	0.18	(0.01)	0.23	(0.02)	0.35	(0.02)	0.15	(0.02)
USA	0.24	(0.01)	0.15	(0.01)	0.04	(0.01)	0.22	(0.02)	0.13	(0.01)

Figure 16.1
Relationship between the segregation index of students' expected occupational status and the segregation index of student performance in reading (PISA 2000)

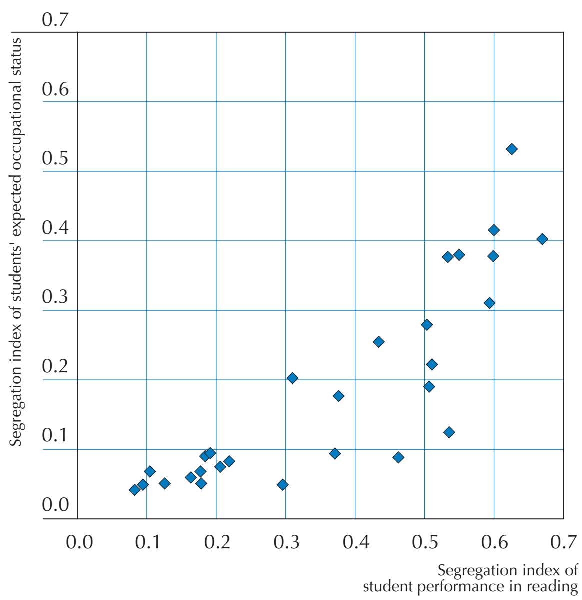

Figure 16.1 presents the correlation at the country level between the segregation index of student performance in reading and the segregation index of students' expected occupational status. It can be observed in this figure that the segregation index of students' expected occupational status increases as the academic segregation increases. This result makes sense as in highly segregated educational systems, low performers are more likely to attend vocational schools that train students for specific types of occupations.

Figure 16.2 is quite appealing. As the intraclass correlation of the students' expected occupational status increases, the correlation between the parents occupation and the self-expected correlation tends to be higher than what is observed in non-segregated educational systems.

Figure 16.2

Relationship between the segregation index of students' expected occupational status and the correlation between HISEI and students' expected occulational status

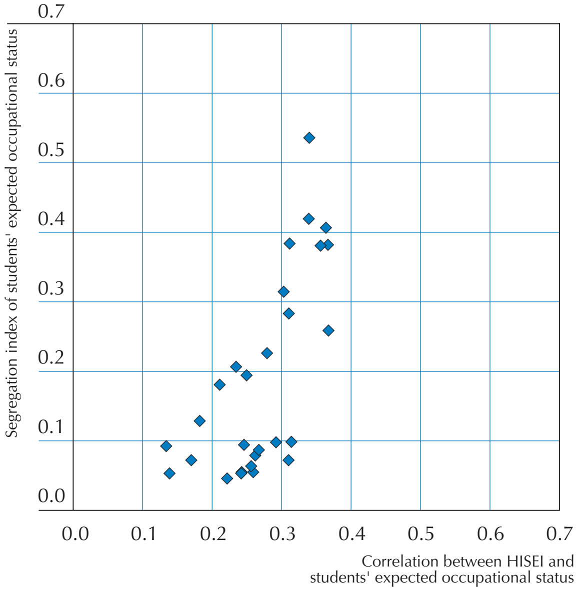

Table 16.9 and Table 16.10 present the correlation at the country level between the five indicators.

Table 16.9

Country correlations (PISA 2000)

	Segregation index of international socio-economic index of occupational status (HISEI)	Segregation index of students' expected occupational status	Correlation between student performance in reading and students' expected occupational status	Correlation between international socio-economic index of occupational status (HISEI) and students' expected occupational status
Segregation index of student performance in reading	0.63	0.86	0.28	0.43
Segregation index of international socio-economic index of occupational status (HISEI)		0.58	0.24	0.41
Segregation index of students' expected occupational status			0.54	0.69
Correlation between student performance in reading and students' expected occupational status				0.85

Table 16.10
Country correlations (PISA 2006)

	Segregation index of international socio-economic index of occupational status (HISEI)	Segregation index of students' expected occupational status	Correlation between student performance in science and students' expected occupational status	Correlation between international socio-economic index of occupational status (HISEI) and students' expected occupational status
Segregation index of student performance in science	0.65	0.88	0.23	0.29
Segregation index of international socio-economic index of occupational status (HISEI)		0.69	0.38	0.48
Segregation index of students' expected occupational status			0.45	0.60
Correlation between student performance in science and students' expected occupational status				0.78

As shown by Tables 16.9 and 16.10, academic segregation is highly associated with the segregation index of students' expected occupational status which seems to reinforce the correlation between: *(i)* performance and students' expected occupational status; and *(ii)* parents' occupational status and students' expected occupational status.

CONCLUSION

This chapter illustrated how policy relevant questions might be at least partially answered by PISA data. The first example addressed an important equity issue, *i.e.* the gender gap in reading. Results indicate that education reforms for reducing the gender gap in reading performance should be targeted at low male achievers. It also identified the methodological concern of the impact of item format on the respective standard deviation for boys and for girls. This is obviously an area where PISA offers extensive opportunities for methodological research.

The second example demystified the concept of school socio-economic composition in a particular context and revealed that in Belgium, social segregation mainly results from academic segregation.

Finally, the last example broadened the consequences on segregated education systems to students' expected occupational status at the age of 30. It concretised the long-term effects of educational policies.

17

SAS® Macro

INTRODUCTION

This chapter presents the 17 SAS® macros used in the previous chapters. These are also available from *www.pisa.oecd.org.* Table 17.1 presents a summary of the 17 SAS® macros. The file names are in blue and the macro names as well as their arguments are in black.

STRUCTURE OF THE SAS® MACROS

All SAS® macros have the same structure.

- The first step consists of:
  - Saving the INFILE data file into a temporary data file denoted BRRDATA and dropping all variables that are not necessary for the analysis; and
  - Sorting that file by all variables specified in the BYVAR argument.
- The second step is the iterative part of the macro:
  - The requested statistics is computed 81 times for the computation without plausible values or 405 times for the computation with plausible values;
  - At each run, the results are stored in a temporary file, with the number of the replicate and the number of the plausible values if needed then added to that file; and
  - That file is merged with another temporary file that keeps the results of all runs.
- The third step consists of data file transformations to allow the computation of the final estimate and its respective standard error. This step is quite specific to each SAS® macro.
- The fourth step is devoted to the computation of the final statistic and its respective standard error:
  - The final estimates and 80 replicates are separated, *i.e.* BRR_TEMP1 is divided into BRR_TEMP2 (final estimates) and BRR_TEMP3 (replicate estimates). In the case of the plausible values, the five estimates are averaged and the measurement error is computed;
  - The two files are then merged to create BRR_TEMP4 and the squared differences between the final estimate and the 80 replicates are computed;
  - Through a PROC UNIVARIATE procedure, the sum of the squared differences is computed and divided by 20. These results are saved in BRR_TEMP5; and
  - BRR_TEMP3 (finale estimates and, in the case of the plausible values, the measurement variance) and BRR_TEMP5 (the sampling variance estimates) are combined. The final estimates and their respective standard errors are saved in the OUTFILE datafile.
- The final step flags the statistics for not reaching minimum sample size requirements that researchers set. This step is not included in some macros.
  - The unweighted numbers of students, the unweighted number of schools and the weighted percentage of the population are firstly computed per population estimates returned by the macro;
  - The unweighted number of schools and the weighted percentage of the population are then compared with the benchmarks provided by the researchers; and
  - If these numbers are below the benchmarks, the results are flagged.

The SAS® syntax is presented hereafter.

Table 17.1
Synthesis of the 17 SAS® macros

Requested statistics	Without plausible values	With plausible values
Mean, STD, VAR, Quartiles, Median, Percentiles	**PROC_MEANS_NO_PV.sas** %**BRR_PROCMEAN**(INFILE= , REPLI_ROOT= , BYVAR= , VAR= , STAT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);	**PROC_MEANS_PV.sas** %**BRR_PROCMEAN_PV**(INFILE= , REPLI_ROOT= , BYVAR= , PV_ROOT= , STAT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Frequencies	**PROC_FREQ_NO_PV.sas** %**BRR_FREQ**(INFILE= , REPLI_ROOT= , BYVAR= , VAR= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);	**PROC_FREQ_PV.sas** %**BRR_FREQ_PV**(INFILE= , REPLI_ROOT= , BYVAR= , PV_ROOT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Regression	**PROC_REG_NO_PV.sas** %**BRR_REG**(INFILE= , REPLI_ROOT= , VARDEP= , EXPLICA= , BYVAR= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);	**PROC_REG_PV.sas** %**BRR_REG_PV**(INFILE= , REPLI_ROOT= , EXPLICA= , BYVAR= , PV_ROOT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Correlation coefficients	**PROC_CORR_NO_PV.sas** %**BRR_CORR**(INFILE= , REPLI_ROOT= , BYVAR= , VAR1= , VAR2= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);	**PROC_CORR_PV.sas** %**BRR_CORR_PV**(INFILE= , REPLI_ROOT= , BYVAR= , EXPLICA= , PV_ROOT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Differences on mean, STD, VAR, Quartiles, Median, Percentiles	**PROC_DIF_NO_PV.sas** %**BRR_PROCMEAN_DIF**(INFILE= , REPLI_ROOT= , BYVAR= , VAR= , COMPARE= , CATEGORY= , STAT= , OUTFILE=);	**PROC_DIF_PV.sas** %**BRR_PROCMEAN_DIF_PV**(INFILE= , REPLI_ROOT= , BYVAR= , PV_ROOT= , COMPARE= , CATEGORY= , STAT= , OUTFILE=);
Quartiles		**QUARTILE _PV.sas** %**QUARTILE_PV**(INFILE= , REPLI_ROOT= , BYVAR= , PV_ROOT= , INDEX= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Relative risk	**RELATIVE_RISK_NO_PV.sas** %**BRR_RR**(INFILE= , REPLI_ROOT= , BYVAR= , ANTECEDENT= , OUTCOME= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);	**RELATIVE_RISK_PV.sas** %**BRR_RR_PV**(INFILE= , REPLI_ROOT= , BYVAR= , ANTECEDENT_ROOT= , OUTCOME_ROOT= , LIMIT= , LIMIT_CRITERIA= , ID_SCHOOL= , OUTFILE=);
Effect size	**EFFECT_SIZE_NO_PV.sas** %**BRR_EFFECT**(INFILE= , REPLI_ROOT= , BYVAR= , VAR= , EFFECT= , OUTFILE=);	**EFFECT_SIZE_PV.sas** %**BRR_EFFECT_PV**(INFILE= , REPLI_ROOT= , BYVAR= , PV_ROOT= , EFFECT= , OUTFILE=);
Multilevel regression	**PROC_MIXED_NO_PV.sas** %**BRR_MIXED**(INFILE= , REPLI_ROOT= , VARDEP= , FIXEF= , RANEF= , BYVAR= , LEVEL2= , OUTSCREEN= , OUTFILE=);	**PROC_MIXED_PV.sas** %**BRR_MIXED_PV**(INFILE= , REPLI_ROOT= , PV_ROOT= , FIXEF= , RANEF= , BYVAR= , LEVEL2= , OUTSCREEN= , OUTFILE=);

Box 17.1 [1/3] **SAS® macro of PROC_MEANS_NO_PV.sas**

```
%MACRO BRR_PROCMEAN(INFILE =,
                    REPLI_ROOT =,
                    BYVAR = ,
                    VAR =,
                    STAT =,
                    LIMIT=,
                    LIMIT_CRITERIA=,
                    ID_SCHOOL=,
                    OUTFILE =);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE   = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL WEIGHT
VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
VAR = VARIABLE ON WHICH THE REQUESTED STATISTIC WILL BE COMPUTED.
STAT =   REQUESTED STATISTIQUE.
         SUMWGT = SUM OF THE WEIGHT
         MEAN    = MEAN
         VAR =   VARIANCE
         STD = STANDARD DEVIATION
         CV =    COEFFICIENT OF VARIATION
         MEDIAN =      MEDIAN
         Q1 =    FIRST QUARTILE
         Q3 =    THIRD QUARTILE
         QRANGE = RANGE BETWEEN Q1 AND Q3
         PX =    PERCENTILE, WITH P1, P5, P10, P25, P50, P75, P90, P95 and P99
LIMIT = FLAGGING  YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF STUDENTS
AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE POPULATION OF
REFERENCE.
ID_SCHOOL    =   VARIABLE NAME FOR THE SCHOOL IDENTIFICATION.
OUTFILE =    FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
         DELETE BRR_TEMP1;
RUN;

PROC  SORT  DATA=&INFILE  OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80  &BYVAR  &VAR
&ID_SCHOOL);
  BY &BYVAR;
RUN;

%DO I = 0 %TO 80;
         PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
             VAR &VAR ;
             BY &BYVAR;
             WEIGHT &REPLI_ROOT&I;
             OUTPUT OUT=MEAN_TEMP &STAT=PV;
         RUN;

         DATA MEAN_TEMP;
             SET MEAN_TEMP;
             L=&I;
         RUN;

         PROC APPEND BASE = BRR_TEMP1 DATA=MEAN_TEMP;
         RUN;
%END;
```


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Box 17.1 [2/3] **SAS® macro of PROC_MEANS_NO_PV.sas**

```
DATA BRR_TEMP4;
         MERGE BRR_TEMP2 BRR_TEMP3;
         BY &BYVAR;
         VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
         VAR VARI;
         BY &BYVAR;
         OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;


DATA BRR_TEMP6;
         MERGE BRR_TEMP3 BRR_TEMP5;
         BY &BYVAR;
         SESTAT=(SS)**0.5;
         FORMAT STAT F10.2;
         FORMAT SESTAT F10.2;
         KEEP &BYVAR STAT SESTAT;
RUN;

%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

         DATA &OUTFILE;
             SET BRR_TEMP6;
         RUN;

%END;
%ELSE %DO;
         DATA BRR_TEMP7;
             SET BRRDATA;
             NB_MISS=0;
             ARRAY LIST_VAR (1) &VAR;
             DO K=1 TO 1;
                 IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
             END;
             IF (NB_MISS>1) THEN NB_MISS=1;
         RUN;
         PROC FREQ DATA=BRR_TEMP7 NOPRINT;
             TABLE NB_MISS /OUT=BRR_TEMP8;
             BY &BYVAR;
             WHERE (NB_MISS=0);
         RUN;
         %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
         DATA BRR_TEMP8;
             SET BRR_TEMP8;
             IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
             ELSE FLAG_STUD=0;
             KEEP &BYVAR FLAG_STUD;
         RUN;
         PROC SORT DATA=BRR_TEMP7;
             BY &BYVAR &ID_SCHOOL;
         RUN;
         PROC FREQ DATA=BRR_TEMP7 NOPRINT;
             TABLE NB_MISS /OUT=BRR_TEMP9;
             BY &BYVAR &ID_SCHOOL;
             WHERE (NB_MISS=0);
         RUN;
         PROC FREQ DATA=BRR_TEMP9 NOPRINT;
             TABLE NB_MISS /OUT=BRR_TEMP10;
             BY &BYVAR;
         RUN;
```

Box 17.1 [3/3] **SAS® macro of PROC_MEANS_NO_PV.sas**

```
%LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
         DATA BRR_TEMP10;
             SET BRR_TEMP10;
             IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
             ELSE FLAG_SCH=0;
             KEEP &BYVAR FLAG_SCH;
         RUN;
         PROC SORT DATA=BRR_TEMP7;
             BY &BYVAR NB_MISS;
         RUN;
         PROC FREQ DATA=BRR_TEMP7 NOPRINT;
             TABLE NB_MISS/OUT=BRR_TEMP11;
             BY &BYVAR;
             WEIGHT &REPLI_ROOT.0;
         RUN;
         %LET K=1;
         %LET POPREF=;
         %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
         %DO %WHILE(&K <= &NBVAR);
             %LET POPREF_ADD=%SCAN(&BYVAR,&K);
             %LET POPREF=&POPREF &POPREF_ADD;
             %LET K=%EVAL(&K+1);
         %END;

         PROC MEANS DATA=BRR_TEMP11 NOPRINT;
             VAR COUNT;
             BY &POPREF;
             OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
         RUN;
         %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
         DATA BRR_TEMP13;
             MERGE BRR_TEMP11 BRR_TEMP12;
             BY &POPREF;
             PCT=(COUNT/SOMWGT)*100;
             IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
             ELSE FLAG_PCT=0;
             IF (NB_MISS=0);
             KEEP &BYVAR FLAG_PCT;
         RUN;
         DATA &OUTFILE;
             MERGE BRR_TEMP6 BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
             BY &BYVAR;
         RUN;
         PROC DATASETS LIBRARY=WORK NOLIST;
             DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_TEMP12
BRR_TEMP13;
         RUN;

%END;

PROC DATASETS LIBRARY=WORK NOLIST;
         DELETE BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6 MEAN_
TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_PROCMEAN;
```

Box 17.2 [1/3] **SAS® macro of PROC_MEANS_PV.sas**

```
%MACRO BRR_PROCMEAN_PV(INFILE =,
                       REPLI_ROOT =,
                       BYVAR = ,
                       PV_ROOT =,
                       STAT =,
                       LIMIT=,
                       LIMIT_CRITERIA=,
                       ID_SCHOOL=,
                       OUTFILE =);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES
PV_ROOT = ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES
STAT =  REQUESTED STATISTIQUE.
       SUMWGT = SUM OF THE WEIGHT
       MEAN = MEAN
       VAR = VARIANCE
       STD = STANDARD DEVIATION
       CV = COEFFICIENT OF VARIATION
       MEDIAN = MEDIAN
       Q1  = FIRST QUARTILE
       Q3  = THIRD QUARTILE
       QRANGE = RANGE BETWEEN Q1 AND Q3
       PX = PERCENTILE, WITH P1, P5, P10, P25, P50, P75, P90, P95 and P99
LIMIT = FLAGGING  YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;

PROC SORT DATA=&INFILE
       OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &PV_ROOT.1-&PV_ROOT.5
&ID_SCHOOL);
       BY &BYVAR;
RUN;

%DO I = 0 %TO 80;
        PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
        VAR &PV_ROOT.1 - &PV_ROOT.5 ;
        BY &BYVAR;
        WEIGHT &REPLI_ROOT&I;
        OUTPUT OUT=MEAN_TEMP &STAT=PV1 - PV5;
       RUN;

       DATA MEAN_TEMP;
              SET MEAN_TEMP;
              L=&I;
       RUN;

       PROC APPEND BASE = BRR_TEMP1 DATA=MEAN_TEMP;
       RUN;

%END;
```

Box 17.2 [2/3] **SAS® macro of PROC_MEANS_PV.sas**

```
DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR) BRR_TEMP3(KEEP=&BYVAR STAT FIN1-FIN5
MESVAR);
        SET BRR_TEMP1;
    IF L > 0 THEN OUTPUT BRR_TEMP2;
    ELSE DO;
        STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
        MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
        OUTPUT BRR_TEMP3;
        END;
RUN;
PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR;
RUN;
PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR;
RUN;
DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
        C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.1;
        FORMAT SESTAT F10.2;
        sestat2=(ss1+(1.2*MESVAR))**0.5;
        KEEP &BYVAR STAT SESTAT sestat2 ;
RUN;
%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;
%END;
%ELSE %DO;
        DATA BRR_TEMP7;
                SET BRRDATA;
                NB_MISS=0;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP8;
                BY &BYVAR;
        RUN;
```

Box 17.2 [3/3] **SAS® macro of PROC_MEANS_PV.sas**

```
%LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP8;
                SET BRR_TEMP8;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP9;
                BY &BYVAR &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP9 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP10;
                BY &BYVAR;
        RUN;
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP10;
                SET BRR_TEMP10;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR FLAG_SCH;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR NB_MISS;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS/OUT=BRR_TEMP11;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
        RUN;
        %LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
        %END;
        PROC MEANS DATA=BRR_TEMP11 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
        RUN;
        %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
        DATA BRR_TEMP13;
                MERGE BRR_TEMP11 BRR_TEMP12;
                BY &POPREF;
                PCT=(COUNT/SOMWGT)*100;
                IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
                ELSE FLAG_PCT=0;
                KEEP &BYVAR FLAG_PCT;
        RUN;
        DATA &OUTFILE;
                MERGE BRR_TEMP6 BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
                BY &BYVAR;
        RUN;
        PROC DATASETS LIBRARY=WORK NOLIST;
                DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12 BRR_TEMP13;
        RUN;
%END;
PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6 MEAN_
TEMP BRRDATA;
RUN;
OPTIONS NOTES;
%MEND BRR_PROCMEAN_PV;
```

Box 17.3 [1/3] **SAS® macro of PROC_FREQ_NO_PV.sas**

```
%macro BRR_FREQ(INFILE=,
                REPLI_ROOT=,
                BYVAR=,
                VAR=,
                LIMIT=,
                LIMIT_CRITERIA=,
                ID_SCHOOL=,
                OUTFILE=);
/*
MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
VAR = VARIABLES ON WHICH PERCENTAGES WILL BE COMPUTED.
LIMIT = FLAGGING  YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION.
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.
*/
OPTIONS NONOTES;
PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP0;
RUN;
PROC SORT DATA=&INFILE
       OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &VAR &ID_SCHOOL);
       BY &BYVAR &VAR;
RUN;
%DO I = 0 %TO 80;
       PROC FREQ DATA=BRRDATA NOPRINT;
              TABLE &VAR /OUT=FREQ_TEMP ;
              BY &BYVAR;
              WEIGHT &REPLI_ROOT&I;
       RUN;
       DATA FREQ_TEMP;
              SET FREQ_TEMP;
              L=&I;
              KEEP &BYVAR L &VAR PERCENT;
       RUN;
       PROC APPEND BASE = BRR_TEMP0 DATA=FREQ_TEMP;
       RUN;
%END;
PROC SORT DATA=BRR_TEMP0 OUT=BRR_TEMP1 (RENAME=(PERCENT=PV));
       BY &BYVAR L &VAR;
RUN;
DATA BRR_TEMP2(KEEP=&BYVAR &VAR PV)BRR_TEMP3(KEEP=&BYVAR &VAR STAT);
       SET BRR_TEMP1;
       IF L > 0 THEN OUTPUT BRR_TEMP2;
       ELSE DO;
              STAT =PV;
              OUTPUT BRR_TEMP3;
       END;
RUN;
PROC SORT DATA=BRR_TEMP2;
       BY &BYVAR &VAR;
RUN;
PROC SORT DATA=BRR_TEMP3;
       BY &BYVAR &VAR;
RUN;
```

Box 17.3 [2/3] **SAS® macro of PROC_FREQ_NO_PV.sas**

```
DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR &VAR;
        VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR &VAR;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR &VAR;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR &VAR STAT SESTAT;
RUN;

%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;

%END;
%ELSE %DO;

        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE &VAR /OUT=BRR_TEMP7;
                BY &BYVAR;
        RUN;
        %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP7;
                SET BRR_TEMP7;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR &VAR FLAG_STUD;
        RUN;
        PROC SORT DATA=BRRDATA;
                BY &BYVAR  &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE &VAR /OUT=BRR_TEMP8;
                BY &BYVAR  &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP8 NOPRINT;
                TABLE &VAR /OUT=BRR_TEMP9;
                BY &BYVAR;
        RUN;
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP9;
                SET BRR_TEMP9;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR &VAR FLAG_SCH;
        RUN;

        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE &VAR/OUT=BRR_TEMP10;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
        RUN;
```

Box 17.3 [3/3] **SAS® macro of PROC_FREQ_NO_PV.sas**

```
%LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
        %END;

        PROC MEANS DATA=BRR_TEMP10 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP11 SUM=SOMWGT;
        RUN;
        %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
        DATA BRR_TEMP12;
                MERGE BRR_TEMP10 BRR_TEMP11;
                BY &POPREF;
                PCT=(COUNT/SOMWGT)*100;
                IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
                ELSE FLAG_PCT=0;
                KEEP &BYVAR &VAR FLAG_PCT;
        RUN;
        DATA &OUTFILE;
                MERGE BRR_TEMP6 BRR_TEMP7 BRR_TEMP9 BRR_TEMP12;
                BY &BYVAR &VAR;
                IF (STAT NE .);
        RUN;


        PROC DATASETS LIBRARY=WORK NOLIST;
                DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_TEMP12;
        RUN;
%END;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6
FREQ_TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_FREQ;
```


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Box 17.4 [1/4] **SAS® macro of PROC_FREQ_PV.sas**

```
%macro BRR_FREQ_PV(INFILE=,
                   REPLI_ROOT=,
                   BYVAR=,
                   PV_ROOT=,
                   LIMIT=,
                   LIMIT_CRITERIA=,
                   ID_SCHOOL=,
                   OUTFILE=);
/*

MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
PV_ROOT =      ROOT OF THE 5 PROFICIENCY LEVEL VARIABLES NAMES.
LIMIT = FLAGGING  YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL      =       VARIABLE NAME FOR THE SCHOOL IDENTIFICATION.
OUTFILE =      FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR
ESTIMATES.

*/
OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP0;
RUN;
%DO I = 1 %TO 5;
       PROC SORT DATA=&INFILE
              OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &PV_ROOT.1-&PV_
ROOT.5 &ID_SCHOOL);
              BY &BYVAR &PV_ROOT&I;
       RUN;
       %DO J = 0 %TO 80;
              PROC FREQ DATA=BRRDATA NOPRINT;
                     TABLE &PV_ROOT&I /OUT=FREQ_TEMP ;
                     BY &BYVAR;
                     WEIGHT &REPLI_ROOT&J;
              RUN;
              DATA FREQ_TEMP;
                     SET FREQ_TEMP;
                     K=&I;
                     L=&J;
                     &PV_ROOT=&PV_ROOT&I;
                     KEEP &BYVAR K L PERCENT &PV_ROOT;
              RUN;
              PROC APPEND BASE = BRR_TEMP0 DATA=FREQ_TEMP;
              RUN;
       %END;
%END;
PROC SORT DATA=BRR_TEMP0;
       BY &BYVAR L &PV_ROOT;
RUN;
PROC TRANSPOSE DATA=BRR_TEMP0 OUT=BRR_TEMP1 PREFIX=PV;
       BY &BYVAR L &PV_ROOT;
       VAR PERCENT;
RUN;
DATA BRR_TEMP1;
       SET BRR_TEMP1;
       DROP _NAME_ _LABEL_;
RUN;
```

Box 17.4 [2/4] **SAS® macro of PROC_FREQ_PV.sas**

```
DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR)BRR_TEMP3(KEEP=&BYVAR &PV_ROOT STAT FIN1-
FIN5 MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
        END;
RUN;
PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR &PV_ROOT;
RUN;
PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR &PV_ROOT;
RUN;
DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR &PV_ROOT;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR &PV_ROOT;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR &PV_ROOT;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        KEEP &BYVAR &PV_ROOT STAT SESTAT;
RUN;
%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;

%END;
%ELSE %DO;
        %DO M=1 %TO 5;
        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE &PV_ROOT&M/OUT=BRR_TEMP7;
                BY &BYVAR;
        RUN;
        DATA BRR_TEMP8;
                SET BRR_TEMP7;
                COUNT&M=COUNT;
                &PV_ROOT=&PV_ROOT&M;
                KEEP &BYVAR &PV_ROOT COUNT&M;
        RUN;
```

Box 17.4 [3/4] **SAS® macro of PROC_FREQ_PV.sas**

```
%IF (&M=1) %THEN %DO;
               DATA BRR_TEMP9;
                       SET BRR_TEMP8;
               RUN;
       %END;
       %ELSE %DO;
               DATA BRR_TEMP9;
                       MERGE BRR_TEMP9 BRR_TEMP8;
                       BY &BYVAR &PV_ROOT;
               RUN;
       %END;
       %END;
       %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
       DATA BRR_TEMP9;
               SET BRR_TEMP9;
               COUNT=(COUNT1+COUNT2+COUNT3+COUNT4+COUNT5)/5;
               IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
               ELSE FLAG_STUD=0;
               KEEP &BYVAR &PV_ROOT FLAG_STUD;
       RUN;
       PROC SORT DATA=BRRDATA;
               BY &BYVAR  &ID_SCHOOL;
       RUN;
       %DO M=1 %TO 5;
       PROC FREQ DATA=BRRDATA NOPRINT;
               TABLE &PV_ROOT&M /OUT=BRR_TEMP10;
               BY &BYVAR  &ID_SCHOOL;
       RUN;
       PROC FREQ DATA=BRR_TEMP10 NOPRINT;
               TABLE &PV_ROOT&M  /OUT=BRR_TEMP11;
               BY &BYVAR;
       RUN;
       DATA BRR_TEMP12;
               SET BRR_TEMP11;
               COUNT&M=COUNT;
               &PV_ROOT=&PV_ROOT&M;
               KEEP &BYVAR &PV_ROOT COUNT&M;
       RUN;
       %IF (&M=1) %THEN %DO;
               DATA BRR_TEMP13;
                       SET BRR_TEMP12;
               RUN;
       %END;
       %ELSE %DO;
               DATA BRR_TEMP13;
                       MERGE BRR_TEMP13 BRR_TEMP12;
                       BY &BYVAR &PV_ROOT;
               RUN;
       %END;
       %END;
       %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
       DATA BRR_TEMP13;
               SET BRR_TEMP13;
               COUNT=(COUNT1+COUNT2+COUNT3+COUNT4+COUNT5)/5;
               IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
               ELSE FLAG_SCH=0;
               KEEP &BYVAR &PV_ROOT FLAG_SCH;
       RUN;

       %DO M=1 %TO 5;
       PROC FREQ DATA=BRRDATA NOPRINT;
               TABLE &PV_ROOT&M/OUT=BRR_TEMP14;
               BY &BYVAR;
               WEIGHT &REPLI_ROOT.0;
       RUN;
       DATA BRR_TEMP15;
               SET BRR_TEMP14;
               COUNT&M=COUNT;
               &PV_ROOT=&PV_ROOT&M;
               KEEP &BYVAR &PV_ROOT COUNT&M;
       RUN;
```

Box 17.4 [4/4] **SAS® macro of PROC_FREQ_PV.sas**

```
%IF (&M=1) %THEN %DO;
        DATA BRR_TEMP16;
                SET BRR_TEMP15;
        RUN;
      %END;
      %ELSE %DO;
      DATA BRR_TEMP16;
                MERGE BRR_TEMP16 BRR_TEMP15;
                BY &BYVAR &PV_ROOT;
        RUN;
      %END;
      %END;

      %LET K=1;
      %LET POPREF=;
      %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
      %DO %WHILE(&K <= &NBVAR);
        %LET POPREF_ADD=%SCAN(&BYVAR,&K);
        %LET POPREF=&POPREF &POPREF_ADD;
        %LET K=%EVAL(&K+1);
      %END;

      PROC MEANS DATA=BRR_TEMP16 NOPRINT;
        VAR COUNT1-COUNT5 ;
        BY &POPREF;
        OUTPUT OUT=BRR_TEMP17 SUM=SOMWGT1-SOMWGT5;
      RUN;
      %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
      DATA BRR_TEMP18;
        MERGE BRR_TEMP16 BRR_TEMP17;
        BY &POPREF;
        ARRAY B1 (5) PCT1-PCT5;
        ARRAY B2 (5) COUNT1-COUNT5;
        ARRAY B3 (5) SOMWGT1-SOMWGT5;
        DO A=1 TO 5;
                B1(A)=(B2(A)/B3(A))*100;
        END;
        PCT=(PCT1+PCT2+PCT3+PCT4+PCT5)/5;
        IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
        ELSE FLAG_PCT=0;
        KEEP &BYVAR &PV_ROOT FLAG_PCT;
      RUN;

      DATA &OUTFILE;
        MERGE BRR_TEMP6 BRR_TEMP9 BRR_TEMP13 BRR_TEMP18;
        BY &BYVAR &PV_ROOT;
      RUN;

      PROC DATASETS LIBRARY=WORK NOLIST;
      DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_TEMP12 BRR_TEMP13
                        BRR_TEMP14 BRR_TEMP15 BRR_TEMP16 BRR_TEMP17 BRR_TEMP18;
      RUN;

%END;

PROC DATASETS LIBRARY=WORK NOLIST;
      DELETE BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 FREQ_TEMP
BRR_TEMP6 MEAN_TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_FREQ_PV;
```


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Box 17.5 [1/3] **SAS® macro of PROC_REG_NO_PV.sas**

```
%macro BRR_REG(INFILE=,
               REPLI_ROOT=,
               VARDEP=,
               EXPLICA=,
               BYVAR=,
               LIMIT=,
               LIMIT_CRITERIA=,
               ID_SCHOOL=,
               OUTFILE=);
/*
MEANING OF THE MACRO ARGUMENTS

INFILE = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
VARDEP = DEPENDENT VARIABLE
EXPLICA = LIST OF INDEPENDENT VARIABLES
BYVAR = BREAKDOWN VARIABLES
LIMIT = FLAGGING  YES OR NO
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.
*/
OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;
PROC SORT DATA=&INFILE OUT=BRRDATA (KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR
&VARDEP &EXPLICA &ID_SCHOOL);
       BY &BYVAR;
RUN;
%DO I = 0 %TO 80;

       PROC REG DATA=BRRDATA OUTEST=COEF_TEMP NOPRINT EDF;
              MODEL &VARDEP=&EXPLICA;
              WEIGHT &REPLI_ROOT&I;
              BY &BYVAR;
       RUN;
       DATA COEF_TEMP;
              SET COEF_TEMP;
              L=&I;
       RUN;
       PROC APPEND BASE = BRR_TEMP1 DATA=COEF_TEMP;
       RUN;
%END;
PROC SORT DATA=BRR_TEMP1;
       BY &BYVAR L;
RUN;
PROC TRANSPOSE DATA=BRR_TEMP1 OUT=BRR_TEMP;
       BY &BYVAR L;
       VAR INTERCEPT &EXPLICA _RSQ_;
RUN;

DATA BRR_TEMP1 ;
       SET BRR_TEMP (RENAME=(_NAME_=CLASS COL1=COEF));
RUN;

%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&EXPLICA,&I)));
       %LET I=%EVAL(&I+1);
%END;
```

Box 17.5 [2/3] **SAS® macro of PROC_REG_NO_PV.sas**

```
%LET NB=%EVAL(&I-1);
%DO J=0 %to &NB;
        %IF &J=0 %THEN %DO;
                %LET INDEP=Intercept;
        %END;
        %IF &J>0 %THEN %DO;
                %LET INDEP=%SCAN(&EXPLICA,&J);
        %END;
        DATA BRR_TEMP1;
                SET BRR_TEMP1;
                IF (UPCASE(CLASS)=UPCASE("&INDEP")) THEN ORDRE=&J;
                IF (SUBSTR(CLASS,1,5)="_RSQ_") THEN ORDRE=&I;
        RUN;
%END;
DATA BRR_TEMP2(KEEP=&BYVAR CLASS COEF) BRR_TEMP3(KEEP=&BYVAR CLASS ORDRE STAT);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =COEF;
                OUTPUT BRR_TEMP3;
        END;
RUN;
PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR CLASS;
RUN;
PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR CLASS;
RUN;
DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR CLASS;
        VARI=((COEF-STAT)**2)*(1/20);
RUN;
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR CLASS;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;
DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR CLASS;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR CLASS ORDRE STAT SESTAT;
RUN;
PROC SORT DATA=BRR_TEMP6 OUT=&OUTFILE (DROP=ORDRE);
        BY &BYVAR ORDRE;
RUN;
%IF (%UPCASE(&LIMIT)=YES) %THEN %DO;

        DATA BRR_TEMP7;
                SET BRRDATA;
                NB_MISS=0;
                ARRAY LIST_VAR (&I) &EXPLICA &VARDEP;
                DO K=1 TO &I;
                        IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
                END;
                IF (NB_MISS>1) THEN NB_MISS=1;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP8;
                BY &BYVAR;
                WHERE (NB_MISS=0);
        RUN;
```

Box 17.5 [3/3] **SAS® macro of PROC_REG_NO_PV.sas**

```
%LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
         DATA BRR_TEMP8;
                SET BRR_TEMP8;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
         RUN;
         PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR &ID_SCHOOL;
         RUN;
         PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP9;
                BY &BYVAR &ID_SCHOOL;
                WHERE (NB_MISS=0);
         RUN;
         PROC FREQ DATA=BRR_TEMP9 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP10;
                BY &BYVAR;
         RUN;
         %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
         DATA BRR_TEMP10;
                SET BRR_TEMP10;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR FLAG_SCH;
         RUN;
         PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR NB_MISS;
         RUN;
         PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS/OUT=BRR_TEMP11;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
         RUN;
         %LET K=1;
         %LET POPREF=;
         %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
         %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
         %END;
         PROC MEANS DATA=BRR_TEMP11 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
         RUN;
         %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
         DATA BRR_TEMP13;
                MERGE BRR_TEMP11 BRR_TEMP12;
                BY &POPREF;
                PCT=(COUNT/SOMWGT)*100;
                IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
                ELSE FLAG_PCT=0;
                IF (NB_MISS=0);
                KEEP &BYVAR FLAG_PCT;
         RUN;
         DATA &OUTFILE._CRITERIA;
                MERGE BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
                BY &BYVAR;
         RUN;
         PROC DATASETS LIBRARY=WORK NOLIST;
         DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_TEMP12 BRR_TEMP13;
         RUN;
%END;
PROC DATASETS LIBRARY=WORK NOLIST;
         DELETE BRR_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6
COEF_TEMP BRRDATA;
RUN;
OPTIONS NOTES;
%MEND BRR_REG;
```

Box 17.6 [1/4] **SAS® macro of PROC_REG_PV.sas**

```
%macro BRR_REG_PV(INFILE=,
                  REPLI_ROOT=,
                  EXPLICA=,
                  BYVAR=,
                  PV_ROOT=,
                  LIMIT=,
                  LIMIT_CRITERIA=,
                  ID_SCHOOL=,
                  OUTFILE=);
/*
MEANING OF THE MACRO ARGUMENTS
INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
EXPLICA = LIST OF INDEPENDENT VARIABLES
BYVAR = BREAKDOWN VARIABLES
PV_ROOT = ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES
LIMIT = FLAGGING  YES OR NO
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.
*/
OPTIONS NONOTES;
PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;
PROC SORT DATA=&INFILE OUT=BRRDATA (KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &PV_
ROOT.1-&PV_ROOT.5 &EXPLICA &ID_SCHOOL);
       BY &BYVAR;
RUN;
%DO I = 0 %TO 80;
       PROC REG DATA=BRRDATA OUTEST=COEF_TEMP NOPRINT EDF;
              MODEL &PV_ROOT.1=&EXPLICA;
              MODEL &PV_ROOT.2=&EXPLICA;
              MODEL &PV_ROOT.3=&EXPLICA;
              MODEL &PV_ROOT.4=&EXPLICA;
              MODEL &PV_ROOT.5=&EXPLICA;
              WEIGHT &REPLI_ROOT&I;
              BY &BYVAR;
       RUN;
       DATA COEF_TEMP;
              SET COEF_TEMP;
              L=&I;
       RUN;
       PROC APPEND BASE = BRR_TEMP1 DATA=COEF_TEMP;
       RUN;

%END;
PROC SORT DATA=BRR_TEMP1;
       BY &BYVAR L;
RUN;

PROC TRANSPOSE DATA=BRR_TEMP1 OUT=BRR_TEMP PREFIX=PV;
       BY &BYVAR L;
       VAR INTERCEPT &EXPLICA _RSQ_;
RUN;
DATA BRR_TEMP1 ;
       SET BRR_TEMP (RENAME=(_NAME_=CLASS));
       DROP _LABEL_;
RUN;
```


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Box 17.6 [2/4] **SAS® macro of PROC_REG_PV.sas**

```
%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&EXPLICA,&I)));
         %LET I=%EVAL(&I+1);
%END;
%let NB=%EVAL(&I-1);

%DO J=0 %to &NB;
         %IF &J=0 %THEN %DO;
        %LET INDEP=Intercept;
         %END;
         %IF &J>0 %THEN %DO;
               %LET INDEP=%SCAN(&EXPLICA,&J);
         %END;

         DATA BRR_TEMP1;
               SET BRR_TEMP1;
               IF (UPCASE(CLASS)=UPCASE(“&INDEP”)) THEN ORDRE=&J;
               IF (SUBSTR(CLASS,1,5)=”_RSQ_”) THEN ORDRE=&I;
         RUN;
%END;
DATA BRR_TEMP2(KEEP=&BYVAR CLASS ORDRE PV1-PV5)BRR_TEMP3(KEEP=&BYVAR CLASS ORDRE
FIN1-FIN5 STAT MESVAR);
         SET BRR_TEMP1;
         IF L > 0 THEN OUTPUT BRR_TEMP2;
         ELSE DO;
           STAT =(PV1+PV2+PV3+PV4+PV5)/5;
           FIN1=PV1;
           FIN2=PV2;
           FIN3=PV3;
           FIN4=PV4;
           FIN5=PV5;
           MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
           OUTPUT BRR_TEMP3;
         END;
RUN;
PROC SORT DATA=BRR_TEMP2;
         BY &BYVAR CLASS;
RUN;

PROC SORT DATA=BRR_TEMP3;
         BY &BYVAR CLASS;
RUN;
DATA BRR_TEMP4;
         MERGE BRR_TEMP2 BRR_TEMP3;
         BY &BYVAR CLASS;
         ARRAY A (5)
               PV1-PV5;
         ARRAY B (5)
               FIN1-FIN5;
         ARRAY C(5)
               VAR1-VAR5;
         DO I=1 TO 5;
               C(I)=(1/20)*((A(I)-B(I))**2);
         END;
RUN;
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
         VAR VAR1 VAR2 VAR3 VAR4 VAR5;
         BY &BYVAR CLASS;
         OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
DATA BRR_TEMP6;
         MERGE BRR_TEMP3 BRR_TEMP5;
         BY &BYVAR CLASS;
         SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
         FINVAR=(SAMP+(1.2*MESVAR));
         SESTAT=(FINVAR)**0.5;
         FORMAT STAT F10.2;
         FORMAT SESTAT F10.2;
         KEEP &BYVAR CLASS STAT SESTAT ORDRE;
RUN;
```

Box 17.6 [3/4] **SAS® macro of PROC_REG_PV.sas**

```
PROC SORT DATA=BRR_TEMP6 OUT=&OUTFILE (DROP=ORDRE);
        BY &BYVAR ORDRE;
RUN;


%IF (%UPCASE(&LIMIT)=YES) %THEN %DO;

        %LET NB_M=%EVAL(&NB+5);

        DATA BRR_TEMP7;
                SET BRRDATA;
                NB_MISS=0;
                ARRAY LIST_VAR (&NB_M) &EXPLICA &PV_ROOT.1-&PV_ROOT.5;
                DO K=1 TO &NB;
                        IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
                END;
                IF (NB_MISS>1) THEN NB_MISS=1;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP8;
                BY &BYVAR;
                WHERE (NB_MISS=0);
        RUN;
        %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP8;
                SET BRR_TEMP8;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP9;
                BY &BYVAR &ID_SCHOOL;
                WHERE (NB_MISS=0);
        RUN;
        PROC FREQ DATA=BRR_TEMP9 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP10;
                BY &BYVAR;
        RUN;
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP10;
                SET BRR_TEMP10;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR FLAG_SCH;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR NB_MISS;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS/OUT=BRR_TEMP11;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
        RUN;
        %LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
        %END;

        PROC MEANS DATA=BRR_TEMP11 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
        RUN;
```


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Box 17.6 [4/4] **SAS® macro of PROC_REG_PV.sas**

```
%LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
       DATA BRR_TEMP13;
              MERGE BRR_TEMP11 BRR_TEMP12;
              BY &POPREF;
              PCT=(COUNT/SOMWGT)*100;
              IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
              ELSE FLAG_PCT=0;
              IF (NB_MISS=0);
              KEEP &BYVAR FLAG_PCT;
       RUN;
       DATA &OUTFILE._CRITERIA;
              MERGE BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
              BY &BYVAR;
       RUN;
       PROC DATASETS LIBRARY=WORK NOLIST;
              DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12 BRR_TEMP13;
       RUN;
%END;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6
COEF_TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_REG_PV;
```


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Box 17.7 [1/3] **SAS® macro of PROC_CORR_NO_PV.sas**

```
%macro BRR_CORR(INFILE=,
                REPLI_ROOT=,
                BYVAR=,
                VAR1=,
                VAR2=,
                LIMIT=,
                LIMIT_CRITERIA=,
                ID_SCHOOL=,
                OUTFILE=);
/*
MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
VAR1 =  FIRST NUMERIC VARIABLE.
VAR2 =  SECOND NUMERIC VARIABLE.
LIMIT = FLAGGING YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION.
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR RESPECTIVE STANDARD ERROR ESTIMATE.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;

PROC SORT DATA=&INFILE OUT=BRRDATA (KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &VAR1
&VAR2 &ID_SCHOOL);
       BY &BYVAR;
RUN;

%DO I = 0 %TO 80;

       PROC CORR DATA=BRRDATA VARDEF=WGT NOPRINT OUTP=CORR_TEMP;
              VAR &VAR1 ;
              WITH &VAR2;
              BY &BYVAR;
              WEIGHT &REPLI_ROOT&I;
       RUN;

       DATA CORR_TEMP;
              SET CORR_TEMP;
              L=&I;
       RUN;

       PROC APPEND BASE = BRR_TEMP1 DATA=CORR_TEMP;
       RUN;
%END;

DATA BRR_TEMP1;
       SET BRR_TEMP1;
       IF (_TYPE_ NE “CORR”) THEN DELETE;
       PV=&VAR1;
       KEEP &BYVAR L PV;
RUN;

DATA BRR_TEMP2(KEEP=&BYVAR PV) BRR_TEMP3(KEEP=&BYVAR STAT);
       SET BRR_TEMP1;
       IF L > 0 THEN OUTPUT BRR_TEMP2;
       ELSE DO;
              STAT =PV;
              OUTPUT BRR_TEMP3;
       END;
RUN;
```


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Box 17.7 [2/3] **SAS® macro of PROC_CORR_NO_PV.sas**

```
PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR;
        VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR;
        SESTAT=(SS)**0.5;
        FORMAT STAT F5.2;
        FORMAT SESTAT F5.2;
        KEEP &BYVAR STAT SESTAT;
RUN;


%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;

%END;
%ELSE %DO;
        DATA BRR_TEMP7;
                SET BRRDATA;
                NB_MISS=0;
                ARRAY LIST_VAR (2) &VAR1 &VAR2;
                DO K=1 TO 2;
                        IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
                END;
                IF (NB_MISS>1) THEN NB_MISS=1;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP8;
                BY &BYVAR;
                WHERE (NB_MISS=0);
        RUN;
        %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP8;
                SET BRR_TEMP8;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP9;
                BY &BYVAR &ID_SCHOOL;
                WHERE (NB_MISS=0);
        RUN;
        PROC FREQ DATA=BRR_TEMP9 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP10;
                BY &BYVAR;
        RUN;
```

Box 17.7 [3/3] **SAS® macro of PROC_CORR_NO_PV.sas**

```
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP10;
                SET BRR_TEMP10;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR FLAG_SCH;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR NB_MISS;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS/OUT=BRR_TEMP11;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
        RUN;
        %LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
        %END;

        PROC MEANS DATA=BRR_TEMP11 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
        RUN;
        %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
        DATA BRR_TEMP13;
                MERGE BRR_TEMP11 BRR_TEMP12;
                BY &POPREF;
                PCT=(COUNT/SOMWGT)*100;
                IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
                ELSE FLAG_PCT=0;
                IF (NB_MISS=0);
                KEEP &BYVAR FLAG_PCT;
        RUN;
        DATA &OUTFILE;
                MERGE BRR_TEMP6 BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
                BY &BYVAR;
        RUN;
        PROC DATASETS LIBRARY=WORK NOLIST;
                DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12 BRR_TEMP13;
        RUN;

%END;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6 CORR_
TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_CORR;
```


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Box 17.8 [1/3] **SAS® macro of PROC_CORR_PV.sas**

```
%macro BRR_CORR_PV(INFILE=,
                   REPLI_ROOT=,
                   BYVAR=,
                   EXPLICA=,
                   PV_ROOT=,
                   LIMIT=,
                   LIMIT_CRITERIA=,
                   ID_SCHOOL=,
                   OUTFILE=);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
EXPLICA = NUMERIC VARIABLE.
PV_ROOT = ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES
LIMIT = FLAGGING  YES OR NO.
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION.
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR RESPECTIVE STANDARD ERROR ESTIMATE.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;

PROC SORT DATA=&INFILE OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &PV_
ROOT.1-&PV_ROOT.5 &EXPLICA &ID_SCHOOL);
       BY &BYVAR;
RUN;

%DO I = 0 %TO 80;
       PROC CORR DATA=BRRDATA VARDEF=WGT NOPRINT OUTP=CORR_TEMP;
              VAR &PV_ROOT.1 - &PV_ROOT.5 ;
              WITH &EXPLICA;
       BY &BYVAR;
       WEIGHT &REPLI_ROOT&I;
 RUN;

       DATA CORR_TEMP;
              SET CORR_TEMP;
              L=&I;
       RUN;

       PROC APPEND BASE = BRR_TEMP1 DATA=CORR_TEMP;
       RUN;

%END;

 DATA BRR_TEMP1;
       SET BRR_TEMP1;
       IF (_TYPE_ NE "CORR") THEN DELETE;
       PV1=&PV_ROOT.1;
       PV2=&PV_ROOT.2;
       PV3=&PV_ROOT.3;
       PV4=&PV_ROOT.4;
       PV5=&PV_ROOT.5;
       KEEP &BYVAR L PV1-PV5;
RUN;
```

Box 17.8 [2/3] **SAS® macro of PROC_CORR_PV.sas**

```
DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR) BRR_TEMP3(KEEP=&BYVAR STAT FIN1-FIN5
MESVAR);
      SET BRR_TEMP1;
      IF L > 0 THEN OUTPUT BRR_TEMP2;
      ELSE DO;
         STAT =(PV1+PV2+PV3+PV4+PV5)/5;
         FIN1=PV1;
         FIN2=PV2;
         FIN3=PV3;
         FIN4=PV4;
         FIN5=PV5;
         MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
         OUTPUT BRR_TEMP3;
      END;
RUN;
PROC SORT DATA=BRR_TEMP2;
      BY &BYVAR;
RUN;
PROC SORT DATA=BRR_TEMP3;
      BY &BYVAR;
RUN;
DATA BRR_TEMP4;
      MERGE BRR_TEMP2 BRR_TEMP3;
      BY &BYVAR;
      ARRAY A (5)
         PV1-PV5;
      ARRAY B (5)
         FIN1-FIN5;
      ARRAY C(5)
         VAR1-VAR5;
      DO I=1 TO 5;
         C(I)=(1/20)*((A(I)-B(I))**2);
      END;
RUN;
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
      VAR VAR1 VAR2 VAR3 VAR4 VAR5;
      BY &BYVAR;
      OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
DATA BRR_TEMP6;
      MERGE BRR_TEMP3 BRR_TEMP5;
      BY &BYVAR;
      SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
      FINVAR=(SAMP+(1.2*MESVAR));
      SESTAT=(FINVAR)**0.5;
      FORMAT STAT F5.2;
      FORMAT SESTAT F5.2;
      KEEP &BYVAR STAT SESTAT ;
RUN;
%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

      DATA &OUTFILE;
         SET BRR_TEMP6;
      RUN;
%END;
%ELSE %DO;
      DATA BRR_TEMP7;
         SET BRRDATA;
         NB_MISS=0;
         ARRAY LIST_VAR (6) &EXPLICA &PV_ROOT.1-&PV_ROOT.5;
         DO K=1 TO 6;
               IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
         END;
         IF (NB_MISS>1) THEN NB_MISS=1;
      RUN;
      PROC FREQ DATA=BRR_TEMP7 NOPRINT;
         TABLE NB_MISS /OUT=BRR_TEMP8;
         BY &BYVAR;
         WHERE (NB_MISS=0);
      RUN;
```


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Box 17.8 [3/3] **SAS® macro of PROC_CORR_PV.sas**

```
%LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP8;
                SET BRR_TEMP8;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR &ID_SCHOOL;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP9;
                BY &BYVAR &ID_SCHOOL;
                WHERE (NB_MISS=0);
        RUN;
        PROC FREQ DATA=BRR_TEMP9 NOPRINT;
                TABLE NB_MISS /OUT=BRR_TEMP10;
                BY &BYVAR;
        RUN;
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP10;
                SET BRR_TEMP10;
                IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
                ELSE FLAG_SCH=0;
                KEEP &BYVAR FLAG_SCH;
        RUN;
        PROC SORT DATA=BRR_TEMP7;
                BY &BYVAR NB_MISS;
        RUN;
        PROC FREQ DATA=BRR_TEMP7 NOPRINT;
                TABLE NB_MISS/OUT=BRR_TEMP11;
                BY &BYVAR;
                WEIGHT &REPLI_ROOT.0;
        RUN;
        %LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
                %LET POPREF_ADD=%SCAN(&BYVAR,&K);
                %LET POPREF=&POPREF &POPREF_ADD;
                %LET K=%EVAL(&K+1);
        %END;

        PROC MEANS DATA=BRR_TEMP11 NOPRINT;
                VAR COUNT;
                BY &POPREF;
                OUTPUT OUT=BRR_TEMP12 SUM=SOMWGT;
        RUN;
        %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
        DATA BRR_TEMP13;
                MERGE BRR_TEMP11 BRR_TEMP12;
                BY &POPREF;
                PCT=(COUNT/SOMWGT)*100;
                IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
                ELSE FLAG_PCT=0;
                IF (NB_MISS=0);
                KEEP &BYVAR FLAG_PCT;
        RUN;
        DATA &OUTFILE;
                MERGE BRR_TEMP6 BRR_TEMP8 BRR_TEMP10 BRR_TEMP13;
                BY &BYVAR;
        RUN;
        PROC DATASETS LIBRARY=WORK NOLIST;
                DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12 BRR_TEMP13;
        RUN;
%END;
PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6 CORR_
TEMP BRRDATA;
RUN;
OPTIONS NOTES;
%MEND BRR_CORR_PV;
```


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Box 17.9 [1/3] **SAS® macro of PROC_DIF_NO_PV.sas**

```
%MACRO BRR_PROCMEAN_DIF(INFILE =,
                        REPLI_ROOT =,
                        BYVAR =,
                        VAR =,
                        COMPARE =,
                        CATEGORY =,
                        STAT =,
                        OUTFILE =);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
VAR = VARIABLES FOR WHIXH THE STATISTIC IS REQUESTED.
COMPARE = BREAKDOWN VARIABLE NAME FOR WICH CATEGORY CONTRASTS ARE REQUESTED.
CATEGORY = LIST OF THE "COMPARE" VARIABLE CATEGORIES FOR WHICH A CONTRAT IS
REQUESTED.
STAT =  REQUESTED STATISTIQUE.
        SUMWGT = SUM OF THE WEIGHT
        MEAN = MEAN
        VAR = VARIANCE
        STD = STANDARD DEVIATION
        CV = COEFFICIENT OF VARIATION
        SKEWNESS = SKEWNESS
        KURTOSIS = KURTOSIS
        MEDIAN = MEDIAN
        Q1 = FIRST QUARTILE
        Q3 = THIRD QUARTILE
        QRANGE = RANGE BETWEEN Q1 AND Q3
        PX = PERCENTILE, WITH X BETWEEN 1 AND 99
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/
OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0 BRR_TEMP1 ;
RUN;

PROC SORT DATA=&INFILE OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR
&COMPARE &VAR);
        BY &BYVAR &COMPARE;
RUN;

%DO I = 0 %TO 80;

        PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
               VAR &VAR ;
               BY &BYVAR &COMPARE;
               WEIGHT &REPLI_ROOT&I;
               OUTPUT OUT=MEAN_TEMP &STAT=PV;
        RUN;

        DATA MEAN_TEMP;
               SET MEAN_TEMP;
               L=&I;
        RUN;

        PROC APPEND BASE = BRR_TEMP0 DATA=MEAN_TEMP;
        RUN;
%END;
```


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Box 17.9 [2/3] **SAS® macro of PROC_DIF_NO_PV.sas**

```
%LET DEBUT=1;
%LET SUIVANT=2;
%LET COMPTE=1;

%LET I=1;

%DO %WHILE(%LENGTH(%SCAN(&CATEGORY,&I)));
       %LET I=%EVAL(&I+1);
%END;

%LET NBCAT=%EVAL(&I-1);
%LET NBDIF=%EVAL((&NBCAT*(&NBCAT-1))/2);
%LET ORDRE=1;

%DO J=1 %TO &NBDIF;

       %DO K=&DEBUT %TO &NBCAT-1;

              %LET CAT1=%SCAN(&CATEGORY,&DEBUT);
              %LET CAT2=%SCAN(&CATEGORY,&SUIVANT);

              DATA BRR_DIF1;
                      SET BRR_TEMP0 (RENAME=(PV=M1PV));
                      LENGTH CONTRAST $5;
                      CONTRAST="&CAT1.-&CAT2";
                      IF (&COMPARE=&CAT1);
                      KEEP &BYVAR L CONTRAST M1PV &compare;
              RUN;

              DATA BRR_DIF2 ;
                      SET BRR_TEMP0 (RENAME=(PV=M2PV));
                   IF (&COMPARE=&CAT2);
                      KEEP &BYVAR L M2PV &compare;
              RUN;

              PROC SORT DATA=BRR_DIF1;
                     BY &BYVAR L;
              RUN;

              PROC SORT DATA=BRR_DIF2;
                     BY &BYVAR L;
              RUN;

              DATA BRR_TEMP_DIF;
                     MERGE BRR_DIF1 BRR_DIF2;
                     BY &BYVAR L;
                     IF (M1PV EQ . OR M2PV EQ .) THEN DELETE;
                     PV=M1PV-M2PV;
                     ORDRE=&ORDRE;
                     KEEP &BYVAR CONTRAST L PV ORDRE;
              RUN;

              PROC APPEND BASE = BRR_TEMP1 DATA=BRR_TEMP_DIF;
              RUN;

              %LET SUIVANT=%EVAL(&SUIVANT+1);
              %LET COMPTE=%EVAL(&COMPTE+1);
              %LET ORDRE=%EVAL(&ORDRE+1);

       %END;

       %LET DEBUT=%EVAL(&DEBUT+1);
       %LET SUIVANT=%EVAL(&DEBUT+1);

%END;
```

Box 17.9 [3/3] **SAS® macro of PROC_DIF_NO_PV.sas**

```
DATA BRR_TEMP2(KEEP=&BYVAR CONTRAST PV) BRR_TEMP3(KEEP=&BYVAR CONTRAST ORDRE STAT);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =PV;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR CONTRAST;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR CONTRAST;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR CONTRAST;
        VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR CONTRAST;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR CONTRAST;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR CONTRAST ORDRE STAT SESTAT;
RUN;

PROC SORT DATA=BRR_TEMP6 OUT=&OUTFILE (DROP=ORDRE);
        BY &BYVAR ORDRE;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6
        MEAN_TEMP BRRDATA BRR_DIF1 BRR_DIF2 BRR_TEMP_DIF;
RUN;

OPTIONS NOTES;

%MEND BRR_PROCMEAN_DIF;
```


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Box 17.10 [1/3] **SAS® macro of PROC_DIF_PV.sas**

```
%MACRO BRR_PROCMEAN_DIF_PV(INFILE =,
                           REPLI_ROOT =,
                           BYVAR =,
                           PV_ROOT =,
                           COMPARE =,
                           CATEGORY =,
                           STAT =,
                           OUTFILE =);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  =       INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL WEI-
GHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
PV_ROOT =       ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES.
COMPARE = BREAKDOWN VARIABLE NAME FOR WICH CATEGORY CONTRASTS ARE REQUESTED.
CATEGORY        =       LIST OF THE "COMPARE" VARIABLE CATEGORIES FOR WHICH A
CONTRAT IS REQUESTED.
STAT =  REQUESTED STATISTIQUE.
        SUMWGT = SUM OF THE WEIGHT
        MEAN = MEAN
        VAR = VARIANCE
        STD = STANDARD DEVIATION
        CV =    COEFFICIENT OF VARIATION
        SKEWNESS = SKEWNESS
        KURTOSIS = KURTOSIS
        MEDIAN = MEDIAN
        Q1 =    FIRST QUARTILE
        Q3 =    THIRD QUARTILE
        QRANGE = RANGE BETWEEN Q1 AND Q3
        PX =    PERCENTILE, WITH X BETWEEN 1 AND 99
OUTFILE =       FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATE

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0 BRR_TEMP1 ;
RUN;

PROC SORT DATA=&INFILE OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &COM-
PARE &PV_ROOT.1-&PV_ROOT.5);
        BY &BYVAR &COMPARE;
RUN;

%DO I = 0 %TO 80;

        PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
                VAR &PV_ROOT.1 - &PV_ROOT.5 ;
                BY &BYVAR &COMPARE;
                WEIGHT &REPLI_ROOT&I;
                OUTPUT OUT=MEAN_TEMP &STAT=PV1 - PV5;
        RUN;

        DATA MEAN_TEMP;
                SET MEAN_TEMP;
                L=&I;
        RUN;

        PROC APPEND BASE = BRR_TEMP0 DATA=MEAN_TEMP;
        RUN;

%END;
```

Box 17.10 [2/3] **SAS® macro of PROC_DIF_PV.sas**

```
%LET DEBUT=1;
%LET SUIVANT=2;
%LET COMPTE=1;
%LET I=1;

%DO %WHILE(%LENGTH(%SCAN(&CATEGORY,&I)));
       %LET I=%EVAL(&I+1);
%END;

%LET NBCAT=%EVAL(&I-1);
%LET NBDIF=%EVAL((&NBCAT*(&NBCAT-1))/2);
%LET ORDRE=1;

%DO J=1 %TO &NBDIF;
       %DO K=&DEBUT %TO &NBCAT-1;
              %LET CAT1=%SCAN(&CATEGORY,&DEBUT);
              %LET CAT2=%SCAN(&CATEGORY,&SUIVANT);

              DATA BRR_DIF1;
                       SET BRR_TEMP0 (RENAME=(PV1=M1PV1 PV2=M1PV2 PV3=M1PV3
PV4=M1PV4 PV5=M1PV5));
                       LENGTH CONTRAST $5;
                       CONTRAST=”&CAT1.-&CAT2”;
                       IF (&COMPARE=&CAT1);
                       KEEP &BYVAR L CONTRAST M1PV1-M1PV5 &compare;
              RUN;

              DATA BRR_DIF2 ;
                       SET BRR_TEMP0 (RENAME=(PV1=M2PV1 PV2=M2PV2 PV3=M2PV3
PV4=M2PV4 PV5=M2PV5));
                    IF (&COMPARE=&CAT2);
                       KEEP &BYVAR L M2PV1-M2PV5 &compare;
              RUN;

              PROC SORT DATA=BRR_DIF1;
                      BY &BYVAR L;
              RUN;

              PROC SORT DATA=BRR_DIF2;
                      BY &BYVAR L;
              RUN;

              DATA BRR_TEMP_DIF;
                      MERGE BRR_DIF1 BRR_DIF2;
                      BY &BYVAR L;
                      IF (M1PV1 EQ . OR M2PV1 EQ .) THEN DELETE;
                      PV1=M1PV1-M2PV1;
                      PV2=M1PV2-M2PV2;
                      PV3=M1PV3-M2PV3;
                      PV4=M1PV4-M2PV4;
                      PV5=M1PV5-M2PV5;
                      ORDRE=&ORDRE;
                      KEEP &BYVAR CONTRAST L PV1-PV5 ORDRE;
              RUN;

              PROC APPEND BASE = BRR_TEMP1 DATA=BRR_TEMP_DIF;
              RUN;

              %LET SUIVANT=%EVAL(&SUIVANT+1);
              %LET COMPTE=%EVAL(&COMPTE+1);
              %LET ORDRE=%EVAL(&ORDRE+1);

       %END;

%LET DEBUT=%EVAL(&DEBUT+1);
%LET SUIVANT=%EVAL(&DEBUT+1);

%END;
```

Box 17.10 [3/3] **SAS® macro of PROC_DIF_PV.sas**

```
DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR) BRR_TEMP3(KEEP=&BYVAR CONTRAST ORDRE
STAT FIN1-FIN5 MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
   END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR CONTRAST;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR CONTRAST;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR CONTRAST;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR CONTRAST;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;

DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR CONTRAST;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        KEEP &BYVAR CONTRAST ORDRE STAT SESTAT;
RUN;

PROC SORT DATA=BRR_TEMP6 OUT=&OUTFILE (DROP=ORDRE);
        BY &BYVAR ORDRE;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6
        MEAN_TEMP BRRDATA BRR_DIF1 BRR_DIF2 BRR_TEMP_DIF;
RUN;

OPTIONS NOTES;

%MEND BRR_PROCMEAN_DIF_PV;
```


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Box 17.11 [1/6] **SAS® macro of QUARTILE_PV.sas**

```
%MACRO QUARTILE_PV(INFILE=,
                   REPLI_ROOT=,
                   BYVAR = ,
                   PV_ROOT =,
                   INDEX =,
                   LIMIT=,
                   LIMIT_CRITERIA=,
                   ID_SCHOOL=,
                   OUTFILE =);
/*

MEANING OF THE MACRO ARGUMENTS

INFILE= INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL WEIGHT
VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES
PV_ROOT = ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES
INDEX = VARIABLE NAME USED TO CREATE THE FOUR QUARTERS
LIMIT = FLAGGING  YES OR NO
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF STUDENTS
AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE POPULATION OF
REFERENCE.
ID_SCHOOL =  VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTIONS NONOTES;

DATA QUARTILE_TEMP1 (KEEP=&BYVAR &REPLI_ROOT.0-&REPLI_ROOT.80 &PV_ROOT.1-&PV_ROOT.5
INDEX1-INDEX5 &ID_SCHOOL &INDEX NB_MISS) ;
      SET &INFILE;
      NB_MISS=0;
      ARRAY A (6) &INDEX &PV_ROOT.1-&PV_ROOT.5;
      DO I=1 TO 6;
          IF (A(I) IN (.,.M,.N,.I)) THEN NB_MISS=NB_MISS+1;
      END;
      INDEX1=&INDEX + (0.01*normal(-01));
      INDEX2=&INDEX + (0.01*normal(-23));
      INDEX3=&INDEX + (0.01*normal(-45));
      INDEX4=&INDEX + (0.01*normal(-67));
      INDEX5=&INDEX + (0.01*normal(-89));
RUN;

PROC SORT  DATA=QUARTILE_TEMP1;
      BY &BYVAR;
RUN;

PROC MEANS DATA=QUARTILE_TEMP1 NOPRINT;
      VAR INDEX1-INDEX5;
      BY &BYVAR;
      WEIGHT &REPLI_ROOT.0;
      WHERE (NB_MISS=0);
      OUTPUT OUT=QUARTILE_TEMP2 P25=Q1_1-Q1_5 P50=Q2_1-Q2_5 P75=Q3_1-Q3_5;
RUN;
```


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Box 17.11 [2/6] **SAS® macro of QUARTILE_PV.sas**

```
DATA
      QUARTILE_TEMP3 (KEEP = &BYVAR &REPLI_ROOT.0-&REPLI_ROOT.80 &PV_ROOT.1-&PV_ROOT.5
          INDEX1-INDEX5 CAT1-CAT5 &ID_SCHOOL &INDEX NB_MISS)
      QUARTILE_TEMP4 (KEEP = &BYVAR CAT1-CAT5 &REPLI_ROOT.0 NB_MISS &ID_SCHOOL
&INDEX);
      MERGE QUARTILE_TEMP1 QUARTILE_TEMP2;
      BY &BYVAR;
      ARRAY A1 (5) INDEX1-INDEX5;
      ARRAY A2 (5) Q1_1-Q1_5;
      ARRAY A3 (5) Q2_1-Q2_5;
      ARRAY A4 (5) Q3_1-Q3_5;
      ARRAY A5 (5) CAT1-CAT5;
      DO I=1 TO 5;
          IF (A1(i) <= A2(i)) THEN A5(i)=1;
          IF (A1(i) >  A2(i) AND A1(i) <= A3(i)) THEN A5(i)=2;
          IF (A1(i) >  A3(i) AND A1(i) <= A4(i)) THEN A5(i)=3;
          IF (A1(i) >  A4(i)) THEN A5(i)=4;
          IF (A1(i) IN (.,.M,.N,.I)) THEN A5(i) = .;
      END;
      IF (NB_MISS=0) THEN OUTPUT QUARTILE_TEMP3;
      OUTPUT QUARTILE_TEMP4;
RUN;

%DO QUARTILE=1 %TO 5;

%SUBQUARTILE1(INFILE =QUARTILE_TEMP3,
              REPLI_ROOT =&REPLI_ROOT,
              SUB_BY_VAR = &BYVAR CAT&QUARTILE ,
              VAR =&INDEX,
              OUTFILE =INDEX&QUARTILE);
RUN;

DATA INDEX&QUARTILE;
      SET INDEX&QUARTILE;
      STAT&QUARTILE=STAT;
      SESTAT&QUARTILE=SESTAT;
      CAT=CAT&QUARTILE;
      KEEP &BYVAR CAT STAT&QUARTILE SESTAT&QUARTILE ;
RUN;

%END;

DATA QUARTILE_TEMP5;
      MERGE INDEX1 INDEX2 INDEX3 INDEX4 INDEX5;
      BY &BYVAR CAT;
      STAT=(STAT1+STAT2+STAT3+STAT4+STAT5)/5;
      VAR_IMP=(((STAT1-STAT)**2)+((STAT2-STAT)**2)+((STAT3-STAT)**2)+((STAT4-
STAT)**2)+((STAT5-STAT)**2))/4;
      VAR_SAMP=((SESTAT1**2)+(SESTAT2**2)+(SESTAT3**2)+(SESTAT4**2)+(SESTAT5**2))/5;
      SESTAT=(VAR_SAMP+(1.2*VAR_IMP))**0.5;
      KEEP &BYVAR CAT STAT SESTAT;
RUN;

%DO QUARTILE=1 %TO 5;

%SUBQUARTILE1(INFILE =QUARTILE_TEMP3,
              REPLI_ROOT =&REPLI_ROOT,
              SUB_BY_VAR = &BYVAR CAT&QUARTILE ,
              VAR =&PV_ROOT&QUARTILE,
              OUTFILE =RESULT&QUARTILE);
RUN;

DATA RESULT&QUARTILE;
      SET RESULT&QUARTILE;
      STAT&QUARTILE=STAT;
      SESTAT&QUARTILE=SESTAT;
      CAT=CAT&QUARTILE;
      KEEP &BYVAR CAT STAT&QUARTILE SESTAT&QUARTILE ;
RUN;

%END;
```

Box 17.11 [3/6] **SAS® macro of QUARTILE_PV.sas**

```
DATA QUARTILE_TEMP6;
      MERGE RESULT1 RESULT2 RESULT3 RESULT4 RESULT5;
      BY &BYVAR CAT;
      STAT=(STAT1+STAT2+STAT3+STAT4+STAT5)/5;
      VAR_IMP=(((STAT1-STAT)**2)+((STAT2-STAT)**2)+((STAT3-STAT)**2)+((STAT4-
STAT)**2)+((STAT5-STAT)**2))/4;
      VAR_SAMP=((SESTAT1**2)+(SESTAT2**2)+(SESTAT3**2)+(SESTAT4**2)+(SESTAT5**2))/5;
      SESTAT=(VAR_SAMP+(1.2*VAR_IMP))**0.5;
      KEEP &BYVAR CAT STAT SESTAT;
RUN;

DATA QUARTILE_TEMP7;
      MERGE  QUARTILE_TEMP5 (RENAME=(STAT=INDEX_STAT SESTAT=INDEX_SESTAT))
             QUARTILE_TEMP6 (RENAME=(STAT=PV_STAT SESTAT=PV_SESTAT))  ;
      BY &BYVAR CAT;
RUN;


%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

      DATA &OUTFILE;
          SET QUARTILE_TEMP7;;
      RUN;

%END;
%ELSE %DO;
      PROC FREQ DATA=QUARTILE_TEMP3 NOPRINT;
          TABLE &BYVAR * CAT1 /OUT=QUARTILE_TEMP8_1;
          TABLE &BYVAR * CAT2 /OUT=QUARTILE_TEMP8_2;
          TABLE &BYVAR * CAT3 /OUT=QUARTILE_TEMP8_3;
          TABLE &BYVAR * CAT4 /OUT=QUARTILE_TEMP8_4;
          TABLE &BYVAR * CAT5 /OUT=QUARTILE_TEMP8_5;
      RUN;
      %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
      DATA QUARTILE_TEMP8;
          MERGE
              QUARTILE_TEMP8_1 (RENAME=(COUNT=C1 CAT1=CAT))
              QUARTILE_TEMP8_2 (RENAME=(COUNT=C2 CAT2=CAT))
              QUARTILE_TEMP8_3 (RENAME=(COUNT=C3 CAT3=CAT))
              QUARTILE_TEMP8_4 (RENAME=(COUNT=C4 CAT4=CAT))
              QUARTILE_TEMP8_5 (RENAME=(COUNT=C5 CAT5=CAT));
          BY &BYVAR ;
          C=(C1+C2+C3+C4+C5)/5;
          IF (C < &FLAG_STUD) THEN FLAG_STUD=1;
          ELSE FLAG_STUD=0;
          KEEP &BYVAR FLAG_STUD;
      RUN;

      %DO M=1 %TO 5;
      PROC FREQ DATA=QUARTILE_TEMP3 NOPRINT;
          TABLE &BYVAR * CAT&M * &ID_SCHOOL /OUT=QUARTILE_TEMP9_&M;
      RUN;
      PROC FREQ DATA=QUARTILE_TEMP9_&M NOPRINT;
          TABLE &BYVAR * CAT&M /OUT=QUARTILE_TEMP10_&M;
      RUN;
      %END;
      %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
      DATA QUARTILE_TEMP10;
          MERGE
              QUARTILE_TEMP10_1 (RENAME=(COUNT=C1 CAT1=CAT))
              QUARTILE_TEMP10_2 (RENAME=(COUNT=C2 CAT2=CAT))
              QUARTILE_TEMP10_3 (RENAME=(COUNT=C3 CAT3=CAT))
              QUARTILE_TEMP10_4 (RENAME=(COUNT=C4 CAT4=CAT))
              QUARTILE_TEMP10_5 (RENAME=(COUNT=C5 CAT5=CAT));
          BY &BYVAR CAT;
          C=(C1+C2+C3+C4+C5)/5;
          IF (C < &FLAG_SCH) THEN FLAG_SCH=1;
          ELSE FLAG_SCH=0;
          KEEP &BYVAR FLAG_SCH;
      RUN;
```

Box 17.11 [4/6] **SAS® macro of QUARTILE_PV.sas**

```
%LET K=1;
      %LET POPREF=;
      %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
      %DO %WHILE(&K <= &NBVAR);
          %LET POPREF_ADD=%SCAN(&BYVAR,&K);
          %LET POPREF=&POPREF &POPREF_ADD;
          %LET K=%EVAL(&K+1);
      %END;
      %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
      PROC FREQ DATA=QUARTILE_TEMP4 NOPRINT;
          TABLE &BYVAR * CAT1 * NB_MISS / OUT=QUARTILE_TEMP11_1;
          TABLE &BYVAR * CAT2 * NB_MISS / OUT=QUARTILE_TEMP11_2;
          TABLE &BYVAR * CAT3 * NB_MISS / OUT=QUARTILE_TEMP11_3;
          TABLE &BYVAR * CAT4 * NB_MISS / OUT=QUARTILE_TEMP11_4;
          TABLE &BYVAR * CAT5 * NB_MISS / OUT=QUARTILE_TEMP11_5;
          WEIGHT W_FSTR0;
      RUN;
      DATA QUARTILE_TEMP11;
          MERGE
              QUARTILE_TEMP11_1 (RENAME=(COUNT=C1 CAT1=CAT))
              QUARTILE_TEMP11_2 (RENAME=(COUNT=C2 CAT2=CAT))
              QUARTILE_TEMP11_3 (RENAME=(COUNT=C3 CAT3=CAT))
              QUARTILE_TEMP11_4 (RENAME=(COUNT=C4 CAT4=CAT))
              QUARTILE_TEMP11_5 (RENAME=(COUNT=C5 CAT5=CAT));
          BY &BYVAR CAT NB_MISS;
      RUN;
      PROC MEANS DATA=QUARTILE_TEMP11 NOPRINT;
          VAR C1-C5;
          BY &BYVAR;
          OUTPUT OUT=QUARTILE_TEMP12 SUM=SOMWGT1-SOMWGT5;
      RUN;

      DATA QUARTILE_TEMP13;
          MERGE QUARTILE_TEMP11 QUARTILE_TEMP12;
          BY &BYVAR;
          IF (NB_MISS=0);
          ARRAY A1 (5) C1-C5;
          ARRAY A2 (5) SOMWGT1-SOMWGT5;
          ARRAY A3 (5) PCT1-PCT5;
          DO I=1 TO 5;
              A3(I)=(A1(I)/A2(I))*100;
          END;
          PCT=(PCT1+PCT2+PCT3+PCT4+PCT5)/5;
          IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
          ELSE FLAG_PCT=0;
          KEEP &BYVAR FLAG_PCT;
      RUN;
      DATA &OUTFILE;
          MERGE QUARTILE_TEMP7 QUARTILE_TEMP8 QUARTILE_TEMP10 QUARTILE_TEMP13;
          BY &BYVAR;
      RUN;
      PROC DATASETS LIBRARY=WORK NOLIST;
          DELETE
              QUARTILE_TEMP8_1 QUARTILE_TEMP8_2 QUARTILE_TEMP8_3 QUARTILE_TEMP8_4
QUARTILE_TEMP8_5
              QUARTILE_TEMP8
              QUARTILE_TEMP9_1 QUARTILE_TEMP9_2 QUARTILE_TEMP9_3 QUARTILE_TEMP9_4
QUARTILE_TEMP9_5
              QUARTILE_TEMP10_1 QUARTILE_TEMP10_2 QUARTILE_TEMP10_3 QUARTILE_TEMP10_4
QUARTILE_TEMP10_5
              QUARTILE_TEMP10
              QUARTILE_TEMP11_1 QUARTILE_TEMP11_2 QUARTILE_TEMP11_3 QUARTILE_TEMP11_4
QUARTILE_TEMP11_5
              QUARTILE_TEMP11 QUARTILE_TEMP12 QUARTILE_TEMP13;
      RUN;
%END;
```

Box 17.11 [5/6] **SAS® macro of QUARTILE_PV.sas**

```
PROC DATASETS LIBRARY=WORK NOLIST;
      DELETE  QUARTILE_TEMP1 QUARTILE_TEMP2 QUARTILE_TEMP3 QUARTILE_TEMP4 QUARTILE_
TEMP5 QUARTILE_TEMP6 QUARTILE_TEMP7
             INDEX1 INDEX2 INDEX3 INDEX4 INDEX5
             RESULT1 RESULT2 RESULT3 RESULT4 RESULT5;
RUN;

OPTION NOTES;

%MEND ;


%MACRO SUBQUARTILE1(INFILE =,
                    REPLI_ROOT =,
                    SUB_BY_VAR =  ,
                    VAR =,
                    OUTFILE =);

PROC DATASETS LIBRARY=WORK NOLIST;
      DELETE BRR_TEMP1;
RUN;

PROC SORT DATA=&INFILE OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &SUB_BY_VAR
&VAR);
  BY &SUB_BY_VAR;
RUN;

%DO I = 0 %TO 80;
      PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
         VAR &VAR ;
         BY &SUB_BY_VAR;
         WEIGHT &REPLI_ROOT&I;
         OUTPUT OUT=MEAN_TEMP MEAN=PV;
      RUN;

      DATA MEAN_TEMP;
         SET MEAN_TEMP;
         L=&I;
      RUN;

      PROC APPEND BASE = BRR_TEMP1 DATA=MEAN_TEMP;
      RUN;
%END;

DATA BRR_TEMP2(KEEP=&SUB_BY_VAR PV)BRR_TEMP3(KEEP=&SUB_BY_VAR STAT);
      SET BRR_TEMP1;
      IF L > 0 THEN OUTPUT BRR_TEMP2;
      ELSE DO;
         STAT =PV;
         OUTPUT BRR_TEMP3;
      END;
RUN;

PROC SORT DATA=BRR_TEMP2;
      BY &SUB_BY_VAR;
RUN;

PROC SORT DATA=BRR_TEMP3;
      BY &SUB_BY_VAR;
RUN;

DATA BRR_TEMP4;
      MERGE BRR_TEMP2 BRR_TEMP3;
      BY &SUB_BY_VAR;
      VARI=((PV-STAT)**2)*(1/20);
RUN;
```

Box 17.11 [6/6] **SAS® macro of QUARTILE_PV.sas**

```
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
      VAR VARI;
      BY &SUB_BY_VAR;
      OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;


DATA &OUTFILE;
      MERGE BRR_TEMP3 BRR_TEMP5;
      BY &SUB_BY_VAR;
      SESTAT=(SS)**0.5;
      FORMAT STAT F10.2;
      FORMAT SESTAT F10.2;
      KEEP &SUB_BY_VAR STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
      DELETE BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 BRR_TEMP6 MEAN_TEMP
BRRDATA;
RUN;

%MEND SUBQUARTILE1;
```

Box 17.12 [1/3] **SAS® macro of RELATIVE_RISK_NO_PV.sas**

```
%macro BRR_RR(INFILE=,
              REPLI_ROOT=,
              BYVAR=,
              ANTECEDENT=,
              OUTCOME=,
              LIMIT=,
              LIMIT_CRITERIA=,
              ID_SCHOOL=,
              OUTFILE=);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  =       INPUT DATA FILE.
REPLI_ROOT =     ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES
ANTECEDENT = ANTECEDENT VARIABLES (0,1)
OUTCOME =       CONSEQUENCE VARIABLES (0,1)
LIMIT = FLAGGING  YES OR NO
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL       = VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP;
RUN;

PROC SORT DATA=&INFILE
       OUT=BRRDATA(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &ANTECEDENT &OUTCOME
&ID_SCHOOL);
       BY &BYVAR &ANTECEDENT;
RUN;

%DO I = 0 %TO 80;
       PROC FREQ DATA=BRRDATA NOPRINT;
              TABLE &OUTCOME /OUT=FREQ_TEMP ;
              BY &BYVAR &ANTECEDENT ;
              WEIGHT &REPLI_ROOT&I;
              WHERE (&ANTECEDENT IN (0,1) AND &OUTCOME IN (0,1));
       RUN;

       DATA FREQ_TEMP;
              SET FREQ_TEMP;
              L=&I;
              IF (&OUTCOME=1);
              KEEP &BYVAR L &ANTECEDENT PERCENT;
       RUN;

       PROC APPEND BASE = BRR_TEMP DATA=FREQ_TEMP;
       RUN;
%END;

PROC SORT DATA=BRR_TEMP OUT=BRR_TEMP0;
       BY &BYVAR L &ANTECEDENT ;
RUN;

PROC TRANSPOSE DATA=BRR_TEMP0 OUT=BRR_TEMP1;
       VAR PERCENT;
       BY &BYVAR L;
       ID &ANTECEDENT ;
RUN;
```

Box 17.12 [2/3] **SAS® macro of RELATIVE_RISK_NO_PV.sas**

```
DATA BRR_TEMP1;
        SET BRR_TEMP1;
        PV=(_1/_0);
RUN;

DATA BRR_TEMP2(KEEP=&BYVAR PV)BRR_TEMP3(KEEP=&BYVAR STAT);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =PV;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR;
        VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR STAT SESTAT;
RUN;

%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;

%END;
%ELSE %DO;
        DATA BRRDATA;
                SET BRRDATA;
                MIS=0;
                IF (&ANTECEDENT NOT IN (0,1) OR &OUTCOME NOT IN (0,1)) THEN MIS=1;
        RUN;
        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE MIS /OUT=BRR_TEMP7;
                BY &BYVAR;
                WHERE (MIS=0);
        RUN;
        %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP7;
                SET BRR_TEMP7;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;
```

Box 17.12 [3/3] **SAS® macro of RELATIVE_RISK_NO_PV.sas**

```
PROC SORT DATA=BRRDATA;
               BY &BYVAR  &ID_SCHOOL;
       RUN;
       PROC FREQ DATA=BRRDATA NOPRINT;
               TABLE MIS /OUT=BRR_TEMP8;
               BY &BYVAR  &ID_SCHOOL;
               WHERE (MIS=0);
       RUN;
       PROC FREQ DATA=BRR_TEMP8 NOPRINT;
               TABLE MIS /OUT=BRR_TEMP9;
               BY &BYVAR;
       RUN;
       %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
       DATA BRR_TEMP9;
               SET BRR_TEMP9;
               IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
               ELSE FLAG_SCH=0;
               KEEP &BYVAR FLAG_SCH ;
       RUN;

       PROC FREQ DATA=BRRDATA NOPRINT;
               TABLE MIS/OUT=BRR_TEMP10;
               BY &BYVAR;
               WEIGHT &REPLI_ROOT.0;
       RUN;
       %LET K=1;
       %LET POPREF=;
       %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
       %DO %WHILE(&K <= &NBVAR);
               %LET POPREF_ADD=%SCAN(&BYVAR,&K);
               %LET POPREF=&POPREF &POPREF_ADD;
               %LET K=%EVAL(&K+1);
       %END;

       PROC MEANS DATA=BRR_TEMP10 NOPRINT;
               VAR COUNT;
               BY &POPREF;
               OUTPUT OUT=BRR_TEMP11 SUM=SOMWGT;
       RUN;
       %LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
       DATA BRR_TEMP12;
               MERGE BRR_TEMP10 BRR_TEMP11;
               BY &POPREF;
               PCT=(COUNT/SOMWGT)*100;
               IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
               ELSE FLAG_PCT=0;
               IF (MIS=0);
               KEEP &BYVAR FLAG_PCT;
       RUN;
       DATA &OUTFILE;
               MERGE BRR_TEMP6 BRR_TEMP7 BRR_TEMP9 BRR_TEMP12;
               BY &BYVAR;
               IF (STAT NE .);
       RUN;

       PROC DATASETS LIBRARY=WORK NOLIST;
               DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12;
       RUN;
%END;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5
BRR_TEMP6 FREQ_TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_RR;
```

Box 17.13 [1/5] **SAS® macro of RELATIVE_RISK_PV.sas**

```
%macro BRR_RR_PV(INFILE=,
                 REPLI_ROOT=,
                 BYVAR=,
                 ANTECEDENT_ROOT=,
                 OUTCOME_ROOT=,
                 LIMIT=,
                 LIMIT_CRITERIA=,
                 ID_SCHOOL=,
                 OUTFILE=);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES.
FINAL WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES
ANTECEDENT_ROOT =      ROOT OF THE 5 ANTECEDENT VARIABLES (0,1)
OUTCOME_ROOT = ROOT OF THE 5 CONSEQUENCE VARIABLES   (0,1)
LIMIT = FLAGGING  YES OR NO
LIMIT_CRITERIA = 1) NUMBER OF STUDENTS 2) NUMBER OF SCHOOLS 3) PERCENTAGE OF
STUDENTS AND 4) NUMBER OF VARIABLES FROM THE BYVAR ARGUMENT FOR DEFINING THE
POPULATION OF REFERENCE.
ID_SCHOOL =    VARIABLE NAME FOR THE SCHOOL IDENTIFICATION
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP;
RUN;

%DO I = 1 %TO 5;

PROC SORT DATA=&INFILE
       OUT=BRRDATA(KEEP=     &REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &ANTECEDENT_
ROOT.1-&ANTECEDENT_ROOT.5
                                            &OUTCOME_ROOT.1-&OUTCOME_ROOT.5 &ID_
SCHOOL);

       BY &BYVAR &ANTECEDENT_ROOT&I;
RUN;


%DO J = 0 %TO 80;
       PROC FREQ DATA=BRRDATA NOPRINT;
              TABLE &OUTCOME_ROOT&I /OUT=FREQ_TEMP ;
              BY &BYVAR &ANTECEDENT_ROOT&I ;
              WEIGHT &REPLI_ROOT&J;
              WHERE (&ANTECEDENT_ROOT&I IN (0,1) AND &OUTCOME_ROOT&I IN (0,1));
       RUN;

       DATA FREQ_TEMP;
              SET FREQ_TEMP;
              K=&I;
              L=&J;
              &ANTECEDENT_ROOT=&ANTECEDENT_ROOT&I;
              IF (&OUTCOME_ROOT&I=1);
              KEEP &BYVAR K L &ANTECEDENT_ROOT PERCENT;
       RUN;

       PROC APPEND BASE = BRR_TEMP DATA=FREQ_TEMP;
       RUN;
%END;
```

Box 17.13 [2/5] **SAS® macro of RELATIVE_RISK_PV.sas**

```
PROC SORT DATA=BRR_TEMP OUT=BRR_PREP1;
        BY &BYVAR L K &ANTECEDENT_ROOT ;
RUN;
PROC TRANSPOSE DATA=BRR_PREP1 OUT=BRR_PREP2;
        VAR PERCENT;
        BY &BYVAR L K;
        ID &ANTECEDENT_ROOT ;
RUN;
DATA BRR_PREP2;
        SET BRR_PREP2;
        PV=(_1/_0);
        KEEP &BYVAR L K PV;
RUN;
PROC TRANSPOSE DATA=BRR_PREP2 OUT=BRR_PREP3 PREFIX=PV;
        VAR PV;
        BY &BYVAR L;
        ID K ;
RUN;
DATA BRR_TEMP1;
        SET BRR_PREP3;
        DROP _NAME_ ;
RUN;

DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR)BRR_TEMP3(KEEP=&BYVAR STAT FIN1-FIN5
MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR ;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR ;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR ;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
```

Box 17.13 [3/5] **SAS® macro of RELATIVE_RISK_PV.sas**

```
DATA BRR_TEMP6;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR ;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR STAT SESTAT;
RUN;

%IF (%UPCASE(&LIMIT)=NO) %THEN %DO;

        DATA &OUTFILE;
                SET BRR_TEMP6;
        RUN;

%END;
%ELSE %DO;
        DATA BRRDATA;
                SET BRRDATA;
                MIS=1;
                IF (&ANTECEDENT_ROOT.1 IN (0,1) AND &OUTCOME_ROOT.1 IN (0,1)) THEN
MIS=0;
        RUN;
        %DO M=1 %TO 5;
        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE MIS/OUT=BRR_TEMP7;
                BY &BYVAR;
                WHERE (MIS=0);
        RUN;
        DATA BRR_TEMP8;
                SET BRR_TEMP7;
                COUNT&M=COUNT;
                KEEP &BYVAR COUNT&M;
        RUN;
        %IF (&M=1) %THEN %DO;
                DATA BRR_TEMP9;
                        SET BRR_TEMP8;
                RUN;
        %END;
        %ELSE %DO;
                DATA BRR_TEMP9;
                        MERGE BRR_TEMP9 BRR_TEMP8;
                        BY &BYVAR ;
                RUN;
        %END;
        %END;
        %LET FLAG_STUD=%SCAN(&LIMIT_CRITERIA,1);
        DATA BRR_TEMP9;
                SET BRR_TEMP9;
                COUNT=(COUNT1+COUNT2+COUNT3+COUNT4+COUNT5)/5;
                IF (COUNT < &FLAG_STUD) THEN FLAG_STUD=1;
                ELSE FLAG_STUD=0;
                KEEP &BYVAR FLAG_STUD;
        RUN;

        PROC SORT DATA=BRRDATA;
                BY &BYVAR  &ID_SCHOOL;
        RUN;

        %DO M=1 %TO 5;
        PROC FREQ DATA=BRRDATA NOPRINT;
                TABLE MIS /OUT=BRR_TEMP10;
                BY &BYVAR  &ID_SCHOOL;
                WHERE (MIS=0);
        RUN;
        PROC FREQ DATA=BRR_TEMP10 NOPRINT;
                TABLE MIS  /OUT=BRR_TEMP11;
                BY &BYVAR;
        RUN;
```


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Box 17.13 [4/5] **SAS® macro of RELATIVE_RISK_PV.sas**

```
DATA BRR_TEMP12;
               SET BRR_TEMP11;
               COUNT&M=COUNT;
               KEEP &BYVAR COUNT&M;
        RUN;
        %IF (&M=1) %THEN %DO;
               DATA BRR_TEMP13;
                      SET BRR_TEMP12;
               RUN;
        %END;
        %ELSE %DO;
               DATA BRR_TEMP13;
                      MERGE BRR_TEMP13 BRR_TEMP12;
                      BY &BYVAR;
               RUN;
        %END;
        %END;
        %LET FLAG_SCH=%SCAN(&LIMIT_CRITERIA,2);
        DATA BRR_TEMP13;
               SET BRR_TEMP13;
               COUNT=(COUNT1+COUNT2+COUNT3+COUNT4+COUNT5)/5;
               IF (COUNT < &FLAG_SCH) THEN FLAG_SCH=1;
               ELSE FLAG_SCH=0;
               KEEP &BYVAR FLAG_SCH;
        RUN;

        %DO M=1 %TO 5;
        PROC FREQ DATA=BRRDATA NOPRINT;
               TABLE MIS/OUT=BRR_TEMP14;
               BY &BYVAR;
               WEIGHT &REPLI_ROOT.0;
        RUN;
        DATA BRR_TEMP15;
               SET BRR_TEMP14;
               COUNT&M=COUNT;
               KEEP &BYVAR MIS COUNT&M;
        RUN;
        %IF (&M=1) %THEN %DO;
               DATA BRR_TEMP16;
                      SET BRR_TEMP15;
               RUN;
        %END;
        %ELSE %DO;
               DATA BRR_TEMP16;
                      MERGE BRR_TEMP16 BRR_TEMP15;
                      BY &BYVAR MIS;
               RUN;
        %END;
        %END;

        %LET K=1;
        %LET POPREF=;
        %LET NBVAR=%SCAN(&LIMIT_CRITERIA,4);
        %DO %WHILE(&K <= &NBVAR);
               %LET POPREF_ADD=%SCAN(&BYVAR,&K);
               %LET POPREF=&POPREF &POPREF_ADD;
               %LET K=%EVAL(&K+1);
        %END;

        PROC MEANS DATA=BRR_TEMP16 NOPRINT;
               VAR COUNT1-COUNT5 ;
               BY &POPREF;
               OUTPUT OUT=BRR_TEMP17 SUM=SOMWGT1-SOMWGT5;
        RUN;
```


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Box 17.13 [5/5] **SAS® macro of RELATIVE_RISK_PV.sas**

```
%LET FLAG_PCT=%SCAN(&LIMIT_CRITERIA,3);
       DATA BRR_TEMP18;
              MERGE BRR_TEMP16 BRR_TEMP17;
              BY &POPREF;
              IF (MIS=0);
              ARRAY B1 (5) PCT1-PCT5;
              ARRAY B2 (5) COUNT1-COUNT5;
              ARRAY B3 (5) SOMWGT1-SOMWGT5;
              DO A=1 TO 5;
                     B1(A)=(B2(A)/B3(A))*100;
              END;
              PCT=(PCT1+PCT2+PCT3+PCT4+PCT5)/5;
              IF (PCT < &FLAG_PCT) THEN FLAG_PCT=1;
              ELSE FLAG_PCT=0;
              KEEP &BYVAR FLAG_PCT;
       RUN;

       DATA &OUTFILE;
              MERGE BRR_TEMP6 BRR_TEMP9 BRR_TEMP13 BRR_TEMP18;
              BY &BYVAR ;
       RUN;

       PROC DATASETS LIBRARY=WORK NOLIST;
              DELETE BRR_TEMP7 BRR_TEMP8 BRR_TEMP9 BRR_TEMP10 BRR_TEMP11 BRR_
TEMP12 BRR_TEMP13
                             BRR_TEMP14 BRR_TEMP15 BRR_TEMP16 BRR_TEMP17 BRR_
TEMP18;
       RUN;

%END;


PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_PREP1 BRR_PREP2 BRR_PREP3 BRR_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3
BRR_TEMP4 BRR_TEMP5 FREQ_TEMP BRR_TEMP6 MEAN_TEMP BRRDATA;
RUN;

OPTIONS NOTES;

%MEND BRR_RR_PV;
```

Box 17.14 [1/2] **SAS® macro of EFFECT_SIZE_NO_PV.sas**

```
%MACRO BRR_EFFECT(INFILE=,
                  REPLI_ROOT=,
                  BYVAR=,
                  VAR=,
                  EFFECT=,
                  OUTFILE=);


/*

MEANING OF THE MACRO ARGUMENTS

INFILE = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR   = BREAKDOWN VARIABLES.
VAR = DEPENDENT VARIABLES.
EFFECT = THIS ARGUMENT HAS THREE COMPONENTS: THE VARIABLE NAME AND THE TWO
CATEGORIES ON WHICH THE EFFECT SIZE WILL BE COMPUTED. THE EFFECT SIZE WILL BE THE
SECOND COMPONENT MINUS THE THIRD COMPONENT.
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

%LET GROUP=%SCAN(&EFFECT,1);
%LET CAT1=%SCAN(&EFFECT,2);
%LET CAT2=%SCAN(&EFFECT,3);

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP1;
RUN;

DATA BRRDATA;
        SET &INFILE;
        IF (&GROUP=&CAT1) THEN VAR_GROUP=1;
        IF (&GROUP=&CAT2) THEN VAR_GROUP=2;
        IF (VAR_GROUP IN (1,2));
        KEEP &REPLI_ROOT.0-&REPLI_ROOT.80 &BYVAR &VAR VAR_GROUP;
RUN;

PROC SORT DATA=BRRDATA;
  BY &BYVAR VAR_GROUP;
RUN;

%DO I = 0 %TO 80;
        PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
                VAR &VAR ;
                BY &BYVAR VAR_GROUP;
                WEIGHT &REPLI_ROOT&I;
                OUTPUT OUT=MEAN_TEMP MEAN=STAT1 VAR=STAT2;
        RUN;

        DATA MEAN_TEMP;
                SET MEAN_TEMP;
                L=&I;
        RUN;

        PROC APPEND BASE = BRR_TEMP1 DATA=MEAN_TEMP;
        RUN;

%END;

PROC SORT DATA=BRR_TEMP1;
        BY &BYVAR L VAR_GROUP;
RUN;
```

Box 17.14 [2/2] **SAS® macro of EFFECT_SIZE_NO_PV.sas**

```
PROC TRANSPOSE DATA=BRR_TEMP1 OUT=BRR_TEMP2 PREFIX=M;
        VAR STAT1       ;
        BY &BYVAR L;
        ID VAR_GROUP;
RUN;
PROC TRANSPOSE DATA=BRR_TEMP1 OUT=BRR_TEMP3 PREFIX=V;
        VAR STAT2       ;
        BY &BYVAR L;
        ID VAR_GROUP;
RUN;
DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY      &BYVAR L;
        PV=(M1-M2)/(((V1+V2)/2)**0.5);
        KEEP   &BYVAR L PV;
RUN;

DATA BRR_TEMP5(KEEP=&BYVAR PV)BRR_TEMP6(KEEP=&BYVAR STAT);
        SET BRR_TEMP4;
        IF L > 0 THEN OUTPUT BRR_TEMP5;
        ELSE DO;
                STAT =PV;
                OUTPUT BRR_TEMP6;
        END;
RUN;

PROC SORT DATA=BRR_TEMP5;
        BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP6;
        BY &BYVAR;
RUN;

DATA BRR_TEMP7;
        MERGE BRR_TEMP5 BRR_TEMP6;
        BY &BYVAR;
        VARI=((PV-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP7 NOPRINT;
        VAR VARI;
        BY &BYVAR;
        OUTPUT OUT=BRR_TEMP8 SUM=SS;
RUN;

DATA &OUTFILE;
        MERGE BRR_TEMP6 BRR_TEMP8;
        BY &BYVAR;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRRDATA MEAN_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5
BRR_TEMP6 BRR_TEMP7 BRR_TEMP8;
RUN;

OPTIONS NOTES;

%MEND;
```

Box 17.15 [1/3] **SAS® macro of EFFECT_SIZE_PV.sas**

```
%MACRO BRR_EFFECT_PV(INFILE=,
                     REPLI_ROOT=,
                     BYVAR=,
                     PV_ROOT=,
                     EFFECT=,
                     OUTFILE=);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
BYVAR = BREAKDOWN VARIABLES.
PV_ROOT =    ROOT OF THE 5 PLAUSIBLE VALUES VARIABLES NAMES.
EFFECT = THIS ARGUMENT HAS THREE COMPONENTS: THE VARIABLE NAME AND THE TWO
CATEGORIES ON WHICH THE EFFECT       SIZE WILL BE COMPUTED. THE EFFECT SIZE WILL
BE THE SECOND COMPONENT MINUS THE THIRD COMPONENT.
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

%LET GROUP=%SCAN(&EFFECT,1);
%LET CAT1=%SCAN(&EFFECT,2);
%LET CAT2=%SCAN(&EFFECT,3);

OPTIONS NONOTES;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP1;
RUN;

DATA BRRDATA;
       SET &INFILE;
       IF (&GROUP=&CAT1) THEN VAR_GROUP=1;
       IF (&GROUP=&CAT2) THEN VAR_GROUP=2;
       IF (VAR_GROUP IN (1,2));
       KEEP &REPLI_ROOT.0-&REPLI_ROOT.80 &PV_ROOT.1-&PV_ROOT.5 &BYVAR  VAR_GROUP;
RUN;

PROC SORT DATA=BRRDATA;
  BY &BYVAR VAR_GROUP;
RUN;

%DO I = 0 %TO 80;
       PROC MEANS DATA=BRRDATA VARDEF=WGT NOPRINT;
              VAR &PV_ROOT.1 - &PV_ROOT.5  ;
              BY &BYVAR VAR_GROUP;
              WEIGHT &REPLI_ROOT&I;
              OUTPUT OUT=MEAN_TEMP MEAN=MOY1-MOY5 VAR=VARI1-VARI5;
       RUN;

       DATA MEAN_TEMP;
              SET MEAN_TEMP;
              L=&I;
       RUN;

       PROC APPEND BASE = BRR_TEMP1 DATA=MEAN_TEMP;
       RUN;

%END;

PROC SORT DATA=BRR_TEMP1;
       BY &BYVAR L VAR_GROUP;
RUN;
```

Box 17.15 [2/3] **SAS® macro of EFFECT_SIZE_PV.sas**

```
PROC TRANSPOSE DATA=BRR_TEMP1 (RENAME=(MOY1=V1 MOY2=V2 MOY3=V3 MOY4=V4 MOY5=V5))
OUT=BRR_TEMP2 PREFIX=M;
       VAR V1-V5      ;
       BY &BYVAR L;
       ID VAR_GROUP;
RUN;
PROC TRANSPOSE DATA=BRR_TEMP1 (RENAME=(VARI1=V1 VARI2=V2 VARI3=V3 VARI4=V4
VARI5=V5))OUT=BRR_TEMP3 PREFIX=V;
       VAR V1-V5      ;
       BY &BYVAR L;
       ID VAR_GROUP;
RUN;
DATA BRR_TEMP4;
       MERGE BRR_TEMP2 BRR_TEMP3;
       BY      &BYVAR L _NAME_;
       PV=(M1-M2)/(((V1+V2)/2)**0.5);
       KEEP  &BYVAR L PV _NAME_;
RUN;
PROC TRANSPOSE DATA=BRR_TEMP4 OUT=BRR_TEMP5(DROP=_NAME_) PREFIX=P;
       VAR PV;
       BY &BYVAR L;
       ID _NAME_;
RUN;

DATA BRR_TEMP6(DROP=STAT FIN1-FIN5 MESVAR) BRR_TEMP7(KEEP=&BYVAR STAT FIN1-FIN5
MESVAR);
       SET BRR_TEMP5;
    IF L > 0 THEN OUTPUT BRR_TEMP6;
    ELSE DO;
       STAT =(PV1+PV2+PV3+PV4+PV5)/5;
              FIN1=PV1;
              FIN2=PV2;
              FIN3=PV3;
              FIN4=PV4;
              FIN5=PV5;
       MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
       OUTPUT BRR_TEMP7;
       END;
RUN;

PROC SORT DATA=BRR_TEMP6;
       BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP7;
       BY &BYVAR;
RUN;

DATA BRR_TEMP8;
       MERGE BRR_TEMP6 BRR_TEMP7;
       BY &BYVAR;
       ARRAY A (5)
              PV1-PV5;
       ARRAY B (5)
              FIN1-FIN5;
       ARRAY C(5)
              VAR1-VAR5;
       DO I=1 TO 5;
       C(I)=(1/20)*((A(I)-B(I))**2);
       END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP8 NOPRINT;
       VAR VAR1 VAR2 VAR3 VAR4 VAR5;
       BY &BYVAR;
       OUTPUT OUT=BRR_TEMP9 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
```

Box 17.15 [3/3] **SAS® macro of EFFECT_SIZE_PV.sas**

```
DATA &OUTFILE;
        MERGE BRR_TEMP7 BRR_TEMP9;
        BY &BYVAR;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR STAT SESTAT  ;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRRDATA MEAN_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5
BRR_TEMP6 BRR_TEMP7 BRR_TEMP8 BRR_TEMP9;
RUN;

OPTIONS NOTES;

%MEND;
```

Box 17.16 [1/5] **SAS® macro of PROC_MIXED_NO_PV.sas**

```
%macro BRR_MIXED(INFILE=,
                 REPLI_ROOT=,
                 VARDEP=,
                 FIXEF=,
                 RANEF=,
                 BYVAR=,
                 LEVEL2=,
                 OUTSCREEN=,
                 OUTFILE=);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE  =      INPUT DATA FILE.
REPLI_ROOT =   ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
VARDEP =       DEPENDENT VARIABLES.
FIXEF = LIST OF INDEPENDENT VARIABLES WITH FIXED EFFECT.
RANEF = LIST OF INDEPENDENT VARIABLES WITH RANDOM EFFECT.
LEVEL2  =      LEVEL 2 IDENTIFICATION VARIABLE.
BYVAR = BREAKDOWN VARIABLES.
OUTSCREEN      =      DOS ADRESS FOR EXPORTING LISTING.
OUTFILE =      FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR
ESTIMATES.

*/


OPTION NONOTES CLEANUP;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP0;
RUN;

PROC SORT DATA=&INFILE
       OUT=BRR_PREP1(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80  &VARDEP &BYVAR &FIXEF
&RANEF &LEVEL2);
       BY &BYVAR;
RUN;

%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&FIXEF,&I)));
       %LET I=%EVAL(&I+1);
%END;
%LET NB_FIXE=%EVAL(&I-1);


%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&RANEF,&I)));
       %LET I=%EVAL(&I+1);
%END;
%LET NB_RAN=%EVAL(&I-1);
%LET NB_TOT=%EVAL(&NB_FIXE+&NB_RAN+1);

DATA BRR_PREP2;
               SET BRR_PREP1;
               NB_MISS=0;
               ARRAY LIST_VAR (&NB_TOT) &VARDEP &FIXEF &RANEF;
               DO K=1 TO &NB_TOT;
                      IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
               END;
               IF (NB_MISS>1) THEN NB_MISS=1;
RUN;

PROC FREQ DATA=BRR_PREP2 NOPRINT;
       TABLE NB_MISS/OUT=&OUTFILE._DELETION;
       BY &BYVAR;
       WEIGHT &REPLI_ROOT.0;
RUN;
```


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Box 17.16 [2/5] **SAS® macro of PROC_MIXED_NO_PV.sas**

```
PROC UNIVARIATE DATA=BRR_PREP2 NOPRINT;
        VAR &REPLI_ROOT.0;
        BY &BYVAR;
        WHERE (NB_MISS=0);
        OUTPUT OUT=BRR_PREP3 N=NBRE SUM=SOMWGT;
RUN;

DATA BRRDATA;
        MERGE BRR_PREP2 BRR_PREP3;
        BY &BYVAR;
        ARRAY OLDWGT (81)&REPLI_ROOT.0-&REPLI_ROOT.80;
    ARRAY NEWWGT (81) STD_WGT0-STD_WGT80;
        DO I=1 TO 81;
                NEWWGT(I)=(OLDWGT(I)/SOMWGT)*NBRE;
        END;
RUN;

%DO J = 0 %TO 80;

                PROC MIXED DATA=BRRDATA NOCLPRINT NOITPRINT NOINFO METHOD=ML;
                        CLASS &LEVEL2;
                        MODEL &VARDEP=&FIXEF &RANEF /SOLUTION;
                        RANDOM INTERCEPT &RANEF /SUBJECT=&LEVEL2;
                        WEIGHT STD_WGT&J;
                        BY &BYVAR;
                        ODS OUTPUT SOLUTIONF=FIXE_TEMP COVPARMS=COV_TEMP;
                RUN;

                DATA FIXE_TEMP;
                        SET FIXE_TEMP;
                        L=&J;
                        KEEP &BYVAR L EFFECT ESTIMATE ;
                RUN;
                PROC SORT DATA=FIXE_TEMP;
                        by &BYVAR L EFFECT;
                RUN;
                DATA COV_TEMP;
                        SET COV_TEMP;
                        L=&J;
                        KEEP &BYVAR L COVPARM ESTIMATE ;
                RUN;
                PROC SORT DATA=COV_TEMP;
                        BY &BYVAR L COVPARM;
                RUN;

                %IF (&J=0) %then %do;
                        DATA BRR_TEMP_FIXE;
                                SET FIXE_TEMP;
                        RUN;
                        DATA BRR_TEMP_VAR;
                                SET COV_TEMP;
                        RUN;
                %END;

                DATA BRR_TEMP_FIXE;
                        MERGE BRR_TEMP_FIXE FIXE_TEMP;
                        BY &BYVAR L EFFECT;
                RUN;
                DATA BRR_TEMP_VAR;
                        MERGE BRR_TEMP_VAR COV_TEMP;
                        BY &BYVAR L COVPARM;
                RUN;

%END;

/* FIXE PARAMETERS */

PROC SORT DATA=BRR_TEMP_FIXE OUT=BRR_TEMP1;
        BY &BYVAR L EFFECT;
RUN;
```


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Box 17.16 [3/5] **SAS® macro of PROC_MIXED_NO_PV.sas**

```
DATA BRR_TEMP2(KEEP=&BYVAR EFFECT ESTIMATE) BRR_TEMP3(KEEP=&BYVAR EFFECT STAT);
       SET BRR_TEMP1;
       IF L > 0 THEN OUTPUT BRR_TEMP2;
       ELSE DO;
              STAT =ESTIMATE;
              OUTPUT BRR_TEMP3;
       END;
RUN;

PROC SORT DATA=BRR_TEMP2;
       BY &BYVAR EFFECT;
RUN;

PROC SORT DATA=BRR_TEMP3;
       BY &BYVAR EFFECT;
RUN;

DATA BRR_TEMP4;
       MERGE BRR_TEMP2 BRR_TEMP3;
       BY &BYVAR EFFECT;
       VARI=((ESTIMATE-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
       VAR VARI;
       BY &BYVAR EFFECT;
       OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA &OUTFILE._FIXE;
       MERGE BRR_TEMP3 BRR_TEMP5;
       BY &BYVAR EFFECT;
       SESTAT=(SS)**0.5;
       FORMAT STAT F10.2;
       FORMAT SESTAT F10.2;
       KEEP &BYVAR EFFECT STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_PREP1 BRR_PREP2 BRR_PREP3 BRR_TEMP_FIXE FIXE_TEMP BRR_TEMP1
BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 MEAN_TEMP BRRDATA;
RUN;

/* RANDOM PARAMETERS */

PROC SORT DATA=BRR_TEMP_VAR OUT=BRR_TEMP1;
       BY &BYVAR L COVPARM;
RUN;

DATA BRR_TEMP2(KEEP=&BYVAR COVPARM ESTIMATE) BRR_TEMP3(KEEP=&BYVAR COVPARM STAT);
       SET BRR_TEMP1;
       IF L > 0 THEN OUTPUT BRR_TEMP2;
       ELSE DO;
              STAT =ESTIMATE;
              OUTPUT BRR_TEMP3;
       END;
RUN;

PROC SORT DATA=BRR_TEMP2;
       BY &BYVAR COVPARM;
RUN;

PROC SORT DATA=BRR_TEMP3;
       BY &BYVAR COVPARM;
RUN;

DATA BRR_TEMP4;
       MERGE BRR_TEMP2 BRR_TEMP3;
       BY &BYVAR COVPARM;
       VARI=((ESTIMATE-STAT)**2)*(1/20);
RUN;
```

Box 17.16 [4/5] **SAS® macro of PROC_MIXED_NO_PV.sas**

```
PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR COVPARM;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;

DATA &OUTFILE._VARIANCE;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR COVPARM;
        SESTAT=(SS)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR COVPARM STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE COV_TEMP  BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 MEAN_
TEMP BRRDATA;
RUN;

/* INTRACLASS CORRELATION */

PROC SORT DATA=BRR_TEMP_VAR ;
        BY &BYVAR L COVPARM;
RUN;

PROC TRANSPOSE DATA=BRR_TEMP_VAR OUT=BRR_TEMP0;
        VAR ESTIMATE;
        BY &BYVAR L;
        ID COVPARM;
RUN;

DATA BRR_TEMP1;
        SET BRR_TEMP0;
        ESTIMATE=(INTERCEPT/(INTERCEPT+RESIDUAL));
        KEEP &BYVAR L ESTIMATE;
RUN;

DATA BRR_TEMP2(KEEP=&BYVAR ESTIMATE) BRR_TEMP3(KEEP=&BYVAR STAT);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =ESTIMATE;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR ;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR ;
        VARI=((ESTIMATE-STAT)**2)*(1/20);
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VARI;
        BY &BYVAR ;
        OUTPUT OUT=BRR_TEMP5 SUM=SS;
RUN;
```


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Box 17.16 [5/5] **SAS® macro of PROC_MIXED_NO_PV.sas**

```
DATA &OUTFILE._INTRACLASS;
       MERGE BRR_TEMP3 BRR_TEMP5;
       BY &BYVAR ;
       SESTAT=(SS)**0.5;
       FORMAT STAT F10.2;
       FORMAT SESTAT F10.2;
       KEEP &BYVAR STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE COV_TEMP  BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 MEAN_
TEMP BRRDATA;
RUN;


PROC DATASETS LIBRARY=WORK NOLIST;
       DELETE BRR_TEMP_VAR COV_TEMP  BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_
TEMP4 BRR_TEMP5 MEAN_TEMP BRRDATA;
RUN;


OPTIONS NOTES;

%MEND;
```

Box 17.17 [1/6] **SAS® macro of PROC_MIXED_PV.sas**

```
%macro BRR_MIXED_PV(INFILE=,
                    REPLI_ROOT=,
                    PV_ROOT=,
                    FIXEF=,
                    RANEF=,
                    BYVAR=,
                    LEVEL2=,
                    OUTSCREEN=,
                    OUTFILE=,);

/*

MEANING OF THE MACRO ARGUMENTS

INFILE = INPUT DATA FILE.
REPLI_ROOT = ROOT OF THE FINAL WEIGHT AND 80 REPLICATES VARIABLE NAMES. FINAL
WEIGHT VARIABLE NAME MUST BE THE REPLICATION ROOT FOLLOWED BY 0.
PV_ROOT = ROOT OF THE 5 PROFICIENCY LEVEL VARIABLES NAMES
FIXEF = LIST OF INDEPENDENT VARIABLES WITH FIXED EFFECT
RANEF = LIST OF INDEPENDENT VARIABLES WITH RANDOM EFFECT
LEVEL2 = LEVEL 2 IDENTIFICATION VARIABLE
BYVAR = BREAKDOWN VARIABLES
OUTSCREEN = DOS ADRESS FOR EXPORTING LISTING
OUTFILE = FILE WITH THE STATISTIC ESTIMATES AND THEIR STANDARD ERROR ESTIMATES.

*/

OPTION NONOTES CLEANUP;

FILENAME MYOUTPUT &OUTSCREEN;
PROC PRINTTO PRINT=MYOUTPUT NEW;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP0;
RUN;

PROC SORT DATA=&INFILE
        OUT=BRR_PREP1(KEEP=&REPLI_ROOT.0-&REPLI_ROOT.80  &PV_ROOT.1-&PV_ROOT.5
&BYVAR &FIXEF &RANEF &LEVEL2);
        BY &BYVAR;
RUN;

%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&FIXEF,&I)));
        %LET I=%EVAL(&I+1);
%END;
%LET NB_FIXE=%EVAL(&I-1);


%LET I=1;
%DO %WHILE(%LENGTH(%SCAN(&RANEF,&I)));
        %LET I=%EVAL(&I+1);
%END;
%LET NB_RAN=%EVAL(&I-1);
%LET NB_TOT=%EVAL(&NB_FIXE+&NB_RAN+5);

DATA BRR_PREP2;
                SET BRR_PREP1;
                NB_MISS=0;
                ARRAY LIST_VAR (&NB_TOT) &PV_ROOT.1-&PV_ROOT.5 &FIXEF &RANEF;
                DO K=1 TO &NB_TOT;
                        IF (LIST_VAR(K) IN (.,.I,.M,.N)) THEN NB_MISS=NB_MISS+1;
                END;
                IF (NB_MISS>1) THEN NB_MISS=1;
RUN;

PROC FREQ DATA=BRR_PREP2 NOPRINT;
        TABLE NB_MISS/OUT=&OUTFILE._DELETION;
        BY &BYVAR;
        WEIGHT &REPLI_ROOT.0;
RUN;
```


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Box 17.17 [2/6] **SAS® macro of PROC_MIXED_PV.sas**

```
PROC UNIVARIATE DATA=BRR_PREP2 NOPRINT;
        VAR &REPLI_ROOT.0;
        BY &BYVAR;
        WHERE (NB_MISS=0);
        OUTPUT OUT=BRR_PREP3 N=NBRE SUM=SOMWGT;
RUN;

DATA BRRDATA;
        MERGE BRR_PREP2 BRR_PREP3;
        BY &BYVAR;
        ARRAY OLDWGT (81)&REPLI_ROOT.0-&REPLI_ROOT.80;
    ARRAY NEWWGT (81) STD_WGT0-STD_WGT80;
        DO I=1 TO 81;
                NEWWGT(I)=(OLDWGT(I)/SOMWGT)*NBRE;
        END;
RUN;

%DO I = 1 %TO 5;

        %DO J = 0 %TO 80;

                PROC MIXED DATA=BRRDATA NOCLPRINT NOITPRINT NOINFO METHOD=ML;
                        CLASS &LEVEL2;
                        MODEL &PV_ROOT&I=&FIXEF &RANEF /SOLUTION;
                        RANDOM INTERCEPT &RANEF /SUBJECT=&LEVEL2;
                        WEIGHT STD_WGT&J;
                        BY &BYVAR;
                        ODS OUTPUT SOLUTIONF=FIXE_TEMP COVPARMS=COV_TEMP;
                RUN;

                DATA FIXE_TEMP;
                        SET FIXE_TEMP;
                        L=&J;
                        PV&I=ESTIMATE;
                        KEEP &BYVAR L EFFECT PV&I ;
                RUN;
                PROC SORT DATA=FIXE_TEMP;
                        by &BYVAR L EFFECT;
                RUN;
                DATA COV_TEMP;
                        SET COV_TEMP;
                        L=&J;
                        PV&I=ESTIMATE;
                        KEEP &BYVAR L COVPARM PV&I ;
                RUN;
                PROC SORT DATA=COV_TEMP;
                        BY &BYVAR L COVPARM;
                RUN;

                %IF (&I=1 AND &J=0) %then %do;
                        DATA BRR_TEMP_FIXE;
                                SET FIXE_TEMP;
                        RUN;
                        DATA BRR_TEMP_VAR;
                                SET COV_TEMP;
                        RUN;
                %END;

                DATA BRR_TEMP_FIXE;
                        MERGE BRR_TEMP_FIXE FIXE_TEMP;
                        BY &BYVAR L EFFECT;
                RUN;
                DATA BRR_TEMP_VAR;
                        MERGE BRR_TEMP_VAR COV_TEMP;
                        BY &BYVAR L COVPARM;
                RUN;

        %END;

%END;
```

Box 17.17 [3/6] **SAS® macro of PROC_MIXED_PV.sas**

```
PROC SORT DATA=BRR_TEMP_FIXE OUT=BRR_TEMP1;
        BY &BYVAR L EFFECT;
RUN;

DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR)BRR_TEMP3(KEEP=&BYVAR EFFECT STAT FIN1-
FIN5 MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR EFFECT L;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR EFFECT;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR EFFECT;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR EFFECT;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;

DATA &OUTFILE._FIXE;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR EFFECT;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.1;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR EFFECT STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP_FIXE FIXE_TEMP BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4
BRR_TEMP5 MEAN_TEMP BRRDATA;
RUN;

PROC SORT DATA=BRR_TEMP_VAR OUT=BRR_TEMP1;
        BY &BYVAR L COVPARM;
RUN;
```

Box 17.17 [4/6] **SAS® macro of PROC_MIXED_PV.sas**

```
DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR)BRR_TEMP3(KEEP=&BYVAR COVPARM STAT FIN1-
FIN5 MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR COVPARM L;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR COVPARM;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR COVPARM;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR COVPARM;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;

DATA &OUTFILE._VARIANCE;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR COVPARM;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.1;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR COVPARM STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE  BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_TEMP4 BRR_TEMP5 MEAN_TEMP
/*BRRDATA*/;
RUN;

PROC SORT DATA=BRR_TEMP_VAR ;
        BY &BYVAR L COVPARM;
RUN;

%DO K=1 %TO 5;

PROC TRANSPOSE DATA=BRR_TEMP_VAR OUT=BRR_TEMP0;
        VAR PV&K;
        BY &BYVAR L;
        ID COVPARM;
RUN;
```

Box 17.17 [5/6] **SAS® macro of PROC_MIXED_PV.sas**

```
DATA BRR_TEMP0;
        SET BRR_TEMP0;
        PV&K=(INTERCEPT/(INTERCEPT+RESIDUAL));
        KEEP &BYVAR L PV&K;
RUN;

%IF (&K=1) %THEN %DO;
        DATA BRR_TEMP1;
                SET BRR_TEMP0;
        RUN;
%END;
DATA BRR_TEMP1;
        MERGE BRR_TEMP1 BRR_TEMP0;
        BY &BYVAR L;
RUN;

%END;


DATA BRR_TEMP2(DROP=STAT FIN1-FIN5 MESVAR)BRR_TEMP3(KEEP=&BYVAR STAT FIN1-FIN5
MESVAR);
        SET BRR_TEMP1;
        IF L > 0 THEN OUTPUT BRR_TEMP2;
        ELSE DO;
                STAT =(PV1+PV2+PV3+PV4+PV5)/5;
                FIN1=PV1;
                FIN2=PV2;
                FIN3=PV3;
                FIN4=PV4;
                FIN5=PV5;
                MESVAR=(((STAT-FIN1)**2)+((STAT-FIN2)**2)+((STAT-FIN3)**2)+((STAT-
FIN4)**2)+((STAT-FIN5)**2))/4;
                OUTPUT BRR_TEMP3;
        END;
RUN;

PROC SORT DATA=BRR_TEMP2;
        BY &BYVAR  L;
RUN;

PROC SORT DATA=BRR_TEMP3;
        BY &BYVAR ;
RUN;

DATA BRR_TEMP4;
        MERGE BRR_TEMP2 BRR_TEMP3;
        BY &BYVAR ;
        ARRAY A (5)
                PV1-PV5;
        ARRAY B (5)
                FIN1-FIN5;
        ARRAY C(5)
                VAR1-VAR5;
        DO I=1 TO 5;
                C(I)=(1/20)*((A(I)-B(I))**2);
        END;
RUN;

PROC UNIVARIATE DATA=BRR_TEMP4 NOPRINT;
        VAR VAR1 VAR2 VAR3 VAR4 VAR5;
        BY &BYVAR ;
        OUTPUT OUT=BRR_TEMP5 SUM=SS1 SS2 SS3 SS4 SS5;
RUN;
```


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Box 17.17 [6/6] **SAS® macro of PROC_MIXED_PV.sas**

```
DATA &OUTFILE._INTRACLASS;
        MERGE BRR_TEMP3 BRR_TEMP5;
        BY &BYVAR ;
        SAMP=(SS1+SS2+SS3+SS4+SS5)/5;
        FINVAR=(SAMP+(1.2*MESVAR));
        SESTAT=(FINVAR)**0.5;
        FORMAT STAT F10.2;
        FORMAT SESTAT F10.2;
        KEEP &BYVAR STAT SESTAT;
RUN;

PROC DATASETS LIBRARY=WORK NOLIST;
        DELETE BRR_TEMP_VAR COV_TEMP  BRR_TEMP0 BRR_TEMP1 BRR_TEMP2 BRR_TEMP3 BRR_
TEMP4 BRR_TEMP5 MEAN_TEMP
        BRR_PREP1 BRR_PREP2 BRR_PREP3;
RUN;

PROC PRINTTO PRINT=PRINT;
RUN;

OPTIONS NOTES;

%MEND;
```

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Appendices

APPENDIX 1
THREE-LEVEL REGRESSION ANALYSIS

Method

The multilevel analysis described in Chapter 5 in the PISA 2006 initial report of *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007) was performed using Hierarchical Linear and Nonlinear Modelling (HLM®).[1] A three-level HLM was carried out, with students serving as level 1, schools as level 2, and countries/economies as level 3. The model coefficients and statistics were estimated using a full maximum likelihood procedure.[2] Normalised student final weights were used, so that the sum of the weights was equal to the number of students in the data set, and each country contributed equally to the analysis. Five plausible values for the students' science performance served as the outcome variable.

Data

The data file used for the multilevel analysis includes 387 769 students from 14 052 schools in 55 countries/economies.[3] Three data sources were used:

- The PISA 2006 student and school questionnaire for the majority of indicators used in the multilevel analysis.
- *Education at a Glance 2006* (OECD, 2006), for data on the age of first selection in school systems in the OECD countries.
- The PISA 2006 system-level questionnaire, for additional system-level data in partner countries/economies, concerning in particular the use of standards-based external examination in science and the age of first selection in the school system. The system-level questionnaire was filled out by the National Project Manager of each partner country/economy.

Data preparation

Selecting and recoding variables

Based on both theoretical considerations and previous empirical findings, several school and system-level explanatory variables were selected in order to examine their role in the quality and equity of education. The variables can be sorted into six groups of thematic modules:

- Adminitting grouping and selecting
- School management and funding
- Parental pressure and choice
- Accountability policies
- School autonomy
- Selected resources (human, material and educational)

For each of these six groups, a few variables were selected, mainly from the PISA 2006 database, but also some derived from education system-level information. Indices were preferred over single-item statements whenever they were available since more information could be combined in one index and the problem of measurement error was less severe for indices than for single items. For some of the analysis it was possible to choose from several similar variables. In these cases, variables with the lowest rate of missing data and the highest correlation with performance were selected.

Demographic and socio-economic background variables, which are less likely to be amenable to school and system-level factors, were selected based on previous empirical findings. These background variables were included in the net models (that is, models accounting for background factors) in order to examine the net effects of the school and system-level variables. The background variables used in the net models were:

1. The commercial software HLM® 6.04 (developed by Raudenbush, Bryk and Congdon) was used.
2. In this method, both the regression coefficients and the variance components are included in the likelihood function.
3. France and Qatar were not included.

- Student level
  - PISA of economic, social and cultural status (ESCS) and its squared value
  - Gender
  - Language spoken at home
  - Immigrant status
- School level
  - School average ESCS
  - School size and its squared value
  - School location
- System level
  - Country average ESCS

These selected background and explanatory variables were re-coded where necessary. The descriptive statistics for all variables are listed in Box A1.1. The variables with "X" or "Y" in the first or second place are school-level or system-level variables, respectively. A detailed SPSS syntax for recoding variables is available on line at *www.pisa.oecd.org.*

Treatment of missing data

The proportion of missing values for the variables considered in the analysis is presented in Box A1.1. Even though the missing rate was less than 5% for most of the variables, a listwise deletion of all observations that have a missing value for at least one variable would have reduced the sample size by 28.21%, since more than 30 variables were included in the models. Therefore, missing values were imputed in order to include the maximum number of cases in analysis.

Since the missing rates were not high for most of the variables, a simple imputation approach was used to circumvent the problem of missing data: predictors at the individual and school level were imputed using a dummy variable adjustment (Cohen and Cohen, 1985). Due to the small number of observations (n=55) at the system level, system-level variables were not imputed.

It is known that this imputation method generally produces biased estimates of coefficients (Jones, 1996), and that standard errors of those variables that contain missing values are underestimated since they do not account for the uncertainty introduced through imputation. However, given the fact that only on 2 of 33 variables, more than 5% of the data were missing (Box A1.1), this bias was considered negligible.

As a first step of the imputation, a so-called "missing dummy" variable was created for all variables with missing values regardless of whether a variable was continuous, categorical or dichotomous. A missing dummy variable was set to 1 if the data were missing on that variable and it was set to 0 if the data were not missing. The first letter "M" in variable names in Box A1.1 signifies a missing dummy.

As a second step, missing values were imputed for continuous variables. Missing values were replaced by the weighted school average of the variable. If all data on the respective variable were missing in one school such that the weighted school mean could not be computed, the weighted country mean was imputed. If all data on the respective variable were missing in a country, the weighted international mean was imputed. When a missing value was replaced by the country or school mean, the weights were proportional to the sampling probability (weighting factor W_FSTUWT from the PISA 2006 dataset). When a missing value was replaced by the international mean, equal country weights were used, *i.e.* each country was given an equal weight of 1 000 cases.

Categorical variables were re-coded into a set of dummy variables.[4] For each category or for combined categories, a dummy variable was created with the value of 1 if the observation belongs to the respective category and 0 otherwise. Missing values in dummy and dichotomous variables were replaced by 0.

4. The number of dummy variables created from a categorical variable is smaller than the number of categories of the variable since one or more categories are used as a reference group.

Box A1.1 Descriptive statistics of background and explanatory variables

Variable description	Type	Variable name	Mean	S.D.	Min.	Max.	% missing
STUDENT LEVEL							
Student's index of economic, social and cultural status (ESCS)	B	ESCS; MESCS	-0.22	1.08	-5.67	3.35	0.95%
Student's index of economic, social and cultural status squared	B	ESCS2	1.22	1.81	0.00	32.14	0.95%
Student is female	B	FEMALE	0.50	0.50	0.00	1.00	<0.00%
Student is native student (not first- or second-generation students)	B	NATIVE; MNATIVE	0.88	0.33	0.00	1.00	2.47%
Student speaks the test language or other national language most of the time or always at home	B	SAMELANG; MSAMELANG	0.93	0.26	0.00	1.00	3.44%
SCHOOL LEVEL							
School located in a small town or village (fewer than 15,000 people)	B	XRURAL; MXRURAL	0.33	0.47	0.00	1.00	1.49%
School located in a city (with over 100,000 people)	B	XCITY	0.36	0.48	0.00	1.00	1.49%
School size	B	XSCHSIZE; MXSCHSIZE	8.47	7.44	0.03	100.00	2.61%
School size squared	B	XSCHSIZ2	127.10	382.99	0.00	10000.00	2.61%
School average index of economic, social and cultural status	B	XESCS; MXESCS	-0.22	0.74	-3.67	1.97	<0.00%
Admitting, grouping and selecting							
School with ability grouping for all subjects within school	E	XABGR; MXABGR	0.19	0.40	0.00	1.00	3.33%
School with low academic selectivity of school admittance	E	XLOSELE	0.32	0.47	0.00	1.00	2.33%
School with high academic selectivity of school admittance	E	XHISELE; MXHISELE	0.23	0.42	0.00	1.00	2.33%
School management and funding							
School being privately managed	E	XPRIVMAN; MXPRIVMAN	0.18	0.39	0.00	1.00	3.11%
School funding source from government	E	XGOVFUND; MXGOVFUND	82.75	26.77	0.00	100.00	7.47%
Parental pressure and choice							
School with high level of competition	E	XSCHLCOMP; MXSCHLCOMP	0.73	0.45	0.00	1.00	2.66%
School with high levels of perceived parental pressure	E	XPRESSPA; MXPRESSPA	0.65	0.48	0.00	1.00	2.53%
Accountability practices							
School informing parents of children's performance relative to other students in school	E	XACC1; MXACC1	0.61	0.49	0.00	1.00	2.31%
School informing parents of children's performance relative to national benchmarks	E	XACC2; MXACC2	0.45	0.50	0.00	1.00	2.84%
School informing parents of students' performance relative to other schools	E	XACC3; MXACC3	0.28	0.45	0.00	1.00	3.20%
School posting achievement data publicly	E	XACC4; MXACC4	0.37	0.48	0.00	1.00	2.92%
School using achievement data for evaluating principals	E	XACC5; MXACC5	0.37	0.48	0.00	1.00	3.69%
School using achievement data for evaluating teachers	E	XACC6; MXACC6	0.55	0.50	0.00	1.00	2.93%
School using achievement data for allocating resources to schools	E	XACC7; MXACC7	0.35	0.48	0.00	1.00	3.52%
School tracking achievement data over time	E	XACC8; MXACC8	0.66	0.47	0.00	1.00	3.33%
Any accountability variable missing		MXACC					7.82%
School autonomy							
School autonomy in staffing	E	XFACS; MXFACS	0.00	1.00	-1.24	1.66	1.15%
School autonomy in budgeting	E	XFACB; MXFACB	0.00	1.00	-2.31	0.87	1.12%
School autonomy in educational content	E	XFACC; MXFACC	0.00	1.00	-1.93	1.09	1.11%
Any school autonomy variable missing		MXFAC					1.16%
School resources							
School average number of students per teacher (student-teacher ratio)	E	XSTRATIO; MXSTRATIO	14.75	6.69	0.27	100.33	6.84%
School level index of teacher shortage	E	XTCSHORT; MXTCSHORT	0.05	1.06	-1.06	3.62	2.01%
School average number of computers for instruction per student	E	XIRATCOMP; MXIRATCOMP	0.12	0.12	0.00	1.47	4.32%
School level index of quality of school educational resources	E	XSCMATED; MXSCMATED	-0.28	1.13	-3.43	2.14	1.62%
School average students' learning time for regular lessons in school	E	XLTSCTOT; MXLTSCTOT	10.24	2.37	0.00	21.00	0.31%
School average students' learning time for out-of-school lessons	E	XLTOSTOT; MXLTOSTOT	2.77	1.57	0.00	13.00	0.31%
School average students' learning time for self-study or homework	E	XLTSTTOT; MXLTSTTOT	5.27	1.64	0.00	19.00	0.31%
School providing opportunity of taking science	E	XANYSCIE; MXANYSCIE	81.73	22.29	0.00	100.00	0.27%
School average index of school activities to promote students' learning of science	E	XSCIPROM; MXSCIPROM	0.23	1.01	-2.27	1.64	1.79%
SYSTEM LEVEL							
Country mean ESCS	B	YESCS	-0.22	0.51	-1.52	0.77	-
Admitting, grouping and selecting							
System with early selection (each additional year between the first age of selection and the age of 15)	E	YYRSSEP	1.20	1.62	0.00	5.00	-
System-level number of school types and distinct educational programmes available to 15-year-olds	E	YNRTRACK	2.33	1.21	1.00	5.00	-
Parental pressure and choice							
System with high proportion of competitive schools	E	YSCHLCOM	74.61	16.15	27.81	98.76	-
Accountability practices							
System with standards-based external examinations	E	YSCENTEX	0.56	0.47	0.00	1.00	-
Percentage of observations with at least one missing value on one variable							**28.21%**

Note: In the second column "B" refers to background variable and "E" refers to explanatory variable. For the computation of the percentages of missing values, equal country weights were used. The first letter "M" in variable names signifies a missing dummy. As only four (unweighted) cases are missing in the variable "female", the missing value was imputed to 0 and a missing dummy was not created for this variable. Variables YYRSSEP, YNRTRACK and YSCENTEX were derived from Table 5.2 in the PISA 2006 initial report (OECD, 2007).

Student weights

For the multilevel analysis, data files were weighted at the student level with "normalised student final weights", which were computed based on the student final weights (W_FSTUWT)[5] in the PISA 2006 dataset. Normalised student final weights were developed at two different levels according to the purpose of the analysis:

- At the country level for the two-level regression analysis The student final weights(W_FSTUWT) were normalised at the country level to i) make the sum of the weights within each country equal to the number of students within the country in the dataset (*i.e.* the sample size of the country); and ii) maintain the same proportion of weights as in the student final weights (W_FSTUWT within each country).
- At the international level for the three-level regression analysis The student final weights (W_FSTUWT) were normalised at the international level including 55 of the 57 participating countries to *i)* make the sum of the weights across the 55 countries equal to the number of students across the 55 countries in the dataset; *ii)* maintain the same proportion of weights as in the student final weights (W_FSTUWT) within each country; and *iii)* ensure that each individual country's contribution to the analysis is equal by introducing a country factor (*i.e.* the sum of the weights within each country is the same for all 55 countries).

The SPSS syntax for computing the normalised student final weights is available on line at *www.pisa.oecd.org.*

Modelling student performance

This section outlines the modelling strategy used in the multilevel analysis of school and system-level variables related to educational performance.

For building the multilevel model, a step-by-step approach was adopted, starting from the student level upwards to the country level, following an approach suggested by Raudenbush and Bryk (2002). This resulted in the background variables at all three levels listed above and the background model presented in Box A1.2 [see Model 0b in Table 5.19g in the PISA 2006 initial report (OECD, 2007)].

Throughout the multilevel analysis, unless otherwise specified, an effect is considered statistically significant if the p-value is below 0.1 at country level and below 0.005 at school level. Different criterion values were chosen for the two levels to balance between significance and statistical power. In particular, at the country level, where there are only 55 cases, statistical power is rather low, which is why a higher significance level was chosen. In contrast, there are more than 14 000 observations at the school level and so a rather low significance level of 0.005 was chosen.

Model 0b in Table 5.19g in the PISA 2006 initial report (OECD, 2007) summarises the results for the background model, *i.e.* the model in which only the background variables are considered.

Box A1.2 **Background model for student performance**

Level-1 Model

Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE)
+ P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E

Level-2 Model

P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY)
+ B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ) + R0

Level-3 Model

B00 = G000 + G001(YESCS) +U00

Note: See Box A1.1 for the definition of the variables.

5. The detailed description of student final weights is in PISA 2006 Technical Report (OECD, forthcoming).

Explanatory variables considered

The impact of selected system and school-level variables on science performance was analysed using multilevel models, before and after accounting for the demographic and socio-economic background variables.[6] As described in an earlier section of this annex, the six groups of variables were selected based on both theoretical considerations and previous empirical findings. One or more variables were selected as indicators measuring each of these groups. All background and explanatory variables for each of the six groups are listed in Box A1.1.

In the analysis of the impact of system and school-level variables on learning outcomes, a two-step procedure was applied with the following six groups of system and school-level variables: Admitting, grouping and selecting; school management and funding; parental pressure and choice; accountability policies; school autonomy; and school resources (human, material, and educational).

In the first step, the effects of the variables of each of the six groups were examined in turn, estimating separate models for each group. In the second step, from each of the separate models run in the first step, only the significant predictors were combined in a model. When a predictor turned out to be no longer significant in the combined model, it was dropped from the analysis.

This two-step procedure was applied following the model specification suggested by Raudenbush and Bryk (2002), as well as by Snijders and Bosker (1999). The opposite, backward approach of entering all possible predictors at a time, and then removing the non-significant ones was not feasible due to the large number of variables and multicollinearity problems.[7]

The final net combined model is shown in Box A1.3. The results of this model are presented in the Model 2N in Table 5.19g in the PISA 2006 initial report (OECD, 2007).

Box A1.3 **Final net combined model for student performance**

Level-1 Model

Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE)
+ P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E

Level-2 Model

P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY)
+ B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ)
+ B09*(XLTSTTOT) + B010*(XLTSCTOT) + B011*(XLTOSTOT) + B012*(XSCIPROM)
+ B013*(MXSCIPRO) + B014*(XFACB) + B015*(MXFACB) + B016*(XACC4) + B017*(MXACC4)
+ B018*(XLOSELE) + B019*(XHISELE) + B020*(MXHISELE) + B021*(XABGR) + B022*(MXABGR)
+ B023*(MXLTTOT) + R0

Level-3 Model

B00 = G000 + G001(YFACB) + G002(YESCS) + U00

Note: See Box A1.1 for the definition of the variables.

6. A gross model is defined as the model without accounting for the background variables. A net model is defined as the model accounting for the background variables.

7. Multicollinearity exists when two or more independent variables are highly correlated.

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Besides the final net combined model for student performance depicted here, which is a model where background variables are included, the same two-step analysis strategy was used for gross models, *i.e.* models where background variables are not accounted for. The results of the final gross combined model are depicted in the Model 2G in Table 5.19g in the PISA 2006 initial report (OECD, 2007).

Fixed/random effects and centring

In the models for examining the impact of selected system and school-level variables on science performance, all slopes were fixed and only the intercept was randomised at all three levels.

All variables including both background and explanatory variables were centred on the grand mean. The grand mean centring is a linear transformation of variables by subtracting the overall mean of all 55 countries from the value proper. Note that, for fixed slopes, it does not make a difference for the estimated slope whether a variable is grand-centred or not centred. Only the interpretation of the intercept changes when centring by the grand mean. In all models, the intercept is to be interpreted as the achievement score in science for a student who has the international mean in all variables included in the model.

Modelling the impact of socio-economic background on student performance

In investigating the roles that variables at the school and system level play with respect to the impact which socio-economic background has on student performance, a two-step procedure similar to the models for student performance was conducted.

To look at the net effects of these factors, background variables at the student, school, and system level were included in the analyses. The background variables are exactly the same as those used in the models described in the preceding section. The detailed equity background model specification is presented in Box A1.4.

In Box A1.4, the first letter "M" in variable names signifies a missing dummy and "X" and "Y" in the first or second place denote school and system-level variables, respectively. The only difference to the first set of models (models for student performance)is that the ESCS slope and the XESCS slope were given a random slope.

In Table 5.20g in the PISA 2006 initial report (OECD, 2007), the Model 0b summarises the results for the background model for the impact of socio-economic background on student performance, *i.e.* the model in which only the background variables are considered without any explanatory variables.

Box A1.4 **Background model for the impact of socio-economic background**

Level-1 Model

$$Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE) + P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E$$

Level-2 Model

$$P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY) + B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ) + R0$$

$$P1 = B10 + R1$$

Level-3 Model

$$B00 = G000 + G001(YESCS) + U00$$

$$B01 = G010 + U01$$

$$B10 = G100 + U10$$

Note: See Box A1.1 for the definition of the variables.

Explanatory variables considered

In the first step of the analysis, the variables at the school level were added to the background model for each of the six groups separately, estimating the slope of the student-level PISA index of economic, social and cultural status, as well as the intercept. As an example, Box A1.5 contains the group of the impact of socio-economic background for the group of school resources variables. All variables from the school resources group were introduced to the equations signifying the slope of the student-level PISA index of economic, social and cultural status (P1), in addition to the intercept (P0). The focus is on the coefficients (and corresponding significance values) for the slope, P1. The missing dummies for the variables (starting with the letter M) were included only in the estimation of the intercept, but not in the slope estimation.

Box A1.5 **Model of the impact of socio-economic background: "school resources" module**

Level-1 Model

Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE)

+ P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E

Level-2 Model

P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY)

+ B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ)

+ B09*(XSTRATIO) + B010*(MXSTRATI) + B011*(XTCSHORT) + B012*(MXTCSHOR)

+ B013*(XIRATCOM) + B014*(MXIRATCO) + B015*(XSCMATED) + B016*(MXSCMATE)

+ B017*(XLTSTTOT) + B018*(XLTSCTOT) + B019*(XLTOSTOT) + B020*(XANYSCIE)

+ B021*(MXANYSCI) + B022*(XSCIPROM) + B023*(MXSCIPRO) + B024*(MXLTTOT) + R0

P1 = B10 + B11*(XSTRATIO) + B12*(XTCSHORT) + B13*(XIRATCOM) + B14*(XSCMATED)

+ B15*(XLTSTTOT) + B16*(XLTSCTOT) + B17*(XLTOSTOT) + B18*(XANYSCIE)

+ B19*(XSCIPROM) + R1

Level-3 Model

B00 = G000 + G001(YESCS) + U00

B01 = G010 + U01

B10 = G100 + U10

B110 = G1100

Note: See Box A1.1 for the definition of the variables.

The model for the group of accountability practices variables is presented in Box A1.6. The variables at the system level, such as the existence of a standards-based external examination (SCENTEXA) were included in the estimate of the intercept (B00) and of two slopes, namely the slope of the student-level PISA index of economic, social and cultural status (ESCS; B10) and the slope of school-level PISA index of economic, social and cultural status (XESCS; B01). The coefficients of interest are G011 and G101.

Box A1.6 **Model of the impact of socio-economic background: "accountability practices" module**

Level-1 Model

$$Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE)$$
$$+ P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E$$

Level-2 Model

$$P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY)$$
$$+ B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ)$$
$$+ B09*(XACC1) + B010*(XACC2) + B011*(XACC3) + B012*(XACC4)$$
$$+ B013*(XACC5) + B014*(XACC6) + B015*(XACC7) + B016*(XACC8) + B017*(MXACC) + R0$$
$$P1 = B10 + B11*(XACC1) + B12*(XACC2) + B13*(XACC3) + B14*(XACC4)$$
$$+ B15*(XACC5) + B16*(XACC6) + B17*(XACC7) + B18*(XACC8) + R1$$

Level-3 Model

$$B00 = G000 + G001(YSCENTEX) + G002(YESCS) + U00$$
$$B01 = G010 + G011(YSCENTEX) + U01$$
$$B10 = G100 + G101(YSCENTEX) + U10$$

Note: See Box A1.1 for the definition of the variables.

In the second step of the modelling procedure of the socio-economic impact, the variables that were statistically significant in the first-step estimations were jointly submitted to the analysis, yielding the combined model contained in Box A1.7.

Box A1.7 **Final combined model for the impact of socio-economic background**

Level-1 Model

$$Y = P0 + P1*(ESCS) + P2*(MESCS) + P3*(ESCS2) + P4*(FEMALE)$$
$$+ P5*(NATIVE) + P6*(MNATIVE) + P7*(SAMELANG) + P8*(MSAMELAN) + E$$

Level-2 Model

$$P0 = B00 + B01*(XESCS) + B02*(MXESCS) + B03*(XRURAL) + B04*(XCITY)$$
$$+ B05*(MXRURAL) + B06*(XSCHSIZE) + B07*(XSCHSIZ2) + B08*(MXSCHSIZ)$$
$$+ B09*(XLTSCTOT) + B010*(MXLTSCTO) + R0$$
$$P1 = B10 + B11*(XLTSCTOT) + R1$$

Level-3 Model

$$B00 = G000 + G001(YYRSSEP) + G002(YESCS) + U00$$
$$B01 = G010 + G011(YYRSSEP) + U01$$
$$B10 = G100 + G101(YYRSSEP) + U10$$

Note: See Box A1.1 for the definition of the variables.

The results from the final combined model are given in Table 5.20g (Model 2) in the PISA 2006 initial report (OECD, 2007).

APPENDIX 2
PISA 2006 INTERNATIONAL DATABASE

What is the general structure of the PISA 2006 international database?

This document describes the international database of the OECD Programme for International Student Assessment (PISA) 2006. The database can be accessed through the PISA web page (*www.pisa.oecd.org*). The database comprises data collected in 2006 in 57 countries/economies and processed in the second half of 2006 and in 2007. The first results were released in December 2007 (for the full set of results see OECD, 2007).

For the detail of the PISA 2000 and PISA 2003 data, see the *Manual for the PISA 2003 Database* (OECD, 2002a) and the *PISA 2003 Data Analysis Manual* (OECD, 2005b)

The following sources can provide additional information about PISA:

- The PISA Web site (*www.pisa.oecd.org*) provides: *i)* descriptions about the programme, contact information, participating countries and results of PISA 2006 as well as PISA 2003 and PISA 2000; *ii)* the complete micro-level database, all questionnaires, publications and national reports of PISA 2006 as well as PISA 2003 and PISA 2000, in a downloadable format; and *iii)* an opportunity for users to generate their own tables or request specific ones.
- *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007) include the first results from PISA 2006. It presents evidence on student performance in scientific, reading and mathematical literacy reveals factors that influence the development of these skills at home and at school, and examines what the implications are for policy development.
- *Assessing Scientific, Reading and Mathematical Literacy: A framework for PISA 2006* (OECD, 2006) describes the framework and instruments underlying the PISA 2006 assessment. It introduces the PISA approach to assessing mathematical, reading and scientific literary. Further it presents tasks from the PISA 2006 assessment together with how these tasks were scored and how they relate to the conceptual framework underlying PISA.
- The *PISA 2006 Technical Report* (OECD, 2009) presents the methodology and procedures used in PISA.

Which instruments were included in PISA 2006?

Test design

In PISA 2006, a rotated test design was used to ensure a wide coverage of content while at the same time keeping the testing burden on individual students low. The main study items were allocated to 13 item clusters (seven science clusters, two reading clusters and four mathematics clusters) with each cluster representing 30 minutes of test time. The items were presented to students in 13 test booklets, with each booklet being composed of four clusters according to the rotation design shown in Table A2.1. S1 to S7 denote the science clusters, R1 and R2 denote the reading clusters, and M1 to M4 denote the mathematics clusters. R1 and R2 were the same two reading clusters as in PISA 2003, but the mathematics clusters were not intact clusters from PISA 2003. The eight science link units from PISA 2003 were distributed across the seven science clusters, in first or second position.

Table A2.1
Cluster rotation design used to form test booklets for PISA 2006

Booklet	Cluster 1	Cluster 2	Cluster 3	Cluster 4
1	S1	S2	S4	S7
2	S2	S3	M3	R1
3	S3	S4	M4	M1
4	S4	M3	S5	M2
5	S5	S6	S7	S3
6	S6	R2	R1	S4
7	S7	R1	M2	M4
8	M1	M2	S2	S6
9	M2	S1	S3	R2
10	M3	M4	S6	S1
11	M4	S5	R2	S2
12	R1	M1	S1	S5
13	R2	S7	M1	M3

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The fully-linked design is a balanced incomplete block design. Each cluster appears in each of the four possible positions within a booklet once and so each test item appeared in four of the test booklets. Another feature of the design is that each pair of clusters appears in one (and only one) booklet. Each sampled student was randomly assigned one of the thirteen booklets, which meant each student undertook two hours of testing. Students were allowed a short break after one hour. The directions to students emphasised that there were no correct answers to the attitudinal questions, and that they would not count in their test scores, but that it was important to answer them truthfully.

In addition to the 13 two-hour booklets, a special one-hour booklet, referred to as the UH booklet (Une Heure booklet), was prepared for use in schools catering exclusively to students with special needs. The UH booklet contained about half as many items as the other booklets, with about 50% of the items being science items, 25% reading and 25% mathematics. The items were selected from the main study items taking into account their suitability for students with special educational needs.

Questionnaires

Student questionnaire (see Appendix 3)

The student questionnaire was administered after the literacy assessment and it took students about 30 minutes to complete the instrument. The core questions on home background were similar to those used in PISA 2003, however, for some questions the wording was modified to improve the quality of the data collection based on experiences in previous surveys. The questionnaire covered the following aspects:

- Student characteristics: Grade, study programme, age and gender;
- Family background: Occupation of parents, education of parents, home possessions, number of books at home, country of birth for student and parents, language spoken at home;
- Students' views on science: Enjoyment of science, confidence in solving science tasks, general and personal value of science, participation in science-related activities, sources of information on science and general interest in learning science;
- Students' views on the environment: Awareness of environmental issues, source of information on the environment, perception of the impact of environmental issues, optimism about environmental issues and sense of responsibility for sustainable development;
- Students' views of science-related careers: Usefulness of schooling as preparation for the science labour market, information about science-related careers, future-oriented motivations for science and expected occupation at 30;
- Students' reports on learning time: Mode and duration of students' learning time in different subject areas and duration of students' out-of-school lessons;
- Students' views on teaching and learning of science: Science course taking in current and previous year, nature of science teaching at school (interactive, hands-on activities, student investigations and use of applications), future-oriented motivations to learn science, importance of doing well in subject areas (science, mathematics and test language subjects) and academic self-concept in science.

School questionnaire (see Appendix 5)

The school questionnaire was administered to the school principal and took about 20 minutes to be completed. It covered a variety of school-related aspects:

- Structure and organisation of the school: Enrolment, ownership, funding, grade levels, grade repetition, average test language class size, community size and tracking/ability grouping;
- Staffing and management: Number of teachers, availability of science teaching staff, responsibility for decision-making at school and influences of external bodies on school-level decisions;
- The school's resources: Number of computers at school and principals' views on quality and quantity of staffing and educational resources;

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- Accountability and admission practices: Accountability to parents, parental pressure on school, use of achievement data, parental choice of local school(s) and school admittance policies;
- Teaching of science and the environmental issues: School activities to promote learning of science, environmental issues in school curriculum and school activities to promote learning of environmental issues; and
- Aspects of career guidance: Students' opportunities to participate in career information activities, student training through local businesses, influence of business on school curriculum and structure of career guidance at school.

International options

As in previous surveys, additional questionnaire material was developed, which was offered as international options to participating countries. In PISA 2006, two international options were available, the ICT familiarity questionnaire and the parent questionnaire.

Information Communication Technology (ICT) familiarity questionnaire (see Appendix 4)

The ICT familiarity questionnaire consisted of questions regarding the students' use of, familiarity with and attitudes towards information communication technology which was defined as the use of any equipment or software for processing or transmitting digital information that performs diverse general functions whose options can be specified or programmed by its user. The questionnaire was administered to students after the international student questionnaire (sometimes combined within the same booklet) and it took about five minutes to be completed. It covered the following ICT-related aspects:

- Use of ICT: Students' experience with computers at different locations and frequency of ICT use for different purposes;
- Affective responses to ICT: Confidence in carrying out ICT-related tasks.

Parent questionnaire (see Appendix 6)

The parent questionnaire covered both parental socio-economic background and aspects related to some of the research areas. It took about ten minutes to complete and one questionnaire was administered per student. The questionnaire covered the following aspects:

- Parental reports related to school and science learning: The students' past science activities, parental perceptions of value and quality of the student's schooling, parental views on science-related careers and parental general and personal value of science;
- Parental views on the environment: Parental awareness of environmental views and environmental optimism;
- Annual spending on children's education;
- Parental background: Age, occupation (both parents), education (both parents) and household income.

What is available from the PISA 2006 international database?

What is available for downloading?

The downloadable files are classified into six categories. Some of them are quite small, while others (*e.g.* the micro-level data files) are quite large, taking a long time to download. The six categories of file are:

Questionnaires

The following questionnaires are available for PISA 2006: student questionnaire, ICT familiarity questionnaire, school questionnaire and parent questionnaire. Appendices 3 to 6 of this document show these questionnaires, with the variable name of each item in the left-hand margin.

Codebooks

The codebooks are useful in relating the actual items from the instruments (assessment tests or questionnaires) to the data available in the data files as they identify the variable name with all possible values which are valid for that variable.

In addition to the name of the variable, they also show its label, all possible responses (code and label), type of variable (*e.g.* string or numeric) and the columns where the values are shown in the actual data file. Five codebooks are available: the codebook for student questionnaire and ICT questionnaire (Appendix 7), the codebooks for non-scored and scored cognitive and embedded attitude items (Appendices 8 and 9), the codebook for school questionnaire (Appendix 10) and the codebook for parent questionnaire (Appendix 11).

SAS® Control files

These files will read the raw text file, and convert it into a SAS® data file assigning label and values (valid and missing). The five SAS® control files will read and convert: the student questionnaire data file, two type of cognitive test item data files (*i.e.* non-scored and scored), the school questionnaire data file, and the parent questionnaire data file. These files have extension *.SAS.

SPSS® Control files

Similarly to the SAS® control files, these files will read the raw text file, and convert it into a SPSS® data file assigning labels and values (valid and missing). The five SPSS® control files will read and convert: the student questionnaire data file, two type of cognitive test item data files (*i.e.* non-scored and scored), the school questionnaire data file, and the parent questionnaire data file. The files have extension *.SPS.

Data files in text format

The item by item database is available in text format, which once read by the SAS® or SPSS® control files will be correctly formatted and labelled. As it is, it includes one row for each student with his or her responses to all items. These files have extension *.TXT and are in ASCII form.

Compendia

Compendia show the full item by country results for the two student questionnaires, the school questionnaire and the students' performance. The following files are available: the student questionnaire compendium, the test item compendium, the embedded attitude item compendium, the school questionnaire compendium, the ICT questionnaire compendium and the parent questionnaire compendium. There are two types of data for each item: percentages by categories and performances in science, reading and mathematics by categories. Standard errors are also reported for the percentages and for the literacy means.

Which files are included in the PISA 2006 International database?

The PISA international database consists of six data files[1]: four with student responses, one with school responses and one with parent responses. All are provided in text (or ASCII format) with the corresponding SAS® and SPSS® control files.

Student files

Student performance and questionnaire data file can be found on the PISA website *www.pisa.oecd.org*.

For each student who participated in the assessment, the following information is available:

- Identification variables for the country, school and student;
- The student responses to the two questionnaires, *i.e.* the student questionnaire and the international option information communication technology *(ICT)* questionnaire;
- The indices derived from each student's responses to the original questions in the questionnaires;
- The students' performance scores in mathematics, reading, science, the three scales of science and embedded attitude scores in interest and support (five plausible values for each domain);
- The student weight variable and 80 Fay's replicates for the computation of the sampling variance estimates;

1. Two additional data files were created and sent to countries on request. One file contains the student abilities in WLEs on the 5 domains. The other file contains plausible values for students abilities on an alternative set of science scales, the content subscales.

- Two weight factors to compute normalised (replicate) weights for multi-level analysis, one for countries and one for subnational entities;
- Three sampling related variables: the randomised final variance stratum, the final variance unit and the original explicit strata, mostly labeled by country;
- Some variables that come from the cognitive test: test language, effort variables and three science items that were internationally deleted because of students' misconceptions;
- Database version with the date of the release.

Two types of indices are provided in the student questionnaire files (see Appendix 12). The first set is based on a transformation of one variable or on a combination of the information included in two or more variables. Twenty-five indices are included in the database from this first type. The second set is the result of a Rasch scaling and consists of weighted likelihood estimate indices. Twenty-three indices from the student questionnaire and 4 indices from the international option on information communication technology questionnaire are included in the database from this second type. The index for socio-economic status (ESCS) is derived as factor scores from a Principal Component Analysis and is also included in the database.

For each domain, *i.e.* science, reading and mathematics, and for each scale in science, *i.e. identifying scientific issues, explaining phenomena scientifically* and *using scientific evidence,* a set of five plausible values (transformed to the PISA scale) are provided.

The metrics of the various scales are established so that in the year that the scale is first established the OECD student mean score is 500 and the pooled OECD standard deviation is 100. The reading scale was established in PISA 2000, the mathematics scale in PISA 2003 and the science scale in PISA 2006. When establishing the scale the data is weighted to ensure that each OECD country is given equal weight.

In the case of science, the scale that was established in PISA 2006, the average of the five plausible values means for the 30 equally weighted participating OECD countries has been set at 500 and the average of the five plausible values standard deviations has been set at 100. Note that it follows that the means and variances of each of the five plausible values are not exactly 500 and 100. The same transformation was applied to the three scales in science.

Reading plausible values were mapped to the PISA 2000 scale and mathematics plausible values were mapped to the PISA 2003 scale.

The variable *W_FSTUWT* is the final student weight. The sum of the weights constitutes an estimate of the size of the target population, *i.e.* the number of 15-year-old students in grade 7 or above in that country attending school. When analysing weighted data at the international level, large countries have a greater contribution to the results than small countries. This weighting is used for the OECD total in the tables of the international report for the first results from PISA 2006 (OECD, 2007). To weight all countries equally for a summary statistic, the OECD average is computed and reported. The OECD average is computed as follows. First, the statistic of interest is computed for each OECD country using the final student weights. Second, the mean of the country statistics is computed and reported as the OECD average.[2]

Two student cognitive files for cognitive and embedded attitude items can be found on the PISA website *www.pisa.oecd.org*.

For each student who participated in the assessment, the following information is available:

- Identification variables for the country, school and student;
- Test booklet identification;

2. The definition of the OECD average has changed between PISA 2003 and PISA 2006. In previous cycles, the OECD average was based on a pooled, equally weighted database. To compute the OECD average the data was weighted by an adjusted student weight variable that made the sum of the weights equal in all countries.

- The student responses to the cognitive and attitude items. In the non-scored files, when original reponses consist of multiple digits (complex multiple choice or open ended items), the multiple digits were recoded into single digit variables for use in scaling software). A "T" was added to the end of the recoded single digit variable names. The original response variables have been added at the end of the single digit, unscored file (without a T at the end of the variable name and the Q replaced by an R, see further below). The scored data file only has one single digit variable per item with scores instead of response categories.
- Test language;
- Effort self-report;
- Database version with the date of the release.

The PISA items are organised into units. Each unit consists of a stimulus (consisting of a piece of text or related texts, pictures or graphs) followed by one or more questions. A unit is identified by a short label and by a long label. The units' short labels consist of four characters and form the first part of the variable names in the data files. The first character is R, M or S for reading, mathematics or science, respectively. The next three characters indicate the unit within the domain. For example, M155 is a mathematics unit. The item names (usually seven- or eight-digits) represent questions within a unit and are used as variable names (in the current example the item names within the unit are M155Q01, M155Q02T, M155Q03T and M155Q04T). Thus items within a unit have the same initial four characters plus a question number. Responses that needed to be recoded into single digit variables have a "T" at the end of the variable name. The original multiple digit responses have been added to the end of the unscored, single digit file without a "T" in the name and with the "Q" replaced by a "R" (for example, the variable M155Q02T is a recoded item with the corresponding original responses in M155R02 at the end of the file). The full variable label indicates the domain the unit belongs to, the PISA cycle in which the item was first used, the full name of the unit and the question number. For example, the variable label for M155Q01 is "MATH - P2000 POPULATION PYRAMIDS (Q01)".

In all both files, the cognitive items are sorted by domain and alphabetically by item name within domain. This means that the mathematics items appear at the beginning of the file, followed by the reading items and then the science items. The embedded attitude items have been placed after the cognitive items, first the embedded interest items followed by the embedded support items. Within domains, units with smaller numeric identification appear before those with larger identification, and within each unit, the first question will precede the second, and so on.

School file

The school questionnaire data file can be found on the PISA website *www.pisa.oecd.org*.

For each school that participated in the assessment, the following information is available:

- The identification variables for the country and school;
- The school principals' responses on the school questionnaire;
- The school indices derived from the original questions in the school questionnaire;
- The school weight;
- Explicit strata with national labels; and
- Database version with the date of the release.

The school file contains the original variables collected through the school context questionnaire. In addition, two types of indices are provided in the school questionnaire files. The first set is based on a transformation of one variable or on a combination of two or more variables. The database includes 14 indices from this first type. The second set is the result of a Rasch scaling and consists of weighted likelihood estimate indices. Four indices are included in the database from this second type. For a full description of the indices and how to interpret them see Appendix 12. The school weight (*W_FSCHWT*) is the trimmed school-base weight adjusted for non-response.

Although the student samples were drawn from within a sample of schools, the school sample was designed to optimise the resulting sample of students, rather than to give an optimal sample of schools. For this reason, it is always preferable

to analyse the school-level variables as attributes of students, rather than as elements in their own right (Gonzalez and Kennedy, 2003). Following this recommendation one would not estimate the percentages of private schools versus public schools, for example, but rather the percentages of students attending a private school or public schools. From a practical point of view, this means that the school data should be merged with the student data file prior to analysis.

Parent file

The parent questionnaire file can be found on the PISA website: *wwwpisa.oecd.org*. The following information is available:

- The identification variables for the country, school and student;
- The parents' responses on the parent questionnaire;
- The parent indices derived from the original questions in the parent questionnaire; and
- Database version with the date of the release.

The parent file contains the original variables collected through the parent context questionnaire as a national option instrument. In addition, two types of indices are provided in the parent questionnaire file. The first set is based on a transformation of one variable or on a combination of two or more variables. The database includes six indices from this first type. The second set is the result of a Rasch scaling and consists of weighted likelihood estimate indices. Eleven indices are included in the database from this second type. For a detailed description of the indices and how to interpret them see Appendix 12.

Due to the high parent non-response in most countries, caution is needed when analysing this data. Non-response is not random. When using the final student weights from the student file, the weights of valid students in the analysis do not sum up to the population size of parents of PISA eligible students. A weight adjustment is not provided in the database.

Records in the database

Records included in the database

Student and parent files

- All PISA students who attended test (assessment) sessions.
- PISA students who only attended the questionnaire session are included if they provided at least one response to the student questionnaire and the father's or the mother's occupation is known from the student or the parent questionnaire.

School file

- All participating schools – that is, any school where at least 25% of the sampled eligible, non-excluded students were assessed – have a record in the school-level international database, regardless of whether the school returned the school questionnaire.

Records excluded from the database

Student and parent file

- Additional data collected by countries as part of national or international options.
- Sampled students who were reported as not eligible, students who were no longer at school, students who were excluded for physical, mental or linguistic reasons, and students who were absent on the testing day.
- Students who refused to participate in the assessment sessions.
- Students from schools where less than 25% of the sampled and eligible, non-excluded students participated.

School file

- Additional data collected by countries as part of national or international options.
- Schools where fewer than 25% of the sampled eligible, non-excluded students participated in the testing sessions.

Representing missing data

The coding of the data distinguishes between four different types of missing data:

- Item level non-response: 9 for a one-digit variable, 99 for a two-digit variable, 999 for a three-digit variable, and so on. Missing codes are shown in the codebooks. This missing code is used if the student or school principal was expected to answer a question, but no response was actually provided.
- Multiple or invalid responses: 8 for a one-digit variable, 98 for a two-digit variable, 998 for a three-digit variable, and so on. For the multiple-choice items code 8 is used when the student selected more than one alternative answer.
- Not-administered: 7 for a one-digit variable, 97 for a two-digit variables, 997 for a three-digit variable, and so on. Generally this code is used for cognitive and questionnaire items that were not administered to the students and for items that were deleted after assessment because of misprints or translation errors.
- Not reached items: all consecutive missing values clustered at the end of test session were replaced by the non-reached code, "*r*", except for the first value of the missing series, which is coded as item level non-response.

How are students and schools identified?

The student identification from the student and parent files consists of three variables, which together form a unique identifier for each student:

- A country identification variable labelled *COUNTRY*. The country codes used in PISA are the ISO numerical three-digit country codes.
- A school identification variable labelled *SCHOOLID*.
- A student identification variable labelled *STIDSTD*.

A fourth variable has been included to differentiate adjudicated sub-national entities within countries. This variable (*SUBNATIO*) is used for four countries as follows:

- *Belgium*. The value "05601" is assigned to the Flemish region, "05602" to the French region and "05603" to the German region of Belgium;
- *Italy*. The value "38001" is assigned to Provincia Autonoma of Bolzano, "38002" to Provincia Basilicata, "38003" to Provincia Campania, "38004" to Provincia Emilia Romagna, "38005" to Provincia Friuli Venezia Giulia, "38006" to Provincia Liguria, "38007" to Provincia Lombardia, "38008" to Provincia Piemonte, "38009" to Provincia Puglia, "38010" to Provincia Sardegna, "38011" to Provincia Sicilia, "38012" to Provincia Trento, "38013" to Provincia Veneto, "38014" to the rest of Italy;
- *Spain*. The value "72401" is assigned to Andalusia, "72402" to Aragon, "72403" to Asturias, "72406" to Cantabria, "72407" to Castile and Leon, "72409" to Catalonia, "72411" to Galicia, "72412" to La Rioja, "72415" to Navarre, "72416" to Basque Country; and
- *United Kingdom*. The value "82610" is assigned to England, Northern Ireland and Wales and the value "82620" is assigned to Scotland.

A fifth variable is added to make the identification of countries more convenient. The variable *CNT* uses the ISO 3166-1 ALPHA-3 classification, which is based on alphabetical characters rather than numeric characters (for example, for Sweden has COUNTRY=752 and CNT=SWE).

A sixth variable (*STRATUM*) is also included to differentiate sampling strata. Value labels are provided in the control files to indicate the population defined by each stratum.[3]

The school identification consists of two variables, which together form a unique identifier for each school:

- The country identification variable labelled *COUNTRY*. The country codes used in PISA are the ISO numerical three-digit country codes.
- The school identification variable labelled *SCHOOLID*.

3. Note that not all participants permit the identification of all sampling strata in the database.

Additional technical information and glossary codebook

A codebook is a document that identifies the variables and all possible values associated with them. In addition to the name of the variable, it also shows the variable label, all possible responses (*i.e.* in the case of multiple-choice items it shows the values for all alternatives and the full label of each alternative), type of variable (*e.g.* string or numeric) and the columns where the values are shown in the actual data file.

Compendia

Compendia include a set of tables showing statistics for every item included in the questionnaires, and the relationship with performance. The tables show the percentage of students per category of response and the performance for the group of students in each category of response.

Double-digit coding

Students' responses could give valuable information about their ideas and thinking, besides being correct or incorrect. The marking guides for mathematics and science included a system of two-digit coding for marking so that the frequency of various types of correct and incorrect responses could be recoded. The first digit is the actual score. The second digit is used to categorise the different kinds of responses on the basis of the strategies used by the student to answer the item. There are two main advantages of using double-digit codes. Firstly, more information can be collected about students' misconceptions, common errors, and different approaches to solving problems. Secondly, double-digit coding allows a more structured way of presenting the codes, clearly indicating the hierarchical levels of groups of codes. The assessment data files including the second digit were available to national centres.

SAS®

SAS® is a statistical package. For further information, see *http://www.sas.com*.

SPSS®

SPSS® is a statistical package. For further information, see *http://www.spss.com.*

WesVar®

WesVar® is a statistical package that computes estimates and their variance estimates from survey data using replication methods. The information generated can then be used to estimate sampling errors for different types of survey statistics. It can be used in conjunction with a wide range of complex sample designs, including multistage, stratified, and unequal probability samples. For further information, see *http://www.westat.com/wesvar.*

APPENDIX 3
PISA 2006 STUDENT QUESTIONNAIRE

Section 1 About you

ST01Q01	**Q1 – What <grade> are you in?**
	<grade>

ST02Q01	**Q2 – Which one of the following <programmes> are you in?**	
	<Programme 1>	☐1
	<Programme 2>	☐2
	<Programme 3>	☐3
	<Programme 4>	☐4
	<Programme 5>	☐5
	<Programme 6>	☐6

ST03Q02 ST03Q03	**Q3 – On what date were you born?** *(Please write the day, month and year you were born)*		
			19
	Day	Month	Year

ST04Q01	**Q4 – Are you female or male?**	
	Female	☐1
	Male	☐2

Section 2 Your family and your home

In this section you will be asked some questions about your family and your home.

Some of the following questions are about your mother and father or those persons who are like a mother or father to you – for example, guardians, step-parents, foster parents, etc.

If you share your time with more than one set of parents or guardians, please answer the following questions for those parents/guardians you spend the most time with.

ST05Q01	**Q5a – What is your mother's main job?** (e.g. *school teacher, kitchen-hand, sales manager)*
	(If she is not working now, please tell us her last main job)
	Please write in the job title: ____________
	Q5b – What does your mother do in her main job? (e.g. *teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team)*
	Please use a sentence to describe the kind of work she does or did in that job: ____________

ST06Q01	**Q6 – What is the <highest level of schooling> completed by your mother?** If you are not sure which box to choose, please ask the <test administrator> for help. *(Please tick only one box)*	
	<ISCED level 3A>	☐1
	<ISCED level 3B, 3C>	☐2
	<ISCED level 2>	☐3
	<ISCED level 1>	☐4
	She did not complete <ISCED level 1>	☐5

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Q7 – Does your mother have any of the following qualifications?
If you are not sure how to answer this question, please ask the <test administrator> for help.
(Please tick one box in each row)

		Yes	No
ST07Q01	a) <ISCED level 5A, 6>	☐1	☐2
ST07Q02	b) <ISCED level 5B>	☐1	☐2
ST07Q03	c) <ISCED level 4>	☐1	☐2

ST08Q01

Q8a – What is your father’s main job?
(e.g. *school teacher, kitchen-hand, sales manager)*

(If he is not working now, please tell us his last main job)

Please write in the job title: ______________________

Q8b – What does your father do in her main job?
(e.g. *teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team)*

Please use a sentence to describe the kind of work he does or did in that job: ______________________

ST09Q01

Q9 – What is the <highest level of schooling> completed by your father?
If you are not sure how to answer this question, please ask the <test administrator> for help.
(Please tick only one box)

<ISCED level 3A>	☐1
<ISCED level 3B, 3C>	☐2
<ISCED level 2>	☐3
<ISCED level 1>	☐4
He did not complete <ISCED level 1>	☐5

Q10 – Does your father have any of the following qualifications?
If you are not sure which box to choose, please ask the <test administrator> for help.
(Please tick one box in each row)

		Yes	No
ST10Q01	a) <ISCED level 5A, 6>	☐1	☐2
ST10Q02	b) <ISCED level 5B>	☐1	☐2
ST10Q03	c) <ISCED level 4>	☐1	☐2

ST11Q01 to ST11Q03

Q11a – In what country were you and your parents born?
(Please tick one answer in each column)

	You (ST11Q01)	Mother (ST11Q02)	Father (ST11Q03)
<Country A>	☐01	☐01	☐01
<Country B>	☐02	☐02	☐02
<Country C>	☐03	☐03	☐03
<Country D>	☐04	☐04	☐04
<…etc.>	☐<xx>	☐<xx>	☐<xx>
Other country	☐<xx>	☐<xx>	☐<xx>

ST11Q04

Q11b – If you were NOT born in <country of test>, how old were you when you arrived in <country of test>?
If you were less than 12 months old, please write zero (0)

______________________ years

ST12Q01

Q12 – What language do you speak at home most of the time?
(Please tick only one box)

<Language 1>	☐<xxx>
<Language 2>	☐<xxx>
<Language 3>	☐<xxx>
< …etc. >	☐<xxx>
Other language	☐<xxx>

	Q13 – Which of the following are in your home? *(Please tick one box in each row)*	Yes	No
		Yes	No
ST13Q01	a) A desk to study at	☐1	☐2
ST13Q02	b) A room of your own	☐1	☐2
ST13Q03	c) A quiet place to study	☐1	☐2
ST13Q04	d) A computer you can use for school work	☐1	☐2
ST13Q05	e) Educational software	☐1	☐2
ST13Q06	f) A link to the Internet	☐1	☐2
ST13Q07	g) Your own calculator	☐1	☐2
ST13Q08	h) Classic literature (*e.g.* <Shakespeare>)	☐1	☐2
ST13Q09	i) Books of poetry	☐1	☐2
ST13Q010	j) Works of art (*e.g.* paintings)	☐1	☐2
ST13Q011	k) Books to help with your school work	☐1	☐2
ST13Q012	l) A dictionary	☐1	☐2
ST13Q013	m) A dishwasher	☐1	☐2
ST13Q014	n) A <DVD or VCR> player	☐1	☐2
ST13Q015	o) <Country-specific wealth item 1>	☐1	☐2
ST13Q016	p) <Country-specific wealth item 2>	☐1	☐2
ST13Q017	q) <Country-specific wealth item 3>	☐1	☐2

	Q14 How many of these are there at your home? *(Please tick only one box in each row)*	None	One	Two	Three or more
ST14Q01	a) Cellular phones	☐1	☐2	☐3	☐4
ST14Q02	b) Televisions	☐1	☐2	☐3	☐4
ST14Q03	c) Computers	☐1	☐2	☐3	☐4
ST14Q04	d) Cars	☐1	☐2	☐3	☐4
ST14Q05	e) Rooms with a bath or shower	☐1	☐2	☐3	☐4

ST15Q01	**Q15 – How many books are there in your home?** There are usually about 40 books per metre of shelving. Do not include magazines, newspapers, or your schoolbooks. *(Please tick only one box)*	
	0-10 books	☐1
	11-25 books	☐2
	26-100 books	☐3
	101-200 books	☐4
	201-500 books	☐5
	More than 500 books	☐6

Section 3 Your views on <Broad Science>

This section asks about your views on various issues relating to <broad science>. <Broad science> refers to any topics that you might encounter in school, or outside of school (for example on television) that relate to space science, biology, chemistry, Earth science or physics.

	Q16 – How much do you agree with the statements below? *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST16Q01	a) I generally have fun when I am learning <broad science> topics	☐1	☐2	☐3	☐4
ST16Q02	b) I like reading about <broad science>	☐1	☐2	☐3	☐4
ST16Q03	c) I am happy doing <broad science> problems	☐1	☐2	☐3	☐4
ST16Q04	d) I enjoy acquiring new knowledge in <broad science>	☐1	☐2	☐3	☐4
ST16Q05	e) I am interested in learning about <broad science>	☐1	☐2	☐3	☐4

Q17 – How easy do you think it would be for you to perform the following tasks on your own?
(Please tick only one box in each row)

		I could do this easily	I could do this with a bit of effort	I would struggle to do this on my own	I couldn't do this
ST17Q01	a) Recognise the science question that underlies a newspaper report on a health issue	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q02	b) Explain why earthquakes occur more frequently in some areas than in others	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q03	c) Describe the role of antibiotics in the treatment of disease	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q04	d) Identify the science question associated with the disposal of garbage	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q05	e) Predict how changes to an environment will affect the survival of certain species	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q06	f) Interpret the scientific information provided on the labelling of food items	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q07	g) Discuss how new evidence can lead you to change your understanding about the possibility of life on Mars	☐ 1	☐ 2	☐ 3	☐ 4
ST17Q08	h) Identify the better of two explanations for the formation of acid rain	☐ 1	☐ 2	☐ 3	☐ 4

Q18 – How much do you agree with the statements below?
(Please tick only one box in each row)

		Strongly agree	Agree	Disagree	Strongly disagree
ST18Q01	a) Advances in <broad science and technology> usually improve people's living conditions	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q02	b) <Broad science> is important for helping us to understand the natural world	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q03	c) Some concepts in <broad science> help me see how I relate to other people	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q04	d) Advances in <broad science and technology> usually help improve the economy	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q05	e) I will use <broad science> in many ways when I am an adult	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q06	f) <Broad science> is valuable to society	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q07	g) <Broad science> is very relevant to me	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q08	h) I find that <broad science> helps me to understand the things around me	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q09	i) Advances in <broad science and technology> usually bring social benefits	☐ 1	☐ 2	☐ 3	☐ 4
ST18Q10	j) When I leave school there will be many opportunities for me to use <broad science>	☐ 1	☐ 2	☐ 3	☐ 4

Q19 – How often do you do these things?
(Please tick only one box in each row)

		Very often	Regularly	Sometimes	Never or hardly ever
ST19Q01	a) Watch TV programmes about <broad science>	☐ 1	☐ 2	☐ 3	☐ 4
ST19Q02	b) Borrow or buy books on <broad science> topics	☐ 1	☐ 2	☐ 3	☐ 4
ST19Q03	c) Visit web sites about <broad science> topics	☐ 1	☐ 2	☐ 3	☐ 4
ST19Q04	d) Listen to radio programmes about advances in <broad science>	☐ 1	☐ 2	☐ 3	☐ 4
ST19Q05	e) Read <broad science> magazines or science articles in newspapers	☐ 1	☐ 2	☐ 3	☐ 4
ST19Q06	f) Attend a <science club>	☐ 1	☐ 2	☐ 3	☐ 4

Q20 – Here is a list of <broad science> topics. From which source(s) did you mainly learn about each of these topics?
(Please tick as many boxes as apply in each row)

		None of these, I am not sure what this is	My school	The TV, radio, newspaper or magazines	My friends	My family	The Internet or books
ST20QA1 to ST20QA6	a) Photosynthesis	☐ 1 (ST20QA1)	☐ 1 (ST20QA2)	☐ 1 (ST20QA3)	☐ 1 (ST20QA4)	☐ 1 (ST20QA5)	☐ 1 (ST20QA6)
ST20QB1 to ST20QB6	b) Formation of the continents	☐ 1 (ST20QB1)	☐ 1 (ST20QB2)	☐ 1 (ST20QB3)	☐ 1 (ST20QB4)	☐ 1 (ST20QB5)	☐ 1 (ST20QB6)
ST20QC1 to ST20QC6	c) Genes and chromosomes	☐ 1 (ST20QC1)	☐ 1 (ST20QC2)	☐ 1 (ST20QC3)	☐ 1 (ST20QC4)	☐ 1 (ST20QC5)	☐ 1 (ST20QC6)
ST20QD1 to ST20QD6	d) Soundproofing	☐ 1 (ST20QD1)	☐ 1 (ST20QD2)	☐ 1 (ST20QD3)	☐ 1 (ST20QD4)	☐ 1 (ST20QD5)	☐ 1 (ST20QD6)
ST20QE1 to ST20QE6	e) Climate change	☐ 1 (ST20QE1)	☐ 1 (ST20QE2)	☐ 1 (ST20QE3)	☐ 1 (ST20QE4)	☐ 1 (ST20QE5)	☐ 1 (ST20QE6)
ST20QF1 to ST20QF6	f) Evolution	☐ 1 (ST20QF1)	☐ 1 (ST20QF2)	☐ 1 (ST20QF3)	☐ 1 (ST20QF4)	☐ 1 (ST20QF5)	☐ 1 (ST20QF6)
ST20QG1 to ST20QG6	g) Nuclear energy	☐ 1 (ST20QG1)	☐ 1 (ST20QG2)	☐ 1 (ST20QG3)	☐ 1 (ST20QG4)	☐ 1 (ST20QG5)	☐ 1 (ST20QG6)
ST20QH1 to ST20QH6	h) Health and nutrition	☐ 1 (ST20QH1)	☐ 1 (ST20QH2)	☐ 1 (ST20QH3)	☐ 1 (ST20QH4)	☐ 1 (ST20QH5)	☐ 1 (ST20QH6)

Q21 – How much interest do you have in learning about the following <broad science> topics?
(Please tick only one box in each row)

		High interest	Medium interest	Low interest	No interest
ST21Q01	a) Topics in physics	☐1	☐2	☐3	☐4
ST21Q02	b) Topics in chemistry	☐1	☐2	☐3	☐4
ST21Q03	c) The biology of plants	☐1	☐2	☐3	☐4
ST21Q04	d) Human biology	☐1	☐2	☐3	☐4
ST21Q05	e) Topics in astronomy	☐1	☐2	☐3	☐4
ST21Q06	f) Topics in geology	☐1	☐2	☐3	☐4
ST21Q07	g) Ways scientists design experiments	☐1	☐2	☐3	☐4
ST21Q08	h) What is required for scientific explanations	☐1	☐2	☐3	☐4

Section 4 The Environment

Q22 – How informed are you about the following environmental issues?
(Please tick only one box in each row)

		I have never heard of this	I have heard about this but I would not be able to explain what it is really about	I know something about this and could explain the general issue	I am familiar with this and I would be able to explain this well
ST22Q01	a) The increase of greenhouse gases in the atmosphere	☐1	☐2	☐3	☐4
ST22Q02	b) Use of genetically modified organisms (<GMO>)	☐1	☐2	☐3	☐4
ST22Q03	c) Acid rain	☐1	☐2	☐3	☐4
ST22Q04	d) Nuclear waste	☐1	☐2	☐3	☐4
ST22Q05	e) The consequences of clearing forests for other land use	☐1	☐2	☐3	☐4

Q23 – From which source(s) did you mainly learn about each of these environmental issues?
(Please tick as many boxes as apply in each row)

		None of these, I am not sure what this is	My school	The TV, radio, newspaper or magazines	My friends	My family	The Internet or books
ST23QA1 to ST23QA6	a) Air pollution	☐1 (ST23QA1)	☐1 (ST23QA2)	☐1 (ST23QA3)	☐1 (ST23QA4)	☐1 (ST23QA5)	☐1 (ST23QA6)
ST23QB1 to ST23QB6	b) Energy shortages	☐1 (ST23QB1)	☐1 (ST23QB2))	☐1 (ST23QB3)	☐1 (ST23QB4)	☐1 (ST23QB5)	☐1 (ST23QB6)
ST23QC1 to ST23QC6	c) Extinction of plants and animals	☐1 (ST23QC1)	☐1 (ST23QC2)	☐1 (ST23QC3)	☐1 (ST23QC4)	☐1 (ST23QC5)	☐1 (ST23QC6)
ST23QD1 to ST23QD6	d) Clearing of forests for other land use	☐1 (ST23QD1)	☐1 (ST23QD2)	☐1 (ST23QD3)	☐1 (ST23QD4)	☐1 (ST23QD5)	☐1 (ST23QD6)
ST23QE1 to ST23QE6	e) Water shortages	☐1 (ST23QE1)	☐1 (ST23QE2)	☐1 (ST23QE3)	☐1 (ST23QE4)	☐1 (ST23QE5)	☐1 (ST23QE6)
ST23QF1 to ST23QF6	f) Nuclear waste	☐1 (ST23QF1)	☐1 (ST23QF2)	☐1 (ST23QF3)	☐1 (ST23QF4)	☐1 (ST23QF5)	☐1 (ST23QF6)

Q24 – Do you see the environmental issues below as a serious concern for yourself and/or others?
(Please tick only one box in each row)

		This is a serious concern for me personally as well as others	This is a serious concern for other people in my country but not me personally	This is a serious concern only for people in other countries	This is not a serious concern to anyone
ST24Q01	a) Air pollution	☐1	☐2	☐3	☐4
ST24Q02	b) Energy shortages	☐1	☐2	☐3	☐4
ST24Q03	c) Extinction of plants and animals	☐1	☐2	☐3	☐4
ST24Q04	d) Clearing of forests for other land use	☐1	☐2	☐3	☐4
ST24Q05	e) Water shortages	☐1	☐2	☐3	☐4
ST24Q06	f) Nuclear waste	☐1	☐2	☐3	☐4

	Q25 – Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years? *(Please tick only one box in each row)*	Improve	Stay about the same	Get worse
ST25Q01	a) Air pollution	□1	□2	□3
ST25Q02	b) Energy shortages	□1	□2	□3
ST25Q03	c) Extinction of plants and animals	□1	□2	□3
ST25Q04	d) Clearing of forests for other land use	□1	□2	□3
ST25Q05	e) Water shortages	□1	□2	□3
ST25Q06	f) Nuclear waste	□1	□2	□3

	Q26 – How much do you agree with the statements below? *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST26Q01	a) It is important to carry out regular checks on the emissions from cars as a condition of their use	□1	□2	□3	□4
ST26Q02	b) It disturbs me when energy is wasted through the unnecessary use of electrical appliances	□1	□2	□3	□4
ST26Q03	c) I am in favour of having laws that regulate factory emissions even if this would increase the price of products	□1	□2	□3	□4
ST26Q04	d) To reduce waste, the use of plastic packaging should be kept to a minimum	□1	□2	□3	□4
ST26Q05	e) Industries should be required to prove that they safely dispose of dangerous waste materials	□1	□2	□3	□4
ST26Q06	f) I am in favour of having laws that protect the habitats of endangered species	□1	□2	□3	□4
ST26Q07	g) Electricity should be produced from renewable sources as much as possible, even if this increases the cost	□1	□2	□3	□4

Section 5 Careers and <Broad Science>

In this section we ask you questions about <science-related careers>. When thinking about what a <science-related career> might be, think of the many jobs that involve science – not just the traditional 'scientist'. Careers like engineer (involving physics), weather forecaster (involving Earth science), optician (involving biology and physics), and medical doctors (involving the medical sciences) are all examples of <science-related careers>.

	Q27 – How much do you agree with the statements below? *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST27Q01	a) The subjects available at my school provide students with the basic skills and knowledge for a <science-related career>	□1	□2	□3	□4
ST27Q02	b) The <school science> subjects at my school provide students with the basic skills and knowledge for many different careers.	□1	□2	□3	□4
ST27Q03	c) The subjects I study provide me with the basic skills and knowledge for a <sciencerelated career>	□1	□2	□3	□4
ST27Q04	d) My teachers equip me with the basic skills and knowledge I need for a <science-related career>	□1	□2	□3	□4

	Q28 – How informed are you about these topics? *(Please tick only one box in each row)*	Very well informed	Fairly informed	Not well informed	Not informed at all
ST28Q01	a) <Science-related careers> that are available in the job market	□1	□2	□3	□4
ST28Q02	b) Where to find information about <sciencerelated careers>	□1	□2	□3	□4
ST28Q03	c) The steps students need to take if they want a <science-related career>	□1	□2	□3	□4
ST28Q04	d) Employers or companies that hire people to work in <science-related careers>	□1	□2	□3	□4

	Q29 – How much do you agree with the statements below? *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST29Q01	a) I would like to work in a career involving <broad science>	☐1	☐2	☐3	☐4
ST29Q02	b) I would like to study <broad science> after <secondary school>	☐1	☐2	☐3	☐4
ST29Q03	c) I would like to spend my life doing advanced <broad science>	☐1	☐2	☐3	☐4
ST29Q04	d) I would like to work on <broad science> projects as an adult	☐1	☐2	☐3	☐4

ST30Q01	**Q30 – What kind of job do you expect to have when you are about 30 years old?**
	Write the job title: ______________________

Section 6 Learning time

Q31 – How much time do you typically spend per week studying the following subjects?

For each subject, please indicate separately:
- the time spent attending regular lessons at your school;
- the time spent attending out-of-school-time lessons (at school, at home or somewhere else);
- the time spent studying or doing homework by yourself.

<An hour here refers to 60 minutes, not to a class period>
(Please tick only one box in each row)

	School science	No time	Less than 2 hours a week	2 or more but less than 4 hours a week	4 or more but less than 6 hours a week	6 or more hours a week
ST31Q01	a) Regular lessons in <school science> at my school	☐1	☐2	☐3	☐4	☐5
ST31Q02	b) Out-of school-time lessons in <school science>	☐1	☐2	☐3	☐4	☐5
ST31Q03	c) Study or homework in <school science> by myself	☐1	☐2	☐3	☐4	☐5
	Mathematics					
ST31Q04	d) Regular lessons in mathematics at my school	☐1	☐2	☐3	☐4	☐5
ST31Q05	e) Out-of school-time lessons in mathematics	☐1	☐2	☐3	☐4	☐5
ST31Q06	f) Study or homework in mathematics by myself	☐1	☐2	☐3	☐4	☐5
	Test Language					
ST31Q07	g) Regular lessons in <test language> at my school	☐1	☐2	☐3	☐4	☐5
ST31Q08	h) Out-of school-time lessons in <test Language>	☐1	☐2	☐3	☐4	☐5
ST31Q09	i) Study or homework in <test Language> by myself	☐1	☐2	☐3	☐4	☐5
	Other subjects No time					
ST31Q10	j) Regular lessons in other subjects at my school	☐1	☐2	☐3	☐4	☐5
ST31Q11	k) Out-of-school-time lessons in other subjects	☐1	☐2	☐3	☐4	☐5
ST31Q12	l) Study or homework in other subjects by myself	☐1	☐2	☐3	☐4	☐5

Q32 – What type of out-of-school-time lessons do you attend currently (if any)?
These are lessons in subjects that you are learning at school, that you spend extra time learning outside of normal school hours. The lessons might be held at your school, at your home or somewhere else. These are only lessons in subjects that you also learn at school.
(Please tick one box in each row)

		Yes	No
ST32Q01	a) <One to one> lessons with a <teacher> who is also a teacher at your school	☐1	☐2
ST32Q02	b) <One to one> lessons with a <teacher> who is not a teacher at your school	☐1	☐2
ST32Q03	c) Lessons in small groups (less than 8 students) with a <teacher> who is also a teacher at your school	☐1	☐2
ST32Q04	d) Lessons in small groups (less than 8 students) with a <teacher> who is not a teacher at your school	☐1	☐2
ST32Q05	e) Lessons in larger groups (8 students or more) with a <teacher> who is also a teacher at your school	☐1	☐2
ST32Q06	f) Lessons in larger groups (8 students or more) with a <teacher> who is not a teacher at your school	☐1	☐2

Section 7 Teaching and learning science

	Q33 – Did you or do you take any of the courses listed below? <Instructions for students who do not study science> *(Please tick as many boxes as apply in each row)*	Last year		This year	
		Yes	No	Yes	No
ST33Q11 – ST33Q12	a) A compulsory <general science course>	☐1	☐1	☐1	☐1
		(ST33Q11)		(ST33Q12)	
ST33Q21 – ST33Q22	b) An optional <general science course>	☐1	☐1	☐1	☐1
		(ST33Q21)		(ST33Q22)	
ST33Q31 – ST33Q32	c) A compulsory biology course	☐1	☐1	☐1	☐1
		(ST33Q31)		(ST33Q32)	
ST33Q41 – ST33Q42	d) An optional biology course	☐1	☐1	☐1	☐1
		(ST33Q41)		(ST33Q42)	
ST33Q51 – ST33Q52	e) A compulsory physics course	☐1	☐1	☐1	☐1
		(ST33Q51)		(ST33Q52)	
ST33Q61 – ST33Q62	f) An optional physics course	☐1	☐1	☐1	☐1
		(ST33Q61)		(ST33Q62)	
ST33Q71 – ST33Q72	g) A compulsory chemistry course	☐1	☐1	☐1	☐1
		(ST33Q71)		(ST33Q72)	
ST33Q81 – ST33Q82	h) An optional chemistry course	☐1	☐1	☐1	☐1
		(ST33Q81)		(ST33Q82)	

	Q34 – When learning <school science> topics at school, how often do the following activities occur? *(Please tick only one box in each row)*	In all lessons	In most lessons	In some lessons	Never or hardly ever
ST34Q01	a) Students are given opportunities to explain their ideas	☐1	☐2	☐3	☐4
ST34Q02	b) Students spend time in the laboratory doing practical experiments	☐1	☐2	☐3	☐4
ST34Q03	c) Students are required to design how a <school science> question could be investigated in the laboratory	☐1	☐2	☐3	☐4
ST34Q04	d) The students are asked to apply a <school science> concept to everyday problems	☐1	☐2	☐3	☐4
ST34Q05	e) The lessons involve students' opinions about the topics	☐1	☐2	☐3	☐4
ST34Q06	f) Students are asked to draw conclusions from an experiment they have conducted	☐1	☐2	☐3	☐4
ST34Q07	g) The teacher explains how a <school science> idea can be applied to a number of different phenomena (*e.g.* the movement of objects, substances with similar properties)	☐1	☐2	☐3	☐4
ST34Q08	h) Students are allowed to design their own experiments	☐1	☐2	☐3	☐4
ST34Q09	i) There is a class debate or discussion	☐1	☐2	☐3	☐4
ST34Q10	j) Experiments are done by the teacher as demonstrations	☐1	☐2	☐3	☐4
ST34Q11	k) Students are given the chance to choose their own investigations	☐1	☐2	☐3	☐4
ST34Q12	l) The teacher uses <school science> to help students understand the world outside school	☐1	☐2	☐3	☐4
ST34Q13	m) Students have discussions about the topics	☐1	☐2	☐3	☐4
ST34Q14	n) Students do experiments by following the instructions of the teacher	☐1	☐2	☐3	☐4
ST34Q15	o) The teacher clearly explains the relevance of <broad science> concepts to our lives	☐1	☐2	☐3	☐4
ST34Q16	p) Students are asked to do an investigation to test out their own ideas	☐1	☐2	☐3	☐4
ST34Q17	q) The teacher uses examples of technological application to show how <school science> is relevant to society	☐1	☐2	☐3	☐4

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	Q35 – How much do you agree with the statements below? *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST35Q01	a) Making an effort in my <school science> subject(s) is worth it because this will help me in the work I want to do later on	☐1	☐2	☐3	☐4
ST35Q02	b) What I learn in my <school science> subject(s) is important for me because I need this for what I want to study later on	☐1	☐2	☐3	☐4
ST35Q03	c) I study <school science> because I know it is useful for me	☐1	☐2	☐3	☐4
ST35Q04	d) Studying my <school science> subject(s) is worthwhile for me because what I learn will improve my career prospects	☐1	☐2	☐3	☐4
ST35Q05	e) I will learn many things in my <school science> subject(s) that will help me get a job	☐1	☐2	☐3	☐4

	Q36 – In general, how important do you think it is for you to do well in the subjects below? *(Please tick only one box in each row)*	Very important	Important	Of little importance	Not important at all
ST28Q01	a) <School science> subjects	☐1	☐2	☐3	☐4
ST28Q02	b) Mathematics subjects	☐1	☐2	☐3	☐4
ST28Q03	c) <test language> subjects	☐1	☐2	☐3	☐4

	Q37 – How much do you agree with the statements below? The following question asks about your experience in learning <school science> topics. *(Please tick only one box in each row)*	Strongly agree	Agree	Disagree	Strongly disagree
ST37Q01	a) Learning advanced <school science> topics would be easy for me	☐1	☐2	☐3	☐4
ST37Q02	b) I can usually give good answers to <test questions> on <school science> topics	☐1	☐2	☐3	☐4
ST37Q03	c) I learn <school science> topics quickly	☐1	☐2	☐3	☐4
ST37Q04	d) <School science> topics are easy for me	☐1	☐2	☐3	☐4
ST35Q05	e) When I am being taught <school science>, I can understand the concepts very well	☐1	☐2	☐3	☐4
ST35Q06	f) I can easily understand new ideas in <school science>	☐1	☐2	☐3	☐4

APPENDIX 4
PISA 2006 INFORMATION COMMUNICATION TECHNOLOGY (ICT) QUESTIONNAIRE

Your use of computers

The following questions ask about computers: this does not include calculators or games consoles like a <Sony PlayStation™>.

IC01Q01	**Q1 – Have you ever used a computer?** If you answered Yes to the above question, please continue. If you answered No, please stop here. <Instructions> *(Please tick one box)*	
	Yes	No
	☐1	☐2

IC02Q01	**Q2 – How long have you been using computers?** *(Please tick only one box)*	
	Less than one year	☐1
	One year or more but less than three years	☐2
	Three years or more but less than five years	☐3
	Five years or more	☐4

Q3 – How often do you use a computer at these places?
(Please tick only one box in each row)

		Almost every day	Once or twice a week	A few times a month	Once a month or less	Never
IC03Q01	a) At home	☐1	☐2	☐3	☐4	☐5
IC03Q02	b) At school	☐1	☐2	☐3	☐4	☐5
IC03Q03	c) At other places	☐1	☐2	☐3	☐4	☐5

Q4 – How often do you use computers for the following reasons?
(Please tick only one box in each row)

		Almost every day	A few times each week	Between once a week and once a month	Less than once a month	Never
IC04Q01	a) Browse the Internet for information about people, things, or ideas	☐1	☐2	☐3	☐4	☐5
IC04Q02	b) Play games	☐1	☐2	☐3	☐4	☐5
IC04Q03	c) Write documents (*e.g.* with <Word® or WordPerfect®>)	☐1	☐2	☐3	☐4	☐5
IC04Q04	d) Use the Internet to collaborate with a group or team	☐1	☐2	☐3	☐4	☐5
IC04Q05	e) Use spreadsheets (*e.g.* <Lotus 1 2 3® or Microsoft Excel®>)	☐1	☐2	☐3	☐4	☐5
IC04Q06	f) Download software from the Internet (including games)	☐1	☐2	☐3	☐4	☐5
IC04Q07	g) Drawing, painting or using graphics programs	☐1	☐2	☐3	☐4	☐5
IC04Q08	h) Use educational software such as Mathematics programs	☐1	☐2	☐3	☐4	☐5
IC04Q09	i) Download music from the Internet	☐1	☐2	☐3	☐4	☐5
IC04Q10	j) Writing computer programs	☐1	☐2	☐3	☐4	☐5
IC04Q11	k) For communication (*e.g.* Email or "chat rooms")	☐1	☐2	☐3	☐4	☐5

Q5 – How well can you do each of these tasks on a computer?
(Please tick only one box in each row)

		I can do this very well by myself	I can do this with help from someone	I know what this means but I cannot do it	I don't know what this means
IC05Q01	a) Chat online	☐1	☐2	☐3	☐4
IC05Q02	b) Use software to find and get rid of computer viruses	☐1	☐2	☐3	☐4
IC05Q03	c) Edit digital photographs or other graphic images	☐1	☐2	☐3	☐4
IC05Q04	d) Create a database (*e.g.* using <Microsoft Access®>)	☐1	☐2	☐3	☐4
IC05Q05	e) Copy data to a CD (*e.g.* make a music CD)	☐1	☐2	☐3	☐4
IC05Q06	f) Move files from one place to another on a computer	☐1	☐2	☐3	☐4
IC05Q07	g) Search the internet for information	☐1	☐2	☐3	☐4
IC05Q08	h) Download files or programs from the Internet.	☐1	☐2	☐3	☐4
IC05Q09	i) Attach a file to an E-mail message	☐1	☐2	☐3	☐4
IC05Q10	j) Use a word processor (*e.g.* to write an essay for school)	☐1	☐2	☐3	☐4
IC05Q11	k) Use a spreadsheet to plot a graph	☐1	☐2	☐3	☐4
IC05Q12	l) Create a presentation (*e.g.* using <Microsoft PowerPoint®>)	☐1	☐2	☐3	☐4
IC05Q13	m) Download music from the Internet	☐1	☐2	☐3	☐4
IC05Q14	n) Create a multi-media presentation (with sound, pictures, video)	☐1	☐2	☐3	☐4
IC05Q15	o) Write and send E-mails	☐1	☐2	☐3	☐4
IC05Q16	p) Construct a web page	☐1	☐2	☐3	☐4

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APPENDIX 5
PISA 2006 SCHOOL QUESTIONNAIRE

Section A The structure and organisation of the school

	Q1 – As at <February 1, 2006>, what was the total school enrolment (number of students)? *(Please write a number in each line. Write 0 (zero) if there are none)*	
SC01Q01	a) Number of boys:	______
SC01Q02	b) Number of girls:	______

SC01Q01	**Q2 – Is your school a public or a private school?** *(Please tick only one box)*	
	A public school *(This is a school managed directly or indirectly by a public education authority, government agency, or governing board appointed by government or elected by public franchise.)*	☐1
	A private school *(This is a school managed directly or indirectly by a non-government organisation; e.g. a church, trade union, business, or other private institution.)*	☐2

	Q3 – About what percentage of your total funding for a typical school year comes from the following sources? *(Please write a number in each row. Write 0 (zero) if no funding comes from that source)*	%
SC03Q01	a) Government (includes departments, local, regional, state and national)	___
SC03Q02	b) Student fees or school charges paid by parents	___
SC03Q03	c) Benefactors, donations, bequests, sponsorships, parent fund raising	___
SC03Q04	d) Other	___
	Total	100%

	Q4 – Do you have the following grade levels in your school? *(Please tick one box in each row)*	Yes	No
SC04Q01	a) <Grade 1>	☐1	☐2
SC04Q02	b) <Grade 2>	☐1	☐2
SC04Q03	c) <Grade 3>	☐1	☐2
SC04Q04	d) <Grade 4>	☐1	☐2
SC04Q05	e) <Grade 5>	☐1	☐2
SC04Q06	f) <Grade 6>	☐1	☐2
SC04Q07	g) <Grade 7>	☐1	☐2
SC04Q08	h) <Grade 8>	☐1	☐2
SC04Q09	i) <Grade 9>	☐1	☐2
SC04Q010	j) <Grade 10>	☐1	☐2
SC04Q011	k) <Grade 11>	☐1	☐2
SC04Q012	l) <Grade 12>	☐1	☐2
SC04Q013	m) <Grade 13>	☐1	☐2
SC04Q014	n) <Ungraded school>	☐1	☐2

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Q5 – About what percentage of students in your school repeated a grade, at these <ISCED levels>, last academic year?
(Please write a number in each row. Write 0 (zero) if nobody repeated a grade. Tick the 'not available' box if the <ISCED level> does not exist in your school)

		%	<ISCED level> not available in this school
SC05Q01	a) The approximate percentage of students repeating a grade at <ISCED 2> in this school last year was:	____	☐996
SC05Q02	b) The approximate percentage of students repeating a grade at <ISCED 3> in this school last year was:	____	☐996

SC06Q01 **Q6 – What is the average size of <test language> classes in <national modal grade for 15-year-olds> in your school?**
(Please tick only one box)

15 students or fewer	☐01
16-20 students	☐02
21-25 students	☐03
26-30 students	☐04
31-35 students	☐05
36-40 students	☐06
41-45 students	☐07
46-50 students	☐08
More than 50 students	☐09

SC07Q01 **Q7 – Which of the following best describes the community in which your school is located?**
(Please tick only one box)

A village, hamlet or rural area (fewer than 3 000 people)	☐1
A small town (3 000 to about 15 000 people)	☐2
A town (15 000 to about 100 000 people)	☐3
A city (100 000 to about 1 000 000 people)	☐4
A large city (with over 1 000 000 people)	☐5

Q8 – Some schools organise instruction differently for students with different abilities.
What is your school's policy about this for students in <national modal grade for 15-year-olds>?
(Please tick one box in each row)

		For all subjects	For some subjects	Not for any subject
SC08Q01	a) Students are grouped by ability into different classes	☐1	☐2	☐3
SC08Q02	b) Students are grouped by ability within their classes	☐1	☐2	☐3

Section B Staffing

Q9 – How many of the following are on the staff of your school?
Include both full-time and part-time teachers. A full-time teacher is employed at least 90% of the time as a teacher for the full school year. All other teachers should be considered part-time.
(Please write a number in each space provided. Write 0 (zero) if there is none)

		Full time	Part time
SC09Q11 – SC09Q12	a) Teachers in TOTAL	☐1 (SC09Q11)	☐1 (SC09Q12)
SC09Q21 – SC09Q22	b) Teachers fully certified by <the appropriate authority>	☐1 (SC09Q21)	☐1 (SC09Q22)
SC09Q31 – SC09Q32	c) Teachers with an <ISCED5A> qualification	☐1 (SC09Q31)	☐1 (SC09Q32)

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SC10Q01	**Q10 – In the last academic year, did you fill all vacant <national modal grade for 15-year-olds> science teaching positions at your school?** See the preliminary note on the definition of science <inside the front cover>. A science teacher is defined as a teacher of the subject(s) which meet this definition. *(Please tick only one box)*	
	Not applicable (we had no vacant science teaching positions to be filled)	☐1
	Yes (we filled all vacant science teaching positions, either with newly appointed staff or by reassigning existing staff)	☐2
	No (we could not fill one or more vacant science teaching positions)	☐3

Q11 – Regarding your school, who has a considerable responsibility for the following tasks?
(Please tick as many boxes as appropriate in each row)

		Principal or teachers	<School governing board>	<Regional or local education authority>	National education authority
SC11QA1 to SC11QA4	a) Selecting teachers for hire	☐1 (SC11QA1)	☐1 (SC11QA2)	☐1 (SC11QA3)	☐1 (SC11QA4)
SC11QB1 to SC11QB4	b) Firing teachers	☐1 (SC11QB1)	☐1 (SC11QB2)	☐1 (SC11QB3)	☐1 (SC11QB4)
SC11QC1 to SC11QC4	c) Establishing teachers' starting salaries	☐1 (SC11QC1)	☐1 (SC11QC2)	☐1 (SC11QC3)	☐1 (SC11QC4)
SC11QD1 to SC11QD4	d) Determining teachers' salaries increases	☐1 (SC11QD1)	☐1 (SC11QD2)	☐1 (SC11QD3)	☐1 (SC11QD4)
SC11QE1 to SC11QE4	e) Formulating the school budget	☐1 (SC11QE1)	☐1 (SC11QE2)	☐1 (SC11QE3)	☐1 (SC11QE4)
SC11QF1 to SC11QF4	f) Deciding on budget allocations within the school	☐1 (SC11QF1)	☐1 (SC11QF2)	☐1 (SC11QF3)	☐1 (SC11QF4)
SC11QG1 to SC11QG4	g) Establishing student disciplinary policies	☐1 (SC11QG1)	☐1 (SC11QG2)	☐1 (SC11QG3)	☐1 (SC11QG4)
SC11QH1 to SC11QH4	h) Establishing student assessment policies	☐1 (SC11QH1)	☐1 (SC11QH2)	☐1 (SC11QH3)	☐1 (SC11QH4)
SC11QI1 to SC11QI4	i) Approving students for admission to the school	☐1 (SC11QI1)	☐1 (SC11QI2)	☐1 (SC11QI3)	☐1 (SC11QI4)
SC11QJ1 to SC11QJ4	j) Choosing which textbooks are used	☐1 (SC11QJ1)	☐1 (SC11QJ2)	☐1 (SC11QJ3)	☐1 (SC11QJ4)
SC11QK1 to SC11QK4	k) Determining course content	☐1 (SC11QK1)	☐1 (SC11QK2)	☐1 (SC11QK3)	☐1 (SC11QK4)
SC11QL1 to SC11QL4	l) Deciding which courses are offered	☐1 (SC11QL1)	☐1 (SC11QL2)	☐1 (SC11QL3)	☐1 (SC11QL4)

Q12 – Regarding your school, which of the following bodies exert a direct influence on decision making about staffing, budgeting, instructional content and assessment practices?
(Please tick as many boxes as apply)

		Area of influence			
		Staffing	Budgeting	Instructional content	Assessment practices
SC12QA1 to SC12QA4	a) Regional or national education authorities (*e.g.* inspectorates)	☐1 (SC12QA1)	☐1 (SC12QA2)	☐1 (SC12QA3)	☐1 (SC12QA4)
SC12QB1 to SC12QB4	b) The school's <governing board>	☐1 (SC12QB1)	☐1 (SC12QB2)	☐1 (SC12QB3)	☐1 (SC12QB4)
SC12QC1 to SC12QC4	c) Parent groups	☐1 (SC12QC1)	☐1 (SC12QC2)	☐1 (SC12QC3)	☐1 (SC12QC4)
SC12QD1 to SC12QD4	d) Teacher groups (*e.g.* Staff Association, curriculum committees, trade union)	☐1 (SC12QD1)	☐1 (SC12QD2)	☐1 (SC12QD3)	☐1 (SC12QD4)
SC12QE1 to SC12QE4	e) Student groups (*e.g.* Student Association, youth organisation)	☐1 (SC12QE1)	☐1 (SC12QE2)	☐1 (SC12QE3)	☐1 (SC12QE4)
SC12QF1 to SC12QF4	f) External examination boards	☐1 (SC12QF1)	☐1 (SC12QF2)	☐1 (SC12QF3)	☐1 (SC12QF4)

Section C The school's resources

		Number
SC13Q01	**Q13a – About how many computers are available in the school altogether?** *(Please write 0 (zero) if there are none)*	
SC13Q02	**Q13b – About how many of these computers are available for instruction?**	
SC13Q03	**Q13c – About how many computers in the school are connected to the Internet/World Wide Web?**	

Q14 – Is your school's capacity to provide instruction hindered by any of the following?
(Please tick one box in each row)

		Not at all	Very little	To some extent	A lot
SC14Q01	a) A lack of qualified science teachers	☐1	☐2	☐3	☐4
SC14Q02	b) A lack of qualified mathematics teachers	☐1	☐2	☐3	☐4
SC14Q03	c) A lack of qualified <test language> teachers	☐1	☐2	☐3	☐4
SC14Q04	d) A lack of qualified teachers of other subjects	☐1	☐2	☐3	☐4
SC14Q05	e) A lack of laboratory technicians	☐1	☐2	☐3	☐4
SC14Q06	f) A lack of other support personnel	☐1	☐2	☐3	☐4
SC14Q07	g) Shortage or inadequacy of science laboratory equipment	☐1	☐2	☐3	☐4
SC14Q08	h) Shortage or inadequacy of instructional materials (e.g. textbooks)	☐1	☐2	☐3	☐4
SC14Q09	i) Shortage or inadequacy of computers for instruction	☐1	☐2	☐3	☐4
SC14Q10	j) Lack or inadequacy of Internet connectivity	☐1	☐2	☐3	☐4
SC14Q11	k) Shortage or inadequacy of computer software for instruction	☐1	☐2	☐3	☐4
SC14Q12	l) Shortage or inadequacy of library materials	☐1	☐2	☐3	☐4
SC14Q13	m) Shortage or inadequacy of audio-visual resources	☐1	☐2	☐3	☐4

Section D <Accountability> and Admission practices

Q15 – This set of questions explores aspects of the school's <accountability> to parents.
(Please tick one box in each row)

		Yes	No
SC15Q01	a) Does your school provide information to parents of students in <national modal grade for 15-year-olds> on their child's academic performance relative to other students in <national modal grade for 15-year-olds> in your school?	☐1	☐2
SC15Q02	b) Does your school provide information to parents of students in <national modal grade for 15-year-olds> on their child's academic performance relative to national or regional <benchmarks>?	☐1	☐2
SC15Q03	c) Does your school provide information to parents on the academic performance of students in <national modal grade for 15-year-olds> as a group relative to students in the same grade in other schools?	☐1	☐2

SC16Q01 **Q16 – Which statement below best characterises parental expectations towards your school?**
(Please tick only one box)

There is constant pressure from many parents, who expect our school to set very high academic standards and to have our students achieve them	☐1
Pressure on the school to achieve higher academic standards among students comes from a minority of parents	☐2
Pressure from parents on the school to achieve higher academic standards among students is largely absent	☐3

	Q17 – In your school, are achievement data used in any of the following <accountability procedures>? Achievement data include aggregated school or grade-level test scores or grades, or graduation rates. *(Please tick one box in each row)*	Yes	No
SC17Q01	a) Achievement data are posted publicly (*e.g.* in the media)	☐1	☐2
SC17Q02	b) Achievement data are used in evaluation of the principal's performance	☐1	☐2
SC17Q03	c) Achievement data are used in evaluation of teachers' performance	☐1	☐2
SC17Q04	d) Achievement data are used in decisions about instructional resource allocation to the school	☐1	☐2
SC17Q05	e) Achievement data are tracked over time by an administrative authority	☐1	☐2

SC18Q01	**Q18 –** We are interested in the options parents have when choosing a school for their children. **Which of the following statements best describes the schooling available to students in your location?** *(Please tick only one box)*	
	There are two or more other schools in this area that compete for our students	☐1
	There is one other school in this area that competes for our students	☐2
	There are no other schools in this area that compete for our students	☐3

	Q19 – How much consideration is given to the following factors when students are admitted to your school? *(Please tick one box in each row)*	Prerequisite	High priority	Considered	Not considered
SC19Q01	a) Residence in a particular area	☐1	☐2	☐3	☐4
SC19Q02	b) Student's academic record (including placement tests)	☐1	☐2	☐3	☐4
SC19Q03	c) Recommendation of feeder schools	☐1	☐2	☐3	☐4
SC19Q04	d) Parents' endorsement of the instructional or religious philosophy of the school	☐1	☐2	☐3	☐4
SC19Q05	e) Student's need or desire for a special programme	☐1	☐2	☐3	☐4
SC19Q06	f) Attendance of other family members at the school (past or present)	☐1	☐2	☐3	☐4

Section E Science and the environment

	Q20 – Is your school involved in any of the following activities to promote engagement with science among students in <national modal grade for 15-year-olds>? *(Please tick one box in each row)*	Yes	No
SC20Q01	a) Science clubs	☐1	☐2
SC20Q02	b) Science fairs	☐1	☐2
SC20Q03	c) Science competitions	☐1	☐2
SC20Q04	d) Extracurricular science projects (including research)	☐1	☐2
SC20Q05	e) Excursions and field trips	☐1	☐2

	Q21 – Where do topics on the environment sit in the curriculum received by students in <national modal grade for 15-yearolds> at your school? Environmental topics include all topics related to environmental science. These may include environmental issues such as pollution or the degradation of the environment. Relationships between organisms, biodiversity and conservation of resources would also be examples of environmental topics. *(Please tick one box in each row. If there are no topics on the environment in the curriculum received by students in <national modal grade for 15-year-olds> please tick "No" in all four rows)*	Yes	No
SC21Q01	a) In a specific environmental studies course	☐1	☐2
SC21Q02	b) In the natural sciences courses – for example as part of biology, chemistry, physics, earth science or within an integrated science course	☐1	☐2
SC21Q03	c) As part of a geography course	☐1	☐2
SC21Q04	d) As part of another course	☐1	☐2

	Q22 – Does your school organise any of the following activities to provide opportunities to students in <national modal grade for 15-year-olds> to learn about environmental topics? *(Please tick one box in each row)*	Yes	No
SC22Q01	a) <Outdoor education>	☐1	☐2
SC22Q02	b) Trips to museums	☐1	☐2
SC22Q03	c) Trips to science and/or technology centres	☐1	☐2
SC22Q04	d) Extracurricular environmental projects (including research)	☐1	☐2
SC22Q05	e) Lectures and/or seminars (*e.g.* guest speakers)	☐1	☐2

Section F Careers and further education

	Q23 – How often would students in <national modal grade for 15-year-olds> have the opportunity to participate in the activities below as part of their normal schooling? *(Please tick one box in each row)*	Never	Once a year	More than once a year
SC23Q01	a) <Job fairs>	☐1	☐2	☐3
SC23Q02	b) Lectures (at school) by business or industry representatives	☐1	☐2	☐3
SC23Q03	c) Visits to local businesses or industries	☐1	☐2	☐3

SC24Q01	**Q24 – In your school, about how many students in <national modal grade for 15-year-olds> receive some training within local businesses as part of school activities during the normal school year (*e.g.* apprenticeships)?** *(Please tick only one box)*	
	This is not offered to students in <national modal grade for 15-year-olds>	☐1
	Half or less of students in <national modal grade for 15-year-olds>	☐2
	More than a half of students in <national modal grade for 15-year-olds>	☐3

SC25Q01	**Q25 – Thinking about the curriculum received by students in <national modal grade for 15-year-olds>, which statement below is closest to your view?** *(Please tick only one box)*	
	Business and industry have no influence on the curriculum	☐1
	Business and industry have a minor or indirect influence on the curriculum	☐2
	Business and industry have a considerable influence on the curriculum	☐3

SC26Q01	**Q26 – To what extent do you feel that teachers in your school concentrate on developing in students the skills and knowledge that will help them progress towards sciencerelated careers?** **Science-related career** has been used here to include careers that involve a considerable amount of science but are beyond the traditional idea of a scientist as someone who works in a laboratory or academic environment (like a nuclear physicist). As such, a science-related career is not only one in physics, chemistry or biology. Any career that involves tertiary education in a scientific field is considered science-related. Therefore careers like engineer (involving physics), weather forecaster (involving earth science), optician (involving biology and physics), and medical doctors (involving the medical sciences) are all examples of sciencerelated careers. *(Please tick only one box)*	
	These skills and knowledge are incidental to teachers' pedagogical activities	☐1
	These skills and knowledge are integrated into teachers' pedagogical activities, but they are not emphasised	☐2
	These skills and knowledge are a focus of teachers' pedagogical activities	☐3

SC27Q01	**Q27 – To what extent do you feel that teachers in your school concentrate on developing in students the skills and knowledge that will help them in tertiary education?** *(Please tick only one box)*	
	These skills and knowledge are incidental to teachers' pedagogical activities	☐1
	These skills and knowledge are integrated into teachers' pedagogical activities, but they are not emphasised	☐2
	These skills and knowledge are a focus of teachers' pedagogical activities	☐3

SC28Q01	**Q28 – Who has the main responsibility for career guidance of students in <national modal grade for 15-year-olds> at your school?** *(Please tick only one box)*	
	Not applicable, career guidance is not available in this school	☐1
	All teachers share the responsibility for career guidance	☐2
	Specific teachers have the main responsibility for career guidance	☐3
	We have one or more specific career guidance counsellors employed at school	☐4
	We have one or more specific career guidance counsellors who regularly visit the school	☐5

SC29Q01	**Q29 – If career guidance is available at your school, which of the statements below best describes the situation for students in <national modal grade for 15-year-olds>?** Skip this question if career guidance is not available at your school. *(Please tick only one box)*	
	Career guidance is sought voluntarily by students	☐1
	Career guidance is formally scheduled into students' time at school	☐2

APPENDIX 6
PISA 2006 PARENT QUESTIONNAIRE

	Q1 – Who will complete this questionnaire? *(Please tick all that apply.)*	
PA01Q01	a) Mother or other female guardian	☐1
PA01Q02	b) Father or other male guardian	☐1
PA01Q03	c) Other	☐1
	(If other, please specify) ______	

Your child's past science activities

Please answer this question with reference to <the student who brought this questionnaire home>.

	Q2 – Thinking back to when your child was about 10 years old, how often would your child have done these things? *(Please tick only one box in each row)*				
		Very often	Regularly	Sometimes	Never
PA02Q01	a) Watched TV programmes about science	☐1	☐2	☐3	☐4
PA02Q02	b) Read books on scientific discoveries	☐1	☐2	☐3	☐4
PA02Q03	c) Watched, read or listened to science fiction	☐1	☐2	☐3	☐4
PA02Q04	d) Visited web sites about science topics	☐1	☐2	☐3	☐4
PA02Q05	e) Attended a science club	☐1	☐2	☐3	☐4

Your child's school

We are interested in what you think about your child's school.

	Q3 – How much do you agree with the following statements? *(Please tick only one box in each row)*				
		Strongly agree	Agree	Disagree	Strongly disagree
PA03Q01	a) Most of my child's school teachers seem competent and dedicated	☐1	☐2	☐3	☐4
PA03Q02	b) Standards of achievement are high in my child's school	☐1	☐2	☐3	☐4
PA03Q03	c) I am happy with the content taught and the instructional methods used in my child's school	☐1	☐2	☐3	☐4
PA03Q04	d) I am satisfied with the disciplinary atmosphere in my child's school	☐1	☐2	☐3	☐4
PA03Q05	e) My child's progress is carefully monitored by the school	☐1	☐2	☐3	☐4
PA03Q06	f) My child's school provides regular and useful information on my child's progress	☐1	☐2	☐3	☐4
PA03Q07	g) My child's school does a good job in educating students	☐1	☐2	☐3	☐4

Science in your child's career and the job market

We would like to hear your views on the need for science in the job market today. We are also interested in your child's career and educational aspirations particularly those related to science.

	Q4 – We are interested in what you think about the need for science skills in the job market today. **How much do you agree with the following statements?** *(Please tick only one box in each row)*				
		Strongly agree	Agree	Disagree	Strongly disagree
PA04Q01	a) It is important to have good scientific knowledge and skills in order to get any good job in today's world	☐1	☐2	☐3	☐4
PA04Q02	b) Employers generally appreciate strong scientific knowledge and skills among their employees	☐1	☐2	☐3	☐4
PA04Q03	c) Most jobs today require some scientific knowledge and skills	☐1	☐2	☐3	☐4
PA04Q04	d) It is an advantage in the job market to have good scientific knowledge and skills	☐1	☐2	☐3	☐4

Q5 – The following questions refer to <science-related careers>. A <science-related career> is one that requires studying science at tertiary level (*e.g.* university). So, careers like engineer (involving physics), weather forecaster (involving Earth science), optician (involving biology and physics), and medical doctors (involving the medical sciences) are all examples of <science-related careers>.

Please answer the questions below.

(Please tick one box in each row)

		Yes	No
PA05Q01	a) Does anybody in your family (including you) work in a <sciencerelated career>?	☐1	☐2
PA05Q02	b) Does your child show an interest in working in a <science-related career>?	☐1	☐2
PA05Q03	c) Do you expect your child will go into a <science-related career>?	☐1	☐2
PA05Q04	d) Has your child shown interest in studying science after completing <secondary school>?	☐1	☐2
PA05Q05	e) Do you expect your child will study science after completing <secondary school>?	☐1	☐2

Your views on science

Science is an important part of the PISA study. We are interested in parents' opinions on science and on environmental issues.

Q6 – The following question asks about your views towards science.

How much do you agree with the following statements?

(Please tick only one box in each row)

		Strongly agree	Agree	Disagree	Strongly disagree
PA06Q01	a) Advances in <broad science and technology> usually improve people's living conditions	☐1	☐2	☐3	☐4
PA06Q02	b) <Broad science> is important for helping us to understand the natural world	☐1	☐2	☐3	☐4
PA06Q03	c) Some concepts in <broad science> help me to see how I relate to other people	☐1	☐2	☐3	☐4
PA06Q04	d) Advances in <broad science and technology> usually help improve the economy	☐1	☐2	☐3	☐4
PA06Q05	e) There are many opportunities for me to use <broad science> in my everyday life	☐1	☐2	☐3	☐4
PA06Q06	f) <Broad science> is valuable to society	☐1	☐2	☐3	☐4
PA06Q07	g) <Broad science> is very relevant to me	☐1	☐2	☐3	☐4
PA06Q08	h) I find that <broad science> helps me to understand the things around me	☐1	☐2	☐3	☐4
PA06Q09	i) Advances in <broad science and technology> usually bring social benefits	☐1	☐2	☐3	☐4

Q7 – Do you see the environmental issues below as a serious concern for yourself and/or others?

(Please tick only one box in each row)

		This is a serious concern for me personally as well as others	This is a serious concern for other people in my country but not me personally	This is a serious concern only for people in other countries	This is not a serious concern for anyone
PA07Q01	a) Air pollution	☐1	☐2	☐3	☐4
PA07Q02	b) Energy shortages	☐1	☐2	☐3	☐4
PA07Q03	c) Extinction of plants and animals	☐1	☐2	☐3	☐4
PA07Q04	d) Clearing of forests for other land use	☐1	☐2	☐3	☐4
PA07Q05	e) Water shortages	☐1	☐2	☐3	☐4
PA07Q06	f) Nuclear waste	☐1	☐2	☐3	☐4

Q8 – Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years?

(Please tick only one box in each row)

		Improve	Stay about the same	Get worse
PA08Q01	a) Air pollution	☐1	☐2	☐3
PA08Q02	b) Energy shortages	☐1	☐2	☐3
PA08Q03	c) Extinction of plants and animals	☐1	☐2	☐3
PA08Q04	d) Clearing of forests for other land use	☐1	☐2	☐3
PA08Q05	e) Water shortages	☐1	☐2	☐3
PA08Q06	f) Nuclear waste	☐1	☐2	☐3

The cost of education services

We are interested in how much parents spend on educational services.

PA09Q01

Q9 – Please answer the following question thinking just of expenses related to <the student who brought this questionnaire home>.
In the last twelve months, about how much would you have paid to educational providers for services?

In determining this, please include any tuition fees you pay to your child's school, any other fees paid to individual teachers in the school or to other teachers for any tutoring your child receives, as well as any fees for cram school.

Do not include the costs of goods like sports equipment, school uniforms, computers or textbooks if they are not included in a general fee (that is, if you have to buy these things separately).

(Please tick only one box)

Less than < $W >	☐1
< $W or more but less than $X>	☐2
< $X or more but less than $Y>	☐3
< $Y or more but less than $Z >	☐4
< $Z > or more	☐5

Parents' background

In this section we ask questions about the background of both the mother and the father of the <student who brought this questionnaire home>. These help us obtain better information about the family situation of the student.

PA10Q01 to PA10Q02

Q10 – How old are the child's parents?
(Please tick one box in each column.)

	Mother (PA10Q01)	Father (PA10Q02)
Younger than 36 years	☐1	☐1
36 – 40 years	☐2	☐2
41 – 45 years	☐3	☐3
46 – 50 years	☐4	☐4
51 years or older	☐5	☐5

PA11Q01

Q11a – What is the main job of the child's father?
(e.g. *school teacher, kitchen-hand, sales manager)*

(If he is not working now, please tell us his last main job)

Please write in the job title: ____________________

Q11b – What does the child's father do in his main job?
(e.g. *teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team)*

Please use a sentence to describe the kind of work he does or did in that job: ____________________

Q12 – Does the child's father have any of the following qualifications?
(Please tick one box in each row)

		Yes	No
PA12Q01	a) <ISCED level 5A, 6>	☐1	☐2
PA12Q02	b) <ISCED level 5B>	☐1	☐2
PA12Q03	c) <ISCED level 4>	☐1	☐2
PA12Q04	d) <ISCED level 3A>	☐1	☐2

PA13Q01

Q13a – What is the main job of the child's mother?
(e.g. *school teacher, kitchen-hand, sales manager)*

(If she is not working now, please tell us her last main job)

Please write in the job title: ____________________

Q13b – What does the child's mother do in her main job?
(e.g. *teaches high school students, helps the cook prepare meals in a restaurant, manages a sales team)*

Please use a sentence to describe the kind of work she does or did in that job: ____________________

	Q14 – Does the child's mother have any of the following qualifications? *(Please tick one box in each row)*	Yes	No
		Yes	No
PA14Q01	a) <ISCED level 5A, 6>	☐1	☐2
PA14Q02	b) <ISCED level 5B>	☐1	☐2
PA14Q03	c) <ISCED level 4>	☐1	☐2
PA14Q04	d) <ISCED level 3A>	☐1	☐2

PA15Q01	**Q15 – What is your annual household income?** Please add together the total income, before tax, from all members of your household. Please remember we ask you to answer questions only if you feel comfortable doing so, and that all responses are kept strictly confidential. *(Please tick only one box)*	
	Less than < $A >	☐1
	< $A > or more but less than < $B >	☐2
	< $B > or more but less than < $C >	☐3
	< $C > or more but less than < $D >	☐4
	< $D > or more but less than < $E >	☐5
	< $E > or more	☐6

APPENDIX 7
CODEBOOK FOR PISA 2006 STUDENT QUESTIONNAIRE DATA FILE

SUBNATIO (1) Adjudicated sub-region	
Format: A5	Columns: 1-5
03100	Azerbaijan
03200	Argentina
03600	Australia
04000	Austria
05601	Belgium: Flemish region
05699	Belgium: French & German regions (not adjudicated)
07600	Brazil
10000	Bulgaria
12400	Canada
15200	Chile
15800	Chinese Taipei
17000	Colombia
19100	Croatia
20300	Czech Republic
20800	Denmark
23300	Estonia
24600	Finland
25000	France
27600	Germany
30000	Greece
34400	Hong Kong-China
34800	Hungary
35200	Iceland
36000	Indonesia
37200	Ireland
37600	Israel
38001	Italy: Region 1
38002	Italy: Region 2
38003	Italy: Region 3
38004	Italy: Region 4
38005	Italy: Region 5
38006	Italy: Region 6
38007	Italy: Region 7
38008	Italy: Region 8
38009	Italy: Region 9
38010	Italy: Region 10
38011	Italy: Region 11
38012	Italy: Region 12
38013	Italy: Region 13
38099	Italy: Region 14 (not adjudicated)
39200	Japan
40000	Jordan
41000	Korea
41700	Kyrgyzstan
42800	Latvia
43800	Liechtenstein
44000	Lithuania
44200	Luxembourg
44600	Macao-China
48400	Mexico
49900	Montenegro
52800	Netherlands
55400	New Zealand
57800	Norway
61600	Poland
62000	Portugal
63400	Qatar
64200	Romania
64300	Russian Federation
68800	Serbia
70300	Slovak Republic
70500	Slovenia
72401	Spain: Andalusia
72402	Spain: Aragon
72403	Spain: Asturias
72406	Spain: Cantabria
72407	Spain: Castile and Leon
72409	Spain: Catalonia
72411	Spain: Galicia
72412	Spain: La Rioja
72415	Spain: Navarre
72416	Spain: Basque Country
72499	The rest of Spain (not adjudicated)
75200	Sweden
75600	Switzerland
76400	Thailand
78800	Tunisia
79200	Turkey
82610	United Kingdom: England, Wales & Northern Ireland
82620	United Kingdom: Scotland
84000	United States
85800	Uruguay

SCHOOLID (2) School ID 5-digit	
Format: A5	Columns: 6-10

STIDSTD (3) Student ID 5-digit	
Format: A5	Columns: 11-15

CNT (4) Country code 3-character	
Format: A3	Columns: 16-18
ARG	Argentina
AUS	Australia
AUT	Austria
AZE	Azerbaijan
BEL	Belgium
BGR	Bulgaria
BRA	Brazil
CAN	Canada
CHE	Switzerland
CHL	Chile
COL	Colombia
CZE	Czech Republic
DEU	Germany
DNK	Denmark
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HKG	Hong Kong-China
HRV	Croatia
HUN	Hungary
IDN	Indonesia
IRL	Ireland
ISL	Iceland
ISR	Israel
ITA	Italy
JOR	Jordan
JPN	Japan
KGZ	Kyrgyzstan
KOR	Korea
LIE	Liechtenstein
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia

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MAC	Macao-China
MEX	Mexico
MNE	Montenegro
NLD	Netherlands
NOR	Norway
NZL	New Zealand
POL	Poland
PRT	Portugal
QAT	Qatar
ROU	Romania
RUS	Russian Federation
SRB	Serbia
SVK	Slovak Republic
SVN	Slovenia
SWE	Sweden
TAP	Chinese Taipei
THA	Thailand
TUN	Tunisia
TUR	Turkey
URY	Uruguay
USA	United States

COUNTRY (5) Country code ISO 3-digit	
Format: A3	Columns: 19-21
031	Azerbaijan
032	Argentina
036	Australia
040	Austria
056	Belgium
076	Brazil
100	Bulgaria
124	Canada
152	Chile
158	Chinese Taipei
170	Colombia
191	Croatia
203	Czech Republic
208	Denmark
233	Estonia
246	Finland
250	France
276	Germany
300	Greece
344	Hong Kong-China
348	Hungary
352	Iceland
360	Indonesia
372	Ireland
376	Israel
380	Italy
392	Japan
400	Jordan
410	Korea
417	Kyrgyzstan
428	Latvia
438	Liechtenstein
440	Lithuania
442	Luxembourg
446	Macao-China
484	Mexico
499	Montenegro
528	Netherlands
554	New Zealand
578	Norway
616	Poland
620	Portugal
634	Qatar
642	Romania
643	Russian Federation
688	Serbia
703	Slovak Republic
705	Slovenia
724	Spain
752	Sweden
756	Switzerland
764	Thailand
788	Tunisia
792	Turkey
826	United Kingdom
840	United States
858	Uruguay

OECD (6) OECD country	
Format: F1.0	Columns: 22-22
0	Non-OECD
1	OECD

ST01Q01 (7) Grade Q1	
Format: F2.0	Columns: 23-24
96	Ungraded
99	Missing

ST02Q01 (8) Study programme Q2	
Format: F2.0	Columns: 25-26
99	Missing

ST03Q02 (9) Month of birth Q3	
Format: A2	Columns: 27-28
99	Missing

ST03Q03 (10) Year of birth Q3	
Format: A2	Columns: 29-30
99	Missing

ST04Q01 (11) Gender Q4	
Format: F1.0	Columns: 31-31
1	Female
2	Male
9	Missing

ST05Q01 (12) Mother ISCO code Q5a	
Format: A4	Columns: 32-35
1000	LEGISLATORS, SENIOR OFFICIALS & MANAGERS
1100	LEGISLATORS & SENIOR OFFICIALS
1110	LEGISLATORS [incl. Member of Parliament, Member of Local Council]
1120	SENIOR GOVERNMENT OFFICIALS [incl. Minister, Ambassador]
1130	SENIOR LOCAL GOVERNMENT OFFICIALS
1140	SENIOR OFFICIALS SPECIAL-INTEREST ORGANISATIONS
1141	Senior officials political-party organisations
1142	Senior officials economic-interest organisations
1143	Senior officials special-interest organisations
1200	CORPORATE MANAGERS [LARGE ENTERPRISES]
1210	[LARGE ENTERPRISES] DIRECTORS & CHIEF EXECUTIVES
1220	[LARGE ENTERPRISE OPERATION] DEPARTMENT MANAGERS
1221	Production dep. managers agriculture & fishing
1222	Production dep. managers manufacturing [incl. Factory Manager]
1223	Production dep. managers construction
1224	Production dep. managers wholesale & retail trade
1225	Production dep. managers restaurants & hotels
1226	Production dep. managers transp., storage & communic.
1227	Production dep. managers business services [incl. Bank Manager]
1228	Production dep. managers personal care, cleaning etc
1229	Production dep. managers nec [incl. Dean,School Principal]
1230	[LARGE ENTERPRISES] OTHER DEPARTMENT MANAGERS
1231	Finance & admin. department managers [incl. Company Secretary]
1232	Personnel & industrial relations department managers

1233	Sales & marketing department managers
1234	Advertising & public relations department managers
1235	Supply & distribution department managers
1236	Computing services department managers
1237	Research & development department managers
1239	Other department managers nec
1240	OFFICE MANAGERS [incl. Clerical Supervisor]
1250	MILITARY OFFICERS
1251	Higher military officers [Captain and above]
1252	Lower grade commissioned officers [incl. Army Lieutenant]
1300	[SMALL ENTERPRISE] GENERAL MANAGERS
1310	[SMALL ENTERPRISE] GENERAL MANAGERS [incl. Businessman, Trader]
1311	[Small enterprise] General managers agr., forestry & fishing
1312	[Small enterprise] General managers manufacturing
1313	[Small enterprise] General managers constr. [incl. Contractor]
1314	[Small enterprise] General managers wholesale & retail trade
1315	[Small enterprise] General managers restaurants & hotels
1316	[Small enterprise] General managers transp., storage & comm.
1317	[Small enterprise] General managers business services
1318	[Small enterprise] General managers personal care, cleaning etc.
1319	[Small enterprise] General managers nec [incl. Travel, Fitness]
2000	PROFESSIONALS
2100	PHYSICAL, MATHEMATICAL & ENGINEERING SCIENCE PROFESSIONALS
2110	PHYSICISTS, CHEMISTS & RELATED PROFESSIONALS
2111	Physicists & astronomers
2112	Meteorologists
2113	Chemists
2114	Geologists & geophysicists [incl. Geodesist]
2120	MATHEMATICIANS, STATISTICIANS ETC PROFESSIONALS
2121	Mathematicians etc professionals
2122	Statisticians [incl. Actuary]
2130	COMPUTING PROFESSIONALS
2131	Computer systems designers & analysts [incl. Software Engineer]
2132	Computer programmers
2139	Computing professionals nec
2140	ARCHITECTS, ENGINEERS ETC PROFESSIONALS
2141	Architects town & traffic planners [incl. Landscape Architect]
2142	Civil engineers [incl. Construction Engineer]
2143	Electrical engineers
2144	Electronics & telecommunications engineers
2145	Mechanical engineers
2146	Chemical engineers
2147	Mining engineers, metallurgists etc professionals
2148	Cartographers & surveyors
2149	Architects engineers etc professionals nec [incl. Consultant]
2200	LIFE SCIENCE & HEALTH PROFESSIONALS
2210	LIFE SCIENCE PROFESSIONALS
2211	Biologists, botanists zoologists etc professionals
2212	Pharmacologists, pathologists etc profess. [incl. Biochemist]
2213	Agronomists etc professionals
2220	HEALTH PROFESSIONALS (EXCEPT NURSING)
2221	Medical doctors
2222	Dentists
2223	Veterinarians
2224	Pharmacists
2229	Health professionals except nursing nec
2230	NURSING & MIDWIFERY PROFESS. [incl. Registered Nurses, Midwives]
2300	TEACHING PROFESSIONALS
2310	HIGHER EDUCATION TEACHING PROFESSIONALS [incl. Univ. Professor]
2320	SECONDARY EDUCATION TEACHING PROFESSIONALS
2321	[Sec. teachers, academic track] [incl. Middle School Teacher]
2322	[Sec. teachers, vocational track] [incl. Vocational Instructor]
2330	PRIMARY & PRE-PRIMARY EDUCATION TEACHING PROFESSIONALS
2331	Primary education teaching professionals
2332	Pre-primary educ. teaching professionals [incl. Kindergarten]
2340	SPECIAL EDUC. TEACHING PROFESSIONALS [incl. Remedial, Blind]
2350	OTHER TEACHING PROFESSIONALS
2351	Education methods specialists [incl. Curricula Developer]
2352	School inspectors
2359	Other teaching professionals nec
2400	OTHER PROFESSIONALS [incl. Professional nfs, Admin. Professional]
2410	BUSINESS PROFESSIONALS
2411	Accountants [incl. Auditor]
2412	Personnel & careers profess. [incl. Job Analyst, Stud. Couns.]
2419	Business profess. [incl. Publicity/Patent agent, Market Research]
2420	LEGAL PROFESSIONALS
2421	Lawyers
2422	Judges
2429	Legal professionals nec [incl. Notary, Notary Public]
2430	ARCHIVISTS, LIBRARIANS ETC INFORMATION PROFESSIONALS
2431	Archivists & curators
2432	Librarians etc information professionals
2440	SOCIAL SCIENCE ETC PROFESSIONALS
2441	Economists
2442	Sociologists, anthropologists etc professionals
2443	Philosophers, historians & political scientists
2444	Philologists, translators & interpreters
2445	Psychologists
2446	Social work professionals [incl. Welfare Worker]
2450	WRITERS & CREATIVE OR PERFORMING ARTISTS
2451	Authors journalists & other writers [incl. Editor, Techn. Writer]
2452	Sculptors, painters etc artists
2453	Composers, musicians & singers
2454	Choreographers & dancers
2455	Film, stage etc actors & directors
2460	RELIGIOUS PROFESSIONALS
3000	TECHNICIANS AND ASSOCIATE PROFESSIONALS
3100	PHYSICAL & ENGINEERING SCIENCE ASSOCIATE PROFESSIONALS
3110	PHYSICAL & ENGINEERING SCIENCE TECHNICIANS
3111	Chemical & physical science technicians
3112	Civil engineering technicians
3113	Electrical engineering technicians
3114	Electronics & telecommunications engineering technicians
3115	Mechanical engineering technicians
3116	Chemical engineering technicians
3117	Mining & metallurgical technicians
3118	Draughtspersons [incl. Technical Illustrator]
3119	Physical & engineering science technicians nec
3120	COMPUTER ASSOCIATE PROFESSIONALS
3121	Computer assistants [incl. Assistant Users Services]
3122	Computer equipment operators
3123	Industrial robot controllers
3130	OPTICAL & ELECTRONIC EQUIPMENT OPERATORS
3131	Photographers & electronic equipment operators
3132	Broadcasting & telecommunications equipment operators
3133	Medical equipment operators [incl. X-ray Technician]
3139	Optical & electronic equipment operators nec
3140	SHIP & AIRCRAFT CONTROLLERS & TECHNICIANS
3141	Ships engineers
3142	Ships deck officers & pilots [incl. River Boat Captain]
3143	Aircraft pilots etc associate professionals
3144	Air traffic controllers
3145	Air traffic safety technicians
3150	SAFETY & QUALITY INSPECTORS
3151	Building & fire inspectors
3152	Safety, health & quality inspectors
3200	LIFE SCIENCE & HEALTH ASSOCIATE PROFESSIONALS
3210	LIFE SCIENCE TECHNICIANS ETC ASSOCIATE PROFESSIONALS

3211	Life science technicians [incl. Medical Laboratory Assistant]
3212	Agronomy & forestry technicians
3213	Farming & forestry advisers
3220	MODERN HEALTH ASSOCIATE PROFESSIONALS EXCEPT NURSING
3221	Medical assistants
3222	Sanitarians
3223	Dieticians & nutritionists
3224	Optometrists & opticians [incl. Dispensing Optician]
3225	Dental assistants [incl. Oral Hygienist]
3226	Physiotherapists etc associate professionals
3227	Veterinary assistants [incl. Veterinarian Vaccinater]
3228	Pharmaceutical assistants
3229	Modern health associate professionals except nursing nec
3230	NURSING & MIDWIFERY ASSOCIATE PROFESSIONALS
3231	Nursing associate professionals [incl. Trainee Nurses]
3232	Midwifery associate professionals [incl. Trainee Midwife]
3240	TRADITIONAL MEDICINE PRACTITIONERS & FAITH HEALERS
3241	Traditional medicine practitioners [incl. Herbalist]
3242	Faith healers
3300	TEACHING ASSOCIATE PROFESSIONALS
3310	PRIMARY EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3320	PRE-PRIMARY EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3330	SPECIAL EDUCATION TEACHING ASSOCIATE PROFESSIONALS
3340	OTHER TEACHING ASSOCIATE PROFESSIONALS
3400	OTHER ASSOCIATE PROFESSIONALS
3410	FINANCE & SALES ASSOCIATE PROFESSIONALS
3411	Securities & finance dealers & brokers
3412	Insurance representatives [incl. Insurance Agent, Underwriter]
3413	[Real] estate agents [incl. Real Estate Broker]
3414	Travel consultants & organisers
3415	Technical & commercial sales representatives
3416	Buyers
3417	Appraisers, valuers & auctioneers [incl. Claims Adjuster]
3419	Finance & sales associate professionals nec
3420	BUSINESS SERVICES AGENTS AND TRADE BROKERS
3421	Trade brokers
3422	Clearing & forwarding agents
3423	Employment agents & labour contractors
3429	Business services agents & trade brokers nec
3430	ADMINISTRATIVE ASSOCIATE PROFESSIONALS
3431	Administrative secretaries etc associate professionals
3432	Legal etc business associate profess. [incl. Bailiff, Law Clerk]
3433	Bookkeepers
3434	Statistical, mathematical etc associate professionals
3439	Administrative associate profess. nec [incl. Management Ass.]
3440	CUSTOMS, TAX ETC GOVERNMENT ASSOCIATE PROFESSIONALS
3441	Customs & border inspectors
3442	Government tax & excise officials
3443	Government social benefits officials
3444	Government licensing officials
3449	Customs tax etc government associate professionals nec
3450	POLICE INSPECTORS & DETECTIVES / [ARMY]
3451	Police inspectors & detectives
3452	[Armed forces non-commissioned officers] [incl. Sergeant]
3460	SOCIAL WORK ASSOCIATE PROFESSIONALS
3470	ARTISTIC, ENTERTAINMENT & SPORTS ASSOCIATE PROFESSIONALS
3471	Decorators & commercial designers
3472	Radio, television & other announcers
3473	Street night-club etc musicians, singers & dancers
3474	Clowns, magicians, acrobats etc associate professionals
3475	Athletes, sports persons etc associate professionals
3480	RELIGIOUS ASSOCIATE PROFESS. [incl. Evangelist, Lay Preacher]
4000	CLERKS
4100	OFFICE CLERKS [Incl. Clerk nfs, Government Office Clerk nfs]

4110	SECRETARIES & KEYBOARD-OPERATING CLERKS
4111	Stenographers & typists
4112	Word-processor etc operators [incl. Teletypist]
4113	Data entry operators [incl. Key Puncher]
4114	Calculating-machine operators [incl. Bookkeeping Machine Op.]
4115	Secretaries
4120	NUMERICAL CLERKS
4121	Accounting & bookkeeping clerks [incl. Payroll Clerk]
4122	Statistical & finance clerks [incl. Credit Clerk]
4130	MATERIAL-RECORDING & TRANSPORT CLERKS
4131	Stock clerks [incl. Weighing Clerk, Storehouse Clerk]
4132	Production clerks [incl. Planning Clerks]
4133	Transport clerks [incl. Dispatcher, Expeditor]
4140	LIBRARY, MAIL ETC CLERKS
4141	Library & filing clerks
4142	Mail carriers & sorting clerks
4143	Coding proof-reading etc clerks
4144	Scribes etc workers [incl. Form Filling Assistance Clerk]
4190	OTHER OFFICE CLERKS [incl. Office Boy, Photocopy Machine Op.]
4200	CUSTOMER SERVICES CLERKS [incl. Customer Service Clerk nfs]
4210	CASHIERS, TELLERS ETC CLERKS
4211	Cashiers & ticket clerks [incl. Bank/Store, Toll Collector]
4212	Tellers & other counter clerks [incl. Bank Teller, Post Office]
4213	Bookmakers & croupiers
4214	Pawnbrokers & money-lenders
4215	Debt-collectors etc workers
4220	CLIENT INFORMATION CLERKS
4221	Travel agency etc clerks
4222	Receptionists & information clerks [incl. Medical Receptionist]
4223	Telephone switchboard operators [incl. Telephone Operator]
5000	SERVICE WORKERS & SHOP & MARKET SALES WORKERS
5100	PERSONAL & PROTECTIVE SERVICES WORKERS
5110	TRAVEL ATTENDANTS ETC
5111	Travel attendants & travel stewards
5112	Transport conductors [incl. Train Conductor]
5113	Travel, museum guides
5120	HOUSEKEEPING & RESTAURANT SERVICES WORKERS
5121	Housekeepers etc workers
5122	Cooks
5123	Waiters, waitresses & bartenders
5130	PERSONAL CARE ETC WORK
5131	Child-care workers [incl. Nursemaid, Governess]
5132	Inst.-based personal care workers [incl. Ambulance, Orderly]
5133	Home based personal care workers [incl. Attendant]
5139	[Other] care etc workers nec [incl. Animal Feeder]
5140	OTHER PERSONAL SERVICES WORKERS
5141	Hairdressers, barbers, beauticians etc workers
5142	Companions & valets [incl. Personal Maid]
5143	Undertakers & embalmers [incl. Funeral Director]
5149	Other personal services workers [incl. Escort, Dancing Partner]
5150	ASTROLOGERS, FORTUNE-TELLERS ETC WORKERS
5151	Astrologers etc workers
5152	Fortune-tellers, palmists etc workers
5160	PROTECTIVE SERVICES WORKERS
5161	Fire-fighters
5162	Police officers [Incl. Policeman, Constable, Marshall]
5163	Prison guards
5164	[Armed forces, soldiers] [incl. Enlisted Man]
5169	Protective services workers [incl. Bodyguard, Coastguard]
5200	[SALESPERSONS, MODELS & DEMONSTRATORS]
5210	FASHION & OTHER MODELS [incl. Mannequin, Artists Model]
5220	SHOP SALESPERSONS & DEMONSTRATORS
5230	STALL & MARKET SALESPERSONS
6000	SKILLED AGRICULTURAL & FISHERY WORKERS
6100	MARKET-ORIENTED SKILLED AGRICULTURAL & FISHERY WORKERS

6110	MARKET GARDENERS & CROPGROWERS
6111	Field crop & vegetable growers
6112	Tree & shrub crop growers
6113	Gardeners, horticultural & nursery growers
6114	Mixed-crop growers [Incl. Share Cropper]
6120	MARKET-ORIENTED ANIMAL PRODUCERS ETC WORKERS
6121	Dairy & livestock producers
6122	Poultry producers [incl. Chicken Farmer, Skilled Hatchery Worker]
6123	Apiarists & sericulturists [incl. Beekeeper, Silkworm Raiser]
6124	Mixed-animal producers
6129	Market-oriented animal producers etc workers nec
6130	MARKET-ORIENTED CROP & ANIMAL PRODUCERS
6131	[Mixed farmers]
6132	[Farm foremen/supervisor]
6133	[Farmers nfs]
6134	[Skilled farm workers nfs]
6140	FORESTRY ETC WORKERS
6141	Forestry workers & loggers [incl. Rafter, Timber Cruiser]
6142	Charcoal burners etc workers
6150	FISHERY WORKERS, HUNTERS & TRAPPERS
6151	Aquatic-life cultivation workers
6152	Inland & coastal waters fishery workers
6153	Deep-sea fishery workers [incl. Fisherman nfs, Trawler Crewman]
6154	Hunters & trappers [incl. Whaler]
6200	SUBSISTENCE AGRICULTURAL & FISHERY WORKERS
6210	SUBSISTENCE AGRICULTURAL & FISHERY WORKERS
7000	CRAFT ETC TRADES WORKERS
7100	EXTRACTION & BUILDING TRADES WORKERS
7110	MINERS, SHOTFIRERS, STONE CUTTERS & CARVERS
7111	Miners & quarry workers [incl. Miner nfs]
7112	Shotfirers & blasters
7113	Stone splitters, cutters & carvers [incl. Tombstone Carver]
7120	BUILDING FRAME ETC TRADES WORKERS
7121	Builders traditional materials
7122	Bricklayers & stonemasons [incl. Paviour]
7123	Concrete placers, concrete finishers etc workers
7124	Carpenters & joiners
7129	Building frame etc trades workers nec [incl. Scaffolder]
7130	BUILDING FINISHERS ETC TRADES WORKERS
7131	Roofers
7132	Floor layers & tile setters [incl. Parquetry Worker]
7133	Plasterers [incl. Stucco Mason]
7134	Insulation workers
7135	Glaziers
7136	Plumbers & pipe fitters [incl. Well Digger]
7137	Building etc electricians
7140	PAINTERS, BUILDING STRUCTURE CLEANERS ETC TRADES WORKERS
7141	Painters etc workers [incl. Construction Painter, Paperhanger]
7142	Varnishers etc painters [incl. Automobile Painter]
7143	Building structure cleaners [incl. Chimney Sweep, Sandblaster]
7200	METAL, MACHINERY ETC TRADES WORKERS
7210	METAL MOULDERS, WELDERS, SHEETMETAL WORKERS STRUCTURAL METAL
7211	Metal moulders & coremakers
7212	Welders & flamecutters [incl. Brazier, Solderer]
7213	Sheet-metal workers [incl. Panel Beater, Coppersmith, Tinsmith]
7214	Structural-metal preparers & erectors
7215	Riggers & cable splicers
7216	Underwater workers [incl. Frogman]
7220	BLACKSMITHS, TOOL-MAKERS ETC TRADES WORKERS
7221	Blacksmiths, hammer-smiths & forging press workers
7222	Tool-makers etc workers [incl. Locksmith]
7223	Machine-tool setters & setter-operators [Metal driller, Turner]
7224	Metal wheel-grinders, polishers & tool sharpeners
7230	MACHINERY MECHANICS & FITTERS
7231	Motor vehicle mechanics & fitters [incl. Bicycle Repairman]
7232	Aircraft engine mechanics & fitters

7233	[Industrial & agricultural] machinery mechanics & fitters
7234	[Unskilled garage worker] [incl. Oiler-Greaser]
7240	ELECTRICAL & ELECTRONIC EQUIPMENT MECHANICS & FITTERS
7241	Electrical mechanics & fitters [incl. Office Machine Repairman]
7242	Electronics fitters
7243	Electronics mechanics & servicers
7244	Telegraph & telephone installers & servicers
7245	Electrical line installers, repairers & cable jointers
7300	PRECISION, HANDICRAFT, PRINTING ETC TRADES WORKERS
7310	PRECISION WORKERS IN METAL ETC MATERIALS
7311	Precision-instr. makers & repairers [incl. Dental, Watch Maker]
7312	Musical-instrument makers & tuners
7313	Jewellery & precious-metal workers [incl. Goldsmith]
7320	POTTERS, GLASS-MAKERS ETC TRADES WORKERS
7321	Abrasive wheel formers, potters etc workers
7322	Glass-makers, cutters, grinders & finishers
7323	Glass engravers & etchers
7324	Glass ceramics etc decorative painters
7330	HANDICRAFT WORKERS IN WOOD,TEXTILE, LEATHER ETC
7331	Handicraft workers in wood etc materials
7332	Handicraft workers in textile leather etc materials
7340	PRINTING ETC TRADES WORKERS
7341	Compositors typesetters etc workers
7342	Stereotypers & electrotypers
7343	Printing engravers & etchers
7344	Photographic etc workers [incl. Darkroom worker]
7345	Bookbinders etc workers
7346	Silk-screen, block & textile printers
7400	OTHER CRAFT ETC TRADES WORKERS
7410	FOOD PROCESSING ETC TRADES WORKERS
7411	Butchers, fishmongers etc food preparers
7412	Bakers, pastry-cooks & confectionery makers
7413	Dairy-products makers
7414	Fruit, vegetable etc preservers
7415	Food & beverage tasters & graders
7416	Tobacco preparers & tobacco products makers
7420	WOOD TREATERS, CABINET-MAKERS ETC TRADES WORKERS
7421	Wood treaters [incl. Wood Grader, Wood Impregnator]
7422	Cabinet-makers etc workers [incl. Cartwright, Cooper]
7423	Woodworking-machine setters & setter-operators
7424	Basketry weavers, brush makers etc workers [incl. Broom Maker]
7430	TEXTILE, GARMENT ETC TRADES WORKERS
7431	Fibre preparers
7432	Weavers, knitters etc workers
7433	Tailors, dressmakers & hatters [incl. Milliner]
7434	Furriers etc workers
7435	Textile, leather etc pattern-makers & cutters
7436	Sewers, embroiderers etc workers
7437	Upholsterers etc workers
7440	PELT, LEATHER & SHOEMAKING TRADES WORKERS
7441	Pelt dressers, tanners & fellmongers
7442	Shoe-makers etc workers
7500	[SKILLED WORKERS NFS]
7510	[MANUAL FOREMEN NFS --NON-FARM--]
7520	[SKILLED WORKERS NFS] [incl. Craftsman, Artisan, Tradesman]
7530	[APPRENTICE SKILLED WORK NFS]
8000	PLANT & MACHINE OPERATORS & ASSEMBLERS
8100	STATIONARY-PLANT ETC OPERATORS
8110	MINING- & MINERAL-PROCESSING PLANT OPERATORS
8111	Mining-plant operators
8112	Mineral-ore- & stone-processing-plant operators
8113	Well drillers & borers etc workers
8120	METAL-PROCESSING-PLANT OPERATORS
8121	Ore & metal furnace operators
8122	Metal melters, casters & rolling-mill operators

8123	Metal-heat-treating-plant operators
8124	Metal drawers & extruders
8130	GLASS, CERAMICS ETC PLANT OPERATORS
8131	Glass & ceramics kiln etc machine operators
8139	Glass, ceramics etc plant operators nec
8140	WOOD-PROCESSING- & PAPERMAKING-PLANT OPERATORS
8141	Wood-processing-plant operators [incl. Sawyer]
8142	Paper-pulp plant operators
8143	Papermaking-plant operators
8150	CHEMICAL-PROCESSING-PLANT OPERATORS
8151	Crushing- grinding- & chemical-mixing machinery operators
8152	Chemical-heat-treating-plant operators
8153	Chemical-filtering- & separating-equipment operators
8154	Chemical-still & reactor operators
8155	Petroleum- & natural-gas-refining-plant operators
8159	Chemical-processing-plant operators nec
8160	POWER-PRODUCTION ETC PLANT OPERATORS
8161	Power-production plant operators
8162	Steam-engine & boiler operators [incl. Stoker]
8163	Incinerator water-treatment etc plant operators
8170	AUTOMATED-ASSEMBLY-LINE & INDUSTRIAL-ROBOT OPERATORS
8171	Automated-assembly-line operators
8172	Industrial-robot operators
8200	MACHINE OPERATORS & ASSEMBLERS
8210	METAL- & MINERAL-PRODUCTS MACHINE OPERATORS
8211	Machine-tool operators [incl. Machine Operator nfs]
8212	Cement & other mineral products machine operators
8220	CHEMICAL-PRODUCTS MACHINE OPERATORS
8221	Pharmaceutical- & toiletry-products machine operators
8222	Ammunition- & explosive-products machine operators
8223	Metal finishing- plating- & coating-machine operators
8224	Photographic-products machine operators
8229	Chemical-products machine operators nec
8230	RUBBER- & PLASTIC-PRODUCTS MACHINE OPERATORS
8231	Rubber-products machine operators
8232	Plastic-products machine operators
8240	WOOD-PRODUCTS MACHINE OPERATORS
8250	PRINTING-, BINDING- & PAPER-PRODUCTS MACHINE OPERATORS
8251	Printing-machine operators
8252	Bookbinding-machine operators
8253	Paper-products machine operators
8260	TEXTILE-, FUR- & LEATHER-PRODUCTS MACHINE OPERATORS
8261	Fibre-preparing-, spinning- & winding machine operators
8262	Weaving- & knitting-machine operators
8263	Sewing-machine operators
8264	Bleaching-, dyeing- & cleaning-machine operators
8265	Fur- & leather-preparing-machine operators
8266	Shoemaking- etc machine operators
8269	Textile-, fur- & leather-products machine operators nec
8270	FOOD ETC PRODUCTS MACHINE OPERATORS
8271	Meat- & fish-processing-machine operators
8272	Dairy-products machine operators
8273	Grain- & spice-milling-machine operators
8274	Baked-goods cereal & chocolate-products machine operators
8275	Fruit-, vegetable- & nut-processing-machine operators
8276	Sugar production machine operators
8277	Tea-, coffee- & cocoa-processing-machine operators
8278	Brewers- wine & other beverage machine operators
8279	Tobacco production machine operators
8280	ASSEMBLERS
8281	Mechanical-machinery assemblers [incl. Car Assembly Line Worker]
8282	Electrical-equipment assemblers
8283	Electronic-equipment assemblers
8284	Metal-, rubber- & plastic-products assemblers
8285	Wood etc products assemblers
8286	Paperboard, textile etc products assemblers

8290	OTHER MACHINE OPERATORS & ASSEMBLERS
8300	DRIVERS & MOBILE-PLANT OPERATORS
8310	LOCOMOTIVE-ENGINE DRIVERS ETC WORKERS
8311	Locomotive-engine drivers
8312	Railway brakers signallers & shunters
8320	MOTOR-VEHICLE DRIVERS [incl. Driver nfs]
8321	Motor-cycle drivers
8322	Car, taxi & van drivers [incl. Taxi Owner nfs]
8323	Bus & tram drivers
8324	Heavy truck & lorry drivers
8330	AGRICULTURAL & OTHER MOBILE PLANT OPERATORS
8331	Motorised farm & forestry plant operators [incl. Tractor Driver]
8332	Earth-moving- etc plant operators [incl. Bulldozer Driver]
8333	Crane, hoist etc plant operators
8334	Lifting-truck operators
8340	SHIPS DECK CREWS ETC WORKERS [incl. Boatman, Deck Hand, Sailor]
8400	SEMI-SKILLED WORKERS NFS [Incl. Production Process Worker nfs]
9000	ELEMENTARY OCCUPATIONS
9100	SALES & SERVICES ELEMENTARY OCCUPATIONS
9110	STREET VENDORS ETC WORKERS
9111	Street food vendors
9112	Street vendors non-food products [incl. Hawker, Pedlar]
9113	Door-to-door & tel. salespersons [incl. Solicitor, Canvasser]
9120	STREET SERVICES ELEMENTARY OCCUPATIONS [incl. Billposter]
9130	DOMESTIC ETC HELPERS CLEANERS & LAUNDERERS
9131	Domestic helpers & cleaners [incl. Housemaid, Housekeeper nfs]
9132	Helpers & cleaners in establishments [Kitchen Hand, Chambermaid]
9133	Hand-launderers & pressers
9140	BUILDING CARETAKERS, WINDOW ETC CLEANERS
9141	Building caretakers [incl. Janitor, Sexton, Verger]
9142	Vehicle, window etc cleaners
9150	MESSENGERS, PORTERS, DOORKEEPERS ETC WORKERS
9151	Messengers, package & luggage porters & deliverers
9152	Doorkeepers, watch-persons etc workers
9153	Vending-machine money collectors, meter readers etc workers
9160	GARBAGE COLLECTORS ETC LABOURERS
9161	Garbage collectors [incl. Dustwoman]
9162	Sweepers etc labourers [incl. Odd-Job Worker]
9200	AGRICULTURAL, FISHERY ETC LABOURERS
9210	AGRICULTURAL, FISHERY ETC LABOURERS
9211	Farm-hands & labourers [incl. Cowherd, Farm Helper, Fruit Picker]
9212	Forestry labourers
9213	Fishery, hunting & trapping labourers
9300	LABOURERS IN MINING, CONSTRUCTION, MANUFACTURING & TRANSPORT
9310	MINING & CONSTRUCTION LABOURERS
9311	Mining & quarrying labourers
9312	Construction & maintenance labourers: roads dams etc
9313	Building construction labourers [incl. Handyman, Hod Carrier]
9320	MANUFACTURING LABOURERS
9321	Assembling labourers [incl. Sorter, Bottle Sorter, Winder]
9322	Handpackers & other manufacturing labourers [incl. Crater]
9330	TRANSPORT LABOURERS & FREIGHT HANDLERS
9331	Hand or pedal vehicle drivers [incl. Rickshaw Driver]
9332	Drivers of animal-drawn vehicles & machinery
9333	Freight handlers [incl. Docker, Loader, Longshoreman, Remover]
9501	Housewife
9502	Student
9503	Social beneficiary (unemployed, retired, sickness, etc.)
9504	Do not know
9505	Vague(a good job, a quiet job, a well paid job, an office job)
9997	N/A
9998	Invalid
9999	Missing

ST06Q01 (13) Mother <highest schooling> Q6	
Format: F1.0	Columns: 36-36
1	Completed ISCED 3A
2	Completed ISCED 3B, 3C
3	Completed ISCED 2
4	Completed ISCED 1
5	Did not complete ISCED 1
7	N/A
8	Invalid
9	Missing

ST07Q01 (14) Mother <ISCED 5A or 6> Q7a	
Format: F1.0	Columns: 37-37
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST07Q02 (15) Mother <ISCED 5B> Q7b	
Format: F1.0	Columns: 38-38
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST07Q03 (16) Mother <ISCED 4> Q7c	
Format: F1.0	Columns: 39-39
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST08Q01 (17) Father ISCO Code Q8a	
Format: A4	Columns: 40-43
	See ST05Q01 for labels

ST09Q01 (18) Father <highest schooling> Q9	
Format: F1.0	Columns: 44-44
1	Completed ISCED 3A
2	Completed ISCED 3B, 3C
3	Completed ISCED 2
4	Completed ISCED 1
5	Did not complete ISCED 1
7	N/A
8	Invalid
9	Missing

ST10Q01 (19) Father <ISCED 5A or 6> Q10a	
Format: F1.0	Columns: 45-45
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST10Q02 (20) Father <ISCED 5B> Q10b	
Format: F1.0	Columns: 46-46
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST10Q03 (21) Father <ISCED 4> Q10c	
Format: F1.0	Columns: 47-47
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST11Q01 (22) Self born in country Q11a	
Format: F1.0	Columns: 48-48
1	Country of test
2	Other Country
7	N/A
8	Invalid
9	Missing

ST11Q02 (23) Mother born in country Q11a	
Format: F1.0	Columns: 49-49
1	Country of test
2	Other Country
7	N/A
8	Invalid
9	Missing

ST11Q03 (24) Father born in country Q11a	
Format: F1.0	Columns: 50-50
1	Country of test
2	Other Country
7	N/A
8	Invalid
9	Missing

ST11Q04 (25) Country arrival age Q11b	
Format: F2.0	Columns: 51-52
97	N/A
98	Invalid
99	Missing

ST12Q01 (26) Language at home Q12	
Format: F1.0	Columns: 53-53
1	Language of test
2	Other national language
3	Other language
7	N/A
8	Invalid
9	Missing

ST13Q01 (27) Possessions desk Q13a	
Format: F1.0	Columns: 54-54
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q02 (28) Possessions own room Q13b	
Format: F1.0	Columns: 55-55
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q03 (29) Possessions study place Q13c	
Format: F1.0	Columns: 56-56
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q04 (30) Possessions computer Q13d	
Format: F1.0	Columns: 57-57
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q05 (31) Possessions software Q13e	
Format: F1.0	Columns: 58-58
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q06 (32) Possessions Internet Q13f	
Format: F1.0	Columns: 59-59
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q07 (33) Possessions calculator Q13g	
Format: F1.0	Columns: 60-60
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q08 (34) Possessions literature Q13h	
Format: F1.0	Columns: 61-61
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q09 (35) Possessions poetry Q13i	
Format: F1.0	Columns: 62-62
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q10 (36) Possessions art Q13j	
Format: F1.0	Columns: 63-63
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q11 (37) Possessions textbooks Q13k	
Format: F1.0	Columns: 64-64
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q12 (38) Possessions dictionary Q13l	
Format: F1.0	Columns: 65-65
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q13 (39) Possessions dishwasher Q13m	
Format: F1.0	Columns: 66-66
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q14 (40) Possessions <DVD or VCR> Q13n	
Format: F1.0	Columns: 67-67
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST13Q15 (41) Possessions <country-specific item 1> Q13o	
Format: A6	Columns: 68-73
031001	AZE: Satellite Dish
031002	AZE: No Satellite Dish
032001	ARG: Cable TV (Direct TV, Cablevision, etc.)
032002	ARG: No Cable TV (Direct TV, Cablevision, etc.)
036001	AUS: Cable/Pay TV
036002	AUS: No Cable/Pay TV
040001	AUT: MP3 Player
040002	AUT: AUT: No MP3 Player
056011	QBL: Home Cinema
056012	QBL: No Home Cinema
056961	QBF: Home Cinema (LCD screen…)
056962	QBF: No Home Cinema (LCD screen…)
076001	BRA: Personal Mobile Phone
076002	BRA: No Personal Mobile Phone
100001	BGR: Air Conditioning
100002	BGR: No Air Conditioning
124001	CAN: MP3 Player/iPod
124002	CAN: No MP3 Player/iPod
152001	CHL: Hot Water
152002	CHL: No Hot Water
158001	TAP: Musical Instrument
158002	TAP: No Musical Instrument
170001	COL: Refrigerator
170002	COL: No Refrigerator
191001	HRV: Video Camera
191002	HRV: No Video Camera
203001	CZE: Digital Camera (not part of a mobile phone)
203002	CZE: No Digital Camera (not part of a mobile phone)
208001	DNK: Colour Printer
208002	DNK: No Colour Printer
233001	EST: Video Camera
233002	EST: No Video Camera
246001	FIN: Digital Camera
246002	FIN: No Digital Camera
250001	FRA: Flat Screen TV
250002	FRA: No Flat Screen TV
276001	DEU: Subscription to a Newspaper
276002	DEU: No Subscription to a Newspaper
300001	GRC: Home Cinema
300002	GRC: No Home Cinema
344001	HKG: Digital Camera / Video Recorder
344002	HKG: No Digital Camera / Video Recorder
348001	HUN: Automatic Washing Machine
348002	HUN: No Automatic Washing Machine
352001	ISL: Security Service or Security System
352002	ISL: No Security Service or Security System
360001	IDN: Washing Machine
360002	IDN: No Washing Machine
372001	IRL: MP3 Player (e.g. iPod)
372002	IRL: No MP3 Player (e.g. iPod)
376001	ISR: Home Alarm System
376002	ISR: No Home Alarm System
380001	ITA: Antique Furniture
380002	ITA: No Antique Furniture
392001	JPN: Digital Camera
392002	JPN: No Digital Camera
400001	JOR: Central Heating
400002	JOR: No Central Heating
410001	KOR: Air Conditioning
410002	KOR: No Air Conditioning
417001	KGZ: Camera

417002	KGZ: No Camera
428001	LVA: Bicycle
428002	LVA: No Bicycle
438001	LIE: MP3 Player or iPod
438002	LIE: No MP3 Player or iPod
440001	LTU: Digital Camera
440002	LTU: No Digital Camera
442001	LUX: Digital Camera
442002	LUX: No Digital Camera
446001	MAC: Video Game Machine
446002	MAC: No Video Game Machine
484001	MEX: Pay TV
484002	MEX: No Pay TV
499001	MNE: Cable TV
499002	MNE: No Cable TV
528001	NLD: Digital Camera (not part of mobile phone or laptop computer)
528002	NLD: No Digital Camera (not part of mobile phone or laptop computer)
554001	NZL: Broadband Internet Connection
554002	NZL: No Broadband Internet Connection
578001	NOR: Cleaner
578002	NOR: No Cleaner
616001	POL: Cable TV with at least 30 channels
616002	POL: POL: No Cable TV with at least 30 channels
620001	PRT: Cable TV or Satellite Dish
620002	PRT: PRT: No Cable TV or Satellite Dish
634001	QAT: MP3 Walkman
634002	QAT: QAT: No MP3 Walkman
642001	ROU: Video Camera / Digital Photo Camera
642002	ROU: No Video Camera / Digital Photo Camera
643001	RUS: Digital Camera or Video Camera
643002	RUS: RUS: No Digital Camera or Video Camera
688001	SRB: Digital Camera
688002	SRB: SRB: No Digital Camera
703001	SVK: Video Camera
703002	SVK: SVK: No Video Camera
705001	SVN: Digital Camera or Video Camera
705002	SVN: SVN: No Digital Camera or Video Camera
724001	ESP: Video Camera
724002	ESP: ESP: No Video Camera
752001	SWE: Piano
752002	SWE: SWE: No Piano
756001	CHE: MP3 Player or iPod
756002	CHE: CHE: No MP3 Player or iPod
764001	THA: Air Conditioning
764002	THA: THA: No Air Conditioning
788001	TUN: Satellite Dish
788002	TUN: TUN: No Satellite Dish
792001	TUR: Air-Conditioning-type Heating and Cooling System
792002	TUR: TUR: No Air-Conditioning-type Heating and Cooling System
826101	QUK: Digital TV
826102	QUK: QUK: No Digital TV
826201	QSC: Video Camera
826202	QSC: QSC: No Video Camera
840001	USA: Guest Room
840002	USA: USA: No Guest Room
858001	URY: Television Subscription
858002	URY: URY: No Television Subscription
999997	N/A
999998	Invalid
999999	Missing

ST13Q16 (42) Possessions <country-specific item 2> Q13p	
Format: A6	Columns: 74-79
031001	AZE: Video Camera
031002	AZE: No Video Camera
032001	ARG: Telephone Line
032002	ARG: No Telephone Line
036001	AUS: Digital Camera
036002	AUS: No Digital Camera
040001	AUT: Digital Camera
040002	AUT: No Digital Camera
056011	QBL: Alarm System
056012	QBL: No Alarm System
056961	QBF: Alarm System
056962	QBF: No Alarm System
076001	BRA: Cable TV
076002	BRA: No Cable TV
100001	BGR: Freezer
100002	BGR: No Freezer
124001	CAN: Subscription to a Daily Newspaper
124002	CAN: No Subscription to a Daily Newspaper
152001	CHL: Washing Machine
152002	CHL: No Washing Machine
158001	TAP: iPod
158002	TAP: No iPod
170001	COL: Cable TV or Direct to Home TV
170002	COL: No Cable TV or Direct to Home TV
191001	HRV: Clothes Dryer
191002	HRV: No Clothes Dryer
203001	CZE: Digital Video Camera
203002	CZE: No Digital Video Camera
208001	DNK: MP3 Player
208002	DNK: No MP3 Player
233001	EST: Hi-Fi
233002	EST: No Hi-Fi
246001	FIN: Wide Screen TV
246002	FIN: No Wide Screen TV
250001	FRA: Digital Camera (not part of a mobile phone)
250002	FRA: No Digital Camera (not part of a mobile phone)
276001	DEU: Video Camera
276002	DEU: No Video Camera
300001	GRC: Cable TV (Nova, Filmnet,etc.)
300002	GRC: No Cable TV (Nova, Filmnet,etc.)
344001	HKG: Musical Instrument (e.g. piano, violin)
344002	HKG: No Musical Instrument (e.g. piano, violin)
348001	HUN: Video Camera
348002	HUN: No Video Camera
352001	ISL: Satellite Dish
352002	ISL: No Satellite Dish
360001	IDN: Motorcycle
360002	IDN: No Motorcycle
372001	IRL: Bedroom with an En-suite Bathroom
372002	IRL: No Bedroom with an En-suite Bathroom
376001	ISR: Digital Camera
376002	ISR: No Digital Camera
380001	ITA: Plasma TV Set
380002	ITA: No Plasma TV Set
392001	JPN: Plasma/Liquid Crystal TV
392002	JPN: No Plasma/Liquid Crystal TV
400001	JOR: Satellite Dish
400002	JOR: No Satellite Dish
410001	KOR: Digital Camera
410002	KOR: No Digital Camera
417001	KGZ: Vacuum Cleaner
417002	KGZ: No Vacuum Cleaner
428001	LVA: Snowboard
428002	LVA: No Snowboard
438001	LIE: Digital Camera
438002	LIE: No Digital Camera
440001	LTU: Press Subscription Edition (newspaper, magazine)
440002	LTU: No Press Subscription Edition (newspaper, magazine)
442001	LUX: MP3 Player
442002	LUX: No MP3 Player
446001	MAC: Digital Camera
446002	MAC: No Digital Camera
484001	MEX: Telephone Line
484002	MEX: No Telephone Line

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499001	MNE:	Jacuzzi
499002	MNE:	No Jacuzzi
528001	NLD:	Piano
528002	NLD:	No Piano
554001	NZL:	Digital Camera (not part of mobile phone)
554002	NZL:	No Digital Camera (not part of mobile phone)
578001	NOR:	Plasma/LCD TV
578002	NOR:	No Plasma/LCD TV
616001	POL:	Digital Camera
616002	POL:	No Digital Camera
620001	PRT:	Plasma or LCD Screen TV
620002	PRT:	No Plasma or LCD Screen TV
634001	QAT:	Digital Video Camera
634002	QAT:	No Digital Video Camera
642001	ROU:	Cable TV
642002	ROU:	No Cable TV
643001	RUS:	Home Cinema
643002	RUS:	No Home Cinema
688001	SRB:	Laundry Drying Machine
688002	SRB:	No Laundry Drying Machine
703001	SVK:	Digital Camera (not part of mobile phone)
703002	SVK:	No Digital Camera (not part of mobile phone)
705001	SVN:	Personal MP3 Player
705002	SVN:	No Personal MP3 Player
724001	ESP:	Satellite Dish or Digital TV Set
724002	ESP:	No Satellite Dish or Digital TV Set
752001	SWE:	Video Camera
752002	SWE:	No Video Camera
756001	CHE:	Digital Camera
756002	CHE:	No Digital Camera
764001	THA:	Washing Machine
764002	THA:	No Washing Machine
788001	TUN:	Digital Camera
788002	TUN:	No Digital Camera
792001	TUR:	Treadmill (fitness equipment device)
792002	TUR:	No Treadmill (fitness equipment device)
826101	QUK:	Digital Camcorder
826102	QUK:	No Digital Camcorder
826201	QSC:	Plasma Screen TV
826202	QSC:	No Plasma Screen TV
840001	USA:	High-Speed Internet Connection
840002	USA:	No High-Speed Internet Connection
858001	URY:	Washing Machine
858002	URY:	No Washing Machine
999997		N/A
999998		Invalid
999999		Missing

ST13Q17 (43) Possessions <country-specific item 3> Q13q

Format: A6	Columns: 80-85	
031001	AZE:	Colour Printer
031002	AZE:	No Colour Printer
032001	ARG:	Refrigerator with Freezer
032002	ARG:	No Refrigerator with Freezer
036001	AUS:	Plasma TV
036002	AUS:	No Plasma TV
040001	AUT:	Digital Video Camera
040002	AUT:	No Digital Video Camera
056011	QBL:	Plasma or LCD TV
056012	QBL:	No Plasma or LCD TV
056961	QBF:	Housekeeper
056962	QBF:	No Housekeeper
076001	BRA:	Video Game
076002	BRA:	No Video Game
100001	BGR:	Digital Camera
100002	BGR:	No Digital Camera
124001	CAN:	Central Air Conditioning
124002	CAN:	No Central Air Conditioning
152001	CHL:	Digital Video Camera
152002	CHL:	No Digital Video Camera
158001	TAP:	Jacuzzi Bath
158002	TAP:	No Jacuzzi Bath
170001	COL:	Encyclopedia
170002	COL:	No Encyclopedia
191001	HRV:	Air Conditioning
191002	HRV:	No Air Conditioning
203001	CZE:	Personal Discman or MP3 Player
203002	CZE:	No Personal Discman or MP3 Player
208001	DNK:	Digital Camera
208002	DNK:	No Digital Camera
233001	EST:	Broadband Internet Connection
233002	EST:	No Broadband Internet Connection
246001	FIN:	Fitness Equipment (*e.g.* exercise bike, rowing machine)
246002	FIN:	No Fitness Equipment (*e.g.* exercise bike, rowing machine)
250001	FRA:	Laptop Computer
250002	FRA:	No Laptop Computer
276001	DEU:	ISDN Connection
276002	DEU:	No ISDN Connection
300001	GRC:	Alarm System
300002	GRC:	No Alarm System
344001	HKG:	Pay TV Channel
344002	HKG:	No Pay TV Channel
348001	HUN:	Digital Camera (not part of a mobile phone)
348002	HUN:	No Digital Camera (not part of a mobile phone)
352001	ISL:	Plasma TV or TV Projector
352002	ISL:	No Plasma TV or TV Projector
360001	IDN:	Air Conditioning
360002	IDN:	No Air Conditioning
372001	IRL:	Premium Cable TV Package (*e.g.* Sky Movies, Sky Sports)
372002	IRL:	No Premium Cable TV Package (*e.g.* Sky Movies, Sky Sports)
376001	ISR:	Home Movie Theatre
376002	ISR:	No Home Movie Theatre
380001	ITA:	Air Conditioning
380002	ITA:	No Air Conditioning
392001	JPN:	Clothing Dryer
392002	JPN:	No Clothing Dryer
400001	JOR:	Digital Camera
400002	JOR:	No Digital Camera
410001	KOR:	Water Purifier
410002	KOR:	No Water Purifier
417001	KGZ:	Imported Clothes Washing Machine such as Ariston or Indesit
417002	KGZ:	No Imported Clothes Washing Machine such as Ariston or Indesit
428001	LVA:	Digital Camera
428002	LVA:	No Digital Camera
438001	LIE:	Digital Video Camera
438002	LIE:	No Digital Video Camera
440001	LTU:	MP3 Player
440002	LTU:	No MP3 Player
442001	LUX:	Flat Screen TV
442002	LUX:	No Flat Screen TV
446001	MAC:	MP3 Player
446002	MAC:	No MP3 Player
484001	MEX:	Microwave Oven
484002	MEX:	No Microwave Oven
499001	MNE:	Digital Camera
499002	MNE:	No Digital Camera
528001	NLD:	Laptop
528002	NLD:	No Laptop
554001	NZL:	Clothes Dryer
554002	NZL:	No Clothes Dryer
578001	NOR:	Spa Bath
578002	NOR:	No Spa Bath
616001	POL:	Telescope or Microscope
616002	POL:	No Telescope or Microscope
620001	PRT:	Central Heating or Air Conditioning Equipment
620002	PRT:	No Central Heating or Air Conditioning Equipment

634001	QAT:	X-Box
634002	QAT:	No X-Box
642001	ROU:	Air Conditioning
642002	ROU:	No Air Conditioning
643001	RUS:	Satellite Antenna
643002	RUS:	No Satellite Antenna
688001	SRB:	Cable TV
688002	SRB:	No Cable TV
703001	SVK:	Satellite Receiver or Cable TV
703002	SVK:	No Satellite Receiver or Cable TV
705001	SVN:	Sauna
705002	SVN:	No Sauna
724001	ESP:	Home Cinema Set
724002	ESP:	No Home Cinema Set
752001	SWE:	Wall TV
752002	SWE:	No Wall TV
756001	CHE:	Digital Video Camera
756002	CHE:	No Digital Video Camera
764001	THA:	Microwave Oven
764002	THA:	No Microwave Oven
788001	TUN:	Washing Machine
788002	TUN:	No Washing Machine
792001	TUR:	Home Cinema System (5+1)
792002	TUR:	No Home Cinema System (5+1)
826101	QUK:	Swimming Pool
826102	QUK:	No Swimming Pool
826201	QSC:	Broadband Internet Connection
826202	QSC:	No Broadband Internet Connection
840001	USA:	iPod or MP3 Player
840002	USA:	No iPod or MP3 Player
858001	URY:	Microwave Oven
858002	URY:	No Microwave Oven
999997		N/A
999998		Invalid
999999		Missing

ST14Q01 (44) How many cell phones Q14a	
Format: F1.0	Columns: 86-86
1	None
2	One
3	Two
4	Three or more
7	N/A
8	Invalid
9	Missing

ST14Q02 (45) How many televisions Q14b	
Format: F1.0	Columns: 87-87
1	None
2	One
3	Two
4	Three or more
7	N/A
8	Invalid
9	Missing

ST14Q03 (46) How many computers Q14c	
Format: F1.0	Columns: 88-88
1	None
2	One
3	Two
4	Three or more
7	N/A
8	Invalid
9	Missing

ST14Q04 (47) How many cars Q14d	
Format: F1.0	Columns: 89-89
1	None
2	One
3	Two
4	Three or more
7	N/A
8	Invalid
9	Missing

ST15Q01 (48) How many books at home Q15	
Format: F1.0	Columns: 90-90
1	0-10 books
2	11-25 books
3	26-100 books
4	101-200 books
5	201-500 books
6	More than 500 books
7	N/A
8	Invalid
9	Missing

ST16Q01 (49) Sci enjoyment – Have fun Q16a	
Format: F1.0	Columns: 91-91
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST16Q02 (50) Sci enjoyment – Like reading Q16b	
Format: F1.0	Columns: 92-92
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST16Q03 (51) Sci enjoyment – Sci problems Q16c	
Format: F1.0	Columns: 93-93
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST16Q04 (52) Sci enjoyment – New knowledge Q16d	
Format: F1.0	Columns: 94-94
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST16Q05 (53) Sci enjoyment – Learning science Q16e	
Format: F1.0	Columns: 95-95
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST17Q01 (54) Sci tasks – Newspaper Q17a	
Format: F1.0	Columns: 96-96
1	Do easily

2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q02 (55) Sci tasks – Earthquakes Q17b	
Format: F1.0	Columns: 97-97
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q03 (56) Sci tasks – Antibiotics Q17c	
Format: F1.0	Columns: 98-98
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q04 (57) Sci tasks – Garbage Q17d	
Format: F1.0	Columns: 99-99
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q05 (58) Sci tasks – Species survival Q17e	
Format: F1.0	Columns: 100-100
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q06 (59) Sci tasks – Food labels Q17f	
Format: F1.0	Columns: 101-101
1	Do easily
	2
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q07 (60) Sci tasks – Life on Mars Q17g	
Format: F1.0	Columns: 102-102
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST17Q08 (61) Sci tasks – Acid rain Q17h	
Format: F1.0	Columns: 103-103
1	Do easily
2	With some effort
3	Struggle on own
4	Couldn't do it
7	N/A
8	Invalid
9	Missing

ST18Q01 (62) Sci value – Living conditions Q18a	
Format: F1.0	Columns: 104-104
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q02 (63) Sci value – Natural world Q18b	
Format: F1.0	Columns: 105-105
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q03 (64) Sci value – Relate to others Q18c	
Format: F1.0	Columns: 106-106
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q04 (65) Sci value – Improve economy Q18d	
Format: F1.0	Columns: 107-107
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q05 (66) Sci value – Use as adult Q18e	
Format: F1.0	Columns: 108-108
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q06 (67) Sci value – Value to society Q18f	
Format: F1.0	Columns: 109-109
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q07 (68) Sci value – Relevant to me Q18g	
Format: F1.0	Columns: 110-110
1	Strongly agree
2	Agree
3	Disagree

4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q08 (69) Sci value – Help understand Q18h	
Format: F1.0	Columns: 111-111
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q09 (70) Sci value – Social benefits Q18i	
Format: F1.0	Columns: 112-112
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST18Q10 (71) Sci value – Opportunities Q18j	
Format: F1.0	Columns: 113-113
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST19Q01 (72) Sci activity – Science TV Q19a	
Format: F1.0	Columns: 114-114
1	Very often
2	Agree
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST19Q02 (73) Sci activity – Science books Q19b	
Format: F1.0	Columns: 115-115
1	Very often
2	Agree
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST19Q03 (74) Sci activity – Web content Q19c	
Format: F1.0	Columns: 116-116
1	Very often
2	Regularly
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST19Q04 (75) Sci activity – Science radio Q19d	
Format: F1.0	Columns: 117-117
1	Very often
2	Regularly
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST19Q05 (76) Sci activity – Science mags Q19e	
Format: F1.0	Columns: 118-118
1	Very often
2	Regularly
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST19Q06 (77) Sci activity – Science club Q19f	
Format: F1.0	Columns: 119-119
1	Very often
2	Regularly
3	Sometimes
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST20QA1 (78) Sci info – Photosynthesis – none Q20a	
Format: F1.0	Columns: 120-120
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QA2 (79) Sci info – Photosynthesis – school Q20a	
Format: F1.0	Columns: 121-121
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QA3 (80) Sci info – Photosynthesis – media Q20a	
Format: F1.0	Columns: 122-122
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QA4 (81) Sci info – Photosynthesis – friends Q20a	
Format: F1.0	Columns: 123-123
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QA5 (82) Sci info – Photosynthesis – family Q20a	
Format: F1.0	Columns: 124-124
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QA6 (83) Sci info – Photosynthesis – Internet or books Q20a	
Format: F1.0	Columns: 125-125
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QB1 (84) Sci info – Continents – none Q20b	
Format: F1.0	Columns: 126-126
1	Tick
2	No Tick

7	N/A
8	Invalid

ST20QB2 (85) Sci info – Continents – school Q20b	
Format: F1.0	Columns: 127-127
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QB3 (86) Sci info – Continents – media Q20b	
Format: F1.0	Columns: 128-128
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QB4 (87) Sci info – Continents – friends Q20b	
Format: F1.0	Columns: 129-129
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QB5 (88) Sci info – Continents – family Q20b	
Format: F1.0	Columns: 130-130
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QB6 (89) Sci info – Continents – Internet or books Q20b	
Format: F1.0	Columns: 131-131
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QC1 (90) Sci info – Genes – none Q20c	
Format: F1.0	Columns: 132-132
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QC2 (91) Sci info – Genes – school Q20c	
Format: F1.0	Columns: 133-133
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QC3 (92) Sci info – Genes – media Q20c	
Format: F1.0	Columns: 134-134
1	Tick
2	2
7	N/A
8	Invalid

ST20QC4 (93) Sci info – Genes – friends Q20c	
Format: F1.0	Columns: 135-135
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QC5 (94) Sci info – Genes – family Q20c	
Format: F1.0	Columns: 136-136
1	Tick
2	No Tick

7	N/A
8	Invalid

ST20QC6 (95) Sci info – Genes – Internet or books Q20c	
Format: F1.0	Columns: 137-137
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD1 (96) Sci info – Soundproofing – none Q20d	
Format: F1.0	Columns: 138-138
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD2 (97) Sci info – Soundproofing – school Q20d	
Format: F1.0	Columns: 139-139
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD3 (98) Sci info – Soundproofing – media Q20d	
Format: F1.0	Columns: 140-140
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD4 (99) Sci info – Soundproofing – friends Q20d	
Format: F1.0	Columns: 141-141
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD5 (100) Sci info – Soundproofing – family Q20d	
Format: F1.0	Columns: 142-142
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QD6 (101) Sci info – Soundproofing – Internet or books Q20d	
Format: F1.0	Columns: 143-143
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QE1 (102) Sci info – Climate change – none Q20e	
Format: F1.0	Columns: 144-144
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QE2 (103) Sci info – Climate change – school Q20e	
Format: F1.0	Columns: 145-145
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QE3 (104) Sci info – Climate change – media Q20e	
Format: F1.0	Columns: 146-146
1	Tick
2	No Tick

7	N/A
8	Invalid

ST20QE4 (105) Sci info – Climate change – friends Q20e	
Format: F1.0	Columns: 147-147
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QE5 (106) Sci info – Climate change – family Q20e	
Format: F1.0	Columns: 148-148
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QE6 (107) Sci info – Climate change – Internet or books Q20e	
Format: F1.0	Columns: 149-149
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF1 (108) Sci info – Evolution – none Q20f	
Format: F1.0	Columns: 150-150
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF2 (109) Sci info – Evolution – school Q20f	
Format: F1.0	Columns: 151-151
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF3 (110) Sci info – Evolution – media Q20f	
Format: F1.0	Columns: 152-152
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF4 (111) Sci info – Evolution – friends Q20f	
Format: F1.0	Columns: 153-153
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF5 (112) Sci info – Evolution – family Q20f	
Format: F1.0	Columns: 154-154
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QF6 (113) Sci info – Evolution – Internet or books Q20f	
Format: F1.0	Columns: 155-155
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG1 (114) Sci info – Nuclear energy – none Q20g	
Format: F1.0	Columns: 156-156
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG2 (115) Sci info – Nuclear energy – school Q20g	
Format: F1.0	Columns: 157-157
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG3 (116) Sci info – Nuclear energy – media Q20g	
Format: F1.0	Columns: 158-158
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG4 (117) Sci info – Nuclear energy – friends Q20g	
Format: F1.0	Columns: 159-159
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG5 (118) Sci info – Nuclear energy – family Q20g	
Format: F1.0	Columns: 160-160
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QG6 (119) Sci info – Nuclear energy – Internet or books Q20g	
Format: F1.0	Columns: 161-161
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH1 (120) Sci info – Health – none Q20h	
Format: F1.0	Columns: 162-162
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH2 (121) Sci info – Health – school Q20h	
Format: F1.0	Columns: 163-163
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH3 (122) Sci info – Health – media Q20h	
Format: F1.0	Columns: 164-164
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH4 (123) Sci info – Health – friends Q20h	
Format: F1.0	Columns: 165-165
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH5 (124) Sci info – Health – family Q20h	
Format: F1.0	Columns: 166-166
1	Tick
2	No Tick
7	N/A
8	Invalid

ST20QH6 (125) Sci info – Health – Internet or books Q20h	
Format: F1.0	Columns: 167-167
1	Tick
2	No Tick
7	N/A
8	Invalid

ST21Q01 (126) Sci interest – Physics Q21a	
Format: F1.0	Columns: 168-168
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q02 (127) Sci interest – Chemistry Q21b	
Format: F1.0	Columns: 169-169
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q03 (128) Sci interest – Plant biology Q21c	
Format: F1.0	Columns: 170-170
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q04 (129) Sci interest – Human biology Q21d	
Format: F1.0	Columns: 171-171
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q05 (130) Sci interest – Astronomy Q21e	
Format: F1.0	Columns: 172-172
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q06 (131) Sci interest – Geology Q21f	
Format: F1.0	Columns: 173-173
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q07 (132) Sci interest – Experiments Q21g	
Format: F1.0	Columns: 174-174
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST21Q08 (133) Sci interest – Explanations Q21h	
Format: F1.0	Columns: 175-175
1	High Interest
2	Medium Interest
3	Low Interest
4	No Interest
7	N/A
8	Invalid
9	Missing

ST22Q01 (134) Envr aware – Greenhouse Q22a	
Format: F1.0	Columns: 176-176
1	Never heard
2	Know a little
3	Know something
4	Familiar
7	N/A
8	Invalid
9	Missing

ST22Q02 (135) Envr aware – Genetic modified Q22b	
Format: F1.0	Columns: 177-177
1	Never heard
2	Know a little
3	Know something
4	Familiar
7	N/A
8	Invalid
9	Missing

ST22Q03 (136) Envr aware – Acid rain Q22c	
Format: F1.0	Columns: 178-178
1	Never heard
2	Know a little
3	Know something
4	Familiar
7	N/A
8	Invalid
9	Missing

ST22Q04 (137) Envr aware – Nuclear waste Q22d	
Format: F1.0	Columns: 179-179
1	Never heard
2	Know a little
3	Know something
4	Familiar
7	N/A
8	Invalid
9	Missing

ST22Q05 (138) Envr aware – Forest clearing Q22e	
Format: F1.0	Columns: 180-180
1	Never heard
2	Know a little
3	Know something
4	Familiar
7	N/A
8	Invalid
9	Missing

ST23QA1 (139) Envr info – Air pollution – none Q23a	
Format: F1.0	Columns: 181-181
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QA2 (140) Envr info – Air pollution – school Q23a	
Format: F1.0	Columns: 182-182
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QA3 (141) Envr info – Air pollution – media Q23a	
Format: F1.0	Columns: 183-183
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QA4 (142) Envr info – Air pollution – friends Q23a	
Format: F1.0	Columns: 184-184
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QA5 (143) Envr info – Air pollution – family Q23a	
Format: F1.0	Columns: 185-185
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QA6 (144) Envr info – Air pollution – Internet or books Q23a	
Format: F1.0	Columns: 186-186
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB1 (145) Envr info – Energy shortages – none Q23b	
Format: F1.0	Columns: 187-187
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB2 (146) Envr info – Energy shortages – school Q23b	
Format: F1.0	Columns: 188-188
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB3 (147) Envr info – Energy shortages – media Q23b	
Format: F1.0	Columns: 189-189
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB4 (148) Envr info – Energy shortages – friends Q23b	
Format: F1.0	Columns: 190-190
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB5 (149) Envr info – Energy shortages – family Q23b	
Format: F1.0	Columns: 191-191
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QB6 (150) Envr info – Energy shortages – Internet or books Q23b	
Format: F1.0	Columns: 192-192
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC1 (151) Envr info – Extinction – none Q23c	
Format: F1.0	Columns: 193-193
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC2 (152) Envr info – Extinction – school Q23c	
Format: F1.0	Columns: 194-194
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC3 (153) Envr info – Extinction – media Q23c	
Format: F1.0	Columns: 195-195
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC4 (154) Envr info – Extinction – friends Q23c	
Format: F1.0	Columns: 196-196
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC5 (155) Envr info – Extinction – family Q23c	
Format: F1.0	Columns: 197-197
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QC6 (156) Envr info – Extinction – Internet or books Q23c	
Format: F1.0	Columns: 198-198
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD1 (157) Envr info – Forest clearing – none Q23d	
Format: F1.0	Columns: 199-199
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD2 (158) Envr info – Forest clearing – school Q23d	
Format: F1.0	Columns: 200-200
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD3 (159) Envr info – Forest clearing – media Q23d	
Format: F1.0	Columns: 201-201
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD4 (160) Envr info – Forest clearing – friends Q23d	
Format: F1.0	Columns: 202-202
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD5 (161) Envr info – Forest clearing – family Q23d	
Format: F1.0	Columns: 203-203
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QD6 (162) Envr info – Forest clearing – Internet or books Q23d	
Format: F1.0	Columns: 204-204
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE1 (163) Envr info – Water shortages – none Q23e	
Format: F1.0	Columns: 205-205
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE2 (164) Envr info – Water shortages – school Q23e	
Format: F1.0	Columns: 206-206
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE3 (165) Envr info – Water shortages – media Q23e	
Format: F1.0	Columns: 207-207
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE4 (166) Envr info – Water shortages – friends Q23e	
Format: F1.0	Columns: 208-208
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE5 (167) Envr info – Water shortages – family Q23e	
Format: F1.0	Columns: 209-209
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QE6 (168) Envr info – Water shortages – Internet or books Q23e	
Format: F1.0	Columns: 210-210
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF1 (169) Envr info – Nuclear waste – none Q23f	
Format: F1.0	Columns: 211-211
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF2 (170) Envr info – Nuclear waste – school Q23f	
Format: F1.0	Columns: 212-212
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF3 (171) Envr info – Nuclear waste – media Q23f	
Format: F1.0	Columns: 213-213
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF4 (172) Envr info – Nuclear waste – friends Q23f	
Format: F1.0	Columns: 214-214
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF5 (173) Envr info – Nuclear waste – family Q23f	
Format: F1.0	Columns: 215-215
1	Tick
2	No Tick
7	N/A
8	Invalid

ST23QF6 (174) Envr info – Nuclear waste – Internet or books Q23f	
Format: F1.0	Columns: 216-216
1	Tick
2	No Tick
7	N/A
8	Invalid

ST24Q01 (175) Envr issues – Air pollution Q24a	
Format: F1.0	Columns: 217-217
1	Concern for me
2	Concern for others
3	Concern other countries
4	Not a concern
7	N/A
8	Invalid
9	Missing

ST24Q02 (176) Envr issues – Energy shortages Q24b	
Format: F1.0	Columns: 218-218
1	Concern for me
2	Concern for others
3	Concern other countries
4	Not a concern
7	N/A
8	Invalid
9	Missing

ST24Q03 (177) Envr issues – Extinction Q24c	
Format: F1.0	Columns: 219-219
1	Concern for me
2	Concern for others
3	Concern other countries
4	Not a concern
7	N/A
8	Invalid
9	Missing

ST24Q04 (178) Envr issues – Forest clearing Q24d	
Format: F1.0	Columns: 220-220
1	Concern for me
2	Concern for others
3	Concern other countries

4	Not a concern
7	N/A
8	Invalid
9	Missing

ST24Q05 (179) Envr issues – Water shortages Q24e	
Format: F1.0	Columns: 221-221
1	Concern for me
2	Concern for others
3	Concern other countries
4	Not a concern
7	N/A
8	Invalid
9	Missing

ST24Q06 (180) Envr issues – Nuclear waste Q24f	
Format: F1.0	Columns: 222-222
1	Concern for me
2	Concern for others
3	Concern other countries
4	Not a concern
7	N/A
8	Invalid
9	Missing

ST25Q01 (181) Envr improve – Air pollution Q25a	
Format: F1.0	Columns: 223-223
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST25Q02 (182) Envr improve – Energy shortages Q25b	
Format: F1.0	Columns: 224-224
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST25Q03 (183) Envr improve – Extinction Q25c	
Format: F1.0	Columns: 225-225
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST25Q04 (184) Envr improve – Forest clearing Q25d	
Format: F1.0	Columns: 226-226
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST25Q05 (185) Envr improve – Water shortages Q25e	
Format: F1.0	Columns: 227-227
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST25Q06 (186) Envr improve – Nuclear waste Q25f	
Format: F1.0	Columns: 228-228
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

ST26Q01 (187) Envr responsibility – Car emissions Q26a	
Format: F1.0	Columns: 229-229
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q02 (188) Envr responsibility- Energy wasted Q26b	
Format: F1.0	Columns: 230-230
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q03 (189) Envr responsibility- Factory emissions Q26c	
Format: F1.0	Columns: 231-231
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q04 (190) Envr responsibility- Plastic pack Q26d	
Format: F1.0	Columns: 232-232
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q05 (191) Envr responsibility- Dangerous waste Q26e	
Format: F1.0	Columns: 233-233
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q06 (192) Envr responsibility- Endangered Q26f	
Format: F1.0	Columns: 234-234
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST26Q07 (193) Envr responsibility- Renewable electricity Q26g	
Format: F1.0	Columns: 235-235
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST27Q01 (194) Useful for Science career – School subjects Q27a	
Format: F1.0	Columns: 236-236
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST27Q02 (195) Useful for career – Science subjects Q27b	
Format: F1.0	Columns: 237-237
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST27Q03 (196) Useful for Science career – My subjects Q27c	
Format: F1.0	Columns: 238-238
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST27Q04 (197) Useful for Science career – Teaching Q27d	
Format: F1.0	Columns: 239-239
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST28Q01 (198) Science know – Job available Q28a	
Format: F1.0	Columns: 240-240
1	Very well informed
2	Fairly informed
3	Not well informed
4	Not informed at all
7	N/A
8	Invalid
9	Missing

ST28Q02 (199) Science know – Find Where Q28b	
Format: F1.0	Columns: 241-241
1	Very well informed
2	Fairly informed
3	Not well informed
4	Not informed at all
7	N/A
8	Invalid
9	Missing

ST28Q03 (200) Science know – Steps to take Q28c	
Format: F1.0	Columns: 242-242
1	Very well informed
2	Fairly informed
3	Not well informed
4	Not informed at all
7	N/A
8	Invalid
9	Missing

ST28Q04 (201) Science know – Employers Q28d	
Format: F1.0	Columns: 243-243
1	Very well informed
2	Fairly informed
3	Not well informed
4	Not informed at all
7	N/A
8	Invalid
9	Missing

ST29Q01 (202) Sci future – Like career Q29a	
Format: F1.0	Columns: 244-244
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST29Q02 (203) Sci future – After <secondary school> Q29b	
Format: F1.0	Columns: 245-245
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST29Q03 (204) Sci future – Advanced Q29c	
Format: F1.0	Columns: 246-246
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST29Q04 (205) Sci future – Work as adult Q29d	
Format: F1.0	Columns: 247-247
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST30Q01 (206) Self expected occupation at 30 ISCO code Q30	
Format: A4	Columns: 248-251
	See ST05Q01 for labels

ST31Q01 (207) Regular lessons – Science Q31a	
Format: F1.0	Columns: 252-252
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours

5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q02 (208) Out of school – Science Q31b	
Format: F1.0	Columns: 253-253
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q03 (209) Self study – Science Q31c	
Format: F1.0	Columns: 254-254
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q04 (210) Regular lessons – Mathematics Q31d	
Format: F1.0	Columns: 255-255
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q05 (211) Out of school – Mathematics Q31e	
Format: F1.0	Columns: 256-256
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q06 (212) Self study – Mathematics Q31f	
Format: F1.0	Columns: 257-257
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q07 (213) Regular lessons – Language Q31g	
Format: F1.0	Columns: 258-258
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q08 (214) Out of school – Language Q31h	
Format: F1.0	Columns: 259-259
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q09 (215) Self study – Language Q31i	
Format: F1.0	Columns: 260-260
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q10 (216) Regular lessons – Other Q31j	
Format: F1.0	Columns: 261-261
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q11 (217) Out of school – Other Q31k	
Format: F1.0	Columns: 262-262
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST31Q12 (218) Self study – Other Q31l	
Format: F1.0	Columns: 263-263
1	No time
2	Less than 2 hours
3	2 up to 4 hours
4	4 up to 6 hours
5	6 or more hours
7	N/A
8	Invalid
9	Missing

ST32Q01 (219) Lessons – School 1-1 Q32a	
Format: F1.0	Columns: 264-264
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST32Q02 (220) Lessons – Not school 1-1 Q32b	
Format: F1.0	Columns: 265-265
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST32Q03 (221) Lessons – School small Q32c	
Format: F1.0	Columns: 266-266
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST32Q04 (222) Lessons – Not school small Q32d	
Format: F1.0	Columns: 267-267
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST32Q05 (223) Lessons – School large Q32e	
Format: F1.0	Columns: 268-268
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST32Q06 (224) Lessons – Not school large Q32f	
Format: F1.0	Columns: 269-269
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q11 (225) Course – Comp Sci last yr Q33a	
Format: F1.0	Columns: 270-270
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q12 (226) Course – Comp Sci this yr Q33a	
Format: F1.0	Columns: 271-271
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q21 (227) Course – Opt Sci last yr Q33b	
Format: F1.0	Columns: 272-272
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q22 (228) Course – Opt Sci this yr Q33b	
Format: F1.0	Columns: 273-273
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q31 (229) Course – Comp Bio last yr Q33c	
Format: F1.0	Columns: 274-274
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q32 (230) Course – Comp Bio this yr Q33c	
Format: F1.0	Columns: 275-275
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q41 (231) Course – Opt Bio last yr Q33d	
Format: F1.0	Columns: 276-276
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q42 (232) Course – Opt Bio this yr Q33d	
Format: F1.0	Columns: 277-277
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q51 (233) Course – Comp Phy last yr Q33e	
Format: F1.0	Columns: 278-278
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q52 (234) Course – Comp Phy this yr Q33e	
Format: F1.0	Columns: 279-279
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q61 (235) Course – Opt Phy last yr Q33f	
Format: F1.0	Columns: 280-280
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q62 (236) Course – Opt Phy this yr Q33f	
Format: F1.0	Columns: 281-281
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q71 (237) Course – Comp Chem last yr Q33g	
Format: F1.0	Columns: 282-282
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q72 (238) Course – Comp Chem this yr Q33g	
Format: F1.0	Columns: 283-283
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q81 (239) Course – Opt Chem last yr Q33h	
Format: F1.0	Columns: 284-284
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST33Q82 (240) Course – Opt Chem this yr Q33h	
Format: F1.0	Columns: 285-285
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

ST34Q01 (241) Learning – Student ideas Q34a	
Format: F1.0	Columns: 286-286
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q02 (242) Learning – Experiments Q34b	
Format: F1.0	Columns: 287-287
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q03 (243) Learning – Design for lab Q34c	
Format: F1.0	Columns: 288-288
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q04 (244) Learning – Apply everyday Q34d	
Format: F1.0	Columns: 289-289
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q05 (245) Learning – Student opinion Q34e	
Format: F1.0	Columns: 290-290
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q06 (246) Learning – Draw conclusions Q34f	
Format: F1.0	Columns: 291-291
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q07 (247) Learning – Differnt phenomena Q34g	
Format: F1.0	Columns: 292-292
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q08 (248) Learning – Own experiments Q34h	
Format: F1.0	Columns: 293-293
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q09 (249) Learning – Class debate Q34i	
Format: F1.0	Columns: 294-294
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q10 (250) Learning – Demonstrations Q34j	
Format: F1.0	Columns: 295-295
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q11 (251) Learning – Choose own Q34k	
Format: F1.0	Columns: 296-296
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q12 (252) Learning – World outside Q34l	
Format: F1.0	Columns: 297-297
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q13 (253) Learning – Discussion Q34m	
Format: F1.0	Columns: 298-298
1	All lessons
2	Most Lessons

3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q14 (254) Learning – Follow instructions Q34n	
Format: F1.0	Columns: 299-299
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q15 (255) Learning – Explain relevance Q34o	
Format: F1.0	Columns: 300-300
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q16 (256) Learning – Test ideas Q34p	
Format: F1.0	Columns: 301-301
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST34Q17 (257) Learning – Society relevance Q34q	
Format: F1.0	Columns: 302-302
1	All lessons
2	Most Lessons
3	Some lessons
4	Hardly ever
7	N/A
8	Invalid
9	Missing

ST35Q01 (258) Sci future – Help later work Q35a	
Format: F1.0	Columns: 303-303
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST35Q02 (259) Sci future – Learn need later Q35b	
Format: F1.0	Columns: 304-304
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST35Q03 (260) Sci future – Useful to me Q35c	
Format: F1.0	Columns: 305-305
1	Strongly agree
2	Agree

3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST35Q04 (261) Sci future – Improve career Q35d	
Format: F1.0	Columns: 306-306
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST35Q05 (262) Sci future – Get a job Q35e	
Format: F1.0	Columns: 307-307
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST36Q01 (263) Self – Do well Science Q36a	
Format: F1.0	Columns: 308-308
1	Very important
2	Important
3	Of little importance
4	Not important at all
7	N/A
8	Invalid
9	Missing

ST36Q02 (264) Self – Do well Maths Q36b	
Format: F1.0	Columns: 309-309
1	Very important
2	Important
3	Of little importance
4	Not important at all
7	N/A
8	Invalid
9	Missing

ST36Q03 (265) Self – Do well Language Q36c	
Format: F1.0	Columns: 310-310
1	Very important
2	Important
3	Of little importance
4	Not important at all
7	N/A
8	Invalid
9	Missing

ST37Q01 (266) Learning – Advanced easy Q37a	
Format: F1.0	Columns: 311-311
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST37Q02 (267) Learning – Good answers Q37b	
Format: F1.0	Columns: 312-312
1	Strongly agree
2	Agree

3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST37Q03 (268) Learning – Topics quickly Q37c	
Format: F1.0	Columns: 313-313
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST37Q04 (269) Learning – Topics easy Q37d	
Format: F1.0	Columns: 314-314
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST37Q05 (270) Learning – Understand well Q37e	
Format: F1.0	Columns: 315-315
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

ST37Q06 (271) Learning – New ideas Q37f	
Format: F1.0	Columns: 316-316
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

IC01Q01 (272) Used computer IC1	
Format: F1.0	Columns: 317-317
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

IC02Q01 (273) How long used computers IC2	
Format: F1.0	Columns: 318-318
1	Less than 1 year
2	1 to 3 years
3	3 to 5 years
4	5 years or more
7	N/A
8	Invalid
9	Missing

IC03Q01 (274) Use computer at home IC3a	
Format: F1.0	Columns: 319-319
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC03Q02 (275) Use computer at school IC3b	
Format: F1.0	Columns: 320-320
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC03Q03 (276) Use computer other places IC3c	
Format: F1.0	Columns: 321-321
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q01 (277) Browse Internet IC4a	
Format: F1.0	Columns: 322-322
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q02 (278) Play games IC4b	
Format: F1.0	Columns: 323-323
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q03 (279) Write documents IC4c	
Format: F1.0	Columns: 324-324
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q04 (280) Collaborate on Internet IC4d	
Format: F1.0	Columns: 325-325
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q05 (281) Use spreadsheets IC4e	
Format: F1.0	Columns: 326-326
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q06 (282) Download software IC4f	
Format: F1.0	Columns: 327-327
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q07 (283) Graphics programs IC4g	
Format: F1.0	Columns: 328-328
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q08 (284) Educational software IC4h	
Format: F1.0	Columns: 329-329
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q09 (285) Download music IC4i	
Format: F1.0	Columns: 330-330
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q10 (286) Write programs IC4j	
Format: F1.0	Columns: 331-331
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC04Q11 (287) E-mail or chat rooms IC4k	
Format: F1.0	Columns: 332-332
1	Almost every day
2	Once or twice a week
3	Few times a month
4	Once a month or less
5	Never
7	N/A
8	Invalid
9	Missing

IC05Q01 (288) How well – Chat IC5a	
Format: F1.0	Columns: 333-333
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q02 (289) How well – Virus IC5b	
Format: F1.0	Columns: 334-334
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q03 (290) How well – Edit photos IC5c	
Format: F1.0	Columns: 335-335
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q04 (291) How well – Database IC5d	
Format: F1.0	Columns: 336-336
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q05 (292) How well – Copy data to CD IC5e	
Format: F1.0	Columns: 337-337
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q06 (293) How well – Move files IC5f	
Format: F1.0	Columns: 338-338
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q07 (294) How well – Search Internet IC5g	
Format: F1.0	Columns: 339-339
1	Do well by myself
2	Do with help

3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q08 (295) How well – Download files IC5h	
Format: F1.0	Columns: 340-340
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q09 (296) How well – Attach e-mail IC5i	
Format: F1.0	Columns: 341-341
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q10 (297) How well – Word processor IC5j	
Format: F1.0	Columns: 342-342
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q11 (298) How well – Spreadsheet IC5k	
Format: F1.0	Columns: 343-343
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q12 (299) How well – Presentation IC5l	
Format: F1.0	Columns: 344-344
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q13 (300) How well – Download music IC5m	
Format: F1.0	Columns: 345-345
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q14 (301) How well – Multi-media IC5n	
Format: F1.0	Columns: 346-346
1	Do well by myself
2	Do with help

3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q15 (302) How well – E-mails IC5o	
Format: F1.0	Columns: 347-347
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

IC05Q16 (303) How well – Web Page IC5p	
Format: F1.0	Columns: 348-348
1	Do well by myself
2	Do with help
3	Know but can't do
4	Don't know
7	N/A
8	Invalid
9	Missing

AGE (304) Age of student	
Format: F5.2	Columns: 349-353
97	N/A
98	Invalid
99	Missing

ISCEDL (305) ISCED level	
Format: F1.0	Columns: 354-354
1	ISCED level 1
2	ISCED level 2
3	ISCED level 3
7	N/A
8	Invalid
9	Missing

ISCEDD (306) ISCED designation	
Format: F1.0	Columns: 355-355
1	A
2	B
3	C
4	M
7	N/A
8	Invalid
9	Missing

ISCEDO (307) ISCED orientation	
Format: F1.0	Columns: 356-356
1	General
2	Pre-Vocational
3	Vocational
7	N/A
8	Invalid
9	Missing

PROGN (308) Unique national study programme code	
Format: A7	Columns: 357-363
0310001	AZE: PROGRAMME OF BASIC GENERAL EDUCATION (LOWER SECONDARY)
0310002	AZE: PROGRAMME OF SECONDARY GENERAL EDUCATION (UPPER SECONDARY)
0310003	AZE: PROGRAMME OF INITIAL PROFESSIONAL EDUC. (PROF. SCHOOLS, ETC.)
0310004	AZE: PROGRAMME OF SEC. PROF. EDUCATION (TECHNIKUM, COLLEGE, ETC.)
0320001	ARG: PRIMARY – 7TH YEAR (OLD)
0320002	ARG: GENERAL PROGRAMME WITH 3RD CYCLE – LOWER SECONDARY (NEW)

0320003	ARG:	GENERAL PROGR. – ONLY GBE 3RD CYCLE – LOWER SEC. (NEW)
0320004	ARG:	ARTISTIC, EGB AND POLIMODAL – LOWER SECONDARY- 7TH TO 9TH YEAR
0320005	ARG:	ARTISTIC-EGB & POLIMODAL – GENERAL UPPER SEC. – YEAR 1-3 (NEW)
0320006	ARG:	GENERAL PROGRAMME – LOWER SEC., CORDOBA, YEAR 1-3 (NEW)
0320007	ARG:	GENERAL PROGRAMME – YEAR 4-6 UPPER SEC., CORDOBA – (NEW)
0320008	ARG:	ARTISTIC / GENERAL PROGR. – LOWER SECONDARY YEAR 1-2 (OLD)
0320009	ARG:	ARTISTIC,GENERAL PROGR. – UPPER SEC. YEAR 3 (OLD)
0320010	ARG:	ARTISTIC, GENERAL PROGR. – LOWER SECONDARY YEAR 1-2 (OLD)
0320011	ARG:	ARTISTIC, GENERAL PROGR. – UPPER SECONDARY (OLD)
0320012	ARG:	VOCATIONAL PROGR. – TECHNICAL EDUC., LOWER SEC. – .YEAR 1-2 (OLD)
0320013	ARG:	VOCATIONAL PROGR. – TECHNICAL EDUC., UPPER SEC. YEAR 3 (OLD)
0320014	ARG:	VOCATIONAL PROGR. – TECHNICAL EDUC., UPPER SEC. YEAR 4-6,7 (OLD)
0320015	ARG:	ARTISTIC, POLIMODAL – YEAR 1-3 (NEW) GENERAL PROGRAMME
0320016	ARG:	SEC. YEAR 3-5 WITH ADULT GENERAL PROGR., UPPER SEC. (NEW)
0320017	ARG:	POLIMODAL WITH ADULT GENERAL PROGR. – UPPER SECONDARY (NEW)
0320018	ARG:	ADULT EDUCATION – GENERAL PROGRAMME UPPER SECONDARY
0320019	ARG:	ARTISTIC AND PROFESSIONAL COURSES (INFORMAL EDUC.)
0360001	AUS:	LOWER SECONDARY GENERAL ACADEMIC
0360002	AUS:	LOWER SECONDARY WITH SOME VET SUBJECTS
0360003	AUS:	UPPER SECONDARY GENERAL ACADEMIC
0360004	AUS:	UPPER SECONDARY WITH SOME VET SUBJECTS
0360005	AUS:	UPPER SECONDARY VET COURSE
0400002	AUT:	LOWER SECONDARY SCHOOL
0400003	AUT:	VOCATIONAL PROGRAMME
0400004	AUT:	SPECIAL EDUCATION SCHOOL (LOWER SECONDARY)
0400005	AUT:	SPECIAL EDUCTION SCHOOL (UPPER SECONDARY)
0400006	AUT:	GYMNASIUM LOWER SECONDARY
0400007	AUT:	GYMNASIUM UPPER SECONDARY
0400008	AUT:	LOWER SECONDARY SCHOOL
0400009	AUT:	UPPER SECONDARY SCHOOL
0400010	AUT:	APPRENTICESHIP
0400011	AUT:	MIDDLE VOCATIONAL SCHOOL
0400012	AUT:	MIDDLE VOCATIONAL SCHOOL (HOME ECONOMICS, HEALTH-SOCIAL SERVICES)
0400013	AUT:	MIDDLE VOCATIONAL SCHOOL (AGRICULTURAL, FORESTRY)
0400014	AUT:	HIGHER VOCATIONAL SCHOOL
0400015	AUT:	VOCATIONAL COLLEGE
0560101	BEL:	(FIRST YEAR A OF FIRST STAGE OF) GENERAL EDUCATION
0560103	BEL:	SECOND YEAR OF FIRST STAGE – PREPARING FOR VOCATIONAL SEC. EDUC.
0560104	BEL:	SECOND YEAR OF FIRST STAGE PREPARING FOR REGULAR SEC. EDUC.
0560105	BEL:	SECOND & THIRD STAGE REGULAR SECONDARY EDUCATION
0560106	BEL:	SECOND & THIRD STAGE TECHNICAL SECONDARY EDUCATION
0560107	BEL:	SECOND & THIRD STAGE ARTISTIC SECONDARY EDUCATION
0560108	BEL:	SECOND & THIRD STAGE VOCATIONAL SECONDARY EDUCATION
0560109	BEL:	PART-TIME VOCATIONAL SEC. EDUC. FOCUSED ON THE LABOUR MARKET
0560110	BEL:	SPECIAL SEC. EDUC. – LOWER SEC. (TRAINING FORM 3 / FIRST 3 YEARS)
0560111	BEL:	SPECIAL SEC. EDUC. – UPPER SEC. (TRAINING FORM 3 / YEARS 4 AND 5)
0569612	BEL:	FIRST DEGREE OF GENERAL EDUCATION (FR/GER)
0569613	BEL:	FIRST YEAR B SPECIAL NEEDS (FR/GER)
0569614	BEL:	2ND YEAR OF VOCATIONAL EDUCATION (FR/GER)
0569615	BEL:	COMPLEMENTARY YEAR TO 1ST DEGREE (FR COM ONLY)
0569616	BEL:	SECOND & THIRD DEGREES OF GENERAL EDUCATION (FR/GER)
0569617	BEL:	2ND & 3RD DEGREES OF TECHN. OR ART. EDUC. (TRANSITION) (FR/GER)
0569618	BEL:	2ND & 3RD DEGREES OF TECHN. OR ART. EDUC. (QUALIF.) (FR/GER)
0569619	BEL:	SECOND & THIRD DEGREES OF VOCATIONAL EDUCATION (FR/GER)
0569620	BEL:	VOCATIONAL TRAINING FOCUSED ON THE LABOUR MARKET (FR COM ONLY)
0569622	BEL:	SPECIAL SEC. EDUC. (LOWER SEC. – TRAINING FORM 3) (FR COM ONLY)
0569623	BEL:	SPECIAL SEC. EDUC. (UPPER SEC.-TRAINING FORM 3)) (FR. ONLY)
0569624	BEL:	SPECIAL SEC. EDUC. (LOWER SEC.) (GER. ONLY)
0760001	BRA:	LOWER SECONDARY EDUCATION
0760002	BRA:	UPPER SECONDARY EDUCATION
1000001	BGR:	SECONDARY EDUCATION (LOWER)
1000002	BGR:	SECONDARY EDUCATION – GENERAL NONSPECIALIZED (UPPER)
1000003	BGR:	SECONDARY EDUCATION – VOCATIONAL (UPPER)
1000004	BGR:	SECONDARY EDUCATION – GENERAL SPECIALIZED (UPPER)
1240001	CAN:	GRADES 7-9 (QUEBEC: SECONDARY 1–3, MANITOBA: SENIOR 1
1240002	CAN:	GRADES 10-12 (QUEB.: SEC. 4-5, MAN.: SNR 2-4, NEWFNDL.: LEV. 1-3)
1520001	CHL:	SECONDARY EDUCATION (LOWER)
1520002	CHL:	FIRST CYCLE OF UPPER SECONDARY
1520003	CHL:	SECOND CYCLE OF UPPER SECONDARY EDUCATION, ACADEMIC ORIENTATION
1520004	CHL:	SECOND CYCLE OF UPPER SECONDARY EDUCATION, TECHNICAL ORIENTATION
1580001	TAP:	SENIOR HIGH SCHOOL
1580002	TAP:	VOCATIONAL SENIOR HIGH SCHOOL
1580003	TAP:	5-YEAR COLLEGE
1580004	TAP:	CONT. SUPP. SCHOOL
1580005	TAP:	PRACTICAL TECHNICAL PROGRAMME
1580006	TAP:	WORKING AND LEARNING PROGRAMME
1580007	TAP:	GENERAL JUNIOR HIGH SCHOOLS
1580008	TAP:	COMPREHENSIVE HIGH SCHOOL (JUNIOR)
1700001	COL:	SECONDARY EDUCATION (LOWER)
1700002	COL:	SECONDARY EDUCATION (UPPER), ACADEMICA
1700003	COL:	SECONDARY EDUCATION (UPPER), TECNICA
1910001	HRV:	LOWER SECONDARY EDUCATION
1910002	HRV:	GYMNASIUM
1910003	HRV:	FOUR YEAR VOCATIONAL PROGRAMMES
1910004	HRV:	ART PROGRAMMES
1910005	HRV:	VOCATIONAL PROGRAMMES FOR INDUSTRY
1910006	HRV:	VOCATIONAL PROGRAMMES FOR CRAFTS
1910007	HRV:	LOWER QUALIFICATION VOCATIONAL PROGRAMMES
2030001	CZE:	BASIC SCHOOL
2030002	CZE:	6, 8-YEAR GYMNASIUM AND 8-YEAR CONSERVATORY (LOWER SECONDARY)
2030003	CZE:	6, 8-YEAR GYMNASIUM (UPPER SECONDARY)
2030004	CZE:	4- YEAR GYMNASIUM
2030005	CZE:	VOC/TECH SECONDARY SCHOOL WITH MATURATE
2030007	CZE:	VOC/TECH SECONDARY SCHOOL WITHOUT MATURATE
2030008	CZE:	SPECIAL SCHOOLS
2030009	CZE:	PRACTICAL SCHOOLS, VOCATIONAL EDUCATION PREDOMINANTLY
2080001	DNK:	LOWER SECONDARY
2080002	DNK:	CONTINUATION SCHOOL
2080004	DNK:	UPPER SECONDARY
2330001	EST:	LOWER SECONDARY
2330002	EST:	UPPER SECONDARY
2460001	FIN:	COMPREHENSIVE SECONDARY SCHOOL
2460002	FIN:	UPPER SECONDARY

2500001	FRA:	LOWER SECONDARY (GENERAL)
2500002	FRA:	SPECIAL LOWER SEC. EDUCATION (SEGPA, CPA)
2500003	FRA:	UPPER SECONDARY (GENERAL OR TECHN.)
2500004	FRA:	UPPER SECONDARY (PROFESSIONAL: CAP, BEP, OTHERS)
2760001	DEU:	LOWER SECONDARY WITH ACCESS TO UPPER SECONDARY (COMPREHENSIVE)
2760002	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (HAUPTSCHULE)
2760003	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (REALSCHULE)
2760004	DEU:	LOWER SEC. WITH ACCESS TO UPPER SECONDARY (GYMNASIUM)
2760005	DEU:	UPPER SEC. LEVEL (GYMNASIUM)
2760006	DEU:	COMPREHENSIVE LOWER SEC. WITH ACCESS TO UPPER SEC. (GESAMTSCHULE)
2760008	DEU:	LOWER SEC., NO ACCESS TO UPPER SEC. (KOOP. GESAMTSCHULE HS)
2760009	DEU:	LOWER SEC., WITH OR WITHOUT ACCESS TO UPPER SEC. (KOOP. GS, RS)
2760010	DEU:	LOWER SEC., WITH ACCESS TO UPPER SEC. (KOOP. GS, GYMN.)
2760012	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (HAUPTSCHULE INTEGRATED)
2760013	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (REALSCHULE INTEGRATED)
2760014	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (HAUPTSCHULKLASSE)
2760015	DEU:	LOWER SEC., NO ACCESS TO UPPER SECONDARY (REALSCHULKLASSE)
2760016	DEU:	LOWER SECONDARY WITH ACCESS TO UPPER SECONDARY (WALDORF)
2760017	DEU:	UPPER SECONDARY LEVEL OF EDUCATION (WALDORF)
2760018	DEU:	PRE-VOCATIONAL TRAINING YEAR
2760019	DEU:	VOCATIONAL SCHOOL (BERUFSSCHULE)
2760020	DEU:	VOCATIONAL SCHOOL (BERUFSFACHSCHULE)
3000001	GRC:	LOWER SECONDARY EDUCATION
3000002	GRC:	UPPER SECONDARY EDUCATION
3000003	GRC:	(TECHNICAL-VOCATIONAL SCHOOLS) UPPER SECONDARY EDUCATION
3000004	GRC:	GYMNASIO (LOWER SECONDARY EDUCATION) EVENING SCHOOL
3000097	GRC:	MISSING/UNKNOWN
3440001	HKG:	LOWER SECONDARY IN GRAMMAR OR INT. PROGR.
3440002	HKG:	UPPER SECONDARY IN GRAMMAR OR INT. PROGR.
3440003	HKG:	LOWER SECONDARY IN PREVOC. OR TECHN. PROGR.
3440004	HKG:	UPPER SECONDARY IN PREVOC. OR TECHN. PROGR.
3480001	HUN:	PRIMARY SCHOOL
3480002	HUN:	VOCATIONAL SCHOOL
3480003	HUN:	VOCATIONAL SECONDARY SCHOOL
3480004	HUN:	GRAMMAR SCHOOL
3520001	ISL:	LOWER SECONDARY SCHOOL
3520007	ISL:	UPPER SECONDARY LEVEL VOCATIONAL 3-YEAR CERTIFICATE
3520010	ISL:	FINE ARTS EXAMINATION
3520012	ISL:	STÚDENTSPRÓF. MATRIC. EXAM. CERT. (ACCESS TO UNIV. STUDIES)
3600001	IDN:	JUNIOR SECONDARY SCHOOL
3600002	IDN:	ISLAMIC JUNIOR SECONDARY SCHOOL
3600003	IDN:	HIGH SCHOOL
3600004	IDN:	ISLAMIC HIGH SCHOOL
3600005	IDN:	VOCATIONAL & TECHNICAL SCHOOL
3720001	IRL:	JUNIOR CERT
3720002	IRL:	TRANSITION YEAR PROGRAMME
3720003	IRL:	LEAVING CERT. APPLIED
3720004	IRL:	LEAVING CERT. ESTABLISHED
3720005	IRL:	LEAVING CERT. VOCATIONAL
3760001	ISR:	SECONDARY EDUCATION (LOWER)
3760002	ISR:	6 YEARS HIGHER EDUCATION YEARS 7-9
3760003	ISR:	6 YEARS HIGHER EDUCATION YEARS 10-12
3760004	ISR:	4 YEARS HIGHER EDUCATION
3760005	ISR:	3 YEARS HIGHER EDUCATION
3760006	ISR:	HIGHER EDUCATION TECHNICAL/VOCATIONAL
3760007	ISR:	HIGHER RELIGIOUS EDUCATION FOR BOYS YEARS 7-9
3760008	ISR:	HIGHER RELIGIOUS EDUC. FOR BOYS YEARS 10-12 WITHOUT MATRICULATION
3760009	ISR:	HIGHER RELIGIOUS EDUCATION FOR BOYS WITH MATRICULATION
3760010	ISR:	HIGHER RELIGIOUS EDUCATION FOR GIRLS YEARS 7-9
3760011	ISR:	HIGHER RELIGIOUS EDUC. FOR GIRLS YEARS 10-12 – WITH MATRICULATION
3800001	ITA:	LICEO (SC., CLASS., SOC. SC., SCIENT.-TECHNOLOGICAL, LINGUISTIC)
3800002	ITA:	TECHNICAL INSTITUTE
3800003	ITA:	VOCATIONAL INSTITUTE, ART INSTITUTE, ART HIGH SCHOOL
3800004	ITA:	LOWER SECONDARY EDUCATION
3800005	ITA:	VOC. TRAINING (VOC. SCHOOLS IN BOLZANO & TRENTO)
3920001	JPN:	UPPER SECONDARY SCHOOL (GENERAL)
3920002	JPN:	TECHNICAL COLLEGE (FIRST 3 YEARS)
3920003	JPN:	UPPER SECONDARY SCHOOL (VOCATIONAL)
4000001	JOR:	BASIC EDUCATION
4100001	KOR:	LOWER SECONDARY EDUCATION
4100002	KOR:	UPPER SECONDARY EDUCATION
4100003	KOR:	UPPER SECONDARY EDUCATION
4170001	KGZ:	PROGRAMME OF BASIC GENERAL EDUCATION (LOWER SECONDARY)
4170002	KGZ:	PROGRAMME OF SECONDARY GENERAL EDUCATION (UPPER SECONDARY)
4170004	KGZ:	PROGRAMME OF SEC. PROF. EDUCATION (TECHNIKUM, COLLEGES, ETC.)
4280001	LVA:	BASIC EDUCATION
4280002	LVA:	SPECIAL BASIC EDUCATION
4280004	LVA:	GENERAL SECONDARY EDUCATION
4280006	LVA:	SECONDARY VOCATIONAL EDUCATION
4380001	LIE:	SECONDARY EDUCATION, FIRST STAGE
4380003	LIE:	SCHOOL PREPARING FOR THE UNIVERSITY ENTRANCE CERTIFICATE
4400001	LTU:	GENERAL BASIC EDUCATION
4400003	LTU:	BASIC EDUCATION (LOWER GYMNASIUM)
4400004	LTU:	SECONDARY EDUCATION (UPPER GYMNASIUM)
4400005	LTU:	BASIC AND VOCATIONAL EDUCATION
4400006	LTU:	VOCATIONAL EDUCATION
4420001	LUX:	LOWER SECONDARY EDUCATION (EST: PREPARATOIRE)
4420002	LUX:	LOWER SECONDARY EDUCATION (EST: INFERIEUR)
4420003	LUX:	LOWER SECONDARY EDUCATION (ES: INFERIEUR)
4420004	LUX:	A 3-YEAR VOCATIONAL EDUCATION (EST: PROF.)
4420005	LUX:	A 4-YEAR VOCATIONAL-TECHNICAL EDUCATION (EST)
4420006	LUX:	A 4 TO 5-YEAR TECHNICAL EDUCATION (EST)
4420007	LUX:	UPPER SECONDARY EDUCATION (ES: SUPERIEUR)
4420008	LUX:	LOWER SECONDARY PRIVATE, NOT SUBSIDIZED
4420009	LUX:	UPPER SECONDARY PRIVATE, NOT SUBSIDIZED
4460001	MAC:	GRAMMAR OR INTERNATIONAL PROGRAM AT LOWER SECONDARY LEVELS
4460002	MAC:	GRAMMAR OR INTERNATIONAL PROGRAM AT HIGHER SECONDARY LEVELS
4460003	MAC:	TECHNICAL OR PREVOCATIONAL PROGRAM AT LOWER SECONDARY LEVELS
4460004	MAC:	TECHNICAL OR PREVOCATIONAL PROGRAM AT HIGHER SECONDARY LEVELS
4840001	MEX:	GENERAL LOWER SECONDARY
4840002	MEX:	TECHNICAL LOWER SECONDARY
4840003	MEX:	LOWER SECONDARY FOR WORKERS
4840004	MEX:	GENERAL LOWER SECONDARY BY TELEVISION
4840005	MEX:	JOB TRAINING
4840006	MEX:	GENERAL BACCALAUREATE OR UPPER SECONDARY
4840007	MEX:	GENERAL BACCALAUREATE OR UPPER SECONDARY
4840008	MEX:	GENERAL BACCALAUREATE OR UPPER SECONDARY

4840009	MEX:	TECHNICAL BACCALAUREATE OR TECHNICAL FROM UPPER SECONDARY
4840010	MEX:	PROFESSIONAL TECHNICIAN
4990001	MNE:	LOWER SECONDARY
4990002	MNE:	GYMNASIUM
4990003	MNE:	TECHNICAL
4990004	MNE:	TECHNICAL VOCATIONAL SCHOOL
4990005	MNE:	ARTS SCHOOL
4990006	MNE:	ECONOMIC
4990008	MNE:	MEDICAL
4990009	MNE:	AGRICULTURAL
4990010	MNE:	AGRICULTURAL VOCATIONAL
4990011	MNE:	CATERING
5280001	NLD:	PRACTICAL PREPARATION FOR LABOUR MARKET
5280002	NLD:	VMBO (GENERAL VOC.)
5280003	NLD:	VMBO BB (1-2 YEAR)
5280004	NLD:	VMBO BB (3-4 YEAR)
5280005	NLD:	VMBO KB (1-2 YEAR)
5280006	NLD:	VMBO KB (3-4 YEAR)
5280007	NLD:	VMBO GL/ TL (1-2 YEAR)
5280008	NLD:	VMBO GL/ TL (3-4 YEAR)
5280009	NLD:	HAVO (YEAR 1-3)
5280010	NLD:	HAVO (SEC. YEAR 4-5)
5280011	NLD:	VWO (YEAR 1-3)
5280012	NLD:	VWO (YEAR 4-6)
5280097	NLD:	MISSING/UNKNOWN
5540001	NZL:	YEARS 7 TO 10
5540002	NZL:	YEARS 11 TO 13
5780001	NOR:	LOWER SECONDARY
5780002	NOR:	UPPER SECONDARY
6160001	POL:	GYMNASIUM
6160002	POL:	LYCEUM – GENERAL EDUCATION
6200001	PRT:	LOWER SECUNDARY
6200002	PRT:	LOWER SECUNDARY UNGRADED
6200003	PRT:	UPPER SECUNDARY
6200004	PRT:	VOCATIONAL SECUNDARY (TECHNICAL)
6200005	PRT:	VOCATIONAL SECUNDARY (PROFESSIONAL)
6200006	PRT:	LOWER SECUNDARY (SPEC. CURR. 1 YEAR)
6200007	PRT:	LOWER SECUNDARY (SPEC. CURR. 2 YEARS)
6200008	PRT:	LOWER SECUNDARY (SPEC. CURR. 3 YEARS)
6340001	QAT:	LOWER SECONDARY
6340002	QAT:	LOWER SECONDARY REFORMED
6340003	QAT:	LOWER SECONDARY INTERNATIONAL
6340004	QAT:	UPPER SECONDARY
6340005	QAT:	UPPER SECONDARY REFORMED
6340006	QAT:	UPPER SECONDARY INTERNATIONAL
6420001	ROU:	GENERAL EDUCATION (GIMNAZIU)
6420002	ROU:	VOCATIONAL EDUCATION (SCUOLA DE ARTE SI MESERII)
6420003	ROU:	LOWER SECONDARY EDUCATION (LICEU INFERIOR)
6430001	RUS:	PROGRAMME OF BASIC GENERAL EDUCATION (LOWER SECONDARY)
6430002	RUS:	PROGRAMME OF SECONDARY GENERAL EDUCATION (UPPER SECONDARY)
6430003	RUS:	PROGRAMME OF INITIAL PROF. EDUCATION (PROFESSIONAL SCHOOLS, ETC.)
6430004	RUS:	PROGRAMME OF SECONDARY PROF. EDUCATION (TECHNIKUM, COLLEGE, ETC.)
6880001	SRB:	PRIMARY SCHOOL
6880002	SRB:	GYMNASIUM
6880003	SRB:	TECHNICAL
6880004	SRB:	TECHNICAL VOCATIONAL
6880005	SRB:	MEDICAL
6880006	SRB:	ECONOMIC
6880007	SRB:	ECONOMIC VOCATIONAL
6880008	SRB:	AGRICULTURAL
6880009	SRB:	AGRICULTURAL VOCATIONAL
6880010	SRB:	ARTISTIC
7030001	SVK:	BASIC SCHOOL
7030002	SVK:	VOCATIONAL BASIC SCHOOL
7030003	SVK:	GENERAL 8-YEAR SECONDARY SCHOOL (YEARS 1-4)

7030004	SVK:	GENERAL 8-YEAR SECONDARY SCHOOL (YEARS 5-8)
7030005	SVK:	HIGH SCHOOL (GYMNASIUM)
7030006	SVK:	SECONDARY COLLEGE
7030007	SVK:	TECHNICAL COLLEGE, CLASS WITH A SCHOOL LEAVING EXAMINATION
7030008	SVK:	TECHNICAL COLLEGE, CLASS WITHOUT A SCHOOL LEAVING EXAMINATION
7030009	SVK:	VOCATIONAL COLLEGE
7050001	SVN:	BASIC (ELEMENTARY) EDUCATION
7050002	SVN:	VOCATIONAL EDUCATION PROGRAMMES OF SHORT DURATION
7050003	SVN:	VOCATIONAL EDUCATION PROGRAMMES OF MEDIUM DURATION
7050004	SVN:	TECHNICAL EDUCATION PROGRAMMES
7050005	SVN:	SECONDARY GENERAL EDUCATION – TECHNICAL GYMNASIUMS
7050006	SVN:	SECONDARY GENERAL EDUCATION – GENERAL AND CASSICAL GYMNASIUMS
7240001	ESP:	COMPULSORY SECONDARY EDUCATION
7240002	ESP:	BACCALAUREAT
7520001	SWE:	COMPULSORY BASIC SCHOOL
7520002	SWE:	UPPER SECONDARY SCHOOL, GENERAL ORIENTATION
7520003	SWE:	UPPER SECONDARY SCHOOL, VOCATIONAL ORIENTATION
7520004	SWE:	UPPER SECONDARY SCHOOL, THE INDIVIDUAL PROGRAMME
7560001	CHE:	SECONDARY EDUCATION, FIRST STAGE
7560002	CHE:	PREPARATORY COURSE FOR VOCATIONAL EDUCATION
7560003	CHE:	SCHOOL PREPARING FOR THE UNIVERSITY ENTRANCE CERTIFICATE
7560004	CHE:	VOCATIONAL BACCALAUREAT, DUAL SYSTEM 3-4 YEARS
7560005	CHE:	VOCATIONAL EDUCATION, DUAL SYSTEM 3-4 YEARS
7560006	CHE:	INTERMEDIATE DIPLOMA SCHOOL
7560007	CHE:	BASIC VOCATIONAL EDUCATION, DUAL SYSTEM 1-2 YEARS
7640001	THA:	LOWER SECONDARY LEVEL
7640002	THA:	UPPER SECONDARY LEVEL
7640003	THA:	VOCATIONAL CERTIFICATE LEVEL (UPPER SECONDARY LEVEL)
7880001	TUN:	ENSEIGNEMENT DE BASE (LOWER SECONDARY)
7880002	TUN:	ENSEIGNEMENT SECONDAIRE (UPPER SECONDARY)
7920001	TUR:	PRIMARY EDUCATION
7920002	TUR:	GENERAL HIGH SCHOOL
7920003	TUR:	ANATOLIAN HIGH SCHOOL
7920004	TUR:	HIGH SCHOOL WITH INTENSIVE FOREIGN LANGUAGE TEACHING
7920005	TUR:	SCIENCE HIGH SCHOOLS
7920006	TUR:	VOCATIONAL HIGH SCHOOLS
7920007	TUR:	ANATOLIAN VOCATIONAL HIGH SCHOOLS
7920011	TUR:	SECONDARY AND VOCATIONAL HIGH SCHOOL
8261001	GBR:	STUDYING MOSTLY TOWARD ENTRY LEVEL CERTIFICATES
8261002	GBR:	STUDYING MOSTLY TOWARD GCSE OR LEVEL 1 OR 2 QUALIF.
8261003	GBR:	STUDYING MOSTLY FOR AS OR A LEV. OR NON-VOC. LEV. 3 QUALIF.
8261007	GBR:	STUDENTS < YEAR 10 (ENG. & WALES) OR < YEAR 11 (NORTH. IRELAND)
8262001	GBR:	STUDYING IN S3 OR S4. (SCO)
8262002	GBR:	S5-S6 & NAT. QUALIF. AT HIGHER LEV., A-LEV., OR EQUIV. (SCO)
8262003	GBR:	S5-S6 & NAT. QUAL. AT INTERMED. OR ACCESS LEVEL, OR EQUIV. (SCO)
8400001	USA:	GRADES 7-9
8400002	USA:	GRADES 10-12
8400097	USA:	MISSING/UNKNOWN
8580001	URY:	LOWER SECONDARY
8580002	URY:	LOWER SECONDARY WITH A TECHNOLOGICAL COMPONENT
8580003	URY:	VOCATIONAL LOWER SECONDARY (BASIC COURSES)
8580004	URY:	VOCATIONAL LOWER SECONDARY (BASIC PROF. EDUC.)

8580005	URY: RURAL LOWER SECONDARY
8580006	URY: GENERAL UPPER SECONDARY
8580007	URY: TECHNICAL UPPER SECONDARY
8580008	URY: VOCATIONAL UPPER SECONDARY
8580009	URY: MILITARY SCHOOL

BMMJ (309) Occupational status Mother (SEI)	
Format: F2.0	Columns: 364-365
97	N/A
99	Missing

BFMJ (310) Occupational status Father (SEI)	
Format: F2.0	Columns: 366-367
97	N/A
99	Missing

BSMJ (311) Occupational status Self (SEI)	
Format: F2.0	Columns: 368-369
97	N/A
99	Missing

HISEI (312) Highest parental occupational status (SEI)	
Format: F2.0	Columns: 370-371
97	N/A
99	Missing

MSECATEG (313) Mother White collar/Blue collar classification	
Format: F1.0	Columns: 372-372
1	White collar high skilled
2	White collar low skilled
3	Blue collar high skilled
4	Blue collar low skilled
7	N/A
9	Missing

FSECATEG (314) Father White collar/Blue collar classification	
Format: F1.0	Columns: 373-373
1	White collar high skilled
2	White collar low skilled
3	Blue collar high skilled
4	Blue collar low skilled
7	N/A
9	Missing

HSECATEG (315) Highest parent White collar/Blue collar classification	
Format: F1.0	Columns: 374-374
1	White collar high skilled
2	White collar low skilled
3	Blue collar high skilled
4	Blue collar low skilled
7	N/A
9	Missing

SRC_M (316) Mother science-related career	
Format: F1.0	Columns: 375-375
0	No or indeterminate
1	Yes
7	N/A
9	Missing

SRC_F (317) Father science-related career	
Format: F1.0	Columns: 376-376
0	No or indeterminate
1	Yes
7	N/A
9	Missing

SRC_E (318) Either parent science-related career	
Format: F1.0	Columns: 377-377
0	No or indeterminate
1	Yes
7	N/A
9	Missing

SRC_S (319) Self science-related career at 30	
Format: F1.0	Columns: 378-378
0	No or indeterminate
1	Yes
7	N/A
9	Missing

MISCED (320) Educational level of mother (ISCED)	
Format: F1.0	Columns: 379-379
0	None
1	ISCED 1
2	ISCED 2
3	ISCED 3B, C
4	ISCED 3A, ISCED 4
5	ISCED 5B
6	ISCED 5A, 6
7	N/A
9	Missing

FISCED (321) Educational level of father (ISCED)	
Format: F1.0	Columns: 380-380
0	None
1	ISCED 1
2	ISCED 2
3	ISCED 3B, C
4	ISCED 3A, ISCED 4
5	ISCED 5B
6	ISCED 5A, 6
7	N/A
9	Missing

HISCED (322) Highest educational level of parents (ISCED)	
Format: F1.0	Columns: 381-381
0	None
1	ISCED 1
2	ISCED 2
3	ISCED 3B, C
4	ISCED 3A, ISCED 4
5	ISCED 5B
6	ISCED 5A, 6
7	N/A
9	Missing

PARED (323) Highest parental education in years	
Format: F4.1	Columns: 382-385
97	N/A
99	Missing

COBN_M (324) Country of birth (Mother) 5-digit code	
Format: A5	Columns: 386-390
00020	Africa
00021	A Sub-Saharan country (Africa excl. Maghreb)
00080	Albania
00110	Cap Verde (in Western Africa)
00150	North African country (Maghreb)
00290	Caribbean
00310	Azerbaijan
00320	Argentina
00360	Australia
00361	England
00400	Austria
00500	Bangladesh
00560	Belgium
00680	Bolivia
00700	Bosnia and Herzegovina
00760	Brazil

01000	Bulgaria
01120	Belarus
01240	Canada
01451	Middle Eastern country
01510	An Eastern European country
01520	Chile
01560	China
01561	China (incl. HongKong)
01580	Chinese Taipei
01700	Colombia
01910	Croatia
02030	Czech Republic
02080	Denmark
02330	Estonia
02460	Finland
02500	France
02750	Occupied Palestinian Territory
02760	Germany
03000	Greece
03440	Hong Kong-China
03480	Hungary
03520	Iceland
03560	India
03600	Indonesia
03720	Republic of Ireland
03760	Israel
03800	Italy
03920	Japan
04000	Jordan
04100	Republic of Korea
04170	Kyrgyzstan
04280	Latvia
04380	Liechtenstein
04400	Lithuania
04420	Luxembourg
04460	Macao-China
04461	Mainland China
04580	Malaysia
04840	Mexico
05280	Netherlands
05540	New Zealand
05780	Norway
05860	Pakistan
06000	Paraguay
06080	Philippines
06160	Poland
06200	Portugal
06340	Qatar
06420	Romania
06430	Russian Federation
07020	Singapore
07030	Slovakia
07050	Slovenia
07100	South Africa
07240	Spain
07241	Andalusia (in Spain)
07242	Aragon (in Spain)
07243	Asturias (in Spain)
07244	Balearic Islands (in Spain)
07245	Canary Islands (in Spain)
07246	Cantabria (in Spain)
07247	Castile-La Mancha (in Spain)
07248	Castile and Leon (in Spain)
07249	Catalonia (in Spain)
07251	Extremadura (in Spain)
07252	Galicia (in Spain)
07253	La Rioja (in Spain)
07254	Madrid (in Spain)
07255	Murcia (in Spain)
07256	Navarre (in Spain)
07257	Basque Country (in Spain)
07258	Valencian Community (in Spain)
07259	Ceuta and Melilla (in Spain)
07520	Sweden
07560	Switzerland
07620	Tajikistan
07640	Thailand
07880	Tunisia
07920	Turkey
08040	Ukraine
08070	Former Yugoslav Republic of Macedonia
08100	A former USSR republic
08101	Another former USSR republic (RUS)
08102	Another former USSR republic (EST)
08180	Egypt
08260	United Kingdom
08261	United Kingdom (excl.Scotland)
08262	United Kingdom (Scotland)
08263	Northern Ireland
08264	Great Britain
08400	United States
08580	Uruguay
08600	Uzbekistan
08820	Samoa
08870	Yemen
08900	A former Yugoslav republic
08910	Serbia-Montenegro
08911	Serbia
08912	Montenegro
10560	Other Western European country (BEL)
11910	nother former Yugoslav republic (HRV)
13800	Other European Union Country (ITA)
14420	Other European Union Country (LUX)
15280	Other European country (NLD)
16200	African country with Portuguese as the official language
18262	Other European country (QSC)
18911	One of the other former Yugoslav republics (SRB)
23800	A European country that is not a member of the European Union
26200	Other European Union Country (PRT)
36200	An Eastern European country outside the EU
90310	Other countries (AZE)
90320	Other countries (ARG)
90360	Other countries (AUS)
90400	Other countries (AUT)
90560	Other countries (BEL)
90760	Other countries (BRA)
91000	Other countries (BGR)
91240	Other countries (CAN)
91520	Other countries (CHL)
91580	Other countries (TAP)
91700	Other countries (COL)
91910	Other countries (HRV)
92030	Other countries (CZE)
92080	Other countries (DNK)
92330	Other countries (EST)
92460	Other countries (FIN)
92500	Other countries (FRA)
92760	Other countries (DEU)
93000	Other countries (GRC)
93440	Other countries (HKG)
93480	Other countries (HUN)
93520	Other countries (ISL)
93600	Other countries (IDN)
93720	Other countries (IRL)
93760	Other countries (ISR)
93800	Other countries (ITA)
93920	Other countries (JPN)
94000	Other countries (JOR)
94100	Other countries (KOR)

94170	Other countries (KGZ)
94280	Other countries (LVA)
94400	Other countries (LTU)
94420	Other countries (LUX)
94460	Other countries (MAC)
94840	Other countries (MEX)
95280	Other countries (NLD)
95540	Other countries (NZL)
95780	Other countries (NOR)
96160	Other countries (POL)
96200	Other countries (PRT)
96340	Other countries (QAT)
96420	Other countries (ROU)
96430	Other countries (RUS)
97030	Other countries (SVK)
97050	Other countries (SVN)
97240	Other countries (ESP)
97520	Other countries (SWE)
97560	Other countries (CHE)
97640	Other countries (THA)
97770	Other countries (URY)
97880	Other countries (TUN)
97920	Other countries (TUR)
98260	Other countries (GBR-QUK)
98262	Other countries (GBR-QSC)
98400	Other countries (USA)
98911	Other countries (SRB)
98912	Other countries (MNE)
99997	N/A
99998	Invalid
99999	Missing

COBN_F (325) Country of birth (Father) 5-digit code	
Format: A5	Columns: 391-395
	See COBN_M for labels

COBN_S (326) Country of birth (Self) 5-digit code	
Format: A5	Columns: 396-400
	See COBN_M for labels

IMMIG (327) Immigration status	
Format: F1.0	Columns: 401-401
1	Native
2	Second-Generation
3	First-Generation
7	N/A
8	Invalid
9	Missing

LANGN (328) Language at home (3-digit)	
Format: A3	Columns: 402-404
105	Kurdish
108	Tagalog
113	Indonesian
118	Romanian
121	Estonian
133	Romansh
140	Albanian
148	German
156	Spanish
160	Catalan
170	Slovak
192	Bosnian
200	Italian
230	Walloon
232	Portuguese
244	Czech
258	Urdu
264	Danish
266	Croatian
272	Samoan
273	Polish
286	Japanese
301	Korean
313	English
316	Chinese
317	Serbian
322	Dutch
325	Latvian
329	Vietnamese
344	Turkish
351	Bulgarian
363	Kyrgyz
369	Azerbaijani
375	Lithuanian
379	Welsh
381	Romani
382	Scottish Gaelic
412	Panjabi
415	Hindi
420	Finnish
422	Hebrew
434	Irish
442	Slovenian
449	Greek, Modern
451	Basque
463	Australian Indigenous languages
465	Maori
467	Icelandic
471	Uzbek
474	Galician
492	Macedonian
493	French
494	Swedish
495	Russian
496	Hungarian
500	Arabic
507	Letzeburgesch
514	Ukrainian
523	Norwegian
540	Sami
555	Thai
600	Yugoslavian - Serbian, Croatian, etc
602	National Minorities languages and Bulgarian dialects (BGR)
604	Italian (CHE)
605	European Languages (QSC)
606	Western European languages
607	Regional languages (FRA)
608	Valencian
609	Chinese dialects or languages (HKG)
610	Another language officially recognised in Italy
611	A dialect (ITA)
612	German (CHE)
614	Languages of the former USSR
615	Eastern European languages
616	National dialects or languages (THA)
617	Arabic dialect (TUN)
620	Dialect of Slovak (SVK)
621	Flemish dialect (BEL)
622	Serbian of a yekavian variant or Montenegrin
623	Other European Languages (NLD)
624	Another language spoken in a European Union country (ITA)
625	Cantonese
626	Ulster Scots
627	Other national dialects or languages (ROU)
628	Taiwanese dialect (TWN)
629	Indigenous language (ARG)
638	German (LIE)
639	Languages of other republics in the former Yugoslavia (SVN)
640	German dialect (BEL)

641	Mandarin
642	Local language in Indonesia (IDN)
650	Aboriginal dialect (TWN)
661	Hakka dialect (TWN)
800	Other languages (ARG)
801	Other languages (AUS)
802	Other languages (AUT)
803	Other languages (AZE)
804	Other languages (BEL)
805	Other languages (BRA)
806	Other languages (BGR)
807	Other languages (CAN)
808	Other languages (CHL)
809	Other languages (TWN)
810	Other languages (COL)
811	Other languages (HRV)
812	Other languages (CZE)
813	Other languages (DNK)
814	Other languages (EST)
815	Other languages (FIN)
816	Other languages (FRA)
818	Other languages (DEU)
819	Other languages (GRC)
820	Other languages (HKG)
821	Other languages (HUN)
822	Other languages (ISL)
823	Other languages (IDN)
824	Other languages (IRL)
825	Other languages (ISR)
826	Other languages (ITA)
827	Other languages (JPN)
828	Other languages (JOR)
830	Other languages (KGZ)
831	Other languages (LVA)
833	Other languages (LTU)
834	Other languages (LUX)
835	Other languages (MAC)
836	Other languages (MEX)
837	Other languages (MNE)
838	Other languages (NLD)
839	Other languages (NZL)
840	Other languages (NOR)
842	Other languages (POL)
843	Other languages (PRT)
844	Other languages (QAT)
845	Other languages (KOR)
846	Other languages (ROU)
847	Other languages (RUS)
848	Other languages (GBR-QSC)
850	Other languages (SVK)
851	Other languages (SVN)
852	Other languages (ESP)
853	Other languages (SWE)
854	Other languages (CHE)
855	Other languages (THA)
856	Other languages (TUN)
857	Other languages (TUR)
858	Other languages (GBR-QUK)
859	Other languages (USA)
860	Other languages (URY)
861	Other languages (SRB)
997	N/A
998	Invalid
999	Missing

CARINFO (329) Student information on science-related careers PISA 2006 (WLE)	
Format: F9.4	Columns: 405-413
997	N/A
999	Missing

CARPREP (330) School preparation for science-related careers PISA 2006 (WLE)	
Format: F9.4	Columns: 414-422
997	N/A
999	Missing

CULTPOSS (331) Cultural possessions at home PISA 2006 (WLE)	
Format: F9.4	Columns: 423-431
997	N/A
999	Missing

ENVAWARE (332) Awareness of environmental issues PISA 2006 (WLE)	
Format: F9.4	Columns: 432-440
997	N/A
999	Missing

ENVOPT (333) Environmental optimism PISA 2006 (WLE)	
Format: F9.4	Columns: 441-449
997	N/A
999	Missing

ENVPERC (334) Perception of environmental issues PISA 2006 (WLE)	
Format: F9.4	Columns: 450-458
997	N/A
999	Missing

GENSCIE (335) General value of science PISA 2006 (WLE)	
Format: F9.4	Columns: 459-467
997	N/A
999	Missing

HEDRES (336) Home educational resources PISA 2006 (WLE)	
Format: F9.4	Columns: 468-476
997	N/A
999	Missing

HOMEPOS (337) Index of home possessions PISA 2006 (WLE)	
Format: F9.4	Columns: 477-485
997	N/A
999	Missing

INSTSCIE (338) Instrumental motivation in science PISA 2006 (WLE)	
Format: F9.4	Columns: 486-494
997	N/A
999	Missing

INTSCIE (339) General interest in learning science PISA 2006 (WLE)	
Format: F9.4	Columns: 495-503
997	N/A
999	Missing

JOYSCIE (340) Enjoyment of science PISA 2006 (WLE)	
Format: F9.4	Columns: 504-512
997	N/A
999	Missing

PERSCIE (341) Personal value of science PISA 2006 (WLE)	
Format: F9.4	Columns: 513-521
997	N/A
999	Missing

RESPDEV (342) Responsibility for sustainable development PISA 2006 (WLE)	
Format: F9.4	Columns: 522-530
997	N/A
999	Missing

SCAPPLY (343) Science Teaching - Focus on applications or models PISA 2006 (WLE)	
Format: F9.4	Columns: 531-539
997	N/A
999	Missing

SCHANDS (344) Science Teaching - Hands-on activities PISA 2006 (WLE)	
Format: F9.4	Columns: 540-548
997	N/A
999	Missing

SCIEACT (345) Science activities PISA 2006 (WLE)	
Format: F9.4	Columns: 549-557
997	N/A
999	Missing

SCIEEFF (346) Science self-efficacy PISA 2006 (WLE)	
Format: F9.4	Columns: 558-566
997	N/A
999	Missing

SCIEFUT (347) Future-oriented science motivation PISA 2006 (WLE)	
Format: F9.4	Columns: 567-575
997	N/A
999	Missing

SCINTACT (348) Science Teaching - Interaction PISA 2006 (WLE)	
Format: F9.4	Columns: 576-584
997	N/A
999	Missing

SCINVEST (349) Science Teaching - Student investigations PISA 2006 (WLE)	
Format: F9.4	Columns: 585-593
997	N/A
999	Missing

SCSCIE (350) Science self-concept PISA 2006 (WLE)	
Format: F9.4	Columns: 594-602
997	N/A
999	Missing

WEALTH (351) Family wealth PISA 2006 (WLE)	
Format: F9.4	Columns: 603-611
997	N/A
999	Missing

HIGHCONF (352) Self-confidence in ICT high level tasks PISA 2006 (WLE)	
Format: F9.4	Columns: 612-620
997	N/A
999	Missing

INTCONF (353) Self-confidence in ICT Internet tasks PISA 2006 (WLE)	
Format: F9.4	Columns: 621-629
997	N/A
999	Missing

INTUSE (354) ICT Internet/entertainment use PISA 2006 (WLE)	
Format: F9.4	Columns: 630-638
997	N/A
999	Missing

PRGUSE (355) ICT program/software use PISA 2006 (WLE)	
Format: F9.4	Columns: 639-647
997	N/A
999	Missing

ESCS (356) Index of economic, social and cultural status PISA 2006	
Format: F9.4	Columns: 648-656
997	N/A
999	Missing

PV1MATH (357) Plausible value in math	
Format: F9.4	Columns: 657-665

PV2MATH (358) Plausible value in math	
Format: F9.4	Columns: 666-674

PV3MATH (359) Plausible value in math	
Format: F9.4	Columns: 675-683

PV4MATH (360) Plausible value in math	
Format: F9.4	Columns: 684-692

PV5MATH (361) Plausible value in math	
Format: F9.4	Columns: 693-701

PV1READ (362) Plausible value in reading	
Format: F9.4	Columns: 702-710
9997	N/A

PV2READ (363) Plausible value in reading	
Format: F9.4	Columns: 711-719
9997	N/A

PV3READ (364) Plausible value in reading	
Format: F9.4	Columns: 720-728
9997	N/A

PV4READ (365) Plausible value in reading	
Format: F9.4	Columns: 729-737
9997	N/A

PV5READ (366) Plausible value in reading	
Format: F9.4	Columns: 738-746
9997	N/A

PV1SCIE (367) Plausible value in science	
Format: F9.4	Columns: 747-755

PV2SCIE (368) Plausible value in science	
Format: F9.4	Columns: 756-764

PV3SCIE (369) Plausible value in science	
Format: F9.4	Columns: 765-773

PV4SCIE (370) Plausible value in science	
Format: F9.4	Columns: 774-782

PV5SCIE (371) Plausible value in science	
Format: F9.4	Columns: 783-791

PV1INTR (372) Plausible value in interest in science	
Format: F9.4	Columns: 792-800

PV2INTR (373) Plausible value in interest in science	
Format: F9.4	Columns: 801-809

PV3INTR (374) Plausible value in interest in science	
Format: F9.4	Columns: 810-818

PV4INTR (375) Plausible value in interest in science	
Format: F9.4	Columns: 819-827

PV5INTR (376) Plausible value in interest in science	
Format: F9.4	Columns: 828-836

PV1SUPP (377) Plausible value in support for scientific inquiry	
Format: F9.4	Columns: 837-845

PV2SUPP (378) Plausible value in support for scientific inquiry	
Format: F9.4	Columns: 846-854

PV3SUPP (379) Plausible value in support for scientific inquiry	
Format: F9.4	Columns: 855-863

PV4SUPP (380) Plausible value in support for scientific inquiry	
Format: F9.4	Columns: 864-872

PV5SUPP (381) Plausible value in support for scientific inquiry
Format: F9.4 | Columns: 873-881

PV1EPS (382) Plausible value in explaining phenomena scientifically
Format: F9.4 | Columns: 882-890

PV2EPS (383) Plausible value in explaining phenomena scientifically
Format: F9.4 | Columns: 891-899

PV3EPS (384) Plausible value in explaining phenomena scientifically
Format: F9.4 | Columns: 900-908

PV4EPS (385) Plausible value in explaining phenomena scientifically
Format: F9.4 | Columns: 909-917

PV5EPS (386) Plausible value in explaining phenomena scientifically
Format: F9.4 | Columns: 918-926

PV1ISI (387) Plausible value in identifying scientific issues
Format: F9.4 | Columns: 927-935

PV2ISI (388) Plausible value in identifying scientific issues
Format: F9.4 | Columns: 936-944

PV3ISI (389) Plausible value in identifying scientific issues
Format: F9.4 | Columns: 945-953

PV4ISI (390) Plausible value in identifying scientific issues
Format: F9.4 | Columns: 954-962

PV5ISI (391) Plausible value in identifying scientific issues
Format: F9.4 | Columns: 963-971

PV1USE (392) Plausible value in using scientific evidence
Format: F9.4 | Columns: 972-980

PV2USE (393) Plausible value in using scientific evidence
Format: F9.4 | Columns: 981-989

PV3USE (394) Plausible value in using scientific evidence
Format: F9.4 | Columns: 990-998

PV4USE (395) Plausible value in using scientific evidence
Format: F9.4 | Columns: 999-1007

PV5USE (396) Plausible value in using scientific evidence
Format: F9.4 | Columns: 1008-1016

W_FSTUWT (397) FINAL STUDENT WEIGHT
Format: F9.4 | Columns: 1017-1025

W_FSTR1 (398) FINAL STUDENT REPLICATE BRR-FAY WEIGHT1
Format: F9.4 | Columns: 1026-1034

W_FSTR2 (399) FINAL STUDENT REPLICATE BRR-FAY WEIGHT2
Format: F9.4 | Columns: 1035-1043

W_FSTR3 (400) FINAL STUDENT REPLICATE BRR-FAY WEIGHT3
Format: F9.4 | Columns: 1044-1052

W_FSTR4 (401) FINAL STUDENT REPLICATE BRR-FAY WEIGHT4
Format: F9.4 | Columns: 1053-1061

W_FSTR5 (402) FINAL STUDENT REPLICATE BRR-FAY WEIGHT5
Format: F9.4 | Columns: 1062-1070

W_FSTR6 (403) FINAL STUDENT REPLICATE BRR-FAY WEIGHT6
Format: F9.4 | Columns: 1071-1079

W_FSTR7 (404) FINAL STUDENT REPLICATE BRR-FAY WEIGHT7
Format: F9.4 | Columns: 1080-1088

W_FSTR8 (405) FINAL STUDENT REPLICATE BRR-FAY WEIGHT8
Format: F9.4 | Columns: 1089-1097

W_FSTR9 (406) FINAL STUDENT REPLICATE BRR-FAY WEIGHT9
Format: F9.4 | Columns: 1098-1106

W_FSTR10 (407) FINAL STUDENT REPLICATE BRR-FAY WEIGHT10
Format: F9.4 | Columns: 1107-1115

W_FSTR11 (408) FINAL STUDENT REPLICATE BRR-FAY WEIGHT11
Format: F9.4 | Columns: 1116-1124

W_FSTR12 (409) FINAL STUDENT REPLICATE BRR-FAY WEIGHT12
Format: F9.4 | Columns: 1125-1133

W_FSTR13 (410) FINAL STUDENT REPLICATE BRR-FAY WEIGHT13
Format: F9.4 | Columns: 1134-1142

W_FSTR14 (411) FINAL STUDENT REPLICATE BRR-FAY WEIGHT14
Format: F9.4 | Columns: 1143-1151

W_FSTR15 (412) FINAL STUDENT REPLICATE BRR-FAY WEIGHT15
Format: F9.4 | Columns: 1152-1160

W_FSTR16 (413) FINAL STUDENT REPLICATE BRR-FAY WEIGHT16
Format: F9.4 | Columns: 1161-1169

W_FSTR17 (414) FINAL STUDENT REPLICATE BRR-FAY WEIGHT17
Format: F9.4 | Columns: 1170-1178

W_FSTR18 (415) FINAL STUDENT REPLICATE BRR-FAY WEIGHT18
Format: F9.4 | Columns: 1179-1187

W_FSTR19 (416) FINAL STUDENT REPLICATE BRR-FAY WEIGHT19
Format: F9.4 | Columns: 1188-1196

W_FSTR20 (417) FINAL STUDENT REPLICATE BRR-FAY WEIGHT20
Format: F9.4 | Columns: 1197-1205

W_FSTR21 (418) FINAL STUDENT REPLICATE BRR-FAY WEIGHT21
Format: F9.4 | Columns: 1206-1214

W_FSTR22 (419) FINAL STUDENT REPLICATE BRR-FAY WEIGHT22
Format: F9.4 | Columns: 1215-1223

W_FSTR23 (420) FINAL STUDENT REPLICATE BRR-FAY WEIGHT23
Format: F9.4 | Columns: 1224-1232

W_FSTR24 (421) FINAL STUDENT REPLICATE BRR-FAY WEIGHT24
Format: F9.4 | Columns: 1233-1241

W_FSTR25 (422) FINAL STUDENT REPLICATE BRR-FAY WEIGHT25
Format: F9.4 | Columns: 1242-1250

W_FSTR26 (423) FINAL STUDENT REPLICATE BRR-FAY WEIGHT26
Format: F9.4 | Columns: 1251-1259

W_FSTR27 (424) FINAL STUDENT REPLICATE BRR-FAY WEIGHT27
Format: F9.4 | Columns: 1260-1268

W_FSTR28 (425) FINAL STUDENT REPLICATE BRR-FAY WEIGHT28
Format: F9.4 | Columns: 1269-1277

W_FSTR29 (426) FINAL STUDENT REPLICATE BRR-FAY WEIGHT29
Format: F9.4 | Columns: 1278-1286

W_FSTR30 (427) FINAL STUDENT REPLICATE BRR-FAY WEIGHT30
Format: F9.4 | Columns: 1287-1295

W_FSTR31 (428) FINAL STUDENT REPLICATE BRR-FAY WEIGHT31
Format: F9.4 | Columns: 1296-1304

W_FSTR32 (429) FINAL STUDENT REPLICATE BRR-FAY WEIGHT32
Format: F9.4 | Columns: 1305-1313

W_FSTR33 (430) FINAL STUDENT REPLICATE BRR-FAY WEIGHT33
Format: F9.4 | Columns: 1314-1322

W_FSTR34 (431) FINAL STUDENT REPLICATE BRR-FAY WEIGHT34
Format: F9.4 | Columns: 1323-1331

W_FSTR35 (432) FINAL STUDENT REPLICATE BRR-FAY WEIGHT35
Format: F9.4 | Columns: 1332-1340

W_FSTR36 (433) FINAL STUDENT REPLICATE BRR-FAY WEIGHT36
Format: F9.4 | Columns: 1341-1349

W_FSTR37 (434) FINAL STUDENT REPLICATE BRR-FAY WEIGHT37
Format: F9.4 | Columns: 1350-1358

W_FSTR38 (435) FINAL STUDENT REPLICATE BRR-FAY WEIGHT38
Format: F9.4 | Columns: 1359-1367

W_FSTR39 (436) FINAL STUDENT REPLICATE BRR-FAY WEIGHT39
Format: F9.4 | Columns: 1368-1376

W_FSTR40 (437) FINAL STUDENT REPLICATE BRR-FAY WEIGHT40
Format: F9.4 | Columns: 1377-1385

W_FSTR41 (438) FINAL STUDENT REPLICATE BRR-FAY WEIGHT41
Format: F9.4 | Columns: 1386-1394

W_FSTR42 (439) FINAL STUDENT REPLICATE BRR-FAY WEIGHT42
Format: F9.4 | Columns: 1395-1403

W_FSTR43 (440) FINAL STUDENT REPLICATE BRR-FAY WEIGHT43
Format: F9.4 | Columns: 1404-1412

W_FSTR44 (441) FINAL STUDENT REPLICATE BRR-FAY WEIGHT44
Format: F9.4 | Columns: 1413-1421

W_FSTR45 (442) FINAL STUDENT REPLICATE BRR-FAY WEIGHT45
Format: F9.4 | Columns: 1422-1430

W_FSTR46 (443) FINAL STUDENT REPLICATE BRR-FAY WEIGHT46
Format: F9.4 | Columns: 1431-1439

W_FSTR47 (444) FINAL STUDENT REPLICATE BRR-FAY WEIGHT47
Format: F9.4 | Columns: 1440-1448

W_FSTR48 (445) FINAL STUDENT REPLICATE BRR-FAY WEIGHT48
Format: F9.4 | Columns: 1449-1457

W_FSTR49 (446) FINAL STUDENT REPLICATE BRR-FAY WEIGHT49
Format: F9.4 | Columns: 1458-1466

W_FSTR50 (447) FINAL STUDENT REPLICATE BRR-FAY WEIGHT50
Format: F9.4 | Columns: 1467-1475

W_FSTR51 (448) FINAL STUDENT REPLICATE BRR-FAY WEIGHT51
Format: F9.4 | Columns: 1476-1484

W_FSTR52 (449) FINAL STUDENT REPLICATE BRR-FAY WEIGHT52
Format: F9.4 | Columns: 1485-1493

W_FSTR53 (450) FINAL STUDENT REPLICATE BRR-FAY WEIGHT53
Format: F9.4 | Columns: 1494-1502

W_FSTR54 (451) FINAL STUDENT REPLICATE BRR-FAY WEIGHT54
Format: F9.4 | Columns: 1503-1511

W_FSTR55 (452) FINAL STUDENT REPLICATE BRR-FAY WEIGHT55
Format: F9.4 | Columns: 1512-1520

W_FSTR56 (453) FINAL STUDENT REPLICATE BRR-FAY WEIGHT56
Format: F9.4 | Columns: 1521-1529

W_FSTR57 (454) FINAL STUDENT REPLICATE BRR-FAY WEIGHT57
Format: F9.4 | Columns: 1530-1538

W_FSTR58 (455) FINAL STUDENT REPLICATE BRR-FAY WEIGHT58
Format: F9.4 | Columns: 1539-1547

W_FSTR59 (456) FINAL STUDENT REPLICATE BRR-FAY WEIGHT59
Format: F9.4 | Columns: 1548-1556

W_FSTR60 (457) FINAL STUDENT REPLICATE BRR-FAY WEIGHT60
Format: F9.4 | Columns: 1557-1565

W_FSTR61 (458) FINAL STUDENT REPLICATE BRR-FAY WEIGHT61
Format: F9.4 | Columns: 1566-1574

W_FSTR62 (459) FINAL STUDENT REPLICATE BRR-FAY WEIGHT62
Format: F9.4 | Columns: 1575-1583

W_FSTR63 (460) FINAL STUDENT REPLICATE BRR-FAY WEIGHT63
Format: F9.4 | Columns: 1584-1592

W_FSTR64 (461) FINAL STUDENT REPLICATE BRR-FAY WEIGHT64
Format: F9.4 | Columns: 1593-1601

W_FSTR65 (462) FINAL STUDENT REPLICATE BRR-FAY WEIGHT65
Format: F9.4 | Columns: 1602-1610

W_FSTR66 (463) FINAL STUDENT REPLICATE BRR-FAY WEIGHT66
Format: F9.4 | Columns: 1611-1619

W_FSTR67 (464) FINAL STUDENT REPLICATE BRR-FAY WEIGHT67
Format: F9.4 | Columns: 1620-1628

W_FSTR68 (465) FINAL STUDENT REPLICATE BRR-FAY WEIGHT68
Format: F9.4 | Columns: 1629-1637

W_FSTR69 (466) FINAL STUDENT REPLICATE BRR-FAY WEIGHT69
Format: F9.4 | Columns: 1638-1646

W_FSTR70 (467) FINAL STUDENT REPLICATE BRR-FAY WEIGHT70
Format: F9.4 | Columns: 1647-1655

W_FSTR71 (468) FINAL STUDENT REPLICATE BRR-FAY WEIGHT71
Format: F9.4 | Columns: 1656-1664

W_FSTR72 (469) FINAL STUDENT REPLICATE BRR-FAY WEIGHT72
Format: F9.4 | Columns: 1665-1673

W_FSTR73 (470) FINAL STUDENT REPLICATE BRR-FAY WEIGHT73
Format: F9.4 | Columns: 1674-1682

W_FSTR74 (471) FINAL STUDENT REPLICATE BRR-FAY WEIGHT74
Format: F9.4 | Columns: 1683-1691

W_FSTR75 (472) FINAL STUDENT REPLICATE BRR-FAY WEIGHT75
Format: F9.4 | Columns: 1692-1700

W_FSTR76 (473) FINAL STUDENT REPLICATE BRR-FAY WEIGHT76
Format: F9.4 | Columns: 1701-1709

W_FSTR77 (474) FINAL STUDENT REPLICATE BRR-FAY WEIGHT77
Format: F9.4 | Columns: 1710-1718

W_FSTR78 (475) FINAL STUDENT REPLICATE BRR-FAY WEIGHT78
Format: F9.4 | Columns: 1719-1727

W_FSTR79 (476) FINAL STUDENT REPLICATE BRR-FAY WEIGHT79
Format: F9.4 | Columns: 1728-1736

W_FSTR80 (477) FINAL STUDENT REPLICATE BRR-FAY WEIGHT80	
Format: F9.4	Columns: 1737-1745

CNTFAC (478) Country weight factor for normalised weights (multi-level)	
Format: F13.10	Columns: 1746-1758

SUBFAC (479) Adjudicated region weight factor for normalised weights (multi-level)	
Format: F13.10	Columns: 1759-1771

WVARSTRR (480) RANDOMIZED FINAL VARIANCE STRATUM (1-80)	
Format: F2.0	Columns: 1772-1773

RANDUNIT (481) FINAL VARIANCE UNIT (1,2,3)	
Format: F1.0	Columns: 1774-1774

STRATUM (482) Original stratum	
Format: A5	Columns: 1775-1779
03197	AZE: Stratum 97
03201	ARG: COD_PROV02
03202	ARG: COD_PROV05
03203	ARG: COD_PROV06
03204	ARG: COD_PROV10
03205	ARG: COD_PROV14
03206	ARG: COD_PROV18
03207	ARG: COD_PROV22
03208	ARG: COD_PROV26
03209	ARG: COD_PROV30
03210	ARG: COD_PROV34
03211	ARG: COD_PROV38
03212	ARG: COD_PROV42
03213	ARG: COD_PROV46
03214	ARG: COD_PROV50
03215	ARG: COD_PROV54
03216	ARG: COD_PROV58
03217	ARG: COD_PROV62
03218	ARG: COD_PROV66
03219	ARG: COD_PROV70
03220	ARG: COD_PROV74
03221	ARG: COD_PROV78
03222	ARG: COD_PROV82
03223	ARG: COD_PROV86
03224	ARG: COD_PROV90
03225	ARG: COD_PROV94
03226	ARG: Moderately Small schools
03227	ARG: Very Small schools
03601	AUS: ACT
03602	AUS: NSW
03603	AUS: NT
03604	AUS: QLD
03605	AUS: SA
03606	AUS: TAS
03607	AUS: VIC
03608	AUS: WA
04097	AUT: Stratum 97
05601	BEL: Stratum 01
05602	BEL: Stratum 02
05603	BEL: Stratum 03
05604	BEL: Stratum 04
05605	BEL: Stratum 05
05606	BEL: Stratum 06
05607	BEL: Stratum 07
05608	BEL: Stratum 08
05609	BEL: Stratum 09
05610	BEL: Stratum 10
05611	BEL: Stratum 11
05612	BEL: Stratum 12
05613	BEL: Stratum 13
05614	BEL: Stratum 14
05615	BEL: Stratum 15
05616	BEL: Stratum 16
05617	BEL: Stratum 17
07601	BRA: Stratum 01
07602	BRA: Stratum 02
07603	BRA: Stratum 03
07604	BRA: Stratum 04
07605	BRA: Stratum 05
07606	BRA: Stratum 06
07607	BRA: Stratum 07
07608	BRA: Stratum 08
07609	BRA: Stratum 09
07610	BRA: Stratum 10
07611	BRA: Stratum 11
07612	BRA: Stratum 12
07613	BRA: Stratum 13
07614	BRA: Stratum 14
07615	BRA: Stratum 15
07616	BRA: Stratum 16
07617	BRA: Stratum 17
07618	BRA: Stratum 18
07619	BRA: Stratum 19
07620	BRA: Stratum 20
07621	BRA: Stratum 21
07622	BRA: Stratum 22
07623	BRA: Stratum 23
07624	BRA: Stratum 24
07625	BRA: Stratum 25
07626	BRA: Stratum 26
07627	BRA: Stratum 27
07628	BRA: Stratum 28
07629	BRA: Stratum 29
07630	BRA: Stratum 30
10001	BGR: Stratum 01
10002	BGR: Stratum 02
10003	BGR: Stratum 03
10004	BGR: Stratum 04
10005	BGR: Stratum 05
10006	BGR: Stratum 06
10007	BGR: Stratum 07
10008	BGR: Stratum 08
10009	BGR: Stratum 09
10010	BGR: Stratum 10
10011	BGR: Stratum 11
10012	BGR: Stratum 12
10013	BGR: Stratum 13
12401	CAN: Stratum 01
12402	CAN: Stratum 02
12403	CAN: Stratum 03
12404	CAN: Stratum 04
12405	CAN: Stratum 05
12406	CAN: Stratum 06
12407	CAN: Stratum 07
12408	CAN: Stratum 08
12409	CAN: Stratum 09
12410	CAN: Stratum 10
12411	CAN: Stratum 11
12412	CAN: Stratum 12
12413	CAN: Stratum 13
12414	CAN: Stratum 14
12415	CAN: Stratum 15
12416	CAN: Stratum 16
12417	CAN: Stratum 17
12418	CAN: Stratum 18
12419	CAN: Stratum 19
12420	CAN: Stratum 20
12421	CAN: Stratum 21
12422	CAN: Stratum 22
12423	CAN: Stratum 23
12424	CAN: Stratum 24
12425	CAN: Stratum 25
12426	CAN: Stratum 26

12427	CAN:	Stratum 27
12428	CAN:	Stratum 28
12429	CAN:	Stratum 29
12430	CAN:	Stratum 30
12431	CAN:	Stratum 31
12432	CAN:	Stratum 32
12433	CAN:	Stratum 33
12434	CAN:	Stratum 34
12435	CAN:	Stratum 35
12436	CAN:	Stratum 36
12437	CAN:	Stratum 37
12438	CAN:	Stratum 38
12439	CAN:	Stratum 39
12440	CAN:	Stratum 40
12441	CAN:	Stratum 41
12442	CAN:	Stratum 42
12443	CAN:	Stratum 43
12444	CAN:	Stratum 44
15201	CHL:	Stratum 01
15202	CHL:	Stratum 02
15203	CHL:	Stratum 03
15204	CHL:	Stratum 04
15205	CHL:	Stratum 05
15206	CHL:	Stratum 06
15207	CHL:	Stratum 07
15208	CHL:	Stratum 08
15209	CHL:	Stratum 09
15210	CHL:	Stratum 10
15211	CHL:	Stratum 11
15212	CHL:	Stratum 12
15213	CHL:	Stratum 13
15214	CHL:	Stratum 14
15216	CHL:	Stratum 16
15219	CHL:	Stratum 19
15220	CHL:	Stratum 20
15801	TAP:	Centre
15802	TAP:	East & Little Island
15803	TAP:	Kaohsiung City
15804	TAP:	North
15805	TAP:	South
15806	TAP:	Taipei City
15807	TAP:	Certainty School Stratum
15808	TAP:	Cont. Supp. High schools
15809	TAP:	5-Year colleges
15810	TAP:	Junior parts of comprehensive high schools
15811	TAP:	Junior High schools
15812	TAP:	Practical and technical schools
15814	TAP:	Practical and technical / Working and Learning schools
15815	TAP:	Moderately small schools
15816	TAP:	Very small schools
15817	TAP:	Certainty stratum
17001	COL:	Stratum 01
17002	COL:	Stratum 02
17003	COL:	Stratum 03
19197	HRV:	Stratum 97
20301	CZE:	PRGM1_RGN1
20302	CZE:	PRGM1_RGN1_MSS
20303	CZE:	PRGM1_RGN1_VSS
20304	CZE:	PRGM1_RGN2
20305	CZE:	PRGM1_RGN2_MSS
20306	CZE:	PRGM1_RGN2_VSS
20307	CZE:	PRGM1_RGN3
20308	CZE:	PRGM1_RGN3_MSS
20309	CZE:	PRGM1_RGN3_VSS
20310	CZE:	PRGM1_RGN4
20311	CZE:	PRGM1_RGN4_MSS
20312	CZE:	PRGM1_RGN4_VSS
20313	CZE:	PRGM1_RGN5
20314	CZE:	PRGM1_RGN5_MSS
20315	CZE:	PRGM1_RGN5_VSS
20316	CZE:	PRGM1_RGN6
20317	CZE:	PRGM1_RGN6_MSS
20318	CZE:	PRGM1_RGN6_VSS
20319	CZE:	PRGM1_RGN7
20320	CZE:	PRGM1_RGN7_MSS
20321	CZE:	PRGM1_RGN7_VSS
20322	CZE:	PRGM1_RGN8
20323	CZE:	PRGM1_RGN8_MSS
20324	CZE:	PRGM1_RGN8_VSS
20325	CZE:	PRGM1_RGN9
20326	CZE:	PRGM1_RGN9_MSS
20327	CZE:	PRGM1_RGN9_VSS
20328	CZE:	PRGM1_RGN10
20329	CZE:	PRGM1_RGN10_MSS
20330	CZE:	PRGM1_RGN10_VSS
20331	CZE:	PRGM1_RGN11
20332	CZE:	PRGM1_RGN11_MSS
20333	CZE:	PRGM1_RGN11_VSS
20334	CZE:	PRGM1_RGN 12
20335	CZE:	PRGM1_RGN 12_MSS
20336	CZE:	PRGM1_RGN 12_VSS
20337	CZE:	PRGM1_RGN13
20338	CZE:	PRGM1_RGN13_MSS
20339	CZE:	PRGM1_RGN13_VSS
20340	CZE:	PRGM1_RGN14
20341	CZE:	PRGM1_RGN14_MSS
20342	CZE:	PRGM1_RGN14_VSS
20343	CZE:	PRGM2_RGN1
20345	CZE:	PRGM2_RGN2
20346	CZE:	PRGM2_RGN2_MSS
20347	CZE:	PRGM2_RGN3
20348	CZE:	PRGM2_RGN3_MSS
20349	CZE:	PRGM2_RGN4
20351	CZE:	PRGM2_RGN5
20352	CZE:	PRGM2_RGN5_SS
20353	CZE:	PRGM2_RGN6
20354	CZE:	PRGM2_RGN6_SS
20355	CZE:	PRGM2_RGN7
20356	CZE:	PRGM2_RGN7_MSS
20357	CZE:	PRGM2_RGN8
20358	CZE:	PRGM2_RGN8_SS
20359	CZE:	PRGM2_RGN9
20360	CZE:	PRGM2_RGN9_MSS
20361	CZE:	PRGM2_RGN10
20362	CZE:	PRGM2_RGN10_MSS
20363	CZE:	PRGM2_RGN11
20364	CZE:	PRGM2_RGN11_MSS
20365	CZE:	PRGM2_RGN 12
20366	CZE:	PRGM2_RGN 12_SS
20367	CZE:	PRGM2_RGN13
20368	CZE:	PRGM2_RGN13_SS
20369	CZE:	PRGM2_RGN14
20370	CZE:	PRGM2_RGN14_SS
20371	CZE:	PRGM3
20372	CZE:	PRGM4
20373	CZE:	PRGM5
20374	CZE:	PRGM6
20375	CZE:	PRGM3456_MSS
20376	CZE:	PRGM3456_VSS
20801	DNK:	VSS
20802	DNK:	MSS
20803	DNK:	LARGE
23301	EST:	Estonian Schools
23302	EST:	Russian Schools
23303	EST:	Estonian/Russian Schools
23304	EST:	Moderately small schools
23305	EST:	Very small schools
23306	EST:	Certainty stratum
24601	FIN:	Uusimaa, rural
24602	FIN:	Uusimaa, urban

24603	FIN:	Southern Finland, rural
24604	FIN:	Southern Finland, urban
24605	FIN:	Eastern Finland, rural
24606	FIN:	Eastern Finland, urban
24607	FIN:	Mid-Finland, rural
24608	FIN:	Mid-Finland, urban
24609	FIN:	Northern Finland, rural
24610	FIN:	Northern Finland, urban
24611	FIN:	Ahvenanmaa, rural
24612	FIN:	Ahvenanmaa, urban
25001	FRA:	Lycées généraux et technologiques
25002	FRA:	Collèges
25003	FRA:	Lycées professionnels
25004	FRA:	Lycées agricoles
25005	FRA:	Moderately Small schools
25006	FRA:	Very Small schools
27697	DEU:	Stratum 97
30001	GRC:	Stratum 01
30002	GRC:	Stratum 02
30003	GRC:	Stratum 03
30004	GRC:	Stratum 04
30005	GRC:	Stratum 05
30006	GRC:	Stratum 06
30007	GRC:	Stratum 07
30008	GRC:	Stratum 08
30009	GRC:	Stratum 09
30010	GRC:	Stratum 10
30011	GRC:	Stratum 11
30012	GRC:	Stratum 12
30013	GRC:	Stratum 13
30014	GRC:	Stratum 14
30015	GRC:	Stratum 15
30016	GRC:	Stratum 16
34401	HKG:	Government
34402	HKG:	Aided or Caput
34403	HKG:	Private
34404	HKG:	Direct Subsidy Scheme
34802	HUN:	VOC
34803	HUN:	SCNDRY_VOC
34804	HUN:	GRAMMAR
34805	HUN:	MSS
34806	HUN:	VSS
35201	ISL:	Reykjavik
35202	ISL:	Reykjavik neighbouring munincipalities
35203	ISL:	Reykjanes peninsula
35204	ISL:	West
35205	ISL:	West fjords
35206	ISL:	North-West
35207	ISL:	North-East
35208	ISL:	East
35209	ISL:	South
36001	IDN:	Stratum 01
36002	IDN:	Stratum 02
36003	IDN:	Stratum 03
36004	IDN:	Stratum 04
36005	IDN:	Stratum 05
36007	IDN:	Stratum 07
36008	IDN:	Stratum 08
36009	IDN:	Stratum 09
36010	IDN:	Stratum 10
36011	IDN:	Stratum 11
36012	IDN:	Stratum 12
36013	IDN:	Stratum 13
36014	IDN:	Stratum 14
36015	IDN:	Stratum 15
36016	IDN:	Stratum 16
36017	IDN:	Stratum 17
36018	IDN:	Stratum 18
36019	IDN:	Stratum 19
36020	IDN:	Stratum 20
36022	IDN:	Stratum 22
36023	IDN:	Stratum 23
36024	IDN:	Stratum 24
36026	IDN:	Stratum 26
36028	IDN:	Stratum 28
36029	IDN:	Stratum 29
36030	IDN:	Stratum 30
36031	IDN:	Stratum 31
36032	IDN:	Stratum 32
37201	IRL:	Enrollment size <=40
37202	IRL:	Enrollment size between 41 and 80
37203	IRL:	Enrollment size > 80
37601	ISR:	Stratum 01
37602	ISR:	Stratum 02
37603	ISR:	Stratum 03
37604	ISR:	Stratum 04
37605	ISR:	Stratum 05
37606	ISR:	Stratum 06
37607	ISR:	Stratum 07
37608	ISR:	Stratum 08
37609	ISR:	Stratum 09
38001	ITA:	Region 08 – Licei – large schools + moderately small
38002	ITA:	Region 08 – Tecnici – large schools + moderately small
38003	ITA:	Region 08 – Professionali – large schools + moderately small
38004	ITA:	Region 08 – Medie – large schools + moderately small
38005	ITA:	Region 07 – Licei – large schools
38006	ITA:	Region 07 – Tecnici – large schools
38007	ITA:	Region 07 – Professionali – large schools
38009	ITA:	Region 07 – Formazione professionale – large schools
38010	ITA:	Region 06 – Licei – large schools
38011	ITA:	Region 06 – Tecnici – large schools
380 12	ITA:	Region 06 – Professionali – large schools
38014	ITA:	Region 06 – Formazione professionale – census
38015	ITA:	Region 99 – Licei – large schools
38016	ITA:	Region 99 – Tecnici – large schools
38017	ITA:	Region 99 – Professionali – large schools
38019	ITA:	Region 13 – Licei – large schools
38020	ITA:	Region 13 – Tecnici – large schools
38021	ITA:	Region 13 – Professionali – large schools
38023	ITA:	Region 13 – Formazione professionale – large schools
38024	ITA:	Region 12 – Licei – large schools
38025	ITA:	Region 12 – Tecnici – large schools + moderately small
38026	ITA:	Region 12 – Professionali – large schools + moderately small
38028	ITA:	Region 12 – Formazione professionale – census
38029	ITA:	Region 01 – Licei – census
38030	ITA:	Region 01 – Tecnici – census
38031	ITA:	Region 01 – Professionali – census
38032	ITA:	Region 01 – Medie – all schools
38033	ITA:	Region 01 – Formazione professionale – census
38034	ITA:	Region 05 – Licei – large schools
38035	ITA:	Region 05 – Tecnici – large schools
38036	ITA:	Region 05 – Professionali – large schools
38038	ITA:	Region 04 - Licei - large schools
38039	ITA:	Region 04 – Tecnici – large schools
38040	ITA:	Region 04 – Professionali – large schools
38042	ITA:	Region 99 – Licei – large schools
38043	ITA:	Region 99 – Tecnici – large schools
38044	ITA:	Region 99 – Professionali – large schools
38046	ITA:	Region 03 – Licei – large schools + moderately small
38047	ITA:	Region 03 – Tecnici – large schools + moderately small
38048	ITA:	Region 03 – Professionali – large schools + moderately small
38049	ITA:	Region 03 – Medie – large schools + moderately small
38050	ITA:	Region 09 – Licei – large schools+ moderately small

38051	ITA:	Region 09 – Tecnici – large schools+ moderately small
38052	ITA:	Region 09 – Professionali – large schools+ moderately small
38053	ITA:	Region 09 – Medie – moderately small schools
38054	ITA:	Region 99 – Licei – large schools
38055	ITA:	Region 99 – Tecnici – large schools
38056	ITA:	Region 99 – Professionali – large schools
38058	ITA:	Region 02 – Licei – large schools
38059	ITA:	Region 02 – Tecnici – large schools
38060	ITA:	Region 02 – Professionali – large schools
38062	ITA:	Region 02 – Formazione professionale – census
38063	ITA:	Region 10 – Licei – large schools
38064	ITA:	Region 10 – Tecnici – large schools
38065	ITA:	Region 10 – Professionali – large schools
38067	ITA:	Region 11 – Licei – large schools
38068	ITA:	Region 11 – Tecnici – large schools
38069	ITA:	Region 11 – Professionali – large schools
38070	ITA:	Region 11 – Medie – large schools
38071	ITA:	Region 99 – Licei – large schools
38072	ITA:	Region 99 – Tecnici – large schools
38073	ITA:	Region 99 – Professionali – large schools
38075	ITA:	Region 02 – moderately small schools
38076	ITA:	Region 02 – very small schools
38077	ITA:	Region 03 – very small schools
38078	ITA:	Region 04 – moderately small schools
38079	ITA:	Region 04 – very small schools
38080	ITA:	Region 05 – moderately small schools
38081	ITA:	Region 05 – very small schools
38082	ITA:	Region 06 – moderately small schools
38083	ITA:	Region 06 – very small schools
38084	ITA:	Region 07 – moderately small schools
38085	ITA:	Region 07 – very small schools
38086	ITA:	Region 08 – very small schools
38087	ITA:	Region 09 – very small schools
38088	ITA:	Region 10 – moderately small schools
38089	ITA:	Region 10 – very small schools
38090	ITA:	Region 11 – moderately small schools
38091	ITA:	Region 11 – very small schools
38092	ITA:	Region 12 – very small schools
38093	ITA:	Region 13 – moderately small schools
38094	ITA:	Region 13 – very small schools
38095	ITA:	Region 99 – moderately small schools
38096	ITA:	Region 99 – very small schools
38098	ITA:	Certainty stratum
38099	ITA:	Region 05 – Sloveni census
39201	JPN:	Public & Academic Course
39202	JPN:	Public & Practical Course
39203	JPN:	Private & Academic Course
39204	JPN:	Private & Practical Course
40001	JOR:	Stratum 01
40002	JOR:	Stratum 02
40003	JOR:	Stratum 03
40004	JOR:	Stratum 04
40005	JOR:	Stratum 05
40006	JOR:	Stratum 06
41001	KOR:	Stratum 01
41002	KOR:	Stratum 02
41003	KOR:	Stratum 03
41004	KOR:	Stratum 04
41005	KOR:	Stratum 05
41701	KGZ:	Batken / Rural / Russian
41702	KGZ:	Batken / Rural / Kyrgyz
41703	KGZ:	Batken / Rural / Uzbek
41704	KGZ:	Batken / Town / Russian
41705	KGZ:	Batken / Town / Kyrgyz
41706	KGZ:	Batken / Town / Uzbek
41707	KGZ:	Bishkek / Russian
41708	KGZ:	Bishkek / Kyrgz
41709	KGZ:	Chui / Rural / Russian
41710	KGZ:	Chui Rural / Kyrgz
41711	KGZ:	Chui / Town / Russian
41712	KGZ:	Chui / Town / Kyrgz
41714	KGZ:	Issykkul / Rural / Russian
41715	KGZ:	Issykkul / Rural / Kyrgz
41716	KGZ:	Issykkul / Town / Russian
41717	KGZ:	Issykkul / Town / Kyrgz
41718	KGZ:	Jalalabat / Rural / Russian
41719	KGZ:	Jalalabat / Rural / Kyrgz
41720	KGZ:	Jalalabat / Rural / Uzbek
41721	KGZ:	Jalalabat / Town / Russian
41722	KGZ:	Jalalabat / Town / Kyrgz
41723	KGZ:	Jalalabat / Town / Uzbek
41724	KGZ:	Naryn / Rural / Russian
41725	KGZ:	Naryn / Rural / Kyrgz
41726	KGZ:	Naryn / Town / Russian
41727	KGZ:	Naryn / Town / Kyrgz
41728	KGZ:	Osh / Rural / Russian
41729	KGZ:	Osh / Rural / Kyrgz
41730	KGZ:	Osh / Rural / Uzbek
41731	KGZ:	Osh / Town / Russian
41732	KGZ:	Osh / Town / Kyrgz
41733	KGZ:	Osh / Town / Uzbek
41734	KGZ:	Osh City / Rural / Kyrgz
41735	KGZ:	Osh City / Town / Russian
41736	KGZ:	Osh City / Town / Kyrgz
41737	KGZ:	Osh City / Town / Uzbek
41738	KGZ:	Talas / Rural / Russian
41739	KGZ:	Talas / Rural / Kyrgyz
41740	KGZ:	Talas / Town / Russian
41741	KGZ:	Talas / Town / Kyrgyz
41742	KGZ:	Moderately Small Schools
41743	KGZ:	Very Small Schools
41744	KGZ:	Certainty School Stratum
42801	LVA:	Stratum 01
42802	LVA:	Stratum 02
42803	LVA:	Stratum 03
42804	LVA:	Stratum 04
43875	LIE:	Stratum 75
44001	LTU:	Stratum 01
44002	LTU:	Stratum 02
44003	LTU:	Stratum 03
44004	LTU:	Stratum 04
44005	LTU:	Stratum 05
44006	LTU:	Stratum 06
44297	LUX:	Stratum 97
44601	MAC:	Gov, Grammar-International, Chinese and Portuguese
44602	MAC:	Gov, Technical-Prevocational, Chinese
44603	MAC:	Private-In-Net, Grammar-International, Chinese
44604	MAC:	Private-In-Net, Grammar-International, English
44605	MAC:	Private-In-Net, Grammar-International, English and Chinese
44606	MAC:	Private-In-Net, Technical-Prevocational, Chinese
44607	MAC:	Private-not-in-Net, Grammar-International, Chinese
44608	MAC:	Private-not-in-Net, Grammar-International, English
44609	MAC:	Private-not-in-Net, Grammar-International, Portuguese
44610	MAC:	Private-not-in-Net, Grammar-International, Chinese and English
48401	MEX:	AGUASCALIENTES, Lower Secondary
48402	MEX:	AGUASCALIENTES, Upper Secondary
48403	MEX:	BAJA CALIFORNIA, Lower Secondary
48404	MEX:	BAJA CALIFORNIA, Upper Secondary
48405	MEX:	BAJA CALIFORNIA SUR, Lower Secondary
48406	MEX:	BAJA CALIFORNIA SUR, Upper Secondary
48407	MEX:	CAMPECHE, Lower Secondary
48408	MEX:	CAMPECHE, Upper Secondary
48409	MEX:	CHIAPAS, Lower Secondary
48410	MEX:	CHIAPAS, Upper Secondary
48411	MEX:	CHIHUAHUA, Lower Secondary
48412	MEX:	CHIHUAHUA, Upper Secondary
48413	MEX:	COAHUILA, Lower Secondary

48414	MEX:	COAHUILA, Upper Secondary
48415	MEX:	COLIMA, Lower Secondary
48416	MEX:	COLIMA, Upper Secondary
48417	MEX:	DISTRITO FEDERAL, Lower Secondary
48418	MEX:	DISTRITO FEDERAL, Upper Secondary
48419	MEX:	DURANGO, Lower Secondary
48420	MEX:	DURANGO, Upper Secondary
48421	MEX:	GUANAJUATO, Lower Secondary
48422	MEX:	GUANAJUATO, Upper Secondary
48423	MEX:	GUERRERO, Lower Secondary
48424	MEX:	GUERRERO, Upper Secondary
48425	MEX:	HIDALGO, Lower Secondary
48426	MEX:	HIDALGO, Upper Secondary
48427	MEX:	JALISCO, Lower Secondary
48428	MEX:	JALISCO, Upper Secondary
48429	MEX:	MEXICO, Lower Secondary
48430	MEX:	MEXICO, Upper Secondary
48431	MEX:	MICHOACAN, Lower Secondary
48432	MEX:	MICHOACAN, Upper Secondary
48434	MEX:	MORELOS, Upper Secondary
48435	MEX:	NAYARIT, Lower Secondary
48436	MEX:	NAYARIT, Upper Secondary
48437	MEX:	NUEVO LEON, Lower Secondary
48438	MEX:	NUEVO LEON, Upper Secondary
48439	MEX:	OAXACA, Lower Secondary
48440	MEX:	OAXACA, Upper Secondary
48441	MEX:	PUEBLA, Lower Secondary
48442	MEX:	PUEBLA, Upper Secondary
48443	MEX:	QUERETARO, Lower Secondary
48444	MEX:	QUERETARO, Upper Secondary
48445	MEX:	QUINTANA ROO, Lower Secondary
48446	MEX:	QUINTANA ROO, Upper Secondary
48447	MEX:	SAN LUIS POTOSI, Lower Secondary
48448	MEX:	SAN LUIS POTOSI, Upper Secondary
48449	MEX:	SINALOA, Lower Secondary
48450	MEX:	SINALOA, Upper Secondary
48451	MEX:	SONORA, Lower Secondary
48452	MEX:	SONORA, Upper Secondary
48453	MEX:	TABASCO, Lower Secondary
48454	MEX:	TABASCO, Upper Secondary
48455	MEX:	TAMAULIPAS, Lower Secondary
48456	MEX:	TAMAULIPAS, Upper Secondary
48457	MEX:	TLAXCALA, Lower Secondary
48458	MEX:	TLAXCALA, Upper Secondary
48459	MEX:	VERACRUZ, Lower Secondary
48460	MEX:	VERACRUZ, Upper Secondary
48461	MEX:	YUCATAN, Lower Secondary
48462	MEX:	YUCATAN, Upper Secondary
48463	MEX:	ZACATECAS, Lower Secondary
48464	MEX:	ZACATECAS, Upper Secondary
48465	MEX:	Moderately small schools
48466	MEX:	Very small schools
48467	MEX:	Certatinty schools
49901	MNE:	Stratum 01
49902	MNE:	Stratum 02
49903	MNE:	Stratum 03
49904	MNE:	Stratum 04
52801	NLD:	Track A
52802	NLD:	Track B
55497	NZL:	Stratum 97
57801	NOR:	Stratum 01
57802	NOR:	Stratum 02
57803	NOR:	Stratum 03
57804	NOR:	Stratum 04
61601	POL:	PUBLIC
61602	POL:	PRV
61603	POL:	PRV_MSS
61604	POL:	PRV_VSS
61605	POL:	LYCEA
62097	PRT:	Stratum 97

63401	QAT:	Stratum 01
63402	QAT:	Stratum 02
63403	QAT:	Stratum 03
63404	QAT:	Stratum 04
63405	QAT:	Stratum 05
63406	QAT:	Stratum 06
63407	QAT:	Stratum 07
63408	QAT:	Stratum 08
63409	QAT:	Stratum 09
63410	QAT:	Stratum 10
63411	QAT:	Stratum 11
63412	QAT:	Stratum 12
63413	QAT:	Stratum 13
63414	QAT:	Stratum 14
63415	QAT:	Stratum 15
63417	QAT:	Stratum 17
63418	QAT:	Stratum 18
63419	QAT:	Stratum 19
63420	QAT:	Stratum 20
63421	QAT:	Stratum 21
63422	QAT:	Stratum 22
63423	QAT:	Stratum 23
63424	QAT:	Stratum 24
63425	QAT:	Stratum 25
63426	QAT:	Stratum 26
64201	ROU:	Gimnaziu
64202	ROU:	Liceu – Ciclul inferior
64203	ROU:	Scoala de Arte si Meserii
64204	ROU:	Moderately Small Schools
64205	ROU:	Very Small Schools
64301	RUS:	Stratum 01
64302	RUS:	Stratum 02
64303	RUS:	Stratum 03
64304	RUS:	Stratum 04
64305	RUS:	Stratum 05
64306	RUS:	Stratum 06
64307	RUS:	Stratum 07
64308	RUS:	Stratum 08
64309	RUS:	Stratum 09
64310	RUS:	Stratum 10
64311	RUS:	Stratum 11
64312	RUS:	Stratum 12
64313	RUS:	Stratum 13
64314	RUS:	Stratum 14
64315	RUS:	Stratum 15
64316	RUS:	Stratum 16
64317	RUS:	Stratum 17
64318	RUS:	Stratum 18
64319	RUS:	Stratum 19
64320	RUS:	Stratum 20
64321	RUS:	Stratum 21
64322	RUS:	Stratum 22
64323	RUS:	Stratum 23
64324	RUS:	Stratum 24
64325	RUS:	Stratum 25
64326	RUS:	Stratum 26
64327	RUS:	Stratum 27
64328	RUS:	Stratum 28
64329	RUS:	Stratum 29
64330	RUS:	Stratum 30
64331	RUS:	Stratum 31
64332	RUS:	Stratum 32
64333	RUS:	Stratum 33
64334	RUS:	Stratum 34
64335	RUS:	Stratum 35
64336	RUS:	Stratum 36
64337	RUS:	Stratum 37
64338	RUS:	Stratum 38
64339	RUS:	Stratum 39
64340	RUS:	Stratum 40

64341	RUS:	Stratum 41
64342	RUS:	Stratum 42
64343	RUS:	Stratum 43
64344	RUS:	Stratum 44
64345	RUS:	Stratum 45
68801	SRB:	Region 1
68802	SRB:	Region 2
68803	SRB:	Region 3
68804	SRB:	Region 4
68805	SRB:	Region 5
68806	SRB:	Region 6
68807	SRB:	Region 7
68808	SRB:	Region 8
68809	SRB:	Very small schools
68810	SRB:	Certainty stratum
70301	SVK:	Bratislavsky – basic and vocational schools
70302	SVK:	Bratislavsky – secondary, high, secondary + high schools
70303	SVK:	Bratislavsky – secondary, technical, sec. + techn. colleges
70304	SVK:	trnavsky – basic and vocational schools
70305	SVK:	trnavsky – secondary, high, secondary + high schools
70306	SVK:	trnavsky – secondary, technical, sec. + techn. colleges
70307	SVK:	trenciansky – basic and vocational schools
70308	SVK:	trenciansky – secondary, high, secondary + high schools
70309	SVK:	trenciansky – secondary, technical, sec. + techn. colleges
70310	SVK:	nitriansky – basic and vocational schools
70311	SVK:	nitriansky – secondary, high, secondary + high schools
70312	SVK:	nitriansky – secondary, technical, sec. + techn. colleges
70313	SVK:	zilinsky – basic and vocational schools
70314	SVK:	zilinsky – secondary, high, secondary + high schools
70315	SVK:	zilinsky – secondary, technical, sec. + techn. colleges
70316	SVK:	banskobytricky – basic and vocational schools
70317	SVK:	banskobytricky – secondary, high, secondary + high schools
70318	SVK:	banskobytricky – secondary, technical, sec. + techn. colleges
70319	SVK:	presovsky – - basic and vocational schools
70320	SVK:	presovsky – secondary, high, secondary + high schools
70321	SVK:	presovsky – secondary, technical, sec. + techn. colleges
70322	SVK:	kosicky – basic and vocational schools
70323	SVK:	kosicky – secondary, high, secondary + high schools
70324	SVK:	kosicky – secondary, technical, sec. + techn. colleges
70325	SVK:	Moderately small schools
70326	SVK:	Very small schools
70501	SVN:	Stratum 01
70502	SVN:	Stratum 02
70503	SVN:	Stratum 03
70504	SVN:	Stratum 04
70505	SVN:	Stratum 05
70506	SVN:	Stratum 06
70508	SVN:	Stratum 08
70509	SVN:	Stratum 09
72401	ESP:	ANDALUSIA_SCHTYPE1
72402	ESP:	ANDALUSIA_SCHTYPE2
72403	ESP:	ARAGON_SCHTYPE1
72404	ESP:	ARAGON_SCHTYPE2
72405	ESP:	ASTURIAS_SCHTYPE1
72406	ESP:	ASTURIAS_SCHTYPE2
72407	ESP:	BALEARIC_SCHTYPE1
72408	ESP:	BALEARIC_SCHTYPE2
72409	ESP:	CANARY_SCHTYPE1
72410	ESP:	CANARY_SCHTYPE2
72411	ESP:	CANTABRIA_SCHTYPE1
72412	ESP:	CANTABRIA_SCHTYPE2
72413	ESP:	CASTILEyLEON_SCHTYPE1
72414	ESP:	CASTILEyLEON_SCHTYPE2
72415	ESP:	LAMANCHA_SCHTYPE1
72416	ESP:	LAMANCHA_SCHTYPE2
72417	ESP:	CATALONIA_SCHTYPE1
72418	ESP:	CATALONIA_SCHTYPE2
72419	ESP:	EXTRAMADURA_SCHTYPE1
72420	ESP:	EXTRAMADURA_SCHTYPE2
72421	ESP:	GALICIA_SCHTYPE1
72422	ESP:	GALICIA_SCHTYPE2
72423	ESP:	LARIOJA_SCHTYPE1
72425	ESP:	MADRID_SCHTYPE1
72426	ESP:	MADRID_SCHTYPE2
72427	ESP:	MURCIA_SCHTYPE1
72428	ESP:	MURCIA_SCHTYPE2
72429	ESP:	NAVARRA_SCHTYPE1
72430	ESP:	NAVARRA_SCHTYPE2
72431	ESP:	BASQUE_SCHTYPE1
72432	ESP:	BASQUE_SCHTYPE1
72433	ESP:	BASQUE_SCHTYPE1
72434	ESP:	BASQUE_SCHTYPE2
72435	ESP:	BASQUE_SCHTYPE2
72436	ESP:	BASQUE_SCHTYPE2
72437	ESP:	VALENCIA_SCHTYPE1
72438	ESP:	VALENCIA_SCHTYPE2
72439	ESP:	CEUTAyMELILLA_SCHTYPE1
72440	ESP:	CEUTAyMELILLA_SCHTYPE2
72441	ESP:	ANDALUSIA_SS
72442	ESP:	ARAGON_SS
72443	ESP:	ASTURIAS_MSS
72444	ESP:	ASTURIAS_VSS
72445	ESP:	CANTABRIA_MSS
72446	ESP:	CANTABRIA_VSS
72447	ESP:	CASTILEyLEON_MSS
72448	ESP:	CASTILEyLEON_VSS
72449	ESP:	CATALONIA_SS
72450	ESP:	GALICIA_MSS
72451	ESP:	GALICIA_VSS
72454	ESP:	NAVARRA_SS
72455	ESP:	BASQUE_MSS
72456	ESP:	BASQUE_VSS
72457	ESP:	OTHER_SS
72458	ESP:	Certainty stratum
75201	SWE:	Stratum 01
75202	SWE:	Stratum 02
75203	SWE:	Stratum 03
75204	SWE:	Stratum 04
75205	SWE:	Stratum 05
75206	SWE:	Stratum 06
75207	SWE:	Stratum 07
75208	SWE:	Stratum 08
75209	SWE:	Stratum 09
75210	SWE:	Stratum 10
75697	CHE:	Stratum 97
76401	THA:	Stratum 01
76402	THA:	Stratum 02
76403	THA:	Stratum 03
76404	THA:	Stratum 04
76405	THA:	Stratum 05
76406	THA:	Stratum 06
76407	THA:	Stratum 07
76408	THA:	Stratum 08
76409	THA:	Stratum 09
76410	THA:	Stratum 10
76411	THA:	Stratum 11
76412	THA:	Stratum 12
78801	TUN:	PUB_EAST_LEVEL0_GEN
78802	TUN:	PUB_EAST_LEVEL1_GEN
78803	TUN:	PUB_EAST_LEVEL2_GEN
78804	TUN:	PUB_WEST_LEVEL0_GEN
78805	TUN:	PUB_WEST_LEVEL1_GEN
78806	TUN:	PUB_WEST_LEVEL2_GEN
78807	TUN:	PRIVATE
78808	TUN:	VOCATIONAL
78809	TUN:	VSS

78810	TUN: CERTAINTY
79201	TUR: Stratum 01
79202	TUR: Stratum 02
79203	TUR: Stratum 03
79204	TUR: Stratum 04
79205	TUR: Stratum 05
79206	TUR: Stratum 06
79207	TUR: Stratum 07
79208	TUR: Stratum 08
79209	TUR: Stratum 09
82601	GBR: Scotland: SGRADE_LOW
82602	GBR: Scotland: SGRADE_LOWMID
82603	GBR: Scotland: SGRADE_MID
82604	GBR: Scotland: SGRADE_HIGHMID
82605	GBR: Scotland: SGRADE_HIGH
82611	GBR: NONPRU_ENG
82612	GBR: NI
82613	GBR: WALES
82615	GBR: CERTAINTY
84097	USA: Stratum 97
85801	URY: Stratum 01
85802	URY: Stratum 02
85803	URY: Stratum 03
85804	URY: Stratum 04
85805	URY: Stratum 05
85807	URY: Stratum 07
85810	URY: Stratum 10
85811	URY: Stratum 11
85812	URY: Stratum 12
85813	URY: Stratum 13
85814	URY: Stratum 14
85815	URY: Stratum 15
85816	URY: Stratum 16
85817	URY: Stratum 17
85818	URY: Stratum 18
85819	URY: Stratum 19

TESTLANG (483) Language of Test (3-char)	
Format: A3	Columns: 1780-1782
ARA	Arabic
AZE	Azerbaijani
BAQ	Basque
BUL	Bulgarian
CAT	Catalan
CHI	Chinese
CZE	Czech
DAN	Danish
DUT	Dutch
ENG	English
EST	Estonian
FIN	Finnish
FRE	French
GER	German
GLE	Irish
GLG	Galician
GRE	Greek, Modern
HEB	Hebrew
HUN	Hungarian
ICE	Icelandic
IND	Indonesian
ITA	Italian
JPN	Japanese
KIR	Kyrgyz
KOR	Korean
LAV	Latvian
LIT	Lithuanian
NOR	Norwegian
POL	Polish
POR	Portuguese
QMN	Montenegrin
QTU	Arabic dialect (TUN)
QVL	Valencian
RUM	Romanian
RUS	Russian
SCC	Serbian
SCR	Croatian
SLO	Slovak
SLV	Slovenian
SPA	Spanish
SWE	Swedish
THA	Thai
TUR	Turkish
UZB	Uzbek
WEL	Welsh

CLCUSE3A (484) Effort A: real	
Format: F3.0	Columns: 1783-1785
997	N/A
998	Invalid
999	Missing

CLCUSE3B (485) Effort B: if counted	
Format: F3.0	Columns: 1786-1788
997	N/A
998	Invalid
999	Missing

DEFFORT (486) Effort B - Effort A	
Format: F3.0	Columns: 1789-1791
997	N/A
998	Invalid
999	Missing

S421Q02 (487) Deleted science item - Big and Small (Q02)	
Format: A1	Columns: 1792-1792
0	No credit
1	Full credit
7	Not administered
9	Missing

S456Q01 (488) Deleted science item - The Cheetah (Q01)	
Format: A2	Columns: 1793-1794
11	Yes, Yes: Full credit
12	Yes, No: No credit
18	Yes, Invalid: No credit
19	Yes, Missing: No credit
21	No, Yes: No credit
22	No, No: No credit
28	No, Invalid: No credit
29	No, Missing: No credit
71	N/A, Yes: Not administered
77	N/A, N/A: Not administered
81	Invalid, Yes: No credit
82	Invalid, No: No credit
88	Invalid, Invalid: No credit
89	Invalid, Missing: No credit
91	Missing, Yes: No credit
92	Missing, No: No credit
97	Missing, N/A: Not administered
98	Missing, Invalid: No credit
99	Missing, Missing: No credit

S456Q02 (489) Deleted science item - The Cheetah (Q02)	
Format: A1	Columns: 1795-1795
1	No credit
2	No credit
3	Full credit
4	No credit
7	Not administered
8	Invalid
9	Missing

VER_STU (490) Version student database and date of release	
Format: A13	Columns: 1796-1808

APPENDIX 8

CODEBOOK FOR PISA 2006 NON-SCORED COGNITIVE AND EMBEDDED ATTITUDE ITEMS

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
SUBNATIO	Adjudicated sub-region	1-5
A5	See Appendix 7 for labels	
SCHOOLID	School ID 5-digit	6-10
A5		
STIDSTD	Student ID 5-digit	11-15
A5		
CNT	Country code 3-character	16-18
A3	See Appendix 7 for labels	
COUNTRY	Country code 3-digit	19-21
A3	See Appendix 7 for labels	
OECD	OECD Country	22-22
F1.0	0 Non-OECD	
	1 OECD	
BOOKID	Booklet	23-24
F2.0		
M033Q01	MATH – P2000 A View Room (Q01)	26-26
Multiple Choice	1 No credit	Booklet 4: Q52
A1	2 No credit	Booklet 7: Q35
	3 No credit	Booklet 8: Q13
	4 Full credit	Booklet 9: Q1
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M034Q01T	MATH – P2000 Bricks (Q01)	27-27
Closed Constructed	0 No credit	Booklet 4: Q63
Response	1 Full credit	Booklet 7: Q46
A1	7 N/A	Booklet 8: Q24
	8 M/R	Booklet 9: Q12
	9 Missing	
	r Not reached	
M155Q01	MATH – P2000 Population Pyramids (Q01)	28-28
Open Constructed	0 No credit	Booklet 4: Q55
Response	1 Full credit	Booklet 7: Q38
A1	7 N/A	Booklet 8: Q16
	9 Missing	Booklet 9: Q4
	r Not reached	
M155Q02T	MATH – P2000 Population Pyramids (Q02)	29-29
Open Constructed	0 No credit	Booklet 4: Q54
Response	1 Partial credit	Booklet 7: Q37
A1	2 Full credit	Booklet 8: Q15
	7 N/A	Booklet 9: Q3
	9 Missing	
	r Not reached	
M155Q03T	MATH – P2000 Population Pyramids (Q03)	30-30
Open Constructed	0 No credit	Booklet 4: Q56
Response	1 Partial credit	Booklet 7: Q39
A1	2 Full credit	Booklet 8: Q17
	7 N/A	Booklet 9: Q5
	9 Missing	
	r Not reached	
M155Q04T	MATH – P2000 Population Pyramids (Q04)	31-31
Complex Multiple	0 No credit	Booklet 4: Q57
Choice	1 No credit	Booklet 7: Q40
A1	2 No credit	Booklet 8: Q18
	3 No credit	Booklet 9: Q6
	4 Full credit	
	7 N/A	
	8 M/R	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	9 Missing	
	r Not reached	
M192Q01T	MATH – P2000 Containers (Q01)	32-32
Complex Multiple	0 No credit	Booklet 3: Q45
Choice	1 No credit	Booklet 7: Q51
A1	2 Full credit	Booklet 10: Q17
	3 Full credit	Booklet 11: Q5
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M273Q01T	MATH – P2000 Pipelines (Q01)	33-33
Complex Multiple	0 No credit	Booklet 2: Q41
Choice	1 Full credit	Booklet 4: Q22
A1	7 N/A	Booklet 10: Q2
	8 M/R	Booklet 13: Q50
	9 Missing	
	r Not reached	
M302Q01T	MATH – P2003 Car Drive (Q01)	34-34
Closed Constructed	0 No credit	Booklet 3: Q53
Response	1 Full credit	Booklet 8: Q1
A1	7 N/A	Booklet 12: Q14
	8 M/R	Booklet 13: Q37
	9 Missing	Booklet UH: Q29
	r Not reached	
M302Q02	MATH – P2003 Car Drive (Q02)	35-35
Closed Constructed	0 No credit	Booklet 3: Q54
Response	1 Full credit	Booklet 8: Q2
A1	7 N/A	Booklet 12: Q15
	9 Missing	Booklet 13: Q38
	r Not reached	Booklet UH: Q30
M302Q03	MATH – P2003 Car Drive (Q03)	36-36
Open Constructed	0 No credit	Booklet 3: Q55
Response	1 Full credit	Booklet 8: Q3
A1	7 N/A	Booklet 12: Q16
	9 Missing	Booklet 13: Q39
	r Not reached	Booklet UH: Q31
M305Q01	MATH – P2003 Map (Q01)	37-37
Multiple Choice	1 No credit	Booklet 3: Q41
A1	2 No credit	Booklet 7: Q47
	3 Full credit	Booklet 10: Q13
	4 No credit	Booklet 11: Q1
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M406Q01	MATH – P2003 Running Tracks (Q01)	38-38
Open Constructed	0 No credit	Booklet 3: Q46
Response	1 Full credit	Booklet 7: Q52
A1	7 N/A	Booklet 10: Q18
	9 Missing	Booklet 11: Q6
	r Not reached	
M406Q02	MATH – P2003 Running Tracks (Q02)	39-39
Open Constructed	0 No credit	Booklet 3: Q47
Response	1 Full credit	Booklet 7: Q53
A1	7 N/A	Booklet 10: Q19
	9 Missing	Booklet 11: Q7
	r Not reached	
M408Q01T	MATH – P2003 Lotteries (Q01)	40-40
Complex Multiple	0 No credit	Booklet 2: Q42
Choice	1 No credit	Booklet 4: Q23
A1	2 No credit	Booklet 10: Q3

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	3 No credit	Booklet 13: Q51
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M411Q01	MATH – P2003 Diving (Q01)	41-41
Short Response	0 No credit	Booklet 4: Q58
A1	1 Full credit	Booklet 7: Q41
	7 N/A	Booklet 8: Q19
	9 Missing	Booklet 9: Q7
	r Not reached	
M411Q02	MATH – P2003 Diving (Q02)	42-42
Multiple Choice	1 No credit	Booklet 4: Q59
A1	2 No credit	Booklet 7: Q42
	3 No credit	Booklet 8: Q20
	4 Full credit	Booklet 9: Q8
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M420Q01T	MATH – P2003 Transport (Q01)	43-43
Complex Multiple	0 No credit	Booklet 2: Q43
Choice	1 No credit	Booklet 4: Q24
A1	2 No credit	Booklet 10: Q4
	3 No credit	Booklet 13: Q52
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M421Q01	MATH – P2003 Height (Q01)	44-44
Open Constructed	0 No credit	Booklet 3: Q56
Response	1 Full credit	Booklet 8: Q4
A1	7 N/A	Booklet 12: Q17
	9 Missing	Booklet 13: Q40
	r Not reached	
M421Q02T	MATH – P2003 Height (Q02)	45-45
Complex Multiple	0 No credit	Booklet 3: Q57
Choice	1 No credit	Booklet 8: Q5
A1	2 No credit	Booklet 12: Q18
	3 No credit	Booklet 13: Q41
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M421Q03	MATH – P2003 Height (Q03)	46-46
Multiple Choice	1 No credit	Booklet 3: Q58
A1	2 No credit	Booklet 8: Q6
	3 No credit	Booklet 12: Q19
	4 Full credit	Booklet 13: Q42
	5 No credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M423Q01	MATH – P2003 Tossing Coins (Q01)	47-47
Multiple Choice	1 Full credit	Booklet 3: Q44
A1	2 No credit	Booklet 7: Q50
	3 No credit	Booklet 10: Q16
	4 No credit	Booklet 11: Q4
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M442Q02	MATH – P2003 Braille (Q02)	48-48
Closed Constructed	0 No credit	Booklet 4: Q61
Response	1 Full credit	Booklet 7: Q44
A1	7 N/A	Booklet 8: Q22
	9 Missing	Booklet 9: Q10
	r Not reached	
M446Q01	MATH – P2003 Thermometer Cricket (Q01)	49-49
Short Response	0 No credit	Booklet 2: Q44
A1	1 Full credit	Booklet 4: Q25
	7 N/A	Booklet 10: Q5
	9 Missing	Booklet 13: Q53
	r Not reached	
M446Q02	MATH – P2003 Thermometer Cricket (Q02)	50-50
Open Constructed	0 No credit	Booklet 2: Q45
Response	1 Full credit	Booklet 4: Q26
A1	7 N/A	Booklet 10: Q6
	9 Missing	Booklet 13: Q54
	r Not reached	
M447Q01	MATH – P2003 Tile Arrangement (Q01)	51-51
Multiple Choice	1 No credit	Booklet 2: Q40
A1	2 No credit	Booklet 4: Q21
	3 No credit	Booklet 10: Q1
	4 Full credit	Booklet 13: Q49
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M462Q01T	MATH – P2003 Third Side (Q01)	52-52
Open Constructed	0 No credit	Booklet 4: Q62
Response	1 Partial credit	Booklet 7: Q45
A1	2 Full credit	Booklet 8: Q23
	7 N/A	Booklet 9: Q11
	9 Missing	Booklet UH: Q26
	r Not reached	
M464Q01T	MATH – P2003 The Fence (Q01)	53-53
Short Response	0 No credit	Booklet 2: Q50
A1	1 Full credit	Booklet 4: Q31
	7 N/A	Booklet 10: Q11
	8 M/R	Booklet 13: Q59
	9 Missing	
	r Not reached	
M474Q01	MATH – P2003 Running Time (Q01)	54-54
Closed Constructed	0 No credit	Booklet 4: Q53
Response	1 Full credit	Booklet 7: Q36
A1	7 N/A	Booklet 8: Q14
	9 Missing	Booklet 9: Q2
	r Not reached	
M496Q01T	MATH – P2003 Cash Withdrawal (Q01)	55-55
Complex Multiple	0 No credit	Booklet 3: Q42
Choice	1 No credit	Booklet 7: Q48
A1	2 No credit	Booklet 10: Q14
	3 No credit	Booklet 11: Q2
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M496Q02	MATH – P2003 Cash Withdrawal (Q02)	56-56
Short Response	0 No credit	Booklet 3: Q43
A1	1 Full credit	Booklet 7: Q49
	7 N/A	Booklet 10: Q15
	9 Missing	Booklet 11: Q3
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M559Q01	MATH – P2003 Telephone Rates (Q01)	57-57
Multiple Choice A1	1 No credit	Booklet 2: Q46
	2 No credit	Booklet 4: Q27
	3 No credit	Booklet 10: Q7
	4 Full credit	Booklet 13: Q55
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M564Q01	MATH – P2003 Chair Lift (Q01)	58-58
Multiple Choice A1	1 No credit	Booklet 3: Q51
	2 Full credit	Booklet 7: Q57
	3 No credit	Booklet 10: Q23
	4 No credit	Booklet 11: Q11
	7 N/A	Booklet UH: Q27
	8 M/R	
	9 Missing	
	r Not reached	
M564Q02	MATH – P2003 Chair Lift (Q02)	59-59
Multiple Choice A1	1 No credit	Booklet 3: Q52
	2 No credit	Booklet 7: Q58
	3 Full credit	Booklet 10: Q24
	4 No credit	Booklet 11: Q12
	5 No credit	Booklet UH: Q28
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M571Q01	MATH – P2003 Stop The Car (Q01)	60-60
Multiple Choice A1	1 No credit	Booklet 3: Q50
	2 No credit	Booklet 7: Q56
	3 No credit	Booklet 10: Q22
	4 Full credit	Booklet 11: Q10
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M598Q01	MATH – P2003 Making A Booklet (Q01)	61-61
Closed Constructed Response A1	0 No credit	Booklet 3: Q60
	1 Full credit	Booklet 8: Q8
	7 N/A	Booklet 12: Q21
	9 Missing	Booklet 13: Q44
	r Not reached	
M603Q01T	MATH – P2003 Number Check (Q01)	62-62
Complex Multiple Choice A1	0 No credit	Booklet 3: Q48
	1 No credit	Booklet 7: Q54
	2 No credit	Booklet 10: Q20
	3 Full credit	Booklet 11: Q8
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M603Q02T	MATH – P2003 Number Check (Q02)	63-63
Short Response A1	0 No credit	Booklet 3: Q49
	1 Full credit	Booklet 7: Q55
	7 N/A	Booklet 10: Q21
	8 M/R	Booklet 11: Q9
	9 Missing	
	r Not reached	
M710Q01	MATH – P2003 Forecast of Rain (Q01)	64-64
Multiple Choice A1	1 No credit	Booklet 3: Q59
	2 No credit	Booklet 8: Q7
	3 No credit	Booklet 12: Q20
	4 Full credit	Booklet 13: Q43
	5 No credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M800Q01	MATH – P2003 Computer Game (Q01)	65-65
Multiple Choice A1	1 No credit	Booklet 2: Q51
	2 No credit	Booklet 4: Q32
	3 Full credit	Booklet 10: Q12
	4 No credit	Booklet 13: Q60
	7 N/A	Booklet UH: Q25
	8 M/R	
	9 Missing	
	r Not reached	
M803Q01T	MATH – P2003 Labels (Q01)	66-66
Short Response A1	0 No credit	Booklet 4: Q60
	1 Full credit	Booklet 7: Q43
	7 N/A	Booklet 8: Q21
	8 M/R	Booklet 9: Q9
	9 Missing	
	r Not reached	
M810Q01T	MATH – P2003 Bicycles (Q01)	67-67
Short Response A1	0 No credit	Booklet 3: Q61
	1 Full credit	Booklet 8: Q9
	7 N/A	Booklet 12: Q22
	8 M/R	Booklet 13: Q45
	9 Missing	
	r Not reached	
M810Q02T	MATH – P2003 Bicycles (Q02)	68-68
Short Response A1	0 No credit	Booklet 3: Q62
	1 Full credit	Booklet 8: Q10
	7 N/A	Booklet 12: Q23
	8 M/R	Booklet 13: Q46
	9 Missing	
	r Not reached	
M810Q03T	MATH – P2003 Bicycles (Q03)	69-69
Open Constructed Response A1	0 No credit	Booklet 3: Q63
	1 Partial credit	Booklet 8: Q11
	2 Full credit	Booklet 12: Q24
	7 N/A	Booklet 13: Q47
	9 Missing	
	r Not reached	
M828Q01	MATH – P2003 Carbon Dioxide (Q01)	70-70
Open Constructed Response A1	0 No credit	Booklet 2: Q47
	1 Full credit	Booklet 4: Q28
	7 N/A	Booklet 10: Q8
	9 Missing	Booklet 13: Q56
	r Not reached	
M828Q02	MATH – P2003 Carbon Dioxide (Q02)	71-71
Short Response A1	0 No credit	Booklet 2: Q48
	1 Full credit	Booklet 4: Q29
	7 N/A	Booklet 10: Q9
	9 Missing	Booklet 13: Q57
	r Not reached	
M828Q03	MATH – P2003 Carbon Dioxide (Q03)	72-72
Short Response A1	0 No credit	Booklet 2: Q49
	1 Full credit	Booklet 4: Q30
	7 N/A	Booklet 10: Q10
	9 Missing	Booklet 13: Q58
	r Not reached	
M833Q01T	MATH – P2003 Seeing the tower (Q01)	73-73
Complex Multiple Choice A1	0 No credit	Booklet 3: Q64
	1 No credit	Booklet 8: Q12
	2 No credit	Booklet 12: Q25
	3 No credit	Booklet 13: Q48
	4 No credit	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	5 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R055Q01	READ – P2000 Drugged Spiders (Q01)	74-74
Multiple Choice	1 No credit	Booklet 6: Q28
A1	2 No credit	Booklet 9: Q63
	3 No credit	Booklet 11: Q40
	4 Full credit	Booklet 13: Q9
	7 N/A	Booklet UH: Q21
	8 M/R	
	9 Missing	
	r Not reached	
R055Q02	READ – P2000 Drugged Spiders (Q02)	75-75
Open Constructed	0 No credit	Booklet 6: Q29
Response	1 Full credit	Booklet 9: Q64
A1	7 N/A	Booklet 11: Q41
	9 Missing	Booklet 13: Q10
	r Not reached	Booklet UH: Q22
R055Q03	READ – P2000 Drugged Spiders (Q03)	76-76
Open Constructed	0 No credit	Booklet 6: Q30
Response	1 No credit	Booklet 9: Q65
A1	2 Full credit	Booklet 11: Q42
	7 N/A	Booklet 13: Q11
	9 Missing	Booklet UH: Q23
	r Not reached	
R055Q05	READ – P2000 Drugged Spiders (Q05)	77-77
Open Constructed	0 No credit	Booklet 6: Q31
Response	1 Full credit	Booklet 9: Q66
A1	7 N/A	Booklet 11: Q43
	9 Missing	Booklet 13: Q12
	r Not reached	Booklet UH: Q24
R067Q01	READ – P2000 Aesop (Q01)	78-78
Multiple Choice	1 No credit	Booklet 2: Q54
A1	2 No credit	Booklet 6: Q37
	3 Full credit	Booklet 7: Q24
	4 No credit	Booklet 12: Q3
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R067Q04	READ – P2000 Aesop (Q04)	79-79
Open Constructed	0 No credit	Booklet 2: Q55
Response	1 Partial credit	Booklet 6: Q38
A1	2 Full credit	Booklet 7: Q25
	7 N/A	Booklet 12: Q4
	9 Missing	
	r Not reached	
R067Q05	READ – P2000 Aesop (Q05)	80-80
Open Constructed	0 No credit	Booklet 2: Q56
Response	1 Partial credit	Booklet 6: Q39
A1	2 Full credit	Booklet 7: Q26
	7 N/A	Booklet 12: Q5
	9 Missing	
	r Not reached	
R102Q04A	READ – P2000 Shirts (Q04a)	81-81
Open Constructed	0 No credit	Booklet 2: Q57
Response	1 Full credit	Booklet 6: Q40
A1	7 N/A	Booklet 7: Q27
	9 Missing	Booklet 12: Q6
	r Not reached	
R102Q05	READ – P2000 Shirts (Q05)	82-82
Closed Constructed	0 No credit	Booklet 2: Q58
Response	1 Full credit	Booklet 6: Q41
A1	7 N/A	Booklet 7: Q28

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	9 Missing	Booklet 12: Q7
	r Not reached	
R102Q07	READ – P2000 Shirts (Q07)	83-83
Multiple Choice	1 No credit	Booklet 2: Q59
A1	2 No credit	Booklet 6: Q42
	3 Full credit	Booklet 7: Q29
	4 No credit	Booklet 12: Q8
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R104Q01	READ – P2000 Telephone (Q01)	84-84
Closed Constructed	0 No credit	Booklet 6: Q32
Response	1 Full credit	Booklet 9: Q67
A1	7 N/A	Booklet 11: Q44
	9 Missing	Booklet 13: Q13
	r Not reached	
R104Q02	READ – P2000 Telephone (Q02)	85-85
Closed Constructed	0 No credit	Booklet 6: Q33
Response	1 Full credit	Booklet 9: Q68
A1	7 N/A	Booklet 11: Q45
	9 Missing	Booklet 13: Q14
	r Not reached	
R104Q05	READ – P2000 Telephone (Q05)	86-86
Short Response	0 No credit	Booklet 6: Q34
A1	1 Partial credit	Booklet 9: Q69
	2 Full credit	Booklet 11: Q46
	7 N/A	Booklet 13: Q15
	9 Missing	
	r Not reached	
R111Q01	READ – P2000 Exchange (Q01)	87-87
Multiple Choice	1 No credit	Booklet 6: Q24
A1	2 No credit	Booklet 9: Q59
	3 No credit	Booklet 11: Q36
	4 Full credit	Booklet 13: Q5
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R111Q02B	READ – P2000 Exchange (Q02b)	88-88
Open Constructed	0 No credit	Booklet 6: Q25
Response	1 Partial credit	Booklet 9: Q60
A1	2 Full credit	Booklet 11: Q37
	7 N/A	Booklet 13: Q6
	9 Missing	
	r Not reached	
R111Q06B	READ – P2000 Exchange (Q06b)	89-89
Open Constructed	0 No credit	Booklet 6: Q27
Response	1 Partial credit	Booklet 9: Q62
A1	2 Full credit	Booklet 11: Q39
	7 N/A	Booklet 13: Q8
	9 Missing	
	r Not reached	
R219Q01E	READ – P2000 Employment (Q01e)	90-90
Short Response	0 No credit	Booklet 2: Q52
A1	1 Full credit	Booklet 6: Q35
	7 N/A	Booklet 7: Q22
	9 Missing	Booklet 12: Q1
	r Not reached	Booklet UH: Q19
R219Q01T	READ – P2000 Employment (Q01)	91-91
Closed Constructed	0 No credit	Booklet 2: Q52
Response	1 No credit	Booklet 6: Q35
A1	2 No credit	Booklet 7: Q22
	3 No credit	Booklet 12: Q1
	4 Full credit	Booklet UH: Q19
	7 N/A	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
R219Q02	READ – P2000 Employment (Q02)	92-92
Open Constructed	0 No credit	Booklet 2: Q53
Response	1 Full credit	Booklet 6: Q36
A1	7 N/A	Booklet 7: Q23
	9 Missing	Booklet 12: Q2
	r Not reached	Booklet UH: Q20
R220Q01	READ – P2000 South Pole (Q01)	93-93
Short Response	0 No credit	Booklet 2: Q60
A1	1 Full credit	Booklet 6: Q43
	7 N/A	Booklet 7: Q30
	9 Missing	Booklet 12: Q9
	r Not reached	
R220Q02B	READ – P2000 South Pole (Q02b)	94-94
Multiple Choice	1 Full credit	Booklet 2: Q61
A1	2 No credit	Booklet 6: Q44
	3 No credit	Booklet 7: Q31
	4 No credit	Booklet 12: Q10
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R220Q04	READ – P2000 South Pole (Q04)	95-95
Multiple Choice	1 No credit	Booklet 2: Q62
A1	2 No credit	Booklet 6: Q45
	3 No credit	Booklet 7: Q32
	4 Full credit	Booklet 12: Q11
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R220Q05	READ – P2000 South Pole (Q05)	96-96
Multiple Choice	1 No credit	Booklet 2: Q63
A1	2 No credit	Booklet 6: Q46
	3 Full credit	Booklet 7: Q33
	4 No credit	Booklet 12: Q12
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R220Q06	READ – P2000 South Pole (Q06)	97-97
Multiple Choice	1 No credit	Booklet 2: Q64
A1	2 No credit	Booklet 6: Q47
	3 Full credit	Booklet 7: Q34
	4 No credit	Booklet 12: Q13
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R227Q01	READ – P2000 Optician (Q01)	98-98
Multiple Choice	1 No credit	Booklet 6: Q20
A1	2 Full credit	Booklet 9: Q55
	3 No credit	Booklet 11: Q32
	4 No credit	Booklet 13: Q1
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
R227Q02T	READ – P2000 Optician (Q02)	99-99
Complex Multiple	0 No credit	Booklet 6: Q21
Choice	1 Partial credit	Booklet 9: Q56
A1	2 Full credit	Booklet 11: Q33
	7 N/A	Booklet 13: Q2
	8 M/R	
	9 Missing	
	r Not reached	
R227Q03	READ – P2000 Optician (Q03)	100-100
Open Constructed	0 No credit	Booklet 6: Q22
Response	1 Full credit	Booklet 9: Q57
A1	7 N/A	Booklet 11: Q34

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	9 Missing	Booklet 13: Q3
	r Not reached	
R227Q06	READ – P2000 Optician (Q06)	101-101
Short Response	0 No credit	Booklet 6: Q23
A1	1 Full credit	Booklet 9: Q58
	7 N/A	Booklet 11: Q35
	9 Missing	Booklet 13: Q4
	r Not reached	
S114Q03T	SCIE – P2000 Greenhouse (Q03)	102-102
Open Response	0 No credit	Booklet 1: Q28
A1	1 Full credit	Booklet 2: Q6
	7 N/A	Booklet 8: Q30
	9 Missing	Booklet 11: Q52
	r Not reached	
S114Q04T	SCIE – P2000 Greenhouse (Q04)	103-103
Open Response	0 No credit	Booklet 1: Q29
A1	1 Partial credit	Booklet 2: Q7
	2 Full credit	Booklet 8: Q31
	7 N/A	Booklet 11: Q53
	9 Missing	
	r Not reached	
S114Q05T	SCIE – P2000 Greenhouse (Q05)	104-104
Open Response	0 No credit	Booklet 1: Q30
A1	1 Full credit	Booklet 2: Q8
	7 N/A	Booklet 8: Q32
	9 Missing	Booklet 11: Q54
	r Not reached	
S131Q02T	SCIE – P2000 Good Vibrations (Q02)	105-105
Open Response	0 No credit	Booklet 4: Q34
A1	1 Full credit	Booklet 5: Q2
	7 N/A	Booklet 11: Q14
	9 Missing	Booklet 12: Q49
	r Not reached	
S131Q04T	SCIE – P2006 (broken link) Good Vibrations (Q04)	106-106
Open Response	0 No credit	Booklet 4: Q35
A1	1 Full credit	Booklet 5: Q3
	7 N/A	Booklet 11: Q15
	9 Missing	Booklet 12: Q50
	r Not reached	
S213Q01T	SCIE – P2000 Clothes (Q01)	107-107
Complex Multiple	0 No credit	Booklet 1: Q65
Choice	1 No credit	Booklet 5: Q42
A1	2 No credit	Booklet 7: Q4
	3 No credit	Booklet 13: Q19
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S213Q02	SCIE – P2000 Clothes (Q02)	108-108
Multiple Choice	1 Full credit	Booklet 1: Q66
A1	2 No credit	Booklet 5: Q43
	3 No credit	Booklet 7: Q5
	4 No credit	Booklet 13: Q20
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S256Q01	SCIE – P2000 Spoons (Q01)	109-109
Multiple Choice	1 Full credit	Booklet 4: Q33
A1	2 No credit	Booklet 5: Q1
	3 No credit	Booklet 11: Q13
	4 No credit	Booklet 12: Q48
	7 N/A	Booklet UH: Q1
	8 M/R	
	9 Missing	
	r Not reached	

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Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S268Q01	SCIE – P2000 Algae (Q01)	110-110
Multiple Choice	1 No credit	Booklet 2: Q24
A1	2 No credit	Booklet 3: Q5
	3 Full credit	Booklet 5: Q64
	4 No credit	Booklet 9: Q39
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S268Q02T	SCIE – P2000 Algae (Q02)	111-111
Open Response	0 No credit	Booklet 2: Q25
A1	1 Full credit	Booklet 3: Q6
	7 N/A	Booklet 5: Q65
	9 Missing	Booklet 9: Q40
	r Not reached	
S268Q06	SCIE – P2000 Algae (Q06)	112-112
Multiple Choice	1 No credit	Booklet 2: Q26
A1	2 Full credit	Booklet 3: Q7
	3 No credit	Booklet 5: Q66
	4 No credit	Booklet 9: Q41
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S269Q01	SCIE – P2000 Earth Temperature (Q01)	113-113
Open Response	0 No credit	Booklet 1: Q5
A1	1 Full credit	Booklet 9: Q17
	7 N/A	Booklet 10: Q48
	9 Missing	Booklet 12: Q30
	r Not reached	
S269Q03T	SCIE – P2000 Earth Temperature (Q03)	114-114
Open Response	0 No credit	Booklet 1: Q6
A1	1 Full credit	Booklet 9: Q18
	7 N/A	Booklet 10: Q49
	9 Missing	Booklet 12: Q31
	r Not reached	
S269Q04T	SCIE – P2000 Earth Temperature (Q04)	115-115
Complex Multiple	0 No credit	Booklet 1: Q7
Choice	1 No credit	Booklet 9: Q19
A1	2 No credit	Booklet 10: Q50
	3 No credit	Booklet 12: Q32
	4 Full credit	
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S304Q01	SCIE – P2003 Water (Q01)	116-116
Open Response	0 No credit	Booklet 5: Q22
A1	1 Full credit	Booklet 6: Q3
	7 N/A	Booklet 8: Q46
	9 Missing	Booklet 10: Q27
	r Not reached	
S304Q02	SCIE – P2003 Water (Q02)	117-117
Multiple Choice	1 No credit	Booklet 5: Q23
A1	2 No credit	Booklet 6: Q4
	3 Full credit	Booklet 8: Q47
	4 No credit	Booklet 10: Q28
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S304Q03A	SCIE – P2003 Water (Q03a)	118-118
Open Response	0 No credit	Booklet 5: Q24
A1	1 Full credit	Booklet 6: Q5
	7 N/A	Booklet 8: Q48
	9 Missing	Booklet 10: Q29
	r Not reached	
S304Q03B	SCIE – P2003 Water (Q03b)	119-119
Open Response	0 No credit	Booklet 5: Q25
A1	1 Full credit	Booklet 6: Q6
	7 N/A	Booklet 8: Q49

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	9 Missing	Booklet 10: Q30
	r Not reached	
S326Q01	SCIE – P2003 Milk (Q01)	120-120
Open Response	0 No credit	Booklet 1: Q44
A1	1 Full credit	Booklet 3: Q23
	7 N/A	Booklet 4: Q3
	9 Missing	Booklet 6: Q50
	r Not reached	
S326Q02	SCIE – P2003 Milk (Q02)	121-121
Open Response	0 No credit	Booklet 1: Q45
A1	1 Full credit	Booklet 3: Q24
	7 N/A	Booklet 4: Q4
	9 Missing	Booklet 6: Q51
	r Not reached	
S326Q03	SCIE – P2003 Milk (Q03)	122-122
Multiple Choice	1 No credit	Booklet 1: Q46
A1	2 Full credit	Booklet 3: Q25
	3 No credit	Booklet 4: Q5
	4 No credit	Booklet 6: Q52
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S326Q04T	SCIE – P2003 Milk (Q04)	123-123
Complex Multiple	0 No credit	Booklet 1: Q47
Choice	1 No credit	Booklet 3: Q26
A1	2 No credit	Booklet 4: Q6
	3 Full credit	Booklet 6: Q53
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408Q01	SCIE – P2006 Wild Oat Grass (Q01)	124-124
Multiple Choice	1 No credit	Booklet 1: Q48
A1	2 No credit	Booklet 3: Q27
	3 No credit	Booklet 4: Q7
	4 Full credit	Booklet 6: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408Q03	SCIE – P2006 Wild Oat Grass (Q03)	125-125
Open Response	0 No credit	Booklet 1: Q49
A1	1 Full credit	Booklet 3: Q28
	7 N/A	Booklet 4: Q8
	9 Missing	Booklet 6: Q55
	r Not reached	
S408Q04T	SCIE – P2006 Wild Oat Grass (Q04)	126-126
Complex Multiple	0 No credit	Booklet 1: Q50
Choice	1 No credit	Booklet 3: Q29
A1	2 No credit	Booklet 4: Q9
	3 Full credit	Booklet 6: Q56
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408Q05	SCIE – P2006 Wild Oat Grass (Q05)	127-127
Multiple Choice	1 No credit	Booklet 1: Q51
A1	2 No credit	Booklet 3: Q30
	3 No credit	Booklet 4: Q10
	4 Full credit	Booklet 6: Q57
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S413Q04T	SCIE – P2006 Plastic Age (Q04)	128-128
Complex Multiple	0 No credit	Booklet 4: Q49
Choice	1 No credit	Booklet 5: Q17
A1	2 No credit	Booklet 11: Q29
	3 Full credit	Booklet 12: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S413Q05	SCIE – P2006 Plastic Age (Q05)	129-129
Multiple Choice	1 No credit	Booklet 4: Q50
A1	2 Full credit	Booklet 5: Q18
	3 No credit	Booklet 11: Q30
	4 No credit	Booklet 12: Q65
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S413Q06	SCIE – P2006 Plastic Age (Q06)	130-130
Closed Constructed	0 No credit	Booklet 4: Q48
Response	1 Full credit	Booklet 5: Q16
A1	7 N/A	Booklet 11: Q28
	9 Missing	Booklet 12: Q63
	r Not reached	
S415Q02	SCIE – P2006 Solar Power Generation (Q02)	131-131
Multiple Choice	1 No credit	Booklet 1: Q60
A1	2 No credit	Booklet 3: Q39
	3 No credit	Booklet 4: Q19
	4 Full credit	Booklet 6: Q66
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S415Q07T	SCIE – P2006 Solar Power Generation (Q07)	132-132
Complex Multiple	0 No credit	Booklet 1: Q59
Choice	1 No credit	Booklet 3: Q38
A1	2 Full credit	Booklet 4: Q18
	7 N/A	Booklet 6: Q65
	8 M/R	
	9 Missing	
	r Not reached	
S415Q08T	SCIE – P2006 Solar Power Generation (Q08)	133-133
Complex Multiple	0 No credit	Booklet 1: Q61
Choice	1 No credit	Booklet 3: Q40
A1	2 No credit	Booklet 4: Q20
	3 Full credit	Booklet 6: Q67
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416Q01	SCIE – P2006 The Moon (Q01)	134-134
Closed Constructed	0 No credit	Booklet 1: Q67
Response	1 Full credit	Booklet 5: Q44
A1	7 N/A	Booklet 7: Q6
	9 Missing	Booklet 13: Q21
	r Not reached	
S421Q01	SCIE – P2006 Big and Small (Q01)	135-135
Closed Constructed	0 No credit	Booklet 1: Q79
Response	1 Full credit	Booklet 5: Q56
A1	7 N/A	Booklet 7: Q18
	9 Missing	Booklet 13: Q33
	r Not reached	Booklet UH: Q6
S421Q03	SCIE – P2006 Big and Small (Q03)	136-136
Closed Constructed	0 No credit	Booklet 1: Q81
Response	1 Full credit	Booklet 5: Q58
A1	7 N/A	Booklet 7: Q20
	9 Missing	Booklet 13: Q35
	r Not reached	Booklet UH: Q8

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S425Q02	SCIE – P2006 Penguin Island (Q02)	137-137
Multiple Choice	1 No credit	Booklet 1: Q72
A1	2 Full credit	Booklet 5: Q49
	3 No credit	Booklet 7: Q11
	4 No credit	Booklet 13: Q26
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S425Q03	SCIE – P2006 Penguin Island (Q03)	138-138
Open Response	0 No credit	Booklet 1: Q70
A1	1 Full credit	Booklet 5: Q47
	7 N/A	Booklet 7: Q9
	9 Missing	Booklet 13: Q24
	r Not reached	
S425Q04	SCIE – P2006 Penguin Island (Q04)	139-139
Open Response	0 No credit	Booklet 1: Q73
A1	1 Full credit	Booklet 5: Q50
	7 N/A	Booklet 7: Q12
	9 Missing	Booklet 13: Q27
	r Not reached	
S425Q05	SCIE – P2006 Penguin Island (Q05)	140-140
Multiple Choice	1 No credit	Booklet 1: Q71
A1	2 Full credit	Booklet 5: Q48
	3 No credit	Booklet 7: Q10
	4 No credit	Booklet 13: Q25
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S426Q03	SCIE – P2006 The Grand Canyon (Q03)	141-141
Multiple Choice	1 No credit	Booklet 1: Q10
A1	2 No credit	Booklet 9: Q22
	3 No credit	Booklet 10: Q53
	4 Full credit	Booklet 12: Q35
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S426Q05	SCIE – P2006 The Grand Canyon (Q05)	142-142
Multiple Choice	1 No credit	Booklet 1: Q11
A1	2 No credit	Booklet 9: Q23
	3 Full credit	Booklet 10: Q54
	4 No credit	Booklet 12: Q36
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S426Q07T	SCIE – P2006 The Grand Canyon (Q07)	143-143
Complex Multiple	0 No credit	Booklet 1: Q9
Choice	1 No credit	Booklet 9: Q21
A1	2 Full credit	Booklet 10: Q52
	7 N/A	Booklet 12: Q34
	8 M/R	
	9 Missing	
	r Not reached	
S428Q01	SCIE – P2006 Bacteria in Milk (Q01)	144-144
Multiple Choice	1 No credit	Booklet 5: Q26
A1	2 No credit	Booklet 6: Q7
	3 Full credit	Booklet 8: Q50
	4 No credit	Booklet 10: Q31
	7 N/A	Booklet UH: Q2
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S428Q03	SCIE – P2006 Bacteria in Milk (Q03)	145-145
Multiple Choice	1 No credit	Booklet 5: Q27
A1	2 No credit	Booklet 6: Q8
	3 No credit	Booklet 8: Q51
	4 Full credit	Booklet 10: Q32
	7 N/A	Booklet UH: Q3
	8 M/R	
	9 Missing	
	r Not reached	
S428Q05	SCIE – P2006 Bacteria in Milk (Q05)	146-146
Open Response	0 No credit	Booklet 5: Q28
A1	1 Full credit	Booklet 6: Q9
	7 N/A	Booklet 8: Q52
	9 Missing	Booklet 10: Q33
	r Not reached	Booklet UH: Q4
S437Q01	SCIE – P2006 Extinguishing Fires (Q01)	147-147
Multiple Choice	1 No credit	Booklet 1: Q54
A1	2 Full credit	Booklet 3: Q33
	3 No credit	Booklet 4: Q13
	4 No credit	Booklet 6: Q60
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S437Q03	SCIE – P2006 Extinguishing Fires (Q03)	148-148
Multiple Choice	1 No credit	Booklet 1: Q55
A1	2 No credit	Booklet 3: Q34
	3 Full credit	Booklet 4: Q14
	4 No credit	Booklet 6: Q61
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S437Q04	SCIE – P2006 Extinguishing Fires (Q04)	149-149
Multiple Choice	1 No credit	Booklet 1: Q56
A1	2 No credit	Booklet 3: Q35
	3 Full credit	Booklet 4: Q15
	4 No credit	Booklet 6: Q62
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S437Q06	SCIE – P2006 Extinguishing Fires (Q06)	150-150
Open Response	0 No credit	Booklet 1: Q57
A1	1 Full credit	Booklet 3: Q36
	7 N/A	Booklet 4: Q16
	9 Missing	Booklet 6: Q63
	r Not reached	
S438Q01T	SCIE – P2006 Green Parks (Q01)	151-151
Complex Multiple Choice	0 No credit	Booklet 5: Q30
A1	1 No credit	Booklet 6: Q11
	2 No credit	Booklet 8: Q54
	3 Full credit	Booklet 10: Q35
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438Q02	SCIE – P2006 Green Parks (Q02)	152-152
Multiple Choice	1 No credit	Booklet 5: Q31
A1	2 No credit	Booklet 6: Q12
	3 No credit	Booklet 8: Q55
	4 Full credit	Booklet 10: Q36
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S438Q03T	SCIE – P2006 Green Parks (Q03)	153-153
Open Response	0 No credit	Booklet 5: Q32
A1	1 Full credit	Booklet 6: Q13
	7 N/A	Booklet 8: Q56
	9 Missing	Booklet 10: Q37
	r Not reached	
S447Q02	SCIE – P2006 Sunscreens (Q02)	154-154
Multiple Choice	1 No credit	Booklet 4: Q44
A1	2 No credit	Booklet 5: Q12
	3 No credit	Booklet 11: Q24
	4 Full credit	Booklet 12: Q59
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S447Q03	SCIE – P2006 Sunscreens (Q03)	155-155
Multiple Choice	1 Full credit	Booklet 4: Q45
A1	2 No credit	Booklet 5: Q13
	3 No credit	Booklet 11: Q25
	4 No credit	Booklet 12: Q60
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S447Q04	SCIE – P2006 Sunscreens (Q04)	156-156
Multiple Choice	1 No credit	Booklet 4: Q46
A1	2 No credit	Booklet 5: Q14
	3 No credit	Booklet 11: Q26
	4 Full credit	Booklet 12: Q61
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S447Q05	SCIE – P2006 Sunscreens (Q05)	157-157
Open Response	0 No credit	Booklet 4: Q47
A1	1 Partial credit	Booklet 5: Q15
	2 Full credit	Booklet 11: Q27
	7 N/A	Booklet 12: Q62
	9 Missing	
	r Not reached	
S458Q01	SCIE – P2006 The Ice Mummy (Q01)	158-158
Open Response	0 No credit	Booklet 5: Q20
A1	1 Full credit	Booklet 6: Q1
	7 N/A	Booklet 8: Q44
	9 Missing	Booklet 10: Q25
	r Not reached	
S458Q02T	SCIE – P2006 The Ice Mummy (Q02)	159-159
Complex Multiple Choice	0 No credit	Booklet 5: Q21
A1	1 No credit	Booklet 6: Q2
	2 No credit	Booklet 8: Q45
	3 Full credit	Booklet 10: Q26
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S465Q01	SCIE – P2006 Different Climates (Q01)	160-160
Open Response	0 No credit	Booklet 4: Q36
A1	1 Partial credit	Booklet 5: Q4
	2 Full credit	Booklet 11: Q16
	7 N/A	Booklet 12: Q51
	9 Missing	
	r Not reached	
S465Q02	SCIE – P2006 Different Climates (Q02)	161-161
Multiple Choice	1 No credit	Booklet 4: Q37
A1	2 No credit	Booklet 5: Q5
	3 Full credit	Booklet 11: Q17

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	4 No credit	Booklet 12: Q52
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S465Q04	SCIE – P2006 Different Climates (Q04)	162-162
Multiple Choice	1 No credit	Booklet 4: Q38
A1	2 Full credit	Booklet 5: Q6
	3 No credit	Booklet 11: Q18
	4 No credit	Booklet 12: Q53
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S466Q01T	SCIE – P2006 Forest Fires (Q01)	163-163
Complex Multiple	0 No credit	Booklet 5: Q35
Choice	1 No credit	Booklet 6: Q16
A1	2 No credit	Booklet 8: Q59
	3 Full credit	Booklet 10: Q40
	7 N/A	Booklet UH: Q15
	8 M/R	
	9 Missing	
	r Not reached	
S466Q05	SCIE – P2006 Forest Fires (Q05)	164-164
Multiple Choice	1 No credit	Booklet 5: Q37
A1	2 Full credit	Booklet 6: Q18
	3 No credit	Booklet 8: Q61
	4 No credit	Booklet 10: Q42
	7 N/A	Booklet UH: Q17
	8 M/R	
	9 Missing	
	r Not reached	
S466Q07T	SCIE – P2006 Forest Fires (Q07)	165-165
Complex Multiple	0 No credit	Booklet 5: Q36
Choice	1 No credit	Booklet 6: Q17
A1	2 Full credit	Booklet 8: Q60
	7 N/A	Booklet 10: Q41
	8 M/R	Booklet UH: Q16
	9 Missing	
	r Not reached	
S476Q01	SCIE – P2006 Heart Surgery (Q01)	166-166
Multiple Choice	1 No credit	Booklet 1: Q23
A1	2 No credit	Booklet 2: Q1
	3 Full credit	Booklet 8: Q25
	4 No credit	Booklet 11: Q47
	7 N/A	Booklet UH: Q10
	8 M/R	
	9 Missing	
	r Not reached	
S476Q02	SCIE – P2006 Heart Surgery (Q02)	167-167
Multiple Choice	1 No credit	Booklet 1: Q24
A1	2 No credit	Booklet 2: Q2
	3 Full credit	Booklet 8: Q26
	4 No credit	Booklet 11: Q48
	7 N/A	Booklet UH: Q11
	8 M/R	
	9 Missing	
	r Not reached	
S476Q03	SCIE – P2006 Heart Surgery (Q03)	168-168
Multiple Choice	1 Full credit	Booklet 1: Q25
A1	2 No credit	Booklet 2: Q3
	3 No credit	Booklet 8: Q27
	4 No credit	Booklet 11: Q49
	7 N/A	Booklet UH: Q12
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S477Q02	SCIE – P2006 Mary Montagu (Q02)	169-169
Multiple Choice	1 No credit	Booklet 2: Q20
A1	2 Full credit	Booklet 3: Q1
	3 No credit	Booklet 5: Q60
	4 No credit	Booklet 9: Q35
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S477Q03	SCIE – P2006 Mary Montagu (Q03)	170-170
Multiple Choice	1 No credit	Booklet 2: Q21
A1	2 Full credit	Booklet 3: Q2
	3 No credit	Booklet 5: Q61
	4 No credit	Booklet 9: Q36
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S477Q04	SCIE – P2006 Mary Montagu (Q04)	171-171
Open Response	0 No credit	Booklet 2: Q22
A1	1 Full credit	Booklet 3: Q3
	7 N/A	Booklet 5: Q62
	9 Missing	Booklet 9: Q37
	r Not reached	
S478Q01	SCIE – P2006 Antibiotics (Q01)	172-172
Multiple Choice	1 No credit	Booklet 4: Q40
A1	2 No credit	Booklet 5: Q8
	3 Full credit	Booklet 11: Q20
	4 No credit	Booklet 12: Q55
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S478Q02T	SCIE – P2006 Antibiotics (Q02)	173-173
Complex Multiple	0 No credit	Booklet 4: Q41
Choice	1 No credit	Booklet 5: Q9
A1	2 No credit	Booklet 11: Q21
	3 Full credit	Booklet 12: Q56
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S478Q03T	SCIE – P2006 Antibiotics (Q03)	174-174
Complex Multiple	0 No credit	Booklet 4: Q42
Choice	1 No credit	Booklet 5: Q10
A1	2 Full credit	Booklet 11: Q22
	7 N/A	Booklet 12: Q57
	8 M/R	
	9 Missing	
	r Not reached	
S485Q02	SCIE – P2006 Acid Rain (Q02)	175-175
Open Response	0 No credit	Booklet 1: Q18
A1	1 Full credit	Booklet 9: Q30
	2 Full credit	Booklet 10: Q61
	7 N/A	Booklet 12: Q43
	9 Missing	
	r Not reached	
S485Q03	SCIE – P2006 Acid Rain (Q03)	176-176
Multiple Choice	1 Full credit	Booklet 1: Q19
A1	2 No credit	Booklet 9: Q31
	3 No credit	Booklet 10: Q62
	4 No credit	Booklet 12: Q44
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485Q05	SCIE – P2006 Acid Rain (Q05)	177-177
Open Response	0 No credit	Booklet 1: Q20
A1	1 Partial credit	Booklet 9: Q32

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	2 Full credit	Booklet 10: Q63
	7 N/A	Booklet 12: Q45
	9 Missing	
	r Not reached	
S493Q01T	SCIE – P2006 Physical Exercise (Q01)	178-178
Complex Multiple Choice A1	0 No credit	Booklet 1: Q62
	1 No credit	Booklet 5: Q39
	2 No credit	Booklet 7: Q1
	3 Full credit	Booklet 13: Q16
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S493Q03T	SCIE – P2006 Physical Exercise (Q03)	179-179
Complex Multiple Choice A1	0 No credit	Booklet 1: Q63
	1 No credit	Booklet 5: Q40
	2 Full credit	Booklet 7: Q2
	7 N/A	Booklet 13: Q17
	8 M/R	
	9 Missing	
	r Not reached	
S493Q05T	SCIE – P2006 Physical Exercise (Q05)	180-180
Open Response A1	0 No credit	Booklet 1: Q64
	1 Full credit	Booklet 5: Q41
	7 N/A	Booklet 7: Q3
	9 Missing	Booklet 13: Q18
	r Not reached	
S495Q01T	SCIE – P2006 Radiotherapy (Q01)	181-181
Complex Multiple Choice A1	0 No credit	Booklet 1: Q35
	1 No credit	Booklet 2: Q13
	2 No credit	Booklet 8: Q37
	3 Full credit	Booklet 11: Q59
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S495Q02T	SCIE – P2006 Radiotherapy (Q02)	182-182
Complex Multiple Choice A1	0 No credit	Booklet 1: Q36
	1 No credit	Booklet 2: Q14
	2 Full credit	Booklet 8: Q38
	7 N/A	Booklet 11: Q60
	8 M/R	
	9 Missing	
	r Not reached	
S495Q03	SCIE – P2006 Radiotherapy (Q03)	183-183
Open Response A1	0 No credit	Booklet 1: Q37
	1 Full credit	Booklet 2: Q15
	7 N/A	Booklet 8: Q39
	9 Missing	Booklet 11: Q61
	r Not reached	
S495Q04T	SCIE – P2006 Radiotherapy (Q04)	184-184
Complex Multiple Choice A1	0 No credit	Booklet 1: Q34
	1 No credit	Booklet 2: Q12
	2 No credit	Booklet 8: Q36
	3 Full credit	Booklet 11: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498Q02T	SCIE – P2006 Experimental Digestion (Q02)	185-185
Complex Multiple Choice A1	0 No credit	Booklet 2: Q32
	1 No credit	Booklet 3: Q13
	2 No credit	Booklet 5: Q72
	3 Full credit	Booklet 9: Q47
	7 N/A	
	8 M/R	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	9 Missing	
	r Not reached	
S498Q03	SCIE – P2006 Experimental Digestion (Q03)	186-186
Multiple Choice A1	1 Full credit	Booklet 2: Q33
	2 No credit	Booklet 3: Q14
	3 No credit	Booklet 5: Q73
	4 No credit	Booklet 9: Q48
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498Q04	SCIE – P2006 Experimental Digestion (Q04)	187-187
Open Response A1	0 No credit	Booklet 2: Q34
	1 Partial credit	Booklet 3: Q15
	2 Full credit	Booklet 5: Q74
	7 N/A	Booklet 9: Q49
	9 Missing	
	r Not reached	
S508Q02T	SCIE – P2006 Genetically Modified Food (Q02)	188-188
Complex Multiple Choice A1	0 No credit	Booklet 1: Q1
	1 No credit	Booklet 9: Q13
	2 Full credit	Booklet 10: Q44
	7 N/A	Booklet 12: Q26
	8 M/R	
	9 Missing	
	r Not reached	
S508Q03	SCIE – P2006 Genetically Modified Food (Q03)	189-189
Multiple Choice A1	1 No credit	Booklet 1: Q2
	2 No credit	Booklet 9: Q14
	3 No credit	Booklet 10: Q45
	4 Full credit	Booklet 12: Q27
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S510Q01T	SCIE – P2006 Magnetic Hovertrain (Q01)	190-190
Complex Multiple Choice A1	0 No credit	Booklet 1: Q42
	1 No credit	Booklet 3: Q21
	2 Full credit	Booklet 4: Q1
	7 N/A	Booklet 6: Q48
	8 M/R	
	9 Missing	
	r Not reached	
S510Q04T	SCIE – P2006 Magnetic Hovertrain (Q04)	191-191
Open Response A1	0 No credit	Booklet 1: Q43
	1 Full credit	Booklet 3: Q22
	7 N/A	Booklet 4: Q2
	9 Missing	Booklet 6: Q49
	r Not reached	
S514Q02	SCIE – P2006 Development and Disaster (Q02)	192-192
Open Response A1	0 No credit	Booklet 1: Q75
	1 Full credit	Booklet 5: Q52
	7 N/A	Booklet 7: Q14
	9 Missing	Booklet 13: Q29
	r Not reached	
S514Q03	SCIE – P2006 Development and Disaster (Q03)	193-193
Open Response A1	0 No credit	Booklet 1: Q76
	1 Full credit	Booklet 5: Q53
	7 N/A	Booklet 7: Q15
	9 Missing	Booklet 13: Q30
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S514Q04	SCIE – P2006 Development and Disaster (Q04)	194-194
Complex Multiple Choice A1	0 No credit	Booklet 1: Q77
	1 Full credit	Booklet 5: Q54
	7 N/A	Booklet 7: Q16
	9 Missing	Booklet 13: Q31
	r Not reached	
S519Q01	SCIE – P2006 Airbags (Q01)	195-195
Open Response A1	0 No credit	Booklet 2: Q27
	1 Partial credit	Booklet 3: Q8
	2 Full credit	Booklet 5: Q67
	7 N/A	Booklet 9: Q42
	9 Missing	
	r Not reached	
S519Q02T	SCIE – P2006 Airbags (Q02)	196-196
Complex Multiple Choice A1	0 No credit	Booklet 2: Q28
	1 No credit	Booklet 3: Q9
	2 Full credit	Booklet 5: Q68
	7 N/A	Booklet 9: Q43
	8 M/R	
	9 Missing	
	r Not reached	
S519Q03	SCIE – P2006 Airbags (Q03)	197-197
Open Response A1	0 No credit	Booklet 2: Q29
	1 Full credit	Booklet 3: Q10
	7 N/A	Booklet 5: Q69
	9 Missing	Booklet 9: Q44
	r Not reached	
S521Q02	SCIE – P2006 Cooking Outdoors (Q02)	198-198
Multiple Choice A1	1 No credit	Booklet 1: Q31
	2 Full credit	Booklet 2: Q9
	3 No credit	Booklet 8: Q33
	4 No credit	Booklet 11: Q55
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S521Q06	SCIE – P2006 Cooking Outdoors (Q06)	199-199
Multiple Choice A1	1 No credit	Booklet 1: Q32
	2 Full credit	Booklet 2: Q10
	3 No credit	Booklet 8: Q34
	4 No credit	Booklet 11: Q56
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S524Q06T	SCIE – P2006 Penicillin Manufacture (Q06)	200-200
Complex Multiple Choice A1	0 No credit	Booklet 2: Q37
	1 No credit	Booklet 3: Q18
	2 Full credit	Booklet 5: Q77
	7 N/A	Booklet 9: Q52
	8 M/R	
	9 Missing	
	r Not reached	
S524Q07	SCIE – P2006 Penicillin Manufacture (Q07)	201-201
Open Response A1	0 No credit	Booklet 2: Q38
	1 Full credit	Booklet 3: Q19
	7 N/A	Booklet 5: Q78
	9 Missing	Booklet 9: Q53
	r Not reached	
S527Q01T	SCIE – P2006 Extinction of the Dinosaurs (Q01)	202-202
Complex Multiple Choice A1	0 No credit	Booklet 1: Q13
	1 No credit	Booklet 9: Q25
	2 No credit	Booklet 10: Q56
	3 Full credit	Booklet 12: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S527Q03T	SCIE – P2006 Extinction of the Dinosaurs (Q03)	203-203
Complex Multiple Choice A1	0 No credit	Booklet 1: Q14
	1 No credit	Booklet 9: Q26
	2 Full credit	Booklet 10: Q57
	7 N/A	Booklet 12: Q39
	8 M/R	
	9 Missing	
	r Not reached	
S527Q04T	SCIE – P2006 Extinction of the Dinosaurs (Q04)	204-204
Complex Multiple Choice A1	0 No credit	Booklet 1: Q15
	1 No credit	Booklet 9: Q27
	2 No credit	Booklet 10: Q58
	3 Full credit	Booklet 12: Q40
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QNA	INTR – P2006 Wild Oat Grass (A)	205-205
Likert A1	1 High interest (score=3)	Booklet 1: Q52
	2 Medium interest (score=2)	Booklet 3: Q31
	3 Low interest (score=1)	Booklet 4: Q11
	4 No interest (score=0)	Booklet 6: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QNB	INTR – P2006 Wild Oat Grass (B)	206-206
Likert A1	1 High interest (score=3)	Booklet 1: Q52
	2 Medium interest (score=2)	Booklet 3: Q31
	3 Low interest (score=1)	Booklet 4: Q11
	4 No interest (score=0)	Booklet 6: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QNC	INTR – P2006 Wild Oat Grass (C)	207-207
Likert A1	1 High interest (score=3)	Booklet 1: Q52
	2 Medium interest (score=2)	Booklet 3: Q31
	3 Low interest (score=1)	Booklet 4: Q11
	4 No interest (score=0)	Booklet 6: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S413QNA	INTR – P2006 Plastic Age (A)	208-208
Likert A1	1 High interest (score=3)	Booklet 4: Q51
	2 Medium interest (score=2)	Booklet 5: Q19
	3 Low interest (score=1)	Booklet 11: Q31
	4 No interest (score=0)	Booklet 12: Q66
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S413QNB	INTR – P2006 Plastic Age (B)	209-209
Likert A1	1 High interest (score=3)	Booklet 4: Q51
	2 Medium interest (score=2)	Booklet 5: Q19
	3 Low interest (score=1)	Booklet 11: Q31
	4 No interest (score=0)	Booklet 12: Q66
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S413QNC	INTR – P2006 Plastic Age (C)	210-210
Likert	1 High interest (score=3)	Booklet 4: Q51
A1	2 Medium interest (score=2)	Booklet 5: Q19
	3 Low interest (score=1)	Booklet 11: Q31
	4 No interest (score=0)	Booklet 12: Q66
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416QNA	INTR – P2006 The Moon (A)	211-211
Likert	1 High interest (score=3)	Booklet 1: Q68
A1	2 Medium interest (score=2)	Booklet 5: Q45
	3 Low interest (score=1)	Booklet 7: Q7
	4 No interest (score=0)	Booklet 13: Q22
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416QNB	INTR – P2006 The Moon (B)	212-212
Likert	1 High interest (score=3)	Booklet 1: Q68
A1	2 Medium interest (score=2)	Booklet 5: Q45
	3 Low interest (score=1)	Booklet 7: Q7
	4 No interest (score=0)	Booklet 13: Q22
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S428QNA	INTR – P2006 Bacteria in Milk (A)	213-213
Likert	1 High interest (score=3)	Booklet 5: Q29
A1	2 Medium interest (score=2)	Booklet 6: Q10
	3 Low interest (score=1)	Booklet 8: Q53
	4 No interest (score=0)	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 M/R	
	9 Missing	
	r Not reached	
S428QNB	INTR – P2006 Bacteria in Milk (B)	214-214
Likert	1 High interest (score=3)	Booklet 5: Q29
A1	2 Medium interest (score=2)	Booklet 6: Q10
	3 Low interest (score=1)	Booklet 8: Q53
	4 No interest (score=0)	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 M/R	
	9 Missing	
	r Not reached	
S428QNC	INTR – P2006 Bacteria in Milk (C)	215-215
Likert	1 High interest (score=3)	Booklet 5: Q29
A1	2 Medium interest (score=2)	Booklet 6: Q10
	3 Low interest (score=1)	Booklet 8: Q53
	4 No interest (score=0)	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 M/R	
	9 Missing	
	r Not reached	
S437QNA	INTR – P2006 Extinguishing Fires (A)	216-216
Likert	1 High interest (score=3)	Booklet 1: Q58
A1	2 Medium interest (score=2)	Booklet 3: Q37
	3 Low interest (score=1)	Booklet 4: Q17
	4 No interest (score=0)	Booklet 6: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S437QNB	INTR – P2006 Extinguishing Fires (B)	217-217
Likert	1 High interest (score=3)	Booklet 1: Q58
A1	2 Medium interest (score=2)	Booklet 3: Q37
	3 Low interest (score=1)	Booklet 4: Q17
	4 No interest (score=0)	Booklet 6: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S437QNC	INTR – P2006 Extinguishing Fires (C)	218-218
Likert	1 High interest (score=3)	Booklet 1: Q58
A1	2 Medium interest (score=2)	Booklet 3: Q37
	3 Low interest (score=1)	Booklet 4: Q17
	4 No interest (score=0)	Booklet 6: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QNA	INTR – P2006 Green Parks (A)	219-219
Likert	1 High interest (score=3)	Booklet 5: Q33
A1	2 Medium interest (score=2)	Booklet 6: Q14
	3 Low interest (score=1)	Booklet 8: Q57
	4 No interest (score=0)	Booklet 10: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QNB	INTR – P2006 Green Parks (B)	220-220
Likert	1 High interest (score=3)	Booklet 5: Q33
A1	2 Medium interest (score=2)	Booklet 6: Q14
	3 Low interest (score=1)	Booklet 8: Q57
	4 No interest (score=0)	Booklet 10: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QNC	INTR – P2006 Green Parks (C)	221-221
Likert	1 High interest (score=3)	Booklet 5: Q33
A1	2 Medium interest (score=2)	Booklet 6: Q14
	3 Low interest (score=1)	Booklet 8: Q57
	4 No interest (score=0)	Booklet 10: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QNA	INTR – P2006 The Cheetah (A)	222-222
Likert	1 High interest (score=3)	Booklet 1: Q40
A1	2 Medium interest (score=2)	Booklet 2: Q18
	3 Low interest (score=1)	Booklet 8: Q42
	4 No interest (score=0)	Booklet 11: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QNB	INTR – P2006 The Cheetah (B)	223-223
Likert	1 High interest (score=3)	Booklet 1: Q40
A1	2 Medium interest (score=2)	Booklet 2: Q18
	3 Low interest (score=1)	Booklet 8: Q42
	4 No interest (score=0)	Booklet 11: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QNC	INTR – P2006 The Cheetah (C)	224-224
Likert	1 High interest (score=3)	Booklet 1: Q40
A1	2 Medium interest (score=2)	Booklet 2: Q18
	3 Low interest (score=1)	Booklet 8: Q42
	4 No interest (score=0)	Booklet 11: Q64
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S466QNA	INTR – P2006 Forest Fires (A)	225-225
Likert	1 High interest (score=3)	Booklet 5: Q38
A1	2 Medium interest (score=2)	Booklet 6: Q19
	3 Low interest (score=1)	Booklet 8: Q62

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	4 No interest (score=0)	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 M/R	
	9 Missing	
	r Not reached	
S466QNB	INTR – P2006 Forest Fires (B)	226-226
Likert	1 High interest (score=3)	Booklet 5: Q38
A1	2 Medium interest (score=2)	Booklet 6: Q19
	3 Low interest (score=1)	Booklet 8: Q62
	4 No interest (score=0)	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 M/R	
	9 Missing	
	r Not reached	
S466QNC	INTR – P2006 Forest Fires (C)	227-227
Likert	1 High interest (score=3)	Booklet 5: Q38
A1	2 Medium interest (score=2)	Booklet 6: Q19
	3 Low interest (score=1)	Booklet 8: Q62
	4 No interest (score=0)	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 M/R	
	9 Missing	
	r Not reached	
S476QNA	INTR – P2006 Heart Surgery (A)	228-228
Likert	1 High interest (score=3)	Booklet 1: Q26
A1	2 Medium interest (score=2)	Booklet 2: Q4
	3 Low interest (score=1)	Booklet 8: Q28
	4 No interest (score=0)	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 M/R	
	9 Missing	
	r Not reached	
S476QNB	INTR – P2006 Heart Surgery (B)	229-229
Likert	1 High interest (score=3)	Booklet 1: Q26
A1	2 Medium interest (score=2)	Booklet 2: Q4
	3 Low interest (score=1)	Booklet 8: Q28
	4 No interest (score=0)	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 M/R	
	9 Missing	
	r Not reached	
S476QNC	INTR – P2006 Heart Surgery (C)	230-230
Likert	1 High interest (score=3)	Booklet 1: Q26
A1	2 Medium interest (score=2)	Booklet 2: Q4
	3 Low interest (score=1)	Booklet 8: Q28
	4 No interest (score=0)	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 M/R	
	9 Missing	
	r Not reached	
S478QNA	INTR – P2006 Antibiotics (A)	231-231
Likert	1 High interest (score=3)	Booklet 4: Q43
A1	2 Medium interest (score=2)	Booklet 5: Q11
	3 Low interest (score=1)	Booklet 11: Q23
	4 No interest (score=0)	Booklet 12: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S478QNB	INTR – P2006 Antibiotics (B)	232-232
Likert	1 High interest (score=3)	Booklet 4: Q43
A1	2 Medium interest (score=2)	Booklet 5: Q11
	3 Low interest (score=1)	Booklet 11: Q23
	4 No interest (score=0)	Booklet 12: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S478QNC	INTR – P2006 Antibiotics (C)	233-233
Likert	1 High interest (score=3)	Booklet 4: Q43
A1	2 Medium interest (score=2)	Booklet 5: Q11
	3 Low interest (score=1)	Booklet 11: Q23
	4 No interest (score=0)	Booklet 12: Q58
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485QNA	INTR – P2006 Acid Rain (A)	234-234
Likert	1 High interest (score=3)	Booklet 1: Q21
A1	2 Medium interest (score=2)	Booklet 9: Q33
	3 Low interest (score=1)	Booklet 10: Q64
	4 No interest (score=0)	Booklet 12: Q46
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485QNB	INTR – P2006 Acid Rain (B)	235-235
Likert	1 High interest (score=3)	Booklet 1: Q21
A1	2 Medium interest (score=2)	Booklet 9: Q33
	3 Low interest (score=1)	Booklet 10: Q64
	4 No interest (score=0)	Booklet 12: Q46
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485QNC	INTR – P2006 Acid Rain (C)	236-236
Likert	1 High interest (score=3)	Booklet 1: Q21
A1	2 Medium interest (score=2)	Booklet 9: Q33
	3 Low interest (score=1)	Booklet 10: Q64
	4 No interest (score=0)	Booklet 12: Q46
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498QNA	INTR – P2006 Experimental Digestion (A)	237-237
Likert	1 High interest (score=3)	Booklet 2: Q35
A1	2 Medium interest (score=2)	Booklet 3: Q16
	3 Low interest (score=1)	Booklet 5: Q75
	4 No interest (score=0)	Booklet 9: Q50
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498QNB	INTR – P2006 Experimental Digestion (B)	238-238
Likert	1 High interest (score=3)	Booklet 2: Q35
A1	2 Medium interest (score=2)	Booklet 3: Q16
	3 Low interest (score=1)	Booklet 5: Q75
	4 No interest (score=0)	Booklet 9: Q50
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498QNC	INTR – P2006 Experimental Digestion (C)	239-239
Likert	1 High interest (score=3)	Booklet 2: Q35
A1	2 Medium interest (score=2)	Booklet 3: Q16
	3 Low interest (score=1)	Booklet 5: Q75
	4 No interest (score=0)	Booklet 9: Q50
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S508QNA	INTR – P2006 Genetically Modified Food (A)	240-240
Likert	1 High interest (score=3)	Booklet 1: Q4
A1	2 Medium interest (score=2)	Booklet 9: Q16
	3 Low interest (score=1)	Booklet 10: Q47
	4 No interest (score=0)	Booklet 12: Q29
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S508QNB	INTR – P2006 Genetically Modified Food (B)	241-241
Likert	1 High interest (score=3)	Booklet 1: Q4
A1	2 Medium interest (score=2)	Booklet 9: Q16
	3 Low interest (score=1)	Booklet 10: Q47
	4 No interest (score=0)	Booklet 12: Q29
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S508QNC	INTR – P2006 Genetically Modified Food (C)	242-242
Likert	1 High interest (score=3)	Booklet 1: Q4
A1	2 Medium interest (score=2)	Booklet 9: Q16
	3 Low interest (score=1)	Booklet 10: Q47
	4 No interest (score=0)	Booklet 12: Q29
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S514QNA	INTR – P2006 Development and Disaster (A)	243-243
Likert	1 High interest (score=3)	Booklet 1: Q78
A1	2 Medium interest (score=2)	Booklet 5: Q55
	3 Low interest (score=1)	Booklet 7: Q17
	4 No interest (score=0)	Booklet 13: Q32
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S514QNB	INTR – P2006 Development and Disaster (B)	244-244
Likert	1 High interest (score=3)	Booklet 1: Q78
A1	2 Medium interest (score=2)	Booklet 5: Q55
	3 Low interest (score=1)	Booklet 7: Q17
	4 No interest (score=0)	Booklet 13: Q32
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S514QNC	INTR – P2006 Development and Disaster (C)	245-245
Likert	1 High interest (score=3)	Booklet 1: Q78
A1	2 Medium interest (score=2)	Booklet 5: Q55
	3 Low interest (score=1)	Booklet 7: Q17
	4 No interest (score=0)	Booklet 13: Q32
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S519QNA	INTR – P2006 Airbags (A)	246-246
Likert	1 High interest (score=3)	Booklet 2: Q30
A1	2 Medium interest (score=2)	Booklet 3: Q11
	3 Low interest (score=1)	Booklet 5: Q70
	4 No interest (score=0)	Booklet 9: Q45
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S519QNB	INTR – P2006 Airbags (B)	247-247
Likert	1 High interest (score=3)	Booklet 2: Q30
A1	2 Medium interest (score=2)	Booklet 3: Q11
	3 Low interest (score=1)	Booklet 5: Q70
	4 No interest (score=0)	Booklet 9: Q45
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S519QNC	INTR – P2006 Airbags (C)	248-248
Likert	1 High interest (score=3)	Booklet 2: Q30
A1	2 Medium interest (score=2)	Booklet 3: Q11
	3 Low interest (score=1)	Booklet 5: Q70
	4 No interest (score=0)	Booklet 9: Q45
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S521QNA	INTR – P2006 Cooking Outdoors (A)	249-249
Likert	1 High interest (score=3)	Booklet 1: Q33
A1	2 Medium interest (score=2)	Booklet 2: Q11
	3 Low interest (score=1)	Booklet 8: Q35
	4 No interest (score=0)	Booklet 11: Q57
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S521QNB	INTR – P2006 Cooking Outdoors (B)	250-250
Likert	1 High interest (score=3)	Booklet 1: Q33
A1	2 Medium interest (score=2)	Booklet 2: Q11
	3 Low interest (score=1)	Booklet 8: Q35
	4 No interest (score=0)	Booklet 11: Q57
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S524QNA	INTR – P2006 Penicillin Manufacture (A)	251-251
Likert	1 High interest (score=3)	Booklet 2: Q39
A1	2 Medium interest (score=2)	Booklet 3: Q20
	3 Low interest (score=1)	Booklet 5: Q79
	4 No interest (score=0)	Booklet 9: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S524QNB	INTR – P2006 Penicillin Manufacture (B)	252-252
Likert	1 High interest (score=3)	Booklet 2: Q39
A1	2 Medium interest (score=2)	Booklet 3: Q20
	3 Low interest (score=1)	Booklet 5: Q79
	4 No interest (score=0)	Booklet 9: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S524QNC	INTR – P2006 Penicillin Manufacture (C)	253-253
Likert	1 High interest (score=3)	Booklet 2: Q39
A1	2 Medium interest (score=2)	Booklet 3: Q20
	3 Low interest (score=1)	Booklet 5: Q79
	4 No interest (score=0)	Booklet 9: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S527QNA	INTR – P2006 Extinction of the Dinosaurs (A)	254-254
Likert	1 High interest (score=3)	Booklet 1: Q16
A1	2 Medium interest (score=2)	Booklet 9: Q28
	3 Low interest (score=1)	Booklet 10: Q59
	4 No interest (score=0)	Booklet 12: Q41
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S527QNB	INTR – P2006 Extinction of the Dinosaurs (B)	255-255
Likert	1 High interest (score=3)	Booklet 1: Q16
A1	2 Medium interest (score=2)	Booklet 9: Q28
	3 Low interest (score=1)	Booklet 10: Q59
	4 No interest (score=0)	Booklet 12: Q41
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S527QNC	INTR – P2006 Extinction of the Dinosaurs (C)	256-256
Likert	1 High interest (score=3)	Booklet 1: Q16
A1	2 Medium interest (score=2)	Booklet 9: Q28
	3 Low interest (score=1)	Booklet 10: Q59
	4 No interest (score=0)	Booklet 12: Q41
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QSA	SUPP – P2006 Wild Oat Grass (A)	257-257
Likert	1 Strongly agree (score=3)	Booklet 1: Q53
A1	2 Agree (score=2)	Booklet 3: Q32
	3 Disagree (score=1)	Booklet 4: Q12
	4 Strongly disagree (score=0)	Booklet 6: Q59
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QSB	SUPP – P2006 Wild Oat Grass (B)	258-258
Likert	1 Strongly agree (score=3)	Booklet 1: Q53
A1	2 Agree (score=2)	Booklet 3: Q32
	3 Disagree (score=1)	Booklet 4: Q12
	4 Strongly disagree (score=0)	Booklet 6: Q59
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S408QSC	SUPP – P2006 Wild Oat Grass (C)	259-259
Likert	1 Strongly agree (score=3)	Booklet 1: Q53
A1	2 Agree (score=2)	Booklet 3: Q32
	3 Disagree (score=1)	Booklet 4: Q12
	4 Strongly disagree (score=0)	Booklet 6: Q59
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416QSA	SUPP – P2006 The Moon (A)	260-260
Likert	1 Strongly agree (score=3)	Booklet 1: Q69
A1	2 Agree (score=2)	Booklet 5: Q46
	3 Disagree (score=1)	Booklet 7: Q8
	4 Strongly disagree (score=0)	Booklet 13: Q23
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416QSB	SUPP – P2006 The Moon (B)	261-261
Likert	1 Strongly agree (score=3)	Booklet 1: Q69
A1	2 Agree (score=2)	Booklet 5: Q46

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	3 Disagree (score=1)	Booklet 7: Q8
	4 Strongly disagree (score=0)	Booklet 13: Q23
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S416QSC	SUPP – P2006 The Moon (C)	262-262
Likert	1 Strongly agree (score=3)	Booklet 1: Q69
A1	2 Agree (score=2)	Booklet 5: Q46
	3 Disagree (score=1)	Booklet 7: Q8
	4 Strongly disagree (score=0)	Booklet 13: Q23
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S421QSA	SUPP – P2006 Big and Small (A)	263-263
Likert	1 Strongly agree (score=3)	Booklet 1: Q82
A1	2 Agree (score=2)	Booklet 5: Q59
	3 Disagree (score=1)	Booklet 7: Q21
	4 Strongly disagree (score=0)	Booklet 13: Q36
	7 N/A	Booklet UH: Q9
	8 M/R	
	9 Missing	
	r Not reached	
S421QSC	SUPP – P2006 Big and Small (C)	264-264
Likert	1 Strongly agree (score=3)	Booklet 1: Q82
A1	2 Agree (score=2)	Booklet 5: Q59
	3 Disagree (score=1)	Booklet 7: Q21
	4 Strongly disagree (score=0)	Booklet 13: Q36
	7 N/A	Booklet UH: Q9
	8 M/R	
	9 Missing	
	r Not reached	
S425QSA	SUPP – P2006 Penguin Island (A)	265-265
Likert	1 Strongly agree (score=3)	Booklet 1: Q74
A1	2 Agree (score=2)	Booklet 5: Q51
	3 Disagree (score=1)	Booklet 7: Q13
	4 Strongly disagree (score=0)	Booklet 13: Q28
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S425QSB	SUPP – P2006 Penguin Island (B)	266-266
Likert	1 Strongly agree (score=3)	Booklet 1: Q74
A1	2 Agree (score=2)	Booklet 5: Q51
	3 Disagree (score=1)	Booklet 7: Q13
	4 Strongly disagree (score=0)	Booklet 13: Q28
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S425QSC	SUPP – P2006 Penguin Island (C)	267-267
Likert	1 Strongly agree (score=3)	Booklet 1: Q74
A1	2 Agree (score=2)	Booklet 5: Q51
	3 Disagree (score=1)	Booklet 7: Q13
	4 Strongly disagree (score=0)	Booklet 13: Q28
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S426QSA	SUPP – P2006 The Grand Canyon (A)	268-268
Likert	1 Strongly agree (score=3)	Booklet 1: Q12
A1	2 Agree (score=2)	Booklet 9: Q24
	3 Disagree (score=1)	Booklet 10: Q55
	4 Strongly disagree (score=0)	Booklet 12: Q37
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S426QSB	SUPP – P2006 The Grand Canyon (B)	269-269
Likert	1 Strongly agree (score=3)	Booklet 1: Q12
A1	2 Agree (score=2)	Booklet 9: Q24
	3 Disagree (score=1)	Booklet 10: Q55
	4 Strongly disagree (score=0)	Booklet 12: Q37
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S426QSC	SUPP – P2006 The Grand Canyon (C)	270-270
Likert	1 Strongly agree (score=3)	Booklet 1: Q12
A1	2 Agree (score=2)	Booklet 9: Q24
	3 Disagree (score=1)	Booklet 10: Q55
	4 Strongly disagree (score=0)	Booklet 12: Q37
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QSA	SUPP – P2006 Green Parks (A)	271-271
Likert	1 Strongly agree (score=3)	Booklet 5: Q34
A1	2 Agree (score=2)	Booklet 6: Q15
	3 Disagree (score=1)	Booklet 8: Q58
	4 Strongly disagree (score=0)	Booklet 10: Q39
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QSB	SUPP – P2006 Green Parks (B)	272-272
Likert	1 Strongly agree (score=3)	Booklet 5: Q34
A1	2 Agree (score=2)	Booklet 6: Q15
	3 Disagree (score=1)	Booklet 8: Q58
	4 Strongly disagree (score=0)	Booklet 10: Q39
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S438QSC	SUPP – P2006 Green Parks (C)	273-273
Likert	1 Strongly agree (score=3)	Booklet 5: Q34
A1	2 Agree (score=2)	Booklet 6: Q15
	3 Disagree (score=1)	Booklet 8: Q58
	4 Strongly disagree (score=0)	Booklet 10: Q39
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QSA	SUPP – P2006 The Cheetah (A)	274-274
Likert	1 Strongly agree (score=3)	Booklet 1: Q41
A1	2 Agree (score=2)	Booklet 2: Q19
	3 Disagree (score=1)	Booklet 8: Q43
	4 Strongly disagree (score=0)	Booklet 11: Q65
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QSB	SUPP – P2006 The Cheetah (B)	275-275
Likert	1 Strongly agree (score=3)	Booklet 1: Q41
A1	2 Agree (score=2)	Booklet 2: Q19
	3 Disagree (score=1)	Booklet 8: Q43
	4 Strongly disagree (score=0)	Booklet 11: Q65
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S456QSC	SUPP – P2006 The Cheetah (C)	276-276
Likert	1 Strongly agree (score=3)	Booklet 1: Q41
A1	2 Agree (score=2)	Booklet 2: Q19
	3 Disagree (score=1)	Booklet 8: Q43
	4 Strongly disagree (score=0)	Booklet 11: Q65
	7 N/A	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	8 M/R	
	9 Missing	
	r Not reached	
S465QSA	SUPP – P2006 Different Climates (A)	277-277
Likert	1 Strongly agree (score=3)	Booklet 4: Q39
A1	2 Agree (score=2)	Booklet 5: Q7
	3 Disagree (score=1)	Booklet 11: Q19
	4 Strongly disagree (score=0)	Booklet 12: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S465QSB	SUPP – P2006 Different Climates (B)	278-278
Likert	1 Strongly agree (score=3)	Booklet 4: Q39
A1	2 Agree (score=2)	Booklet 5: Q7
	3 Disagree (score=1)	Booklet 11: Q19
	4 Strongly disagree (score=0)	Booklet 12: Q54
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S476QSA	SUPP – P2006 Heart Surgery (A)	279-279
Likert	1 Strongly agree (score=3)	Booklet 1: Q27
A1	2 Agree (score=2)	Booklet 2: Q5
	3 Disagree (score=1)	Booklet 8: Q29
	4 Strongly disagree (score=0)	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 M/R	
	9 Missing	
	r Not reached	
S476QSB	SUPP – P2006 Heart Surgery (B)	280-280
Likert	1 Strongly agree (score=3)	Booklet 1: Q27
A1	2 Agree (score=2)	Booklet 2: Q5
	3 Disagree (score=1)	Booklet 8: Q29
	4 Strongly disagree (score=0)	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 M/R	
	9 Missing	
	r Not reached	
S476QSC	SUPP – P2006 Heart Surgery (C)	281-281
Likert	1 Strongly agree (score=3)	Booklet 1: Q27
A1	2 Agree (score=2)	Booklet 2: Q5
	3 Disagree (score=1)	Booklet 8: Q29
	4 Strongly disagree (score=0)	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 M/R	
	9 Missing	
	r Not reached	
S477QSA	SUPP – P2006 Mary Montagu (A)	282-282
Likert	1 Strongly agree (score=3)	Booklet 2: Q23
A1	2 Agree (score=2)	Booklet 3: Q4
	3 Disagree (score=1)	Booklet 5: Q63
	4 Strongly disagree (score=0)	Booklet 9: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S477QSB	SUPP – P2006 Mary Montagu (B)	283-283
Likert	1 Strongly agree (score=3)	Booklet 2: Q23
A1	2 Agree (score=2)	Booklet 3: Q4
	3 Disagree (score=1)	Booklet 5: Q63
	4 Strongly disagree (score=0)	Booklet 9: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S477QSC	SUPP – P2006 Mary Montagu (C)	284-284
Likert	1 Strongly agree (score=3)	Booklet 2: Q23
A1	2 Agree (score=2)	Booklet 3: Q4

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	3 Disagree (score=1)	Booklet 5: Q63
	4 Strongly disagree (score=0)	Booklet 9: Q38
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485QSB	SUPP – P2006 Acid Rain (B)	285-285
Likert	1 Strongly agree (score=3)	Booklet 1: Q22
A1	2 Agree (score=2)	Booklet 9: Q34
	3 Disagree (score=1)	Booklet 10: Q65
	4 Strongly disagree (score=0)	Booklet 12: Q47
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S485QSC	SUPP – P2006 Acid Rain (C)	286-286
Likert	1 Strongly agree (score=3)	Booklet 1: Q22
A1	2 Agree (score=2)	Booklet 9: Q34
	3 Disagree (score=1)	Booklet 10: Q65
	4 Strongly disagree (score=0)	Booklet 12: Q47
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498QSA	SUPP – P2006 Experimental Digestion (A)	287-287
Likert	1 Strongly agree (score=3)	Booklet 2: Q36
A1	2 Agree (score=2)	Booklet 3: Q17
	3 Disagree (score=1)	Booklet 5: Q76
	4 Strongly disagree (score=0)	Booklet 9: Q51
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S498QSB	SUPP – P2006 Experimental Digestion (B)	288-288
Likert	1 Strongly agree (score=3)	Booklet 2: Q36
A1	2 Agree (score=2)	Booklet 3: Q17
	3 Disagree (score=1)	Booklet 5: Q76
	4 Strongly disagree (score=0)	Booklet 9: Q51
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S519QSA	SUPP – P2006 Airbags (A)	289-289
Likert	1 Strongly agree (score=3)	Booklet 2: Q31
A1	2 Agree (score=2)	Booklet 3: Q12
	3 Disagree (score=1)	Booklet 5: Q71
	4 Strongly disagree (score=0)	Booklet 9: Q46
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S519QSB	SUPP – P2006 Airbags (B)	290-290
Likert	1 Strongly agree (score=3)	Booklet 2: Q31
A1	2 Agree (score=2)	Booklet 3: Q12
	3 Disagree (score=1)	Booklet 5: Q71
	4 Strongly disagree (score=0)	Booklet 9: Q46
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S519QSC	SUPP – P2006 Airbags (C)	291-291
Likert	1 Strongly agree (score=3)	Booklet 2: Q31
A1	2 Agree (score=2)	Booklet 3: Q12
	3 Disagree (score=1)	Booklet 5: Q71
	4 Strongly disagree (score=0)	Booklet 9: Q46
	7 N/A	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	8 M/R	
	9 Missing	
	r Not reached	
S527QSB	SUPP – P2006 Extinction of the Dinosaurs (B)	292-292
Likert	1 Strongly agree (score=3)	Booklet 1: Q17
A1	2 Agree (score=2)	Booklet 9: Q29
	3 Disagree (score=1)	Booklet 10: Q60
	4 Strongly disagree (score=0)	Booklet 12: Q42
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
S527QSC	SUPP – P2006 Extinction of the Dinosaurs (C)	293-293
Likert	1 Strongly agree (score=3)	Booklet 1: Q17
A1	2 Agree (score=2)	Booklet 9: Q29
	3 Disagree (score=1)	Booklet 10: Q60
	4 Strongly disagree (score=0)	Booklet 12: Q42
	7 N/A	
	8 M/R	
	9 Missing	
	r Not reached	
M034R01	MATH – P2000 Bricks (Q01) – original responses	295-302
Closed Constructed	21 Full credit	Booklet 4: Q63
Response	9997 N/A	Booklet 7: Q46
F8.2	9998 M/R	Booklet 8: Q24
	9999 Missing	Booklet 9: Q12
M155R02	MATH – P2000 Population Pyramids (Q02) – original responses	303-304
Open Constructed	00 No credit	Booklet 4: Q54
Response	11 Partial credit	Booklet 7: Q37
A2	12 Partial credit	Booklet 8: Q15
	13 Partial credit	Booklet 9: Q3
	21 Full credit	
	97 N/A	
	99 Missing	
M155R03	MATH – P2000 Population Pyramids (Q03) – original responses	305-306
Open Constructed	00 No credit	Booklet 4: Q56
Response	11 Partial credit	Booklet 7: Q39
A2	12 Partial credit	Booklet 8: Q17
	13 Partial credit	Booklet 9: Q5
	21 Full credit	
	22 Full credit	
	23 Full credit	
	97 N/A	
	99 Missing	
M155R04	MATH – P2000 Population Pyramids (Q04) – original responses	307-310
Complex Multiple	2111 Full credit	Booklet 4: Q57
Choice	7777 N/A	Booklet 7: Q40
A4		Booklet 8: Q18
		Booklet 9: Q6
M192R01	MATH – P2000 Containers (Q01) – original responses	311-313
Complex Multiple	162 Full credit	
Choice	16* Full credit	Booklet 3: Q45
A3	1*2 Full credit	Booklet 7: Q51
	*62 Full credit	Booklet 10: Q17
	777 N/A	Booklet 11: Q5
M273R01	MATH – P2000 Pipelines (Q01) – original responses	314-317
Complex Multiple	4213 Full credit	Booklet 2: Q41
Choice	9997 N/A	Booklet 4: Q22
A4	9998 M/R	Booklet 10: Q2
	9999 Missing	Booklet 13: Q50

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M302R01	MATH – P2003 Car Drive (Q01) – original responses	318-325
Closed Constructed	60 Full credit	Booklet 3: Q53
Response	9997 N/A	Booklet 8: Q1
F8.2	9998 M/R	Booklet 12: Q14
	9999 Missing	Booklet 13: Q37
		Booklet UH: Q29
M408R01	MATH – P2003 Lotteries (Q01) – original responses	326-329
Complex Multiple	1222 Full credit	Booklet 2: Q42
Choice	7777 N/A	Booklet 4: Q23
A4		Booklet 10: Q3
M420R01	MATH – P2003 Transport (Q01) – original responses	330-333
Complex Multiple	1112 Full credit	Booklet 2: Q43
Choice	7777 N/A	Booklet 4: Q24
A4		Booklet 10: Q4
		Booklet 13: Q52
M421R02	MATH – P2003 Height (Q02) – original responses	334-337
Complex Multiple	2222 Full credit	Booklet 3: Q57
Choice	7777 N/A	Booklet 8: Q5
A4		Booklet 12: Q18
		Booklet 13: Q41
M462R01	MATH – P2003 Third Side (Q01) – original responses	338-339
Open Constructed	01 No credit	Booklet 4: Q62
Response	02 No credit	Booklet 7: Q45
A2	11 Partial credit	Booklet 8: Q23
	12 Partial credit	Booklet 9: Q11
	21 Full credit	Booklet UH: Q26
	97 N/A	
	99 Missing	
M464R01	MATH – P2003 The Fence (Q01) – original responses	340-347
Short Response	144 Full credit	Booklet 2: Q50
F8.2	9997 N/A	Booklet 4: Q31
	9998 M/R	Booklet 10: Q11
	9999 Missing	Booklet 13: Q59
M496R01	MATH – P2003 Cash Withdrawal (Q01) – original responses	348-351
Complex Multiple	2111 Full credit	Booklet 3: Q42
Choice	7777 N/A	Booklet 7: Q48
A4	Booklet 10: Q14	
	Booklet 11: Q2	
M603R01	MATH – P2003 Number Check (Q01) – original responses	352-354
Complex Multiple	112 Full credit	Booklet 3: Q48
Choice	777 N/A	Booklet 7: Q54
A3	Booklet 10: Q20	
	Booklet 11: Q8	
M603R02	MATH – P2003 Number Check (Q02) – original responses	355-362
Short Response	7 Full credit	Booklet 3: Q49
F8.2	9997 N/A	Booklet 7: Q55
	9998 M/R	Booklet 10: Q21
	9999 Missing	Booklet 11: Q9
M803R01	MATH – P2003 Labels (Q01) – original responses	363-370
Short Response	12 Full credit	Booklet 4: Q60
F8.2	9997 N/A	Booklet 7: Q43
	9998 M/R	Booklet 8: Q21
	9999 Missing	Booklet 9: Q9
M810R01	MATH – P2003 Bicycles (Q01) – original responses	371-378
Short Response	282 Full credit	Booklet 3: Q61
F8.2	9997 N/A	Booklet 8: Q9
	9998 M/R	Booklet 12: Q22
	9999 Missing	Booklet 13: Q45
M810R02	MATH – P2003 Bicycles (Q02) – original responses	379-386
Short Response	8 Full credit	Booklet 3: Q62
F8.2	9997 N/A	Booklet 8: Q10
	9998 M/R	Booklet 12: Q23
	9999 Missing	Booklet 13: Q46

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M810R03	MATH – P2003 Bicycles (Q03) – original responses	387-388
Open Constructed	00 No credit	Booklet 3: Q63
Response	11 Partial credit	Booklet 8: Q11
A2	12 Partial credit	Booklet 12: Q24
	21 Full credit	Booklet 13: Q47
	97 N/A	
	99 Missing	
M833R01	MATH – P2003 Seeing the tower (Q01) – original responses	389-393
Complex Multiple	43122 Full credit	Booklet 3: Q64
Choice	77777 N/A	Booklet 8: Q12
A5		Booklet 12: Q25
		Booklet 13: Q48
R219R01	READ – P2000 Employment (Q01) – original responses	394-397
Closed Constructed	1111 Full credit	Booklet 2: Q52
Response	7777 N/A	Booklet 6: Q35
A4		Booklet 7: Q22
		Booklet 12: Q1
		Booklet UH: Q19
R227R02	READ – P2000 Optician (Q02) – original responses	398-404
Complex Multiple	2121121 Full credit	Booklet 6: Q21
Choice	5 or 6 out of 7 Partial credit	Booklet 9: Q56
A7	7777777 N/A	Booklet 11: Q33
		Booklet 13: Q2
S114R03	SCIE – P2000 Greenhouse (Q03) – original responses	405-406
Open Response	01 No credit	Booklet 1: Q28
A2	02 No credit	Booklet 2: Q6
	11 Full credit	Booklet 8: Q30
	12 Full credit	Booklet 11: Q52
	97 N/A	
	99 Missing	
S114R05	SCIE – P2000 Greenhouse (Q05) – original responses	407-408
Open Response	01 No credit	Booklet 1: Q30
A2	02 No credit	Booklet 2: Q8
	03 No credit	Booklet 8: Q32
	11 Full credit	Booklet 11: Q54
	12 Full credit	
	97 N/A	
	99 Missing	
S131R02	SCIE – P2000 Good Vibrations (Q02) – original responses	409-410
	01 No credit	Booklet 4: Q34
	02 No credit	Booklet 5: Q2
	03 No credit	Booklet 11: Q14
	11 Full credit	Booklet 12: Q49
	12 Full credit	
	97 N/A	
	99 Missing	
S131R04	SCIE – P2006 (broken link) Good Vibrations (Q04) – original responses	411-412
Open Response	01 No credit	Booklet 4: Q35
A2	02 No credit	Booklet 5: Q3
	03 No credit	Booklet 11: Q15
	04 No credit	Booklet 12: Q50
	11 Full credit	
	12 Full credit	
	97 N/A	
	99 Missing	
S213R01	SCIE – P2000 Clothes (Q01) – original responses	413-416
Complex Multiple	1112 Full credit	Booklet 1: Q65
Choice	7777 N/A	Booklet 5: Q42
A4		Booklet 7: Q4
		Booklet 13: Q19

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S269R03	SCIE – P2000 Earth Temperature (Q03) – original responses	417-418
Open Response A2	01 No credit	Booklet 1: Q6
	02 No credit	Booklet 9: Q18
	11 Full credit	Booklet 10: Q49
	12 Full credit	Booklet 12: Q31
	97 N/A	
	99 Missing	
S269R04	SCIE – P2000 Earth Temperature (Q04) – original responses	419-422
Complex Multiple Choice A4	2112 Full credit	Booklet 1: Q7
	7777 N/A	Booklet 9: Q19
		Booklet 10: Q50
		Booklet 12: Q32
S326R04	SCIE – P2003 Milk (Q04) – original responses	423-425
Complex Multiple Choice A3	122 Full credit	Booklet 1: Q47
	777 N/A	Booklet 3: Q26
		Booklet 4: Q6
		Booklet 6: Q53
S408R04	SCIE – P2006 Wild Oat Grass (Q04) – original responses	426-428
Complex Multiple Choice A3	211 Full credit	Booklet 1: Q50
	777 N/A	Booklet 3: Q29
		Booklet 4: Q9
		Booklet 6: Q56
S413R04	SCIE – P2006 Plastic Age (Q04) – original responses	429-431
Complex Multiple Choice A3	112 Full credit	Booklet 4: Q49
	777 N/A	Booklet 5: Q17
	Booklet 11: Q29	
	Booklet 12: Q64	
S415R07	SCIE – P2006 Solar Power Generation (Q07) – original responses	432-433
Complex Multiple Choice A2	21 Full credit	Booklet 1: Q59
	77 N/A	Booklet 3: Q38
	Booklet 4: Q18	
	Booklet 6: Q65	
S415R08	SCIE – P2006 Solar Power Generation (Q08) – original responses	434-436
Complex Multiple Choice A3	112 Full credit	Booklet 1: Q61
	777 N/A	Booklet 3: Q40
	Booklet 4: Q20	
	Booklet 6: Q67	
S426R07	SCIE – P2006 The Grand Canyon (Q07) – original responses	437-438
Complex Multiple Choice A2	12 Full credit	Booklet 1: Q9
	77 N/A	Booklet 9: Q21
		Booklet 10: Q52
		Booklet 12: Q34
S438R01	SCIE – P2006 Green Parks (Q01) – original responses	439-441
Complex Multiple Choice A3	112 Full credit	Booklet 5: Q30
	777 N/A	Booklet 6: Q11
		Booklet 8: Q54
		Booklet 10: Q35
S438R03	SCIE – P2006 Green Parks (Q03) – original responses	442-443
Open Response A2	01 No credit	Booklet 5: Q32
	11 Full credit	Booklet 6: Q13
	12 Full credit	Booklet 8: Q56
	97 N/A	Booklet 10: Q37
	99 Missing	
S458R02	SCIE – P2006 The Ice Mummy (Q02) – original responses	444-446
Complex Multiple Choice A3	112 Full credit	Booklet 5: Q21
	777 N/A	Booklet 6: Q2
		Booklet 8: Q45
		Booklet 10: Q26

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S466R01	SCIE – P2006 Forest Fires (Q01) – original responses	447-449
Complex Multiple Choice A3	121 Full credit	Booklet 5: Q35
	777 N/A	Booklet 6: Q16
		Booklet 8: Q59
		Booklet 10: Q40
		Booklet UH: Q15
S466R07	SCIE – P2006 Forest Fires (Q07) – original responses	450-451
Complex Multiple Choice A2	21 Full credit	Booklet 5: Q36
	77 N/A	Booklet 6: Q17
		Booklet 8: Q60
		Booklet 10: Q41
		Booklet UH: Q16
S478R02	SCIE – P2006 Antibiotics (Q02) – original responses	452-454
Complex Multiple Choice A3	212 Full credit	Booklet 4: Q41
	777 N/A	Booklet 5: Q9
		Booklet 11: Q21
		Booklet 12: Q56
S478R03	SCIE – P2006 Antibiotics (Q03) – original responses	455-456
Complex Multiple Choice A2	12 Full credit	Booklet 4: Q42
	77 N/A	Booklet 5: Q10
		Booklet 11: Q22
		Booklet 12: Q57
S493R01	SCIE – P2006 Physical Exercise (Q01) – original responses	457-459
Complex Multiple Choice A3	121 Full credit	Booklet 1: Q62
	777 N/A	Booklet 5: Q39
		Booklet 7: Q1
		Booklet 13: Q16
S493R03	SCIE – P2006 Physical Exercise (Q03) – original responses	460-461
Complex Multiple Choice A2	12 Full credit	Booklet 1: Q63
	77 N/A	Booklet 5: Q40
		Booklet 7: Q2
		Booklet 13: Q17
S493R05	SCIE – P2006 Physical Exercise (Q05) – original responses	462-463
Open Response A2	01 No credit	Booklet 1: Q64
	11 Full credit	Booklet 5: Q41
	12 Full credit	Booklet 7: Q3
	97 N/A	Booklet 13: Q18
	99 Missing	
S495R01	SCIE – P2006 Radiotherapy (Q01) – original responses	464-466
Complex Multiple Choice A3	122 Full credit	Booklet 1: Q35
	777 N/A	Booklet 2: Q13
		Booklet 8: Q37
		Booklet 11: Q59
S495R02	SCIE – P2006 Radiotherapy (Q02) – original responses	467-468
Complex Multiple Choice A2	11 Full credit	Booklet 1: Q36
	77 N/A	Booklet 2: Q14
		Booklet 8: Q38
		Booklet 11: Q60
S495R04	SCIE – P2006 Radiotherapy (Q04) – original responses	469-471
Complex Multiple Choice A3	112 Full credit	Booklet 1: Q34
	777 N/A	Booklet 2: Q12
		Booklet 8: Q36
		Booklet 11: Q58
S498R02	SCIE – P2006 Experimental Digestion (Q02) – original responses	472-474
Complex Multiple Choice A3	121 Full credit	Booklet 2: Q32
	777 N/A	Booklet 3: Q13
		Booklet 5: Q72
		Booklet 9: Q47

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S508R02	SCIE – P2006 Genetically Modified Food (Q02) – original responses	475-476
Complex Multiple	21 Full credit	Booklet 1: Q1
Choice	77 N/A	Booklet 9: Q13
A2		Booklet 10: Q44
		Booklet 12: Q26
S510R01	SCIE – P2006 Magnetic Hovertrain (Q01) – original responses	477-478
Complex Multiple	11 Full credit	Booklet 1: Q42
Choice	77 N/A	Booklet 3: Q21
A2		Booklet 4: Q1
		Booklet 6: Q48
S510R04	SCIE – P2006 Magnetic Hovertrain (Q04) – original responses	479-480
Open Response	01 No credit	Booklet 1: Q43
A2	11 Full credit	Booklet 3: Q22
	12 Full credit	Booklet 4: Q2
	97 N/A	Booklet 6: Q49
	99 Missing	
S519R02	SCIE – P2006 Airbags (Q02) – original responses	481-482
Complex Multiple	12 Full credit	Booklet 2: Q28
Choice	77 N/A	Booklet 3: Q9
A2		Booklet 5: Q68
		Booklet 9: Q43
S524R06	SCIE – P2006 Penicillin Manufacture (Q06) – original responses	483-484
Complex Multiple	21 Full credit	Booklet 2: Q37
Choice	77 N/A	Booklet 3: Q18
A2		Booklet 5: Q77
		Booklet 9: Q52
S527R01	SCIE – P2006 Extinction of the Dinosaurs (Q01) – original responses	485-487
Complex Multiple	133 Full credit	Booklet 1: Q13
Choice	777 N/A	Booklet 9: Q25
A3		Booklet 10: Q56
		Booklet 12: Q38
S527R03	SCIE – P2006 Extinction of the Dinosaurs (Q03) – original responses	488-489
Complex Multiple	12 Full credit	Booklet 1: Q14
Choice	77 N/A	Booklet 9: Q26
A2		Booklet 10: Q57
		Booklet 12: Q39
S527R04	SCIE – P2006 Extinction of the Dinosaurs (Q04) – original responses	490-492
Complex Multiple	121 Full credit	Booklet 1: Q15
Choice	777 N/A	Booklet 9: Q27
A3		Booklet 10: Q58
		Booklet 12: Q40
CLCUSE3A	Effort A: real	494-496
F3.0	997 N/A	
	998 M/R	
	999 Missing	
CLCUSE3B	Effort B: if counted	497-499
F3.0	997 N/A	
	998 M/R	
	999 Missing	
DEFFORT	Effort B – Effort A	500-502
F3.0	997 N/A	
	998 M/R	
	999 Missing	
TESTLANG	Language of Test (3-character)	503-505
A3	See Appendix 7 for labels	
VER_COGN	Version of cognitive database and date of release	506-519
A13		

APPENDIX 9
CODEBOOK FOR PISA 2006 SCORED COGNITIVE AND EMBEDDED ATTITUDE ITEMS

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
SUBNATIO	Adjudicated sub-region	1-5
A5	See Appendix 7 for labels	
SCHOOLID	School ID 5-digit	6-10
A5		
STIDSTD	Student ID 5-digit	11-15
A5		
CNT	Country code 3-character	16-18
A3	See Appendix 7 for labels	
COUNTRY	Country code 3-digit	19-21
A3	See Appendix 7 for labels	
OECD	OECD Country	22-22
F1.0	0 Non-OECD	
	1 OECD	
BOOKID	Booklet	23-24
F2.0		
M033Q01	MATH – P2000 A View Room (Q01)	26-26
Multiple Choice	0 Score=0	Booklet 4: Q52
A1	1 Score=1	Booklet 7: Q35
	7 N/A	Booklet 8: Q13
	8 Not reached	Booklet 9: Q1
M034Q01T	MATH – P2000 Bricks (Q01)	27-27
Closed	0 Score=0	Booklet 4: Q63
Constructed	1 Score=1	Booklet 7: Q46
Response	7 N/A	Booklet 8: Q24
A1	8 Not reached	Booklet 9: Q12
M155Q01	MATH – P2000 Population Pyramids (Q01)	28-28
Open Constructed	0 Score=0	Booklet 4: Q55
Response	1 Score=1	Booklet 7: Q38
A1	7 N/A	Booklet 8: Q16
	8 Not reached	Booklet 9: Q4
M155Q02T	MATH – P2000 Population Pyramids (Q02)	29-29
Open Constructed	0 Score=0	Booklet 4: Q54
Response	1 Score=1	Booklet 7: Q37
A1	2 Score=2	Booklet 8: Q15
	7 N/A	Booklet 9: Q3
	8 Not reached	
M155Q03T	MATH – P2000 Population Pyramids (Q03)	30-30
Open Constructed	0 Score=0	Booklet 4: Q56
Response	1 Score=1	Booklet 7: Q39
A1	2 Score=2	Booklet 8: Q17
	7 N/A	Booklet 9: Q5
	8 Not reached	
M155Q04T	MATH – P2000 Population Pyramids (Q04)	31-31
Complex Multiple	0 Score=0	Booklet 4: Q57
Choice	1 Score=1	Booklet 7: Q40
A1	7 N/A	Booklet 8: Q18
	8 Not reached	Booklet 9: Q6
M192Q01T	MATH – P2000 Containers (Q01)	32-32
Complex Multiple	0 Score=0	Booklet 3: Q45
Choice	1 Score=1	Booklet 7: Q51
A1	7 N/A	Booklet 10: Q17
	8 Not reached	Booklet 11: Q5
M273Q01T	MATH – P2000 Pipelines (Q01)	33-33
Complex Multiple	0 Score=0	Booklet 2: Q41
Choice	1 Score=1	Booklet 4: Q22
A1	7 N/A	Booklet 10: Q2
	8 Not reached	Booklet 13: Q50
M302Q01T	MATH – P2003 Car Drive (Q01)	34-34
Closed Constructed	0 Score=0	Booklet 3: Q53
Response	1 Score=1	Booklet 8: Q1
A1	7 N/A	Booklet 12: Q14
	8 Not reached	Booklet 13: Q37
		Booklet UH: Q29

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M302Q02	MATH – P2003 Car Drive (Q02)	35-35
Closed	0 Score=0	Booklet 3: Q54
Constructed	1 Score=1	Booklet 8: Q2
Response	7 N/A	Booklet 12: Q15
A1	8 Not reached	Booklet 13: Q38
		Booklet UH: Q30
M302Q03	MATH – P2003 Car Drive (Q03)	36-36
Open Constructed	0 Score=0	Booklet 3: Q55
Response	1 Score=1	Booklet 8: Q3
A1	7 N/A	Booklet 12: Q16
	8 Not reached	Booklet 13: Q39
		Booklet UH: Q31
M305Q01	MATH – P2003 Map (Q01)	37-37
Multiple Choice	0 Score=0	Booklet 3: Q41
A1	1 Score=1	Booklet 7: Q47
	7 N/A	Booklet 10: Q13
	8 Not reached	Booklet 11: Q1
M406Q01	MATH – P2003 Running Tracks (Q01)	38-38
Open Constructed	0 Score=0	Booklet 3: Q46
Response	1 Score=1	Booklet 7: Q52
A1	7 N/A	Booklet 10: Q18
	8 Not reached	Booklet 11: Q6
	r Not reached	
M406Q02	MATH – P2003 Running Tracks (Q02)	39-39
Open Constructed	0 Score=0	Booklet 3: Q47
Response	1 Score=1	Booklet 7: Q53
A1	7 N/A	Booklet 10: Q19
	8 Not reached	Booklet 11: Q7
M408Q01T	MATH – P2003 Lotteries (Q01)	40-40
Complex Multiple	0 Score=0	Booklet 2: Q42
Choice	1 Score=1	Booklet 4: Q23
A1	7 N/A	Booklet 10: Q3
	8 Not reached	Booklet 13: Q51
M411Q01	MATH – P2003 Diving (Q01)	41-41
Short Response	0 Score=0	Booklet 4: Q58
A1	1 Score=1	Booklet 7: Q41
	7 N/A	Booklet 8: Q19
	8 Not reached	Booklet 9: Q7
M411Q02	MATH – P2003 Diving (Q02)	42-42
Multiple Choice	0 Score=0	Booklet 4: Q59
A1	1 Score=1	Booklet 7: Q42
	7 N/A	Booklet 8: Q20
	8 Not reached	Booklet 9: Q8
M420Q01T	MATH – P2003 Transport (Q01)	43-43
Complex Multiple	0 Score=0	Booklet 2: Q43
Choice	1 Score=1	Booklet 4: Q24
A1	7 N/A	Booklet 10: Q4
	8 Not reached	Booklet 13: Q52
M421Q01	MATH – P2003 Height (Q01)	44-44
Open Constructed	0 Score=0	Booklet 3: Q56
Response	1 Score=1	Booklet 8: Q4
A1	7 N/A	Booklet 12: Q17
	8 Not reached	Booklet 13: Q40
M421Q02T	MATH – P2003 Height (Q02)	45-45
Complex Multiple	0 Score=0	Booklet 3: Q57
Choice	1 Score=1	Booklet 8: Q5
A1	7 N/A	Booklet 12: Q18
	8 Not reached	Booklet 13: Q41
M421Q03	MATH – P2003 Height (Q03)	46-46
Multiple Choice	0 Score=0	Booklet 3: Q58
A1	1 Score=1	Booklet 8: Q6
	7 N/A	Booklet 12: Q19
	8 Not reached	Booklet 13: Q42

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M423Q01	MATH – P2003 Tossing Coins (Q01)	47-47
Multiple Choice	0 Score=0	Booklet 3: Q44
A1	1 Score=1	Booklet 7: Q50
	7 N/A	Booklet 10: Q16
	8 Not reached	Booklet 11: Q4
M442Q02	MATH – P2003 Braille (Q02)	48-48
Closed Constructed	0 Score=0	Booklet 4: Q61
Response	1 Score=1	Booklet 7: Q44
A1	7 N/A	Booklet 8: Q22
	8 Not reached	Booklet 9: Q10
M446Q01	MATH – P2003 Thermometer Cricket (Q01)	49-49
Short Response	0 Score=0	Booklet 2: Q44
A1	1 Score=1	Booklet 4: Q25
	7 N/A	Booklet 10: Q5
	8 Not reached	Booklet 13: Q53
M446Q02	MATH – P2003 Thermometer Cricket (Q02)	50-50
Open Constructed	0 Score=0	Booklet 2: Q45
Response	1 Score=1	Booklet 4: Q26
A1	7 N/A	Booklet 10: Q6
	8 Not reached	Booklet 13: Q54
M447Q01	MATH – P2003 Tile Arrangement (Q01)	51-51
Multiple Choice	0 Score=0	Booklet 2: Q40
A1	1 Score=1	Booklet 4: Q21
	7 N/A	Booklet 10: Q1
	8 Not reached	Booklet 13: Q49
M462Q01T	MATH – P2003 Third Side (Q01)	52-52
Open Constructed	0 Score=0	Booklet 4: Q62
Response	1 Score=1	Booklet 7: Q45
A1	2 Score=2	Booklet 8: Q23
	7 N/A	Booklet 9: Q11
	8 Not reached	Booklet UH: Q26
M464Q01T	MATH – P2003 The Fence (Q01)	53-53
Short Response	0 Score=0	Booklet 2: Q50
A1	1 Score=1	Booklet 4: Q31
	7 N/A	Booklet 10: Q11
	8 Not reached	Booklet 13: Q59
M474Q01	MATH – P2003 Running Time (Q01)	54-54
Closed Constructed	0 Score=0	Booklet 4: Q53
Response	1 Score=1	Booklet 7: Q36
A1	7 N/A	Booklet 8: Q14
	8 Not reached	Booklet 9: Q2
M496Q01T	MATH – P2003 Cash Withdrawal (Q01)	55-55
Complex Multiple	0 Score=0	Booklet 3: Q42
Choice	1 Score=1	Booklet 7: Q48
A1	7 N/A	Booklet 10: Q14
	8 Not reached	Booklet 11: Q2
M496Q02	MATH – P2003 Cash Withdrawal (Q02)	56-56
Short Response	0 Score=0	Booklet 3: Q43
A1	1 Score=1	Booklet 7: Q49
	7 N/A	Booklet 10: Q15
	8 Not reached	Booklet 11: Q3
M559Q01	MATH – P2003 Telephone Rates (Q01)	57-57
Multiple Choice	0 Score=0	Booklet 2: Q46
A1	1 Score=1	Booklet 4: Q27
	7 N/A	Booklet 10: Q7
	8 Not reached	Booklet 13: Q55
M564Q01	MATH – P2003 Chair Lift (Q01)	58-58
Multiple Choice	0 Score=0	Booklet 3: Q51
A1	1 Score=1	Booklet 7: Q57
	7 N/A	Booklet 10: Q23
	8 Not reached	Booklet 11: Q11
		Booklet UH: Q27
M564Q02	MATH – P2003 Chair Lift (Q02)	59-59
Multiple Choice	0 Score=0	Booklet 3: Q52
A1	1 Score=1	Booklet 7: Q58
	7 N/A	Booklet 10: Q24
	8 Not reached	Booklet 11: Q12
		Booklet UH: Q28

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M571Q01	MATH – P2003 Stop The Car (Q01)	60-60
Multiple Choice	0 Score=0	Booklet 3: Q50
A1	1 Score=1	Booklet 7: Q56
	7 N/A	Booklet 10: Q22
	8 Not reached	Booklet 11: Q10
M598Q01	MATH – P2003 Making A Booklet (Q01)	61-61
Closed Constructed	0 Score=0	Booklet 3: Q60
Response	1 Score=1	Booklet 8: Q8
A1	7 N/A	Booklet 12: Q21
	8 Not reached	Booklet 13: Q44
M603Q01T	MATH – P2003 Number Check (Q01)	62-62
Complex Multiple	0 Score=0	Booklet 3: Q48
Choice	1 Score=1	Booklet 7: Q54
A1	7 N/A	Booklet 10: Q20
	8 Not reached	Booklet 11: Q8
M603Q02T	MATH – P2003 Number Check (Q02)	63-63
Short Response	0 Score=0	Booklet 3: Q49
A1	1 Score=1	Booklet 7: Q55
	7 N/A	Booklet 10: Q21
	8 Not reached	Booklet 11: Q9
M710Q01	MATH – P2003 Forecast of Rain (Q01)	64-64
Multiple Choice	0 Score=0	Booklet 3: Q59
A1	1 Score=1	Booklet 8: Q7
	7 N/A	Booklet 12: Q20
	8 Not reached	Booklet 13: Q43
M800Q01	MATH – P2003 Computer Game (Q01)	65-65
Multiple Choice	0 Score=0	Booklet 2: Q51
A1	1 Score=1	Booklet 4: Q32
	7 N/A	Booklet 10: Q12
	8 Not reached	Booklet 13: Q60
		Booklet UH: Q25
M803Q01T	MATH – P2003 Labels (Q01)	66-66
Short Response	0 Score=0	Booklet 4: Q60
A1	1 Score=1	Booklet 7: Q43
	7 N/A	Booklet 8: Q21
	8 Not reached	Booklet 9: Q9
M810Q01T	MATH – P2003 Bicycles (Q01)	67-67
Short Response	0 Score=0	Booklet 3: Q61
A1	1 Score=1	Booklet 8: Q9
	7 N/A	Booklet 12: Q22
	8 Not reached	Booklet 13: Q45
M810Q02T	MATH – P2003 Bicycles (Q02)	68-68
Short Response	0 Score=0	Booklet 3: Q62
A1	1 Score=1	Booklet 8: Q10
	7 N/A	Booklet 12: Q23
	8 Not reached	Booklet 13: Q46
M810Q03T	MATH – P2003 Bicycles (Q03)	69-69
Open Constructed	0 Score=0	Booklet 3: Q63
Response	1 Score=1	Booklet 8: Q11
A1	2 Score=2	Booklet 12: Q24
	7 N/A	Booklet 13: Q47
	8 Not reached	
M828Q01	MATH – P2003 Carbon Dioxide (Q01)	70-70
Open Constructed	0 Score=0	Booklet 2: Q47
Response	1 Score=1	Booklet 4: Q28
A1	7 N/A	Booklet 10: Q8
	8 Not reached	Booklet 13: Q56
M828Q02	MATH – P2003 Carbon Dioxide (Q02)	71-71
Short Response	0 Score=0	Booklet 2: Q48
A1	1 Score=1	Booklet 4: Q29
	7 N/A	Booklet 10: Q9
	8 Not reached	Booklet 13: Q57
M828Q03	MATH – P2003 Carbon Dioxide (Q03)	72-72
Short Response	0 Score=0	Booklet 2: Q49
A1	1 Score=1	Booklet 4: Q30
	7 N/A	Booklet 10: Q10
	8 Not reached	Booklet 13: Q58

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
M833Q01T	MATH – P2003 Seeing the tower (Q01)	73-73
Complex Multiple	0 Score=0	Booklet 3: Q64
Choice	1 Score=1	Booklet 8: Q12
A1	7 N/A	Booklet 12: Q25
	8 Not reached	Booklet 13: Q48
R055Q01	READ – P2000 Drugged Spiders (Q01)	74-74
Multiple Choice	0 Score=0	Booklet 6: Q28
A1	1 Score=1	Booklet 9: Q63
	7 N/A	Booklet 11: Q40
	8 Not reached	Booklet 13: Q9
		Booklet UH: Q21
R055Q02	READ – P2000 Drugged Spiders (Q02)	75-75
Open Constructed	0 Score=0	Booklet 6: Q29
Response	1 Score=1	Booklet 9: Q64
A1	7 N/A	Booklet 11: Q41
	8 Not reached	Booklet 13: Q10
		Booklet UH: Q22
R055Q03	READ – P2000 Drugged Spiders (Q03)	76-76
Open Constructed	0 Score=0	Booklet 6: Q30
Response	1 Score=1	Booklet 9: Q65
A1	7 N/A	Booklet 11: Q42
	8 Not reached	Booklet 13: Q11
		Booklet UH: Q23
R055Q05	READ – P2000 Drugged Spiders (Q05)	77-77
Open Constructed	0 Score=0	Booklet 6: Q31
Response	1 Score=1	Booklet 9: Q66
A1	7 N/A	Booklet 11: Q43
	8 Not reached	Booklet 13: Q12
		Booklet UH: Q24
R067Q01	READ – P2000 Aesop (Q01)	78-78
Multiple Choice	0 Score=0	Booklet 2: Q54
A1	1 Score=1	Booklet 6: Q37
	7 N/A	Booklet 7: Q24
	8 Not reached	Booklet 12: Q3
R067Q04	READ – P2000 Aesop (Q04)	79-79
Open Constructed	0 Score=0	Booklet 2: Q55
Response	1 Score=1	Booklet 6: Q38
A1	2 Score=2	Booklet 7: Q25
	7 N/A	Booklet 12: Q4
	8 Not reached	
R067Q05	READ – P2000 Aesop (Q05)	80-80
Open Constructed	0 Score=0	Booklet 2: Q56
Response	1 Score=1	Booklet 6: Q39
A1	2 Score=2	Booklet 7: Q26
	7 N/A	Booklet 12: Q5
	8 Not reached	
R102Q04A	READ – P2000 Shirts (Q04a)	81-81
Open Constructed	0 Score=0	Booklet 2: Q57
Response	1 Score=1	Booklet 6: Q40
A1	7 N/A	Booklet 7: Q27
	8 Not reached	Booklet 12: Q6
R102Q05	READ – P2000 Shirts (Q05)	82-82
Closed Constructed	0 Score=0	Booklet 2: Q58
Response	1 Score=1	Booklet 6: Q41
A1	7 N/A	Booklet 7: Q28
	8 Not reached	Booklet 12: Q7
R102Q07	READ – P2000 Shirts (Q07)	83-83
Multiple Choice	0 Score=0	Booklet 2: Q59
A1	1 Score=1	Booklet 6: Q42
	7 N/A	Booklet 7: Q29
	8 Not reached	Booklet 12: Q8
R104Q01	READ – P2000 Telephone (Q01)	84-84
Closed Constructed	0 Score=0	Booklet 6: Q32
Response	1 Score=1	Booklet 9: Q67
A1	7 N/A	Booklet 11: Q44
	8 Not reached	Booklet 13: Q13

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
R104Q02	READ – P2000 Telephone (Q02)	85-85
Closed Constructed	0 Score=0	Booklet 6: Q33
Response	1 Score=1	Booklet 9: Q68
A1	7 N/A	Booklet 11: Q45
	8 Not reached	Booklet 13: Q14
R104Q05	READ – P2000 Telephone (Q05)	86-86
Short Response	0 Score=0	Booklet 6: Q34
A1	1 Score=1	Booklet 9: Q69
	2 Score=2	Booklet 11: Q46
	7 N/A	Booklet 13: Q15
	8 Not reached	
R111Q01	READ – P2000 Exchange (Q01)	87-87
Multiple Choice	0 Score=0	Booklet 6: Q24
A1	1 Score=1	Booklet 9: Q59
	7 N/A	Booklet 11: Q36
	8 Not reached	Booklet 13: Q5
R111Q02B	READ – P2000 Exchange (Q02b)	88-88
Open Constructed	0 Score=0	Booklet 6: Q25
Response	1 Score=1	Booklet 9: Q60
A1	2 Score=2	Booklet 11: Q37
	7 N/A	Booklet 13: Q6
	8 Not reached	
R111Q06B	READ – P2000 Exchange (Q06b)	89-89
Open Constructed	0 Score=0	Booklet 6: Q27
Response	1 Score=1	Booklet 9: Q62
A1	2 Score=2	Booklet 11: Q39
	7 N/A	Booklet 13: Q8
	8 Not reached	
R219Q01E	READ – P2000 Employment (Q01e)	90-90
Short Response	0 Score=0	Booklet 2: Q52
A1	1 Score=1	Booklet 6: Q35
	7 N/A	Booklet 7: Q22
	8 Not reached	Booklet 12: Q1
		Booklet UH: Q19
R219Q01T	READ – P2000 Employment (Q01)	91-91
Closed	0 Score=0	Booklet 2: Q52
Constructed	1 Score=1	Booklet 6: Q35
Response	7 N/A	Booklet 7: Q22
A1	8 Not reached	Booklet 12: Q1
		Booklet UH: Q19
R219Q02	READ – P2000 Employment (Q02)	92-92
Open Constructed	0 Score=0	Booklet 2: Q53
Response	1 Score=1	Booklet 6: Q36
A1	7 N/A	Booklet 7: Q23
	8 Not reached	Booklet 12: Q2
		Booklet UH: Q20
R220Q01	READ – P2000 South Pole (Q01)	93-93
Short Response	0 Score=0	Booklet 2: Q60
A1	1 Score=1	Booklet 6: Q43
	7 N/A	Booklet 7: Q30
	8 Not reached	Booklet 12: Q9
R220Q02B	READ – P2000 South Pole (Q02b)	94-94
Multiple Choice	0 Score=0	Booklet 2: Q61
A1	1 Score=1	Booklet 6: Q44
	7 N/A	Booklet 7: Q31
	8 Not reached	Booklet 12: Q10
R220Q04	READ – P2000 South Pole (Q04)	95-95
Multiple Choice	0 Score=0	Booklet 2: Q62
A1	1 Score=1	Booklet 6: Q45
	7 N/A	Booklet 7: Q32
	8 Not reached	Booklet 12: Q11
R220Q05	READ – P2000 South Pole (Q05)	96-96
Multiple Choice	0 Score=0	Booklet 2: Q63
A1	1 Score=1	Booklet 6: Q46
	7 N/A	Booklet 7: Q33
	8 Not reached	Booklet 12: Q12
R220Q06	READ – P2000 South Pole (Q06)	97-97
Multiple Choice	0 Score=0	Booklet 2: Q64
A1	1 Score=1	Booklet 6: Q47
	7 N/A	Booklet 7: Q34
	8 Not reached	Booklet 12: Q13

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
R227Q01	READ – P2000 Optician (Q01)	98-98
Multiple Choice	0 Score=0	Booklet 6: Q20
A1	1 Score=1	Booklet 9: Q55
	7 N/A	Booklet 11: Q32
	8 Not reached	Booklet 13: Q1
R227Q02T	READ – P2000 Optician (Q02)	99-99
Complex Multiple	0 Score=0	Booklet 6: Q21
Choice	1 Score=1	Booklet 9: Q56
A1	2 Score=2	Booklet 11: Q33
	7 N/A	Booklet 13: Q2
	8 Not reached	
R227Q03	READ – P2000 Optician (Q03)	100-100
Open Constructed	0 Score=0	Booklet 6: Q22
Response	1 Score=1	Booklet 9: Q57
A1	7 N/A	Booklet 11: Q34
	8 Not reached	Booklet 13: Q3
R227Q06	READ – P2000 Optician (Q06)	101-101
Short Response	0 Score=0	Booklet 6: Q23
A1	1 Score=1	Booklet 9: Q58
	7 N/A	Booklet 11: Q35
	8 Not reached	Booklet 13: Q4
S114Q03T	SCIE – P2000 Greenhouse (Q03)	102-102
Open Response	0 Score=0	Booklet 1: Q28
A1	1 Score=1	Booklet 2: Q6
	7 N/A	Booklet 8: Q30
	8 Not reached	Booklet 11: Q52
S114Q04T	SCIE – P2000 Greenhouse (Q04)	103-103
Open Response	0 Score=0	Booklet 1: Q29
A1	1 Score=1	Booklet 2: Q7
	2 Score=2	Booklet 8: Q31
	7 N/A	Booklet 11: Q53
	8 Not reached	
S114Q05T	SCIE – P2000 Greenhouse (Q05)	104-104
Open Response	0 Score=0	Booklet 1: Q30
A1	1 Score=1	Booklet 2: Q8
	7 N/A	Booklet 8: Q32
	8 Not reached	Booklet 11: Q54
S131Q02T	SCIE – P2000 Good Vibrations (Q02)	105-105
Open Response	0 Score=0	Booklet 4: Q34
A1	1 Score=1	Booklet 5: Q2
	7 N/A	Booklet 11: Q14
	8 Not reached	Booklet 12: Q49
S131Q04T	SCIE – P2006 (broken link) Good Vibrations (Q04)	106-106
Open Response	0 Score=0	Booklet 4: Q35
	1 Score=1	Booklet 5: Q3
	7 N/A	Booklet 11: Q15
	8 Not reached	Booklet 12: Q50
S213Q01T	SCIE – P2000 Clothes (Q01)	107-107
Complex Multiple	0 Score=0	Booklet 1: Q65
Choice	1 Score=1	Booklet 5: Q42
A1	7 N/A	Booklet 7: Q4
	8 Not reached	Booklet 13: Q19
S213Q02	SCIE – P2000 Clothes (Q02)	108-108
Multiple Choice	0 Score=0	Booklet 1: Q66
A1	1 Score=1	Booklet 5: Q43
	7 N/A	Booklet 7: Q5
	8 Not reached	Booklet 13: Q20
S256Q01	SCIE – P2000 Spoons (Q01)	109-109
Multiple Choice	0 Score=0	Booklet 4: Q33
A1	1 Score=1	Booklet 5: Q1
	7 N/A	Booklet 11: Q13
	8 Not reached	Booklet 12: Q48
		Booklet UH: Q1
S268Q01	SCIE – P2000 Algae (Q01)	110-110
Multiple Choice	0 Score=0	Booklet 2: Q24
A1	1 Score=1	Booklet 3: Q5
	7 N/A	Booklet 5: Q64
	8 Not reached	Booklet 9: Q39
S268Q02T	SCIE – P2000 Algae (Q02)	111-111
Open Response	0 Score=0	Booklet 2: Q25
A1	1 Score=1	Booklet 3: Q6
	7 N/A	Booklet 5: Q65
	8 Not reached	Booklet 9: Q40

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S268Q06	SCIE – P2000 Algae (Q06)	112-112
Multiple Choice	0 Score=0	Booklet 2: Q26
A1	1 Score=1	Booklet 3: Q7
	7 N/A	Booklet 5: Q66
	8 Not reached	Booklet 9: Q41
S269Q01	SCIE – P2000 Earth Temperature (Q01)	113-113
Open Response	0 Score=0	Booklet 1: Q5
A1	1 Score=1	Booklet 9: Q17
	7 N/A	Booklet 10: Q48
	8 Not reached	Booklet 12: Q30
S269Q03T	SCIE – P2000 Earth Temperature (Q03)	114-114
Open Response	0 Score=0	Booklet 1: Q6
A1	1 Score=1	Booklet 9: Q18
	7 N/A	Booklet 10: Q49
	8 Not reached	Booklet 12: Q31
S269Q04T	SCIE – P2000 Earth Temperature (Q04)	115-115
Complex Multiple	0 Score=0	Booklet 1: Q7
Choice	1 Score=1	Booklet 9: Q19
A1	7 N/A	Booklet 10: Q50
	8 Not reached	Booklet 12: Q32
S304Q01	SCIE – P2003 Water (Q01)	116-116
Open Response	0 Score=0	Booklet 5: Q22
A1	1 Score=1	Booklet 6: Q3
	7 N/A	Booklet 8: Q46
	8 Not reached	Booklet 10: Q27
S304Q02	SCIE – P2003 Water (Q02)	117-117
Multiple Choice	0 Score=0	Booklet 5: Q23
A1	1 Score=1	Booklet 6: Q4
	7 N/A	Booklet 8: Q47
	8 Not reached	Booklet 10: Q28
S304Q03A	SCIE – P2003 Water (Q03a)	118-118
Open Response	0 Score=0	Booklet 5: Q24
A1	1 Score=1	Booklet 6: Q5
	7 N/A	Booklet 8: Q48
	8 Not reached	Booklet 10: Q29
S304Q03B	SCIE – P2003 Water (Q03b)	119-119
Open Response	0 Score=0	Booklet 5: Q25
A1	1 Score=1	Booklet 6: Q6
	7 N/A	Booklet 8: Q49
	8 Not reached	Booklet 10: Q30
S326Q01	SCIE – P2003 Milk (Q01)	120-120
Open Response	0 Score=0	Booklet 1: Q44
A1	1 Score=1	Booklet 3: Q23
	7 N/A	Booklet 4: Q3
	8 Not reached	Booklet 6: Q50
S326Q02	SCIE – P2003 Milk (Q02)	121-121
Open Response	0 Score=0	Booklet 1: Q45
A1	1 Score=1	Booklet 3: Q24
	7 N/A	Booklet 4: Q4
	8 Not reached	Booklet 6: Q51
S326Q03	SCIE – P2003 Milk (Q03)	122-122
Multiple Choice	0 Score=0	Booklet 1: Q46
A1	1 Score=1	Booklet 3: Q25
	7 N/A	Booklet 4: Q5
	8 Not reached	Booklet 6: Q52
S326Q04T	SCIE – P2003 Milk (Q04)	123-123
Complex Multiple	0 Score=0	Booklet 1: Q47
Choice	1 Score=1	Booklet 3: Q26
A1	7 N/A	Booklet 4: Q6
	8 Not reached	Booklet 6: Q53
S408Q01	SCIE – P2006 Wild Oat Grass (Q01)	124-124
Multiple Choice	0 Score=0	Booklet 1: Q48
A1	1 Score=1	Booklet 3: Q27
	7 N/A	Booklet 4: Q7
	8 Not reached	Booklet 6: Q54
S408Q03	SCIE – P2006 Wild Oat Grass (Q03)	125-125
Open Response	0 Score=0	Booklet 1: Q49
A1	1 Score=1	Booklet 3: Q28
	7 N/A	Booklet 4: Q8
	8 Not reached	Booklet 6: Q55

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S408Q04T	SCIE – P2006 Wild Oat Grass (Q04)	126-126
Complex Multiple Choice A1	0 Score=0	Booklet 1: Q50
	1 Score=1	Booklet 3: Q29
	7 N/A	Booklet 4: Q9
	8 Not reached	Booklet 6: Q56
S408Q05	SCIE – P2006 Wild Oat Grass (Q05)	127-127
Multiple Choice A1	0 Score=0	Booklet 1: Q51
	1 Score=1	Booklet 3: Q30
	7 N/A	Booklet 4: Q10
	8 Not reached	Booklet 6: Q57
S413Q04T	SCIE – P2006 Plastic Age (Q04)	128-128
Complex Multiple Choice A1	0 Score=0	Booklet 4: Q49
	1 Score=1	Booklet 5: Q17
	7 N/A	Booklet 11: Q29
	8 Not reached	Booklet 12: Q64
S413Q05	SCIE – P2006 Plastic Age (Q05)	129-129
Multiple Choice A1	0 Score=0	Booklet 4: Q50
	1 Score=1	Booklet 5: Q18
	7 N/A	Booklet 11: Q30
	8 Not reached	Booklet 12: Q65
S413Q06	SCIE – P2006 Plastic Age (Q06)	130-130
Closed Constructed Response A1	0 Score=0	Booklet 4: Q48
	1 Score=1	Booklet 5: Q16
	7 N/A	Booklet 11: Q28
	8 Not reached	Booklet 12: Q63
S415Q02	SCIE – P2006 Solar Power Generation (Q02)	131-131
Multiple Choice A1	0 Score=0	Booklet 1: Q60
	1 Score=1	Booklet 3: Q39
	7 N/A	Booklet 4: Q19
	8 Not reached	Booklet 6: Q66
S415Q07T	SCIE – P2006 Solar Power Generation (Q07)	132-132
Complex Multiple Choice A1	0 Score=0	Booklet 1: Q59
	1 Score=1	Booklet 3: Q38
	7 N/A	Booklet 4: Q18
	8 Not reached	Booklet 6: Q65
S415Q08T	SCIE – P2006 Solar Power Generation (Q08)	133-133
Complex Multiple Choice A1	0 Score=0	Booklet 1: Q61
	1 Score=1	Booklet 3: Q40
	7 N/A	Booklet 4: Q20
	8 Not reached	Booklet 6: Q67
S416Q01	SCIE – P2006 The Moon (Q01)	134-134
Closed Constructed Response A1	0 Score=0	Booklet 1: Q67
	1 Score=1	Booklet 5: Q44
	7 N/A	Booklet 7: Q6
	8 Not reached	Booklet 13: Q21
S421Q01	SCIE – P2006 Big and Small (Q01)	135-135
Closed Constructed Response A1	0 Score=0	Booklet 1: Q79
	1 Score=1	Booklet 5: Q56
	7 N/A	Booklet 7: Q18
	8 Not reached	Booklet 13: Q33
		Booklet UH: Q6
S421Q03	SCIE – P2006 Big and Small (Q03)	136-136
Closed Constructed Response A1	0 Score=0	Booklet 1: Q81
	1 Score=1	Booklet 5: Q58
	7 N/A	Booklet 7: Q20
	8 Not reached	Booklet 13: Q35
		Booklet UH: Q8
S425Q02	SCIE – P2006 Penguin Island (Q02)	137-137
Multiple Choice A1	0 Score=0	Booklet 1: Q72
	1 Score=1	Booklet 5: Q49
	7 N/A	Booklet 7: Q11
	8 Not reached	Booklet 13: Q26
S425Q03	SCIE – P2006 Penguin Island (Q03)	138-138
Open Response A1	0 Score=0	Booklet 1: Q70
	1 Score=1	Booklet 5: Q47
	7 N/A	Booklet 7: Q9
	8 Not reached	Booklet 13: Q24
S425Q04	SCIE – P2006 Penguin Island (Q04)	139-139
Open Response A1	0 Score=0	Booklet 1: Q73
	1 Score=1	Booklet 5: Q50
	7 N/A	Booklet 7: Q12
	8 Not reached	Booklet 13: Q27

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S425Q05	SCIE – P2006 Penguin Island (Q05)	140-140
Multiple Choice A1	0 Score=0	Booklet 1: Q71
	1 Score=1	Booklet 5: Q48
	7 N/A	Booklet 7: Q10
	8 Not reached	Booklet 13: Q25
S426Q03	SCIE – P2006 The Grand Canyon (Q03)	141-141
Multiple Choice A1	0 Score=0	Booklet 1: Q10
	1 Score=1	Booklet 9: Q22
	7 N/A	Booklet 10: Q53
	8 Not reached	Booklet 12: Q35
S426Q05	SCIE – P2006 The Grand Canyon (Q05)	142-142
Multiple Choice A1	0 Score=0	Booklet 1: Q11
	1 Score=1	Booklet 9: Q23
	7 N/A	Booklet 10: Q54
	8 Not reached	Booklet 12: Q36
S426Q07T	SCIE – P2006 The Grand Canyon (Q07)	143-143
Complex Multiple Choice A1	0 Score=0	Booklet 1: Q9
	1 Score=1	Booklet 9: Q21
	7 N/A	Booklet 10: Q52
	8 Not reached	Booklet 12: Q34
S428Q01	SCIE – P2006 Bacteria in Milk (Q01)	144-144
Multiple Choice A1	0 Score=0	Booklet 5: Q26
	1 Score=1	Booklet 6: Q7
	7 N/A	Booklet 8: Q50
	8 Not reached	Booklet 10: Q31
		Booklet UH: Q2
S428Q03	SCIE – P2006 Bacteria in Milk (Q03)	145-145
Multiple Choice A1	0 Score=0	Booklet 5: Q27
	1 Score=1	Booklet 6: Q8
	7 N/A	Booklet 8: Q51
	8 Not reached	Booklet 10: Q32
		Booklet UH: Q3
S428Q05	SCIE – P2006 Bacteria in Milk (Q05)	146-146
Open Response A1	0 Score=0	Booklet 5: Q28
	1 Score=1	Booklet 6: Q9
	7 N/A	Booklet 8: Q52
	8 Not reached	Booklet 10: Q33
		Booklet UH: Q4
S437Q01	SCIE – P2006 Extinguishing Fires (Q01)	147-147
Multiple Choice A1	0 Score=0	Booklet 1: Q54
	1 Score=1	Booklet 3: Q33
	7 N/A	Booklet 4: Q13
	8 Not reached	Booklet 6: Q60
S437Q03	SCIE – P2006 Extinguishing Fires (Q03)	148-148
Multiple Choice A1	0 Score=0	Booklet 1: Q55
	1 Score=1	Booklet 3: Q34
	7 N/A	Booklet 4: Q14
	8 Not reached	Booklet 6: Q61
S437Q04	SCIE – P2006 Extinguishing Fires (Q04)	149-149
Multiple Choice A1	0 Score=0	Booklet 1: Q56
	1 Score=1	Booklet 3: Q35
	7 N/A	Booklet 4: Q15
	8 Not reached	Booklet 6: Q62
S437Q06	SCIE – P2006 Extinguishing Fires (Q06)	150-150
Open Response A1	0 Score=0	Booklet 1: Q57
	1 Score=1	Booklet 3: Q36
	7 N/A	Booklet 4: Q16
	8 Not reached	Booklet 6: Q63
S438Q01T	SCIE – P2006 Green Parks (Q01)	151-151
Complex Multiple Choice A1	0 Score=0	Booklet 5: Q30
	1 Score=1	Booklet 6: Q11
	7 N/A	Booklet 8: Q54
	8 Not reached	Booklet 10: Q35
S438Q02	SCIE – P2006 Green Parks (Q02)	152-152
Multiple Choice A1	0 Score=0	Booklet 5: Q31
	1 Score=1	Booklet 6: Q12
	7 N/A	Booklet 8: Q55
	8 Not reached	Booklet 10: Q36

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S438Q03T	SCIE – P2006 Green Parks (Q03)	153-153
Open Response	0 Score=0	Booklet 5: Q32
A1	1 Score=1	Booklet 6: Q13
	7 N/A	Booklet 8: Q56
	8 Not reached	Booklet 10: Q37
S447Q02	SCIE – P2006 Sunscreens (Q02)	154-154
Multiple Choice	0 Score=0	Booklet 4: Q44
A1	1 Score=1	Booklet 5: Q12
	7 N/A	Booklet 11: Q24
	8 Not reached	Booklet 12: Q59
S447Q03	SCIE – P2006 Sunscreens (Q03)	155-155
Multiple Choice	0 Score=0	Booklet 4: Q45
A1	1 Score=1	Booklet 5: Q13
	7 N/A	Booklet 11: Q25
	8 Not reached	Booklet 12: Q60
S447Q04	SCIE – P2006 Sunscreens (Q04)	156-156
Multiple Choice	0 Score=0	Booklet 4: Q46
A1	1 Score=1	Booklet 5: Q14
	7 N/A	Booklet 11: Q26
	8 Not reached	Booklet 12: Q61
S447Q05	SCIE – P2006 Sunscreens (Q05)	157-157
Open Response	0 Score=0	Booklet 4: Q47
A1	1 Score=1	Booklet 5: Q15
	2 Score=2	Booklet 11: Q27
	7 N/A	Booklet 12: Q62
	8 Not reached	
S458Q01	SCIE – P2006 The Ice Mummy (Q01)	158-158
Open Response	0 Score=0	Booklet 5: Q20
A1	1 Score=1	Booklet 6: Q1
	7 N/A	Booklet 8: Q44
	8 Not reached	Booklet 10: Q25
S458Q02T	SCIE – P2006 The Ice Mummy (Q02)	159-159
Complex Multiple Choice	0 Score=0	Booklet 5: Q21
A1	1 Score=1	Booklet 6: Q2
	7 N/A	Booklet 8: Q45
	8 Not reached	Booklet 10: Q26
S465Q01	SCIE – P2006 Different Climates (Q01)	160-160
Open Response	0 Score=0	Booklet 4: Q36
A1	1 Score=1	Booklet 5: Q4
	2 Score=2	Booklet 11: Q16
	7 N/A	Booklet 12: Q51
	8 Not reached	
S465Q02	SCIE – P2006 Different Climates (Q02)	161-161
Multiple Choice	0 Score=0	Booklet 4: Q37
A1	1 Score=1	Booklet 5: Q5
	7 N/A	Booklet 11: Q17
	8 Not reached	Booklet 12: Q52
S465Q04	SCIE – P2006 Different Climates (Q04)	162-162
Multiple Choice	0 Score=0	Booklet 4: Q38
A1	1 Score=1	Booklet 5: Q6
	7 N/A	Booklet 11: Q18
	8 Not reached	Booklet 12: Q53
S466Q01T	SCIE – P2006 Forest Fires (Q01)	163-163
Complex Multiple Choice	0 Score=0	Booklet 5: Q35
A1	1 Score=1	Booklet 6: Q16
	7 N/A	Booklet 8: Q59
	8 Not reached	Booklet 10: Q40
		Booklet UH: Q15
S466Q05	SCIE – P2006 Forest Fires (Q05)	164-164
Multiple Choice	0 Score=0	Booklet 5: Q37
A1	1 Score=1	Booklet 6: Q18
	7 N/A	Booklet 8: Q61
	8 Not reached	Booklet 10: Q42
		Booklet UH: Q17
S466Q07T	SCIE – P2006 Forest Fires (Q07)	165-165
Complex Multiple Choice	0 Score=0	Booklet 5: Q36
A1	1 Score=1	Booklet 6: Q17
	7 N/A	Booklet 8: Q60
	8 Not reached	Booklet 10: Q41
		Booklet UH: Q16

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S476Q01	SCIE – P2006 Heart Surgery (Q01)	166-166
Multiple Choice	0 Score=0	Booklet 1: Q23
A1	1 Score=1	Booklet 2: Q1
	7 N/A	Booklet 8: Q25
	8 Not reached	Booklet 11: Q47
		Booklet UH: Q10
S476Q02	SCIE – P2006 Heart Surgery (Q02)	167-167
Multiple Choice	0 Score=0	Booklet 1: Q24
A1	1 Score=1	Booklet 2: Q2
	7 N/A	Booklet 8: Q26
	8 Not reached	Booklet 11: Q48
		Booklet UH: Q11
S476Q03	SCIE – P2006 Heart Surgery (Q03)	168-168
Multiple Choice	0 Score=0	Booklet 1: Q25
A1	1 Score=1	Booklet 2: Q3
	7 N/A	Booklet 8: Q27
	8 Not reached	Booklet 11: Q49
		Booklet UH: Q12
S477Q02	SCIE – P2006 Mary Montagu (Q02)	169-169
Multiple Choice	0 Score=0	Booklet 2: Q20
A1	1 Score=1	Booklet 3: Q1
	7 N/A	Booklet 5: Q60
	8 Not reached	Booklet 9: Q35
S477Q03	SCIE – P2006 Mary Montagu (Q03)	170-170
Multiple Choice	0 Score=0	Booklet 2: Q21
A1	1 Score=1	Booklet 3: Q2
	7 N/A	Booklet 5: Q61
	8 Not reached	Booklet 9: Q36
S477Q04	SCIE – P2006 Mary Montagu (Q04)	171-171
Open Response	0 Score=0	Booklet 2: Q22
A1	1 Score=1	Booklet 3: Q3
	7 N/A	Booklet 5: Q62
	8 Not reached	Booklet 9: Q37
S478Q01	SCIE – P2006 Antibiotics (Q01)	172-172
Multiple Choice	0 Score=0	Booklet 4: Q40
A1	1 Score=1	Booklet 5: Q8
	7 N/A	Booklet 11: Q20
	8 Not reached	Booklet 12: Q55
S478Q02T	SCIE – P2006 Antibiotics (Q02)	173-173
Complex Multiple Choice	0 Score=0	Booklet 4: Q41
A1	1 Score=1	Booklet 5: Q9
	7 N/A	Booklet 11: Q21
	8 Not reached	Booklet 12: Q56
S478Q03T	SCIE – P2006 Antibiotics (Q03)	174-174
Complex Multiple Choice	0 Score=0	Booklet 4: Q42
A1	1 Score=1	Booklet 5: Q10
	7 N/A	Booklet 11: Q22
	8 Not reached	Booklet 12: Q57
S485Q02	SCIE – P2006 Acid Rain (Q02)	175-175
Open Response	0 Score=0	Booklet 1: Q18
A1	1 Score=1	Booklet 9: Q30
	7 N/A	Booklet 10: Q61
	8 Not reached	Booklet 12: Q43
S485Q03	SCIE – P2006 Acid Rain (Q03)	176-176
Multiple Choice	0 Score=0	Booklet 1: Q19
A1	1 Score=1	Booklet 9: Q31
	7 N/A	Booklet 10: Q62
	8 Not reached	Booklet 12: Q44
S485Q05	SCIE – P2006 Acid Rain (Q05)	177-177
Open Response	0 Score=0	Booklet 1: Q20
A1	1 Score=1	Booklet 9: Q32
	2 Score=2	Booklet 10: Q63
	7 N/A	Booklet 12: Q45
	8 Not reached	
S493Q01T	SCIE – P2006 Physical Exercise (Q01)	178-178
Complex Multiple Choice	0 Score=0	Booklet 1: Q62
A1	1 Score=1	Booklet 5: Q39
	7 N/A	Booklet 7: Q1
	8 Not reached	Booklet 13: Q16
S493Q03T	SCIE – P2006 Physical Exercise (Q03)	179-179
Complex Multiple Choice	0 Score=0	Booklet 1: Q63
A1	1 Score=1	Booklet 5: Q40
	7 N/A	Booklet 7: Q2
	8 Not reached	Booklet 13: Q17

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S493Q05T	SCIE – P2006 Physical Exercise (Q05)	180-180
Open Response	0 Score=0	Booklet 1: Q64
A1	1 Score=1	Booklet 5: Q41
	7 N/A	Booklet 7: Q3
	8 Not reached	Booklet 13: Q18
S495Q01T	SCIE – P2006 Radiotherapy (Q01)	181-181
Complex Multiple	0 Score=0	Booklet 1: Q35
Choice	1 Score=1	Booklet 2: Q13
A1	7 N/A	Booklet 8: Q37
	8 Not reached	Booklet 11: Q59
S495Q02T	SCIE – P2006 Radiotherapy (Q02)	182-182
Complex Multiple	0 Score=0	Booklet 1: Q36
Choice	1 Score=1	Booklet 2: Q14
A1	7 N/A	Booklet 8: Q38
	8 Not reached	Booklet 11: Q60
S495Q03	SCIE – P2006 Radiotherapy (Q03)	183-183
Open Response	0 Score=0	Booklet 1: Q37
A1	1 Score=1	Booklet 2: Q15
	7 N/A	Booklet 8: Q39
	8 Not reached	Booklet 11: Q61
S495Q04T	SCIE – P2006 Radiotherapy (Q04)	184-184
Complex Multiple	0 Score=0	Booklet 1: Q34
Choice	1 Score=1	Booklet 2: Q12
A1	7 N/A	Booklet 8: Q36
	8 Not reached	Booklet 11: Q58
S498Q02T	SCIE – P2006 Experimental Digestion (Q02)	185-185
Complex Multiple	0 Score=0	Booklet 2: Q32
Choice	1 Score=1	Booklet 3: Q13
A1	7 N/A	Booklet 5: Q72
	8 Not reached	Booklet 9: Q47
S498Q03	SCIE – P2006 Experimental Digestion (Q03)	186-186
Multiple Choice	0 Score=0	Booklet 2: Q33
A1	1 Score=1	Booklet 3: Q14
	7 N/A	Booklet 5: Q73
	8 Not reached	Booklet 9: Q48
S498Q04	SCIE – P2006 Experimental Digestion (Q04)	187-187
Open Response	0 Score=0	Booklet 2: Q34
A1	1 Score=1	Booklet 3: Q15
	2 Score=2	Booklet 5: Q74
	7 N/A	Booklet 9: Q49
	8 Not reached	
S508Q02T	SCIE – P2006 Genetically Modified Food (Q02)	188-188
Complex Multiple	0 Score=0	Booklet 1: Q1
Choice	1 Score=1	Booklet 9: Q13
A1	7 N/A	Booklet 10: Q44
	8 Not reached	Booklet 12: Q26
S508Q03	SCIE – P2006 Genetically Modified Food (Q03)	189-189
Multiple Choice	0 Score=0	Booklet 1: Q2
A1	1 Score=1	Booklet 9: Q14
	7 N/A	Booklet 10: Q45
	8 Not reached	Booklet 12: Q27
S510Q01T	SCIE – P2006 Magnetic Hovertrain (Q01)	190-190
Complex Multiple	0 Score=0	Booklet 1: Q42
Choice	1 Score=1	Booklet 3: Q21
A1	7 N/A	Booklet 4: Q1
	8 Not reached	Booklet 6: Q48
S510Q04T	SCIE – P2006 Magnetic Hovertrain (Q04)	191-191
Open Response	0 Score=0	Booklet 1: Q43
A1	1 Score=1	Booklet 3: Q22
	7 N/A	Booklet 4: Q2
	8 Not reached	Booklet 6: Q49
S514Q02	SCIE – P2006 Development and Disaster (Q02)	192-192
Open Response	0 Score=0	Booklet 1: Q75
A1	1 Score=1	Booklet 5: Q52
	7 N/A	Booklet 7: Q14
	8 Not reached	Booklet 13: Q29

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S514Q03	SCIE – P2006 Development and Disaster (Q03)	193-193
Open Response	0 Score=0	Booklet 1: Q76
A1	1 Score=1	Booklet 5: Q53
	7 N/A	Booklet 7: Q15
	8 Not reached	Booklet 13: Q30
S514Q04	SCIE – P2006 Development and Disaster (Q04)	194-194
Complex Multiple	0 Score=0	Booklet 1: Q77
Choice	1 Score=1	Booklet 5: Q54
A1	7 N/A	Booklet 7: Q16
	8 Not reached	Booklet 13: Q31
S519Q01	SCIE – P2006 Airbags (Q01)	195-195
Open Response	0 Score=0	Booklet 2: Q27
A1	1 Score=1	Booklet 3: Q8
	2 Score=2	Booklet 5: Q67
	7 N/A	Booklet 9: Q42
	8 Not reached	
S519Q02T	SCIE – P2006 Airbags (Q02)	196-196
Complex Multiple	0 Score=0	Booklet 2: Q28
Choice	1 Score=1	Booklet 3: Q9
A1	7 N/A	Booklet 5: Q68
	8 Not reached	Booklet 9: Q43
S519Q03	SCIE – P2006 Airbags (Q03)	197-197
Open Response	0 Score=0	Booklet 2: Q29
A1	1 Score=1	Booklet 3: Q10
	7 N/A	Booklet 5: Q69
	8 Not reached	Booklet 9: Q44
S521Q02	SCIE – P2006 Cooking Outdoors (Q02)	198-198
Multiple Choice	0 Score=0	Booklet 1: Q31
A1	1 Score=1	Booklet 2: Q9
	7 N/A	Booklet 8: Q33
	8 Not reached	Booklet 11: Q55
S521Q06	SCIE – P2006 Cooking Outdoors (Q06)	199-199
Multiple Choice	0 Score=0	Booklet 1: Q32
A1	1 Score=1	Booklet 2: Q10
	7 N/A	Booklet 8: Q34
	8 Not reached	Booklet 11: Q56
S524Q06T	SCIE – P2006 Penicillin Manufacture (Q06)	200-200
Complex Multiple	0 Score=0	Booklet 2: Q37
Choice	1 Score=1	Booklet 3: Q18
A1	7 N/A	Booklet 5: Q77
	8 Not reached	Booklet 9: Q52
S524Q07	SCIE – P2006 Penicillin Manufacture (Q07)	201-201
Open Response	0 Score=0	Booklet 2: Q38
A1	1 Score=1	Booklet 3: Q19
	7 N/A	Booklet 5: Q78
	8 Not reached	Booklet 9: Q53
S527Q01T	SCIE – P2006 Extinction of the Dinosaurs (Q01)	202-202
Complex Multiple	0 Score=0	Booklet 1: Q13
Choice	1 Score=1	Booklet 9: Q25
A1	7 N/A	Booklet 10: Q56
	8 Not reached	Booklet 12: Q38
S527Q03T	SCIE – P2006 Extinction of the Dinosaurs (Q03)	203-203
Complex Multiple	0 Score=0	Booklet 1: Q14
Choice	1 Score=1	Booklet 9: Q26
A1	7 N/A	Booklet 10: Q57
	8 Not reached	Booklet 12: Q39
S527Q04T	SCIE – P2006 Extinction of the Dinosaurs (Q04)	204-204
Complex Multiple	0 Score=0	Booklet 1: Q15
Choice	1 Score=1	Booklet 9: Q27
A1	7 N/A	Booklet 10: Q58
	8 Not reached	Booklet 12: Q40
S408QNA	INTR – P2006 Wild Oat Grass (A)	205-205
Likert	0 Score=0	Booklet 1: Q52
A1	1 Score=1	Booklet 3: Q31
	2 Score=2	Booklet 4: Q11
	3 Score=3	Booklet 6: Q58

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	7 N/A	
	8 Not reached	
	9 Missing	
S408QNB	INTR – P2006 Wild Oat Grass (B)	206-206
Likert	0 Score=0	Booklet 1: Q52
A1	1 Score=1	Booklet 3: Q31
	2 Score=2	Booklet 4: Q11
	3 Score=3	Booklet 6: Q58
	7 N/A	
	8 Not reached	
	9 Missing	
S408QNC	INTR – P2006 Wild Oat Grass (C)	207-207
Likert	0 Score=0	Booklet 1: Q52
A1	1 Score=1	Booklet 3: Q31
	2 Score=2	Booklet 4: Q11
	3 Score=3	Booklet 6: Q58
	7 N/A	
	8 Not reached	
	9 Missing	
S413QNA	INTR – P2006 Plastic Age (A)	208-208
Likert	0 Score=0	Booklet 4: Q51
A1	1 Score=1	Booklet 5: Q19
	2 Score=2	Booklet 11: Q31
	3 Score=3	Booklet 12: Q66
	7 N/A	
	8 Not reached	
	9 Missing	
S413QNB	INTR – P2006 Plastic Age (B)	209-209
Likert	0 Score=0	Booklet 4: Q51
A1	1 Score=1	Booklet 5: Q19
	2 Score=2	Booklet 11: Q31
	3 Score=3	Booklet 12: Q66
	7 N/A	
	8 Not reached	
	9 Missing	
S413QNC	INTR – P2006 Plastic Age (C)	210-210
Likert	0 Score=0	Booklet 4: Q51
A1	1 Score=1	Booklet 5: Q19
	2 Score=2	Booklet 11: Q31
	3 Score=3	Booklet 12: Q66
	7 N/A	
	8 Not reached	
	9 Missing	
S416QNA	INTR – P2006 The Moon (A)	211-211
Likert	0 Score=0	Booklet 1: Q68
A1	1 Score=1	Booklet 5: Q45
	2 Score=2	Booklet 7: Q7
	3 Score=3	Booklet 13: Q22
	7 N/A	
	8 Not reached	
	9 Missing	
S416QNB	INTR – P2006 The Moon (B)	212-212
Likert	0 Score=0	Booklet 1: Q68
A1	1 Score=1	Booklet 5: Q45
	2 Score=2	Booklet 7: Q7
	3 Score=3	Booklet 13: Q22
	7 N/A	
	8 Not reached	
	9 Missing	
S428QNA	INTR – P2006 Bacteria in Milk (A)	213-213
Likert	0 Score=0	Booklet 5: Q29
A1	1 Score=1	Booklet 6: Q10
	2 Score=2	Booklet 8: Q53
	3 Score=3	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 Not reached	
	9 Missing	
S428QNB	INTR – P2006 Bacteria in Milk (B)	214-214
Likert	0 Score=0	Booklet 5: Q29
A1	1 Score=1	Booklet 6: Q10
	2 Score=2	Booklet 8: Q53
	3 Score=3	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S428QNC	INTR – P2006 Bacteria in Milk (C)	215-215
Likert	0 Score=0	Booklet 5: Q29
A1	1 Score=1	Booklet 6: Q10
	2 Score=2	Booklet 8: Q53
	3 Score=3	Booklet 10: Q34
	7 N/A	Booklet UH: Q5
	8 Not reached	
	9 Missing	
S437QNA	INTR – P2006 Extinguishing Fires (A)	216-216
Likert	0 Score=0	Booklet 1: Q58
A1	1 Score=1	Booklet 3: Q37
	2 Score=2	Booklet 4: Q17
	3 Score=3	Booklet 6: Q64
	7 N/A	
	8 Not reached	
	9 Missing	
S437QNB	INTR – P2006 Extinguishing Fires (B)	217-217
Likert	0 Score=0	Booklet 1: Q58
A1	1 Score=1	Booklet 3: Q37
	2 Score=2	Booklet 4: Q17
	3 Score=3	Booklet 6: Q64
	7 N/A	
	8 Not reached	
	9 Missing	
S437QNC	INTR – P2006 Extinguishing Fires (C)	218-218
Likert	0 Score=0	Booklet 1: Q58
A1	1 Score=1	Booklet 3: Q37
	2 Score=2	Booklet 4: Q17
	3 Score=3	Booklet 6: Q64
	7 N/A	
	8 Not reached	
	9 Missing	
S438QNA	INTR – P2006 Green Parks (A)	219-219
Likert	0 Score=0	Booklet 5: Q33
A1	1 Score=1	Booklet 6: Q14
	2 Score=2	Booklet 8: Q57
	3 Score=3	Booklet 10: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S438QNB	INTR – P2006 Green Parks (B)	220-220
Likert	0 Score=0	Booklet 5: Q33
A1	1 Score=1	Booklet 6: Q14
	2 Score=2	Booklet 8: Q57
	3 Score=3	Booklet 10: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S438QNC	INTR – P2006 Green Parks (C)	221-221
Likert	0 Score=0	Booklet 5: Q33
A1	1 Score=1	Booklet 6: Q14
	2 Score=2	Booklet 8: Q57
	3 Score=3	Booklet 10: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S456QNA	INTR – P2006 The Cheetah (A)	222-222
Likert	0 Score=0	Booklet 1: Q40
A1	1 Score=1	Booklet 2: Q18
	2 Score=2	Booklet 8: Q42
	3 Score=3	Booklet 11: Q64
	7 N/A	
	8 Not reached	
	9 Missing	
S456QNB	INTR – P2006 The Cheetah (B)	223-223
Likert	0 Score=0	Booklet 1: Q40
A1	1 Score=1	Booklet 2: Q18
	2 Score=2	Booklet 8: Q42
	3 Score=3	Booklet 11: Q64
	7 N/A	
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S456QNC	INTR – P2006 The Cheetah (C)	224-224
Likert	0 Score=0	Booklet 1: Q40
A1	1 Score=1	Booklet 2: Q18
	2 Score=2	Booklet 8: Q42
	3 Score=3	Booklet 11: Q64
	7 N/A	
	8 Not reached	
	9 Missing	
S466QNA	INTR – P2006 Forest Fires (A)	225-225
Likert	0 Score=0	Booklet 5: Q38
A1	1 Score=1	Booklet 6: Q19
	2 Score=2	Booklet 8: Q62
	3 Score=3	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 Not reached	
	9 Missing	
S466QNB	INTR – P2006 Forest Fires (B)	226-226
Likert	0 Score=0	Booklet 5: Q38
A1	1 Score=1	Booklet 6: Q19
	2 Score=2	Booklet 8: Q62
	3 Score=3	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 Not reached	
	9 Missing	
S466QNC	INTR – P2006 Forest Fires (C)	227-227
Likert	0 Score=0	Booklet 5: Q38
A1	1 Score=1	Booklet 6: Q19
	2 Score=2	Booklet 8: Q62
	3 Score=3	Booklet 10: Q43
	7 N/A	Booklet UH: Q18
	8 Not reached	
	9 Missing	
S476QNA	INTR – P2006 Heart Surgery (A)	228-228
Likert	0 Score=0	Booklet 1: Q26
A1	1 Score=1	Booklet 2: Q4
	2 Score=2	Booklet 8: Q28
	3 Score=3	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 Not reached	
	9 Missing	
S476QNB	INTR – P2006 Heart Surgery (B)	229-229
Likert	0 Score=0	Booklet 1: Q26
A1	1 Score=1	Booklet 2: Q4
	2 Score=2	Booklet 8: Q28
	3 Score=3	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 Not reached	
	9 Missing	
S476QNC	INTR – P2006 Heart Surgery (C)	230-230
Likert	0 Score=0	Booklet 1: Q26
A1	1 Score=1	Booklet 2: Q4
	2 Score=2	Booklet 8: Q28
	3 Score=3	Booklet 11: Q50
	7 N/A	Booklet UH: Q13
	8 Not reached	
	9 Missing	
S478QNA	INTR – P2006 Antibiotics (A)	231-231
Likert	0 Score=0	Booklet 4: Q43
A1	1 Score=1	Booklet 5: Q11
	2 Score=2	Booklet 11: Q23
	3 Score=3	Booklet 12: Q58
	7 N/A	
	8 Not reached	
	9 Missing	
S478QNB	INTR – P2006 Antibiotics (B)	232-232
Likert	0 Score=0	Booklet 4: Q43
A1	1 Score=1	Booklet 5: Q11
	2 Score=2	Booklet 11: Q23
	3 Score=3	Booklet 12: Q58
	7 N/A	
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S478QNC	INTR – P2006 Antibiotics (C)	233-233
Likert	0 Score=0	Booklet 4: Q43
A1	1 Score=1	Booklet 5: Q11
	2 Score=2	Booklet 11: Q23
	3 Score=3	Booklet 12: Q58
	7 N/A	
	8 Not reached	
	9 Missing	
S485QNA	INTR – P2006 Acid Rain (A)	234-234
Likert	0 Score=0	Booklet 1: Q21
A1	1 Score=1	Booklet 9: Q33
	2 Score=2	Booklet 10: Q64
	3 Score=3	Booklet 12: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S485QNB	INTR – P2006 Acid Rain (B)	235-235
Likert	0 Score=0	Booklet 1: Q21
A1	1 Score=1	Booklet 9: Q33
	2 Score=2	Booklet 10: Q64
	3 Score=3	Booklet 12: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S485QNC	INTR – P2006 Acid Rain (C)	236-236
Likert	0 Score=0	Booklet 1: Q21
A1	1 Score=1	Booklet 9: Q33
	2 Score=2	Booklet 10: Q64
	3 Score=3	Booklet 12: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S498QNA	INTR – P2006 Experimental Digestion (A)	237-237
Likert	0 Score=0	Booklet 2: Q35
A1	1 Score=1	Booklet 3: Q16
	2 Score=2	Booklet 5: Q75
	3 Score=3	Booklet 9: Q50
	7 N/A	
	8 Not reached	
	9 Missing	
S498QNB	INTR – P2006 Experimental Digestion (B)	238-238
Likert	0 Score=0	Booklet 2: Q35
A1	1 Score=1	Booklet 3: Q16
	2 Score=2	Booklet 5: Q75
	3 Score=3	Booklet 9: Q50
	7 N/A	
	8 Not reached	
	9 Missing	
S498QNC	INTR – P2006 Experimental Digestion (C)	239-239
Likert	0 Score=0	Booklet 2: Q35
A1	1 Score=1	Booklet 3: Q16
	2 Score=2	Booklet 5: Q75
	3 Score=3	Booklet 9: Q50
	7 N/A	
	8 Not reached	
	9 Missing	
S508QNA	INTR – P2006 Genetically Modified Food (A)	240-240
Likert	0 Score=0	Booklet 1: Q4
A1	1 Score=1	Booklet 9: Q16
	2 Score=2	Booklet 10: Q47
	3 Score=3	Booklet 12: Q29
	7 N/A	
	8 Not reached	
	9 Missing	
S508QNB	INTR – P2006 Genetically Modified Food (B)	241-241
Likert	0 Score=0	Booklet 1: Q4
A1	1 Score=1	Booklet 9: Q16
	2 Score=2	Booklet 10: Q47
	3 Score=3	Booklet 12: Q29

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	7 N/A	
	8 Not reached	
	9 Missing	
S508QNC	INTR – P2006 Genetically Modified Food (C)	242-242
Likert	0 Score=0	Booklet 1: Q4
A1	1 Score=1	Booklet 9: Q16
	2 Score=2	Booklet 10: Q47
	3 Score=3	Booklet 12: Q29
	7 N/A	
	8 Not reached	
	9 Missing	
S514QNA	INTR – P2006 Development and Disaster (A)	243-243
Likert	0 Score=0	Booklet 1: Q78
A1	1 Score=1	Booklet 5: Q55
	2 Score=2	Booklet 7: Q17
	3 Score=3	Booklet 13: Q32
	7 N/A	
	8 Not reached	
	9 Missing	
S514QNB	INTR – P2006 Development and Disaster (B)	244-244
Likert	0 Score=0	Booklet 1: Q78
A1	1 Score=1	Booklet 5: Q55
	2 Score=2	Booklet 7: Q17
	3 Score=3	Booklet 13: Q32
	7 N/A	
	8 Not reached	
	9 Missing	
S514QNC	INTR – P2006 Development and Disaster (C)	245-245
Likert	0 Score=0	Booklet 1: Q78
A1	1 Score=1	Booklet 5: Q55
	2 Score=2	Booklet 7: Q17
	3 Score=3	Booklet 13: Q32
	7 N/A	
	8 Not reached	
	9 Missing	
S519QNA	INTR – P2006 Airbags (A)	246-246
Likert	0 Score=0	Booklet 2: Q30
A1	1 Score=1	Booklet 3: Q11
	2 Score=2	Booklet 5: Q70
	3 Score=3	Booklet 9: Q45
	7 N/A	
	8 Not reached	
	9 Missing	
S519QNB	INTR – P2006 Airbags (B)	247-247
Likert	0 Score=0	Booklet 2: Q30
A1	1 Score=1	Booklet 3: Q11
	2 Score=2	Booklet 5: Q70
	3 Score=3	Booklet 9: Q45
	7 N/A	
	8 Not reached	
	9 Missing	
S519QNC	INTR – P2006 Airbags (C)	248-248
Likert	0 Score=0	Booklet 2: Q30
A1	1 Score=1	Booklet 3: Q11
	2 Score=2	Booklet 5: Q70
	3 Score=3	Booklet 9: Q45
	7 N/A	
	8 Not reached	
	9 Missing	
S521QNA	INTR – P2006 Cooking Outdoors (A)	249-249
Likert	0 Score=0	Booklet 1: Q33
A1	1 Score=1	Booklet 2: Q11
	2 Score=2	Booklet 8: Q35
	3 Score=3	Booklet 11: Q57
	7 N/A	
	8 Not reached	
	9 Missing	
S521QNB	INTR – P2006 Cooking Outdoors (B)	250-250
Likert	0 Score=0	Booklet 1: Q33
A1	1 Score=1	Booklet 2: Q11

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	2 Score=2	Booklet 8: Q35
	3 Score=3	Booklet 11: Q57
	7 N/A	
	8 Not reached	
	9 Missing	
S524QNA	INTR – P2006 Penicillin Manufacture (A)	251-251
Likert	0 Score=0	Booklet 2: Q39
A1	1 Score=1	Booklet 3: Q20
	2 Score=2	Booklet 5: Q79
	3 Score=3	Booklet 9: Q54
	7 N/A	
	8 Not reached	
	9 Missing	
S524QNB	INTR – P2006 Penicillin Manufacture (B)	252-252
Likert	0 Score=0	Booklet 2: Q39
A1	1 Score=1	Booklet 3: Q20
	2 Score=2	Booklet 5: Q79
	3 Score=3	Booklet 9: Q54
	7 N/A	
	8 Not reached	
	9 Missing	
S524QNC	INTR – P2006 Penicillin Manufacture (C)	253-253
Likert	0 Score=0	Booklet 2: Q39
A1	1 Score=1	Booklet 3: Q20
	2 Score=2	Booklet 5: Q79
	3 Score=3	Booklet 9: Q54
	7 N/A	
	8 Not reached	
	9 Missing	
S527QNA	INTR – P2006 Extinction of the Dinosaurs (A)	254-254
Likert	0 Score=0	Booklet 1: Q16
A1	1 Score=1	Booklet 9: Q28
	2 Score=2	Booklet 10: Q59
	3 Score=3	Booklet 12: Q41
	7 N/A	
	8 Not reached	
	9 Missing	
S527QNB	INTR – P2006 Extinction of the Dinosaurs (B)	255-255
Likert	0 Score=0	Booklet 1: Q16
A1	1 Score=1	Booklet 9: Q28
	2 Score=2	Booklet 10: Q59
	3 Score=3	Booklet 12: Q41
	7 N/A	
	8 Not reached	
	9 Missing	
S527QNC	INTR – P2006 Extinction of the Dinosaurs (C)	256-256
Likert	0 Score=0	Booklet 1: Q16
A1	1 Score=1	Booklet 9: Q28
	2 Score=2	Booklet 10: Q59
	3 Score=3	Booklet 12: Q41
	7 N/A	
	8 Not reached	
	9 Missing	
S408QSA	SUPP – P2006 Wild Oat Grass (A)	257-257
Likert	0 Score=0	Booklet 1: Q53
A1	1 Score=1	Booklet 3: Q32
	2 Score=2	Booklet 4: Q12
	3 Score=3	Booklet 6: Q59
	7 N/A	
	8 Not reached	
	9 Missing	
S408QSB	SUPP – P2006 Wild Oat Grass (B)	258-258
Likert	0 Score=0	Booklet 1: Q53
A1	1 Score=1	Booklet 3: Q32
	2 Score=2	Booklet 4: Q12
	3 Score=3	Booklet 6: Q59
	7 N/A	
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S408QSC	SUPP – P2006 Wild Oat Grass (C)	259-259
Likert	0 Score=0	Booklet 1: Q53
A1	1 Score=1	Booklet 3: Q32
	2 Score=2	Booklet 4: Q12
	3 Score=3	Booklet 6: Q59
	7 N/A	
	8 Not reached	
	9 Missing	
S416QSA	SUPP – P2006 The Moon (A)	260-260
Likert	0 Score=0	Booklet 1: Q69
A1	1 Score=1	Booklet 5: Q46
	2 Score=2	Booklet 7: Q8
	3 Score=3	Booklet 13: Q23
	7 N/A	
	8 Not reached	
	9 Missing	
S416QSB	SUPP – P2006 The Moon (B)	261-261
Likert	0 Score=0	Booklet 1: Q69
A1	1 Score=1	Booklet 5: Q46
	2 Score=2	Booklet 7: Q8
	3 Score=3	Booklet 13: Q23
	7 N/A	
	8 Not reached	
	9 Missing	
S416QSC	SUPP – P2006 The Moon (C)	262-262
Likert	0 Score=0	Booklet 1: Q69
A1	1 Score=1	Booklet 5: Q46
	2 Score=2	Booklet 7: Q8
	3 Score=3	Booklet 13: Q23
	7 N/A	
	8 Not reached	
	9 Missing	
S421QSA	SUPP – P2006 Big and Small (A)	263-263
Likert	0 Score=0	Booklet 1: Q82
A1	1 Score=1	Booklet 5: Q59
	2 Score=2	Booklet 7: Q21
	3 Score=3	Booklet 13: Q36
	7 N/A	Booklet UH: Q9
	8 Not reached	
	9 Missing	
S421QSC	SUPP – P2006 Big and Small (C)	264-264
Likert	0 Score=0	Booklet 1: Q82
A1	1 Score=1	Booklet 5: Q59
	2 Score=2	Booklet 7: Q21
	3 Score=3	Booklet 13: Q36
	7 N/A	Booklet UH: Q9
	8 Not reached	
	9 Missing	
S425QSA	SUPP – P2006 Penguin Island (A)	265-265
Likert	0 Score=0	Booklet 1: Q74
A1	1 Score=1	Booklet 5: Q51
	2 Score=2	Booklet 7: Q13
	3 Score=3	Booklet 13: Q28
	7 N/A	
	8 Not reached	
	9 Missing	
S425QSB	SUPP – P2006 Penguin Island (B)	266-266
Likert	0 Score=0	Booklet 1: Q74
A1	1 Score=1	Booklet 5: Q51
	2 Score=2	Booklet 7: Q13
	3 Score=3	Booklet 13: Q28
	7 N/A	
	8 Not reached	
	9 Missing	
S425QSC	SUPP – P2006 Penguin Island (C)	267-267
Likert	0 Score=0	Booklet 1: Q74
A1	1 Score=1	Booklet 5: Q51
	2 Score=2	Booklet 7: Q13
	3 Score=3	Booklet 13: Q28
	7 N/A	
	8 Not reached	
	9 Missing	
S426QSA	SUPP – P2006 The Grand Canyon (A)	268-268
Likert	0 Score=0	Booklet 1: Q12
A1	1 Score=1	Booklet 9: Q24
	2 Score=2	Booklet 10: Q55
	3 Score=3	Booklet 12: Q37

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
	7 N/A	
	8 Not reached	
	9 Missing	
S426QSB	SUPP – P2006 The Grand Canyon (B)	269-269
Likert	0 Score=0	Booklet 1: Q12
A1	1 Score=1	Booklet 9: Q24
	2 Score=2	Booklet 10: Q55
	3 Score=3	Booklet 12: Q37
	7 N/A	
	8 Not reached	
	9 Missing	
S426QSC	SUPP – P2006 The Grand Canyon (C)	270-270
Likert	0 Score=0	Booklet 1: Q12
A1	1 Score=1	Booklet 9: Q24
	2 Score=2	Booklet 10: Q55
	3 Score=3	Booklet 12: Q37
	7 N/A	
	8 Not reached	
	9 Missing	
S438QSA	SUPP – P2006 Green Parks (A)	271-271
Likert	0 Score=0	Booklet 5: Q34
A1	1 Score=1	Booklet 6: Q15
	2 Score=2	Booklet 8: Q58
	3 Score=3	Booklet 10: Q39
	7 N/A	
	8 Not reached	
	9 Missing	
S438QSB	SUPP – P2006 Green Parks (B)	272-272
Likert	0 Score=0	Booklet 5: Q34
A1	1 Score=1	Booklet 6: Q15
	2 Score=2	Booklet 8: Q58
	3 Score=3	Booklet 10: Q39
	7 N/A	
	8 Not reached	
	9 Missing	
S438QSC	SUPP – P2006 Green Parks (C)	273-273
Likert	0 Score=0	Booklet 5: Q34
A1	1 Score=1	Booklet 6: Q15
	2 Score=2	Booklet 8: Q58
	3 Score=3	Booklet 10: Q39
	7 N/A	
	8 Not reached	
	9 Missing	
S456QSA	SUPP – P2006 The Cheetah (A)	274-274
Likert	0 Score=0	Booklet 1: Q41
A1	1 Score=1	Booklet 2: Q19
	2 Score=2	Booklet 8: Q43
	3 Score=3	Booklet 11: Q65
	7 N/A	
	8 Not reached	
	9 Missing	
S456QSB	SUPP – P2006 The Cheetah (B)	275-275
Likert	0 Score=0	Booklet 1: Q41
A1	1 Score=1	Booklet 2: Q19
	2 Score=2	Booklet 8: Q43
	3 Score=3	Booklet 11: Q65
	7 N/A	
	8 Not reached	
	9 Missing	
S456QSC	SUPP – P2006 The Cheetah (C)	276-276
Likert	0 Score=0	Booklet 1: Q41
A1	1 Score=1	Booklet 2: Q19
	2 Score=2	Booklet 8: Q43
	3 Score=3	Booklet 11: Q65
	7 N/A	
	8 Not reached	
	9 Missing	
S465QSA	SUPP – P2006 Different Climates (A)	277-277
Likert	0 Score=0	Booklet 4: Q39
A1	1 Score=1	Booklet 5: Q7
	2 Score=2	Booklet 11: Q19
	3 Score=3	Booklet 12: Q54
	7 N/A	
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S465QSB	SUPP – P2006 Different Climates (B)	278-278
Likert	0 Score=0	Booklet 4: Q39
A1	1 Score=1	Booklet 5: Q7
	2 Score=2	Booklet 11: Q19
	3 Score=3	Booklet 12: Q54
	7 N/A	
	8 Not reached	
	9 Missing	
S476QSA	SUPP – P2006 Heart Surgery (A)	279-279
Likert	0 Score=0	Booklet 1: Q27
A1	1 Score=1	Booklet 2: Q5
	2 Score=2	Booklet 8: Q29
	3 Score=3	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 Not reached	
	9 Missing	
S476QSB	SUPP – P2006 Heart Surgery (B)	280-280
Likert	0 Score=0	Booklet 1: Q27
A1	1 Score=1	Booklet 2: Q5
	2 Score=2	Booklet 8: Q29
	3 Score=3	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 Not reached	
	9 Missing	
S476QSC	SUPP – P2006 Heart Surgery (C)	281-281
Likert	0 Score=0	Booklet 1: Q27
A1	1 Score=1	Booklet 2: Q5
	2 Score=2	Booklet 8: Q29
	3 Score=3	Booklet 11: Q51
	7 N/A	Booklet UH: Q14
	8 Not reached	
	9 Missing	
S477QSA	SUPP – P2006 Mary Montagu (A)	282-282
Likert	0 Score=0	Booklet 2: Q23
A1	1 Score=1	Booklet 3: Q4
	2 Score=2	Booklet 5: Q63
	3 Score=3	Booklet 9: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S477QSB	SUPP – P2006 Mary Montagu (B)	283-283
Likert	0 Score=0	Booklet 2: Q23
A1	1 Score=1	Booklet 3: Q4
	2 Score=2	Booklet 5: Q63
	3 Score=3	Booklet 9: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S477QSC	SUPP – P2006 Mary Montagu (C)	284-284
Likert	0 Score=0	Booklet 2: Q23
A1	1 Score=1	Booklet 3: Q4
	2 Score=2	Booklet 5: Q63
	3 Score=3	Booklet 9: Q38
	7 N/A	
	8 Not reached	
	9 Missing	
S485QSB	SUPP – P2006 Acid Rain (B)	285-285
Likert	0 Score=0	Booklet 1: Q22
A1	1 Score=1	Booklet 9: Q34
	2 Score=2	Booklet 10: Q65
	3 Score=3	Booklet 12: Q47
	7 N/A	
	8 Not reached	
	9 Missing	
S485QSC	SUPP – P2006 Acid Rain (C)	286-286
Likert	0 Score=0	Booklet 1: Q22
A1	1 Score=1	Booklet 9: Q34
	2 Score=2	Booklet 10: Q65
	3 Score=3	Booklet 12: Q47
	7 N/A	
	8 Not reached	
	9 Missing	

Variable/ Item Type/ Format	Variable and value labels	Column/booklet & question
S498QSA	SUPP – P2006 Experimental Digestion (A)	287-287
Likert	0 Score=0	Booklet 2: Q36
A1	1 Score=1	Booklet 3: Q17
	2 Score=2	Booklet 5: Q76
	3 Score=3	Booklet 9: Q51
	7 N/A	
	8 Not reached	
	9 Missing	
S498QSB	SUPP – P2006 Experimental Digestion (B)	288-288
Likert	0 Score=0	Booklet 2: Q36
A1	1 Score=1	Booklet 3: Q17
	2 Score=2	Booklet 5: Q76
	3 Score=3	Booklet 9: Q51
	7 N/A	
	8 Not reached	
	9 Missing	
S519QSA	SUPP – P2006 Airbags (A)	289-289
Likert	0 Score=0	Booklet 2: Q31
A1	1 Score=1	Booklet 3: Q12
	2 Score=2	Booklet 5: Q71
	3 Score=3	Booklet 9: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S519QSB	SUPP – P2006 Airbags (B)	290-290
Likert	0 Score=0	Booklet 2: Q31
A1	1 Score=1	Booklet 3: Q12
	2 Score=2	Booklet 5: Q71
	3 Score=3	Booklet 9: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S519QSC	SUPP – P2006 Airbags (C)	291-291
Likert	0 Score=0	Booklet 2: Q31
A1	1 Score=1	Booklet 3: Q12
	2 Score=2	Booklet 5: Q71
	3 Score=3	Booklet 9: Q46
	7 N/A	
	8 Not reached	
	9 Missing	
S527QSB	SUPP – P2006 Extinction of the Dinosaurs (B)	292-292
Likert	0 Score=0	Booklet 1: Q17
A1	1 Score=1	Booklet 9: Q29
	2 Score=2	Booklet 10: Q60
	3 Score=3	Booklet 12: Q42
	7 N/A	
	8 Not reached	
	9 Missing	
S527QSC	SUPP – P2006 Extinction of the Dinosaurs (C)	293-293
Likert	0 Score=0	Booklet 1: Q17
A1	1 Score=1	Booklet 9: Q29
	2 Score=2	Booklet 10: Q60
	3 Score=3	Booklet 12: Q42
	7 N/A	
	8 Not reached	
	9 Missing	
CLCUSE3A	Effort A: real	295-297
F3.0	997 N/A	
	998 M/R	
	999 Missing	
CLCUSE3B	Effort B: if counted	298-300
F3.0	997 N/A	
	998 M/R	
	999 Missing	
DEFFORT	Effort B – Effort A	301-303
F3.0	997 N/A	
	998 M/R	
	999 Missing	
TESTLANG	Language of Test (3-character)	304-306
A3	See Appendix 7 for labels	
VER_COGN	Version of cognitive database and date of release	307-319
A13		

APPENDIX 10
CODEBOOK FOR PISA 2006 SCHOOL QUESTIONNAIRE DATA FILE

SUBNATIO (1) Adjudicated sub-region	
Format: A5	Columns: 1-5
	See Appendix 7 for labels

SCHOOLID (2) School ID 5-digit	
Format: A5	Columns: 6-10

CNT (3) Country code 3-character	
Format: A3	Columns: 11-13
	See Appendix 7 for labels

COUNTRY (4) Country code ISO 3-digit	
Format: A3	Columns: 14-16
	See Appendix 7 for labels

OECD (5) OECD country	
Format: F1.0	Columns: 17-17
0	Non-OECD
1	OECD

SC01Q01 (6) Number of boys Q1a	
Format: F5.0	Columns: 18-22
9997	N/A
9998	Invalid
9999	Missing

SC01Q02 (7) Number of girls Q1b	
Format: F5.0	Columns: 23-27
9997	N/A
9998	Invalid
9999	Missing

SC02Q01 (8) Public or private Q2	
Format: F1.0	Columns: 28-28
1	Public
2	Private
7	N/A
8	Invalid
9	Missing

SC03Q01 (9) Funding government Q3a	
Format: F8.2	Columns: 29-36
9997	N/A
9998	Invalid
9999	Missing

SC03Q02 (10) Funding student fees Q3b	
Format: F8.2	Columns: 37-44
9997	N/A
9998	Invalid
9999	Missing

SC03Q03 (11) Funding benefactors Q3c	
Format: F8.2	Columns: 45-52
9997	N/A
9998	Invalid
9999	Missing

SC03Q04 (12) Funding other Q3d	
Format: F8.2	Columns: 53-60
9997	N/A
9998	Invalid
9999	Missing

SC04Q01 (13) Grade 1 Q4a	
Format: F1.0	Columns: 61-61
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q02 (14) Grade 2 Q4b	
Format: F1.0	Column: 62-62
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q03 (15) Grade 3 Q4c	
Format: F1.0	Column: 63-63
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q04 (16) Grade 4 Q4d	
Format: F1.0	Column: 64-64
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q05 (17) Grade 5 Q4e	
Format: F1.0	Column: 65-65
1	Yes
2	No
7	N/A
8	Invalid
	Missing

SC04Q06 (18) Grade 6 Q4f	
Format: F1.0	Column: 66-66
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q07 (19) Grade 7 Q4g	
Format: F1.0	Column: 67-67
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q08 (20) Grade 8 Q4h	
Format: F1.0	Column: 68-68
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q09 (21) Grade 9 Q4i	
Format: F1.0	Column: 69-69
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q10 (22) Grade 10 Q4j	
Format: F1.0	Column: 70-70
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q11 (23) Grade 11 Q4k	
Format: F1.0	Column: 71-71
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q12 (24) Grade 12 Q4l	
Format: F1.0	Column: 72-72
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q13 (25) Grade 13 Q4m	
Format: F1.0	Column: 73-73
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC04Q14 (26) Ungraded school Q4n	
Format: F1.0	Column: 74-74
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC05Q01 (27) Repeat <grade> at <ISCED2> Q5a	
Format: F8.2	Column: 75-82
996	N/A
9997	N/A
9998	Invalid
9999	Missing

SC05Q02 (28) Repeat <grade> at <ISCED3> Q5b	
Format: F8.2	Column: 83-90
996	N/A
9997	N/A
9998	Invalid
9999	Missing

SC06Q01 (29) Size <test lang> classes <modal 15 year old grade> Q6	
Format: F2.0	Column: 91-92
1	15 students or fewer
2	16-20 students
3	21-25 students
4	26-30 students
5	31-35 students
6	36-40 students
7	41-45 students
8	46-50 students
9	More than 50 students
97	N/A
98	Invalid
99	Missing

SC07Q01 (30) School community Q7	
Format: F1.0	Column: 93-93
1	Village
2	Small town
3	Town
4	City
5	Large city
7	N/A
8	Invalid
9	Missing

SC08Q01 (31) Streaming between classes Q8a	
Format: F1.0	Column: 94-94
1	For all subjects
2	For some subjects
3	Not for any subject
7	N/A
8	Invalid
9	Missing

SC08Q02 (32) Streaming within classes Q8b	
Format: F1.0	Column: 95-95
1	For all subjects
2	For some subjects
3	Not for any subject
7	N/A
8	Invalid
9	Missing

SC09Q11 (33) Full time teachers in TOTAL Q9a1	
Format: F4.0	Column: 96-99
9997	N/A
9998	Invalid
9999	Missing

SC09Q12 (34) Part time teachers in TOTAL Q9a2	
Format: F4.0	Column: 100-103
9997	N/A
9998	Invalid
9999	Missing

SC09Q21 (35) Full time teachers fully certified Q9b1	
Format: F4.0	Column: 104-107
9997	N/A
9998	Invalid
9999	Missing

SC09Q22 (36) Part time teachers fully certified Q9b2	
Format: F4.0	Column: 108-111
9997	N/A
9998	Invalid
9999	Missing

SC09Q31 (37) Full time teachers ISCED5A Qual Q9c1	
Format: F4.0	Column: 112-115
9997	N/A
9998	Invalid
9999	Missing

SC09Q32 (38) Part time teachers ISCED5A Qual Q9c2	
Format: F4.0	Column: 116-119
9997	N/A
9998	Invalid
9999	Missing

SC10Q01 (39) Fill science teaching vacancy Q10	
Format: F1.0	Column: 120-120
1	No vacancies
2	All positions filled
3	Not all filled
7	N/A
8	Invalid
9	Missing

SC11QA1 (40) Responsibility teacher hire – Principal or teachers Q11a1	
Format: F1.0	Column: 121-121
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QA2 (41) Responsibility teacher hire – School governing board Q11a2	
Format: F1.0	Column: 122-122
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QA3 (42) Responsibility teacher hire – Intermediate education authority Q11a3	
Format: F1.0	Columns: 123-123
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QA4 (43) Responsibility teacher hire – Central education authority Q11a4	
Format: F1.0	Columns: 124-124
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QB1 (44) Responsibility firing teachers – Principal or teachers Q11b1	
Format: F1.0	Columns: 125-125
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QB2 (45) Responsibility firing teachers – School governing board Q11b2	
Format: F1.0	Columns: 126-126
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QB3 (46) Responsibility firing teachers – Intermediate education authority Q11b3	
Format: F1.0	Columns: 127-127
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QB4 (47) Responsibility firing teachers – Central education authority Q11b4	
Format: F1.0	Columns: 128-128
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QC1 (48) Responsibility starting salaries – Principal or teachers Q11c1	
Format: F1.0	Columns: 129-129
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QC2 (49) Responsibility starting salaries – School governing board Q11c2	
Format: F1.0	Columns: 130-130
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QC3 (50) Responsibility starting salaries – Intermediate education authority Q11c3	
Format: F1.0	Columns: 131-131
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QC4 (51) Responsibility starting salaries – Central education authority Q11c4	
Format: F1.0	Columns: 132-132
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QD1 (52) Responsibility salary increases – Principal or teachers Q11d1	
Format: F1.0	Columns: 133-133
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QD2 (53) Responsibility salary increases – School governing board Q11d2	
Format: F1.0	Columns: 134-134
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QD3 (54) Responsibility salary increases – Intermediate education authority Q11d3	
Format: F1.0	Columns: 135-135
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QD4 (55) Responsibility salary increases – Central education authority Q11d4	
Format: F1.0	Columns: 136-136
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QE1 (56) Responsibility formulate budget – Principal or teachers Q11e1	
Format: F1.0	Columns: 137-137
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QE2 (57) Responsibility formulate budget – School governing board Q11e2	
Format: F1.0	Columns: 138-138
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QE3 (58) Responsibility formulate budget – Intermediate education authority Q11e3	
Format: F1.0	Columns: 139-139
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QE4 (59) Responsibility formulate budget – Central education authority Q11e4	
Format: F1.0	Columns: 140-140
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QF1 (60) Responsibility budget allocations – Principal or teachers Q11f1	
Format: F1.0	Columns: 141-141
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QF2 (61) Responsibility budget allocations – School governing board Q11f2	
Format: F1.0	Columns: 142-142
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QF3 (62) Responsibility budget allocations – Intermediate education authority Q11f3	
Format: F1.0	Columns: 143-143
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QF4 (63) Responsibility budget allocations – Central education authority Q11f4	
Format: F1.0	Columns: 144-144
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QG1 (64) Responsibility student discipline – Principal or teachers Q11g1	
Format: F1.0	Columns: 145-145
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QG2 (65) Responsibility student discipline – School governing board Q11g2	
Format: F1.0	Columns: 146-146
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QG3 (66) Responsibility student discipline – Intermediate education authority Q11g3	
Format: F1.0	Columns: 147-147
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QG4 (67) Responsibility student discipline – Central education authority Q11g4	
Format: F1.0	Columns: 148-148
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QH1 (68) Responsibility student assessment – Principal or teachers Q11h1	
Format: F1.0	Columns: 149-149
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QH2 (69) Responsibility student assessment – School governing board Q11h2	
Format: F1.0	Columns: 150-150
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QH3 (70) Responsibility student assessment – Intermediate education authority Q11h3	
Format: F1.0	Columns: 151-151
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QH4 (71) Responsibility student assessment – Central education authority Q11h4	
Format: F1.0	Columns: 152-152
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QI1 (72) Responsibility student admission – Principal or teachers Q11i1	
Format: F1.0	Columns: 153-153
1	Tick
2	No tick
7	N/A

8	Invalid
9	Missing

SC11QI2 (73) Responsibility student admission – School governing board Q11i2

Format: F1.0	Columns: 154-154
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QI3 (74) Responsibility student admission – Intermediate education authority Q11i3

Format: F1.0	Columns: 155-155
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QI4 (75) Responsibility student admission – Central education authority Q11i4

Format: F1.0	Columns: 156-156
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QJ1 (76) Responsibility textbook use – Principal or teachers Q11j1

Format: F1.0	Columns: 157-157
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QJ2 (77) Responsibility textbook use – School governing board Q11j2

Format: F1.0	Columns: 158-158
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QJ3 (78) Responsibility textbook use – Intermediate education authority Q11j3

Format: F1.0	Columns: 159-159
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QJ4 (79) Responsibility textbook use – Central education authority Q11j4

Format: F1.0	Columns: 160-160
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QK1 (80) Responsibility course content – Principal or teachers Q11k1

Format: F1.0	Columns: 161-161
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QK2 (81) Responsibility course content – School governing board Q11k2

Format: F1.0	Columns: 162-162
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QK3 (82) Responsibility course content – Intermediate education authority Q11k3

Format: F1.0	Columns: 163-163
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QK4 (83) Responsibility course content – Central education authority Q11k4

Format: F1.0	Columns: 164-164
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QL1 (84) Responsibility courses offered – Principal or teachers Q11l1

Format: F1.0	Columns: 165-165
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QL2 (85) Responsibility courses offered – School governing board Q11l2

Format: F1.0	Columns: 166-166
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QL3 (86) Responsibility courses offered – Intermediate education authority Q11l3

Format: F1.0	Columns: 167-167
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC11QL4 (87) Responsibility courses offered – Central education authority Q11l4

Format: F1.0	Columns: 168-168
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QA1 (88) Intermediate or central authority – Influence staffing Q12a1

Format: F1.0	Columns: 169-169
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QA2 (89) Intermediate or central authority – Influence budget Q12a2

Format: F1.0	Columns: 170-170
1	Tick

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2	No tick
7	N/A
8	Invalid
9	Missing

SC12QA3 (90) Intermediate or central authority – Influence instructional content Q12a3	
Format: F1.0	Columns: 171-171
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QA4 (91) Intermediate or central authority – Influence assessment Q12a4	
Format: F1.0	Columns: 172-172
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QB1 (92) School governing board – Influence staffing Q12b1	
Format: F1.0	Columns: 173-173
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QB2 (93) School governing board – Influence budget Q12b2	
Format: F1.0	Columns: 174-174
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QB3 (94) School governing board – Influence instructional content Q12b3	
Format: F1.0	Columns: 175-175
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QB4 (95) School governing board – Influence assessment Q12b4	
Format: F1.0	Columns: 176-176
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QC1 (96) Parent groups – Influence staffing Q12c1	
Format: F1.0	Columns: 177-177
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QC2 (97) Parent groups – Influence budget Q12c2	
Format: F1.0	Columns: 178-178
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QC3 (98) Parent groups – Influence instructional content Q12c3	
Format: F1.0	Columns: 179-179
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QC4 (99) Parent groups – Influence assessment Q12c4	
Format: F1.0	Columns: 180-180
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QD1 (100) Teacher groups – Influence staffing Q12d1	
Format: F1.0	Columns: 181-181
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QD2 (101) Teacher groups – Influence budget Q12d2	
Format: F1.0	Columns: 182-182
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QD3 (102) Teacher groups – Influence instructional content Q12d3	
Format: F1.0	Columns: 183-183
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QD4 (103) Teacher groups – Influence assessment Q12d4	
Format: F1.0	Columns: 184-184
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QE1 (104) Student groups – Influence staffing Q12e1	
Format: F1.0	Columns: 185-185
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QE2 (105) Student groups – Influence budget Q12e2	
Format: F1.0	Columns: 186-186
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QE3 (106) Student groups – Influence instructional content Q12e3	
Format: F1.0	Columns: 187-187
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QE4 (107) Student groups – Influence assessment Q12e4	
Format: F1.0	Columns: 188-188
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QF1 (108) Examination board – Influence staffing Q12f1	
Format: F1.0	Columns: 189-189
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QF2 (109) Examination board – Influence budget Q12f2	
Format: F1.0	Columns: 190-190
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QF3 (110) Examination board – Influence instructional content Q12f3	
Format: F1.0	Columns: 191-191
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC12QF4 (111) Examination board – Influence assessment Q12f4	
Format: F1.0	Columns: 192-192
1	Tick
2	No tick
7	N/A
8	Invalid
9	Missing

SC13Q01 (112) Computers altogether Q13a	
Format: F5.0	Columns: 193-197
9997	N/A
9998	Invalid
9999	Missing

SC13Q02 (113) Computers instruction Q13b	
Format: F5.0	Columns: 198-202
9997	N/A
9998	Invalid
9999	Missing

SC13Q03 (114) Computers with web Q13c	
Format: F5.0	Columns: 203-207
9997	N/A
9998	Invalid
9999	Missing

SC14Q01 (115) Shortage science teachers Q14a	
Format: F1.0	Columns: 208-208
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q02 (116) Shortage maths teachers Q14b	
Format: F1.0	Columns: 209-209
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q03 (117) Shortage <test lang> teachers Q14c	
Format: F1.0	Columns: 210-210
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q04 (118) Shortage qualified teachers Q14d	
Format: F1.0	Columns: 211-211
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q05 (119) Shortage lab techs Q14e	
Format: F1.0	Columns: 212-212
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q06 (120) Shortage other personnel Q14f	
Format: F1.0	Columns: 213-213
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q07 (121) Shortage science lab equipment Q14g	
Format: F1.0	Columns: 214-214
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q08 (122) Shortage instruct material Q14h	
Format: F1.0	Columns: 215-215
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q09 (123) Shortage computers Q14i	
Format: F1.0	Columns: 216-216
1	Not at all
2	Very little
3	To some extent

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4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q10 (124) Shortage Internet Q14j	
Format: F1.0	Columns: 217-217
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q11 (125) Shortage computer software Q14k	
Format: F1.0	Columns: 218-218
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q12 (126) Shortage library materials Q14l	
Format: F1.0	Columns: 219-219
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC14Q13 (127) Shortage audio-visual Q14m	
Format: F1.0	Columns: 220-220
1	Not at all
2	Very little
3	To some extent
4	A lot
7	N/A
8	Invalid
9	Missing

SC15Q01 (128) Relative to other students Q15a	
Format: F1.0	Columns: 221-221
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC15Q02 (129) Relative to benchmarks Q15b	
Format: F1.0	Columns: 222-222
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC15Q03 (130) Relative to same grade Q15c	
Format: F1.0	Columns: 223-223
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC16Q01 (131) Parent pressure academic standards Q16	
Format: F1.0	Columns: 224-224
1	Many parents
2	Minority of parents

3	Largely absent
7	N/A
8	Invalid
9	Missing

SC17Q01 (132) Achievement public Q17a	
Format: F1.0	Columns: 225-225
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC17Q02 (133) Achievement principal Q17b	
Format: F1.0	Columns: 226-226
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC17Q03 (134) Achievement teachers Q17c	
Format: F1.0	Columns: 227-227
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC17Q04 (135) Achievement resources Q17d	
Format: F1.0	Columns: 228-228
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC17Q05 (136) Achievement tracked Q17e	
Format: F1.0	Columns: 229-229
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC18Q01 (137) Schooling available Q18	
Format: F1.0	Columns: 230-230
1	Two or more schools
2	One other school
3	No other schools
7	N/A
8	Invalid
9	Missing

SC19Q01 (138) Admittance residence Q19a	
Format: F1.0	Columns: 231-231
1	Prerequisite
2	High priority
3	Considered
4	Not considered
7	N/A
8	Invalid
9	Missing

SC19Q02 (139) Admittance academic record Q19b	
Format: F1.0	Columns: 232-232
1	Prerequisite
2	High priority
3	Considered
4	Not considered

7	N/A
8	Invalid
9	Missing

SC19Q03 (140) Admittance recommendation Q19c	
Format: F1.0	Columns: 233-233
1	Prerequisite
2	High priority
3	Considered
4	Not considered
7	N/A
8	Invalid
9	Missing

SC19Q04 (141) Admittance parents endorse Q19d	
Format: F1.0	Columns: 234-234
1	Prerequisite
2	High priority
3	Considered
4	Not considered
7	N/A
8	Invalid
9	Missing

SC19Q05 (142) Admittance special programme Q19e	
Format: F1.0	Columns: 235-235
1	Prerequisite
2	High priority
3	Considered
4	Not considered
7	N/A
8	Invalid
9	Missing

SC19Q06 (143) Admittance family preference Q19f	
Format: F1.0	Columns: 236-236
1	Prerequisite
2	High priority
3	Considered
4	Not considered
7	N/A
8	Invalid
9	Missing

SC20Q01 (144) Activities <science clubs> Q20a	
Format: F1.0	Columns: 237-237
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC20Q02 (145) Activities <science fairs> Q20b	
Format: F1.0	Columns: 238-238
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC20Q03 (146) Activities <science competitions> Q20c	
Format: F1.0	Columns: 239-239
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC20Q04 (147) Activities <science projects> Q20d	
Format: F1.0	Columns: 240-240
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC20Q05 (148) Activities <science trips> Q20e	
Format: F1.0	Columns: 241-241
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC21Q01 (149) Envr specific course Q21a	
Format: F1.0	Columns: 242-242
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC21Q02 (150) Envr natural sciences Q21b	
Format: F1.0	Columns: 243-243
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC21Q03 (151) Envr geography course Q21c	
Format: F1.0	Columns: 244-244
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC21Q04 (152) Envr another course Q21d	
Format: F1.0	Columns: 245-245
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC22Q01 (153) Envr activity <outdoor> Q22a	
Format: F1.0	Columns: 246-246
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC22Q02 (154) Envr activity museum Q22b	
Format: F1.0	Columns: 247-247
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC22Q03 (155) Envr activity sci/tech Q22c	
Format: F1.0	Columns: 248-248
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC22Q04 (156) Envr activity projects Q22d	
Format: F1.0	Columns: 249-249
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC22Q05 (157) Envr activity lectures Q22e	
Format: F1.0	Columns: 250-250
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

SC23Q01 (158) Participate job fairs Q23a	
Format: F1.0	Columns: 251-251
1	Never
2	Once a year
3	More than once a year
7	N/A
8	Invalid
9	Missing

SC23Q02 (159) Participate business/industry lectures Q23b	
Format: F1.0	Columns: 252-252
1	Never
2	Once a year
3	More than once a year
7	N/A
8	Invalid
9	Missing

SC23Q03 (160) Participate business/industry visits Q23c	
Format: F1.0	Columns: 253-253
1	Never
2	Once a year
3	More than once a year
7	N/A
8	Invalid
9	Missing

SC24Q01 (161) Training local business Q24	
Format: F1.0	Columns: 254-254
1	Not offered
2	Half or less
3	More than half
7	N/A
8	Invalid
9	Missing

SC25Q01 (162) Curriculum business/industry Q25	
Format: F1.0	Columns: 255-255
1	No influence
2	Minor influence
3	Considerable influence
7	N/A
8	Invalid
9	Missing

SC26Q01 (163) Developing science skills Q26	
Format: F1.0	Columns: 256-256
1	Incidental
2	Integrated
3	Focal
7	N/A
8	Invalid
9	Missing

SC27Q01 (164) Developing tertiary skills Q27	
Format: F1.0	Columns: 257-257
1	Incidental
2	Integrated
3	Focal
7	N/A
8	Invalid
9	Missing

SC28Q01 (165) Guidance responsibility Q28	
Format: F1.0	Columns: 258-258
1	Not applicable
2	All teachers
3	Specific teachers
4	Counsel employed
5	Counsel visits
7	N/A
8	Invalid
9	Missing

SC29Q01 (166) Career guidance Opportunity Q29	
Format: F1.0	Columns: 259-259
1	Voluntary
2	Compulsory
7	N/A
8	Invalid
9	Missing

ABGROUP (167) Ability grouping within schools recoded from SC08Q01 and SC08Q02 (2006)	
Format: F1.0	Columns: 260-260
1	Not for any subjects
2	For some subjects
3	For all subjects
7	N/A
9	Missing

CLSIZE (168) Size of <test language> class recoded from SC06Q01	
Format: F2.0	Columns: 261-262
97	N/A
99	Miss

COMPWEB (169) Proportion of computers connected to web	
Format: F8.3	Columns: 263-270
9997	N/A
9998	Invalid
9999	Missing

IRATCOMP (170) Ratio of computers for instruction to school size	
Format: F8.3	Columns: 271-278
9997	N/A
9998	Invalid
9999	Missing

PCGIRLS (171) Proportion of girls at school	
Format: F8.3	Columns: 279-286
9997	N/A
9998	Invalid
9999	Missing

PROPCERT (172) Proportion of certified teachers	
Format: F8.3	Columns: 287-294
9997	N/A
9998	Invalid
9999	Missing

PROPQUAL (173) Proportion of teachers with ISCED 5A	
Format: F8.3	Columns: 295-302
9997	N/A
9998	Invalid
9999	Missing

RATCOMP (174) Ratio of computers to school size	
Format: F8.3	Columns: 303-310
9997	N/A
9998	Invalid
9999	Missing

SCHLTYPE (175) School ownership	
Format: F1.0	Columns: 311-311
1	Private independent
2	Private government-dependent
3	Public
7	N/A
8	Invalid
9	Missing

SCHSIZE (176) School size	
Format: F8.0	Columns: 312-319
99997	N/A
99998	Invalid
99999	Missing

SELSCH (177) School academic selectivity recoded from SC19Q02 and SC19Q03 (2006)	
Format: F1.0	Columns: 320-320
1	Not considered
2	At least one considered
3	At least one high priority
4	At least one prerequisite
7	N/A
9	Missing

STRATIO (178) Student-teacher ratio	
Format: F8.3	Columns: 321-328
9997	N/A
9998	Invalid
9999	Missing

RESPRES (179) Responsibility for resource allocation index PISA 2006	
Format: F8.3	Columns: 329-336
997	N/A
999	Miss

RESPCURR (180) Responsibility for curriculum & assessment index PISA 2006	
Format: F8.3	Columns: 337-344
997	N/A
999	Miss

ENVLEARN (181) School activities for learning environmental topics PISA 2006 (WLE)	
Format: F8.4	Columns: 345-352
997	N/A
999	Miss

SCIPROM (182) School activities to promote the learning of science PISA 2006 (WLE)	
Format: F8.4	Columns: 353-360
997	N/A
999	Miss

SCMATEDU (183) Quality of educational resources PISA 2006 (WLE)	
Format: F8.4	Columns: 361-368
997	N/A
999	Miss

TCSHORT (184) Teacher shortage (negative scale) PISA 2006 (WLE)	
Format: F8.4	Columns: 369-376
997	N/A
999	Miss

W_FSCHWT (185) Final school weight	
Format: F9.4	Columns: 377-385

STRATUM (186) Original stratum	
Format: A5	Columns: 386-390
	See Appendix 7 for labels

VER_SCH (187) Version of school database and date of release	
Format: A13	Columns: 391-403

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APPENDIX 11
CODEBOOK FOR PISA 2006 PARENTS QUESTIONNAIRE DATA FILE

SUBNATIO (1) Adjudicated sub-region	
Format: A5	Columns: 1-5
	See Appendix 7 for labels

SCHOOLID (2) School ID 5-digit	
Format: A5	Columns: 6-10

STIDSTD (3) Student ID 5-digit	
Format: A5	Columns: 11-15

CNT (4) Country code 3-character	
Format: A3	Columns: 16-18
	See Appendix 7 for labels

COUNTRY (5) Country code ISO 3-digit	
Format: A3	Columns: 19-21
	See Appendix 7 for labels

OECD (6) OECD country	
Format: F1.0	Columns: 22-22
0	Non-OECD
1	OECD

PA01Q01 (7) Completed Quest – Mother Q1a	
Format: F1.0	Columns: 23-23
1	Yes
7	N/A
9	Missing

PA01Q02 (8) Completed Quest – Father Q1b	
Format: F1.0	Columns: 24-24
1	Yes
7	N/A
9	Missing

PA01Q03 (9) Completed Quest – Other Q1c	
Format: F1.0	Columns: 25-25
1	Yes
7	N/A
9	Missing

PA02Q01 (10) Student at Age 10 – Science TV programmes Q2a	
Format: F1.0	Columns: 26-26
1	Very often
2	Regularly
3	Sometimes
4	Never
7	N/A
8	Invalid
9	Missing

PA02Q02 (11) Student at Age 10 – Science books Q2b	
Format: F1.0	Columns: 27-27
1	Very often
2	Regularly
3	Sometimes
4	Never
7	N/A
8	Invalid
9	Missing

PA02Q03 (12) Student at Age 10 – Science Fiction Q2c	
Format: F1.0	Columns: 28-28
1	Very often
2	Regularly
3	Sometimes
4	Never
7	N/A
8	Invalid
9	Missing

PA02Q04 (13) Student at Age 10 – Science websites Q2d	
Format: F1.0	Columns: 29-29
1	Very often
2	Regularly
3	Sometimes
4	Never
7	N/A
8	Invalid
9	Missing

PA02Q05 (14) Student at Age 10 – Science club Q2e	
Format: F1.0	Columns: 30-30
1	Very often
2	Regularly
3	Sometimes
4	Never
7	N/A
8	Invalid
9	Missing

PA03Q01 (15) School – Teachers competent Q3a	
Format: F1.0	Columns: 31-31
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q02 (16) School – Achievements high Q3b	
Format: F1.0	Columns: 32-32
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q03 (17) School – Content good Q3c	
Format: F1.0	Columns: 33-33
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q04 (18) School – Discipline good Q3d	
Format: F1.0	Columns: 34-34
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q05 (19) School – Progress monitored Q3e	
Format: F1.0	Columns: 35-35
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q06 (20) School – Progress information Q3f	
Format: F1.0	Columns: 36-36
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA03Q07 (21) School – Education good Q3g	
Format: F1.0	Columns: 37-37
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA04Q01 (22) Science Skills – Any job Q4a	
Format: F1.0	Columns: 38-38
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA04Q02 (23) Science Skills – Appreciated by employers Q4b	
Format: F1.0	Columns: 39-39
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA04Q03 (24) Science Skills – Required Q4c	
Format: F1.0	Columns: 40-40
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA04Q04 (25) Science Skills – Advantage Q4d	
Format: F1.0	Columns: 41-41
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA05Q01 (26) Science Career – Family Q5a	
Format: F1.0	Columns: 42-42
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA05Q02 (27) Science Career – Student interest Q5b	
Format: F1.0	Columns: 43-43
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA05Q03 (28) Science Career – Student work Q5c	
Format: F1.0	Columns: 44-44
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA05Q04 (29) Science Study After School – Student interest Q5d	
Format: F1.0	Columns: 45-45
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA05Q05 (30) Science Study After School – Student study Q5e	
Format: F1.0	Columns: 46-46
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA06Q01 (31) Views – Improve conditions Q6a	
Format: F1.0	Columns: 47-47
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q02 (32) Views – Natural world Q6b	
Format: F1.0	Columns: 48-48
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q03 (33) Views – Relate to others Q6c	
Format: F1.0	Columns: 49-49
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q04 (34) Views – Improve economy Q6d	
Format: F1.0	Columns: 50-50
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q05 (35) Views – Everyday life Q6e	
Format: F1.0	Columns: 51-51
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q06 (36) Views – Valuable to society Q6f	
Format: F1.0	Columns: 52-52
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q07 (37) Views – Relevant to me Q6g	
Format: F1.0	Columns: 53-53
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q08 (38) Views – Understand things Q6h	
Format: F1.0	Columns: 54-54
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA06Q09 (39) Views – Social benefits Q6i	
Format: F1.0	Columns: 55-55
1	Strongly agree
2	Agree
3	Disagree
4	Strongly disagree
7	N/A
8	Invalid
9	Missing

PA07Q01 (40) Envr Issues – Air pollution Q7a	
Format: F1.0	Columns: 56-56
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA07Q02 (41) Envr Issues – Energy Q7b	
Format: F1.0	Columns: 57-57
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA07Q03 (42) Envr Issues – Extinction Q7c	
Format: F1.0	Columns: 58-58
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA07Q04 (43) Envr Issues – Forests Q7d	
Format: F1.0	Columns: 59-59
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA07Q05 (44) Envr Issues – Water Q7e	
Format: F1.0	Columns: 60-60
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA07Q06 (45) Envr Issues – Nuclear Q7f	
Format: F1.0	Columns: 61-61
1	Concern for me
2	Concern for others in my country
3	Concern for other countries
4	Concern for no one
7	N/A
8	Invalid
9	Missing

PA08Q01 (46) Envr Probs – Air pollution Q8a	
Format: F1.0	Columns: 62-62
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

PA08Q02 (47) Envr Probs – Energy Q8b	
Format: F1.0	Columns: 63-63
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

PA08Q03 (48) Envr Probs – Extinction Q8c	
Format: F1.0	Columns: 64-64
1	Improve
2	Stay same
3	Get worse

7	N/A
8	Invalid
9	Missing

PA08Q04 (49) Envr Probs – Forests Q8d	
Format: F1.0	Columns: 65-65
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

PA08Q05 (50) Envr Probs – Water Q8e	
Format: F1.0	Columns: 66-66
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

PA08Q06 (51) Envr Probs – Nuclear Q8f	
Format: F1.0	Columns: 67-67
1	Improve
2	Stay same
3	Get worse
7	N/A
8	Invalid
9	Missing

PA09Q01 (52) Education cost Q9	
Format: A4	Columns: 68-71
1001	Less than 100 leva
1002	100 leva or more – less than 500 leva
1003	500 leva or more – less than 1000 leva
1004	1000 leva or more – less than 1500 leva
1005	1500 leva or more
1701	Less than COP$ 50000
1702	COP$ 50000 or more – less than COP$500000
1703	COP$500000 or more – less than COP$1000000
1704	COP$1000000 or more – less than COP$1500000
1705	COP$1500000 or more
1911	Less than 2000 kuna
1912	2000 kuna or more – less than 5000 kuna
1913	5000 kuna or more – less than 8000 kuna
1914	8000 kuna or more – less than 11000 kuna
1915	11000 kuna or more
2081	Less than 500 Dkr
2082	500 Dkr or more – less than 4000 Dkr
2083	4000 Dkr or more – less than 8000 Dkr
2084	8000 Dkr or more – less than 12000 Dkr
2085	12000 Dkr or more
2761	Less than 10 eruo
2762	10 eruo or more – less than 1200 euro
2763	1200 euro or more – less than 2400 euro
2764	2400 euro or more – less than 3600 euro
2765	3600 euro or more
3441	Less than HK$5000
3442	HK$5000 or more – less than HK$10000
3443	HK$10000 or more – less than HK$50000
3444	HK$50000 or more – less than HK$100000
3445	HK$100000 or more
3521	Less than 10000 Ikr
3522	10000 Ikr or more – less than 50000 Ikr
3523	50000 Ikr or more – less than 90000 Ikr
3524	90000 Ikr or more – less than 130000 Ikr
3525	130000 Ikr or more
3801	Less than 100 euro
3802	100 euro or more – less than 200 euro
3803	200 euro or more – less than 300 euro
3804	300 euro or more – less than 400 euro
3805	400 euro or more
4101	Less than 1500000 won
4102	1500000 won or more – less than 3000000 won
4103	3000000 won or more – less than 4500000 won
4104	4500000 won or more – less than 6000000 won
4105	6000000 won or more
4421	Less than 100 euro
4422	100 euro or more – less than 800 euro
4423	800 euro or more – less than 1600 euro
4424	1600 euro or more – less than 2 400 euro
4425	2400 euro or more
4461	Less than MOP$10000
4462	MOP$10000 or more – less than MOP$20000
4463	MOP$20000 or more – less than MOP$30000
4464	MOP$30000 or more – less than MOP$40000
4465	MOP$40000 or more
5541	Less than NZ$200
5542	NZ$200 or more – less than NZ$3000
5543	NZ$3000 or more – less than NZ$6000
5544	NZ$6000 or more – less than NZ$9000
5545	NZ$9000 or more
6161	Less than 300 zlotych
6162	300 zlotych or more – less than 600 zlotych
6163	600 zlotych or more – less than 1200 zlotych
6164	1200 zlotych or more – less than 2500 zlotych
6165	2500 zlotych or more
6201	Less than 20 euro
6202	20 euro or more – less than 4000 euro
6203	4000 euro or more – less than 8000 euro
6204	8000 euro or more – less than 12000 euro
6205	12000 euro or more
6341	Less than QR 1000
6342	QR 1000 or more – less than QR 6000
6343	QR 6000 or more – less than QR 11000
6344	QR 11000 or more – less than QR 16000
6345	QR 16000 or more
7921	Less than YTL 600
7922	YTL 600 or more – less than YTL 1200
7923	YTL 1200 or more – less than YTL 5000
7924	YTL 5000 or more – less than YTL 15000
7925	YTL 15000 or more
9997	N/A
9998	Invalid
9999	Missing

PA10Q01 (53) Father age Q10a	
Format: F1.0	Columns: 72-72
1	Younger than 36
2	36 – 40 years
3	41 – 45 years
4	46 – 50 years
5	51 years or older
7	N/A
8	Invalid
9	Missing

PA10Q02 (54) Mother age Q10b	
Format: F1.0	Columns: 73-73
1	Younger than 36
2	36 – 40 years
3	41 – 45 years
4	46 – 50 years
5	51 years or older
7	N/A
8	Invalid
9	Missing

PA11Q01 (55) PQ Father occupation (ISCO) Q11	
Format: A4	Columns: 74-77
	See ST05Q01 in Appendix 7 for labels

PA12Q01 (56) Father Qual <ISCED 5A,6> Q12a	
Format: F1.0	Columns: 78-78
1	Yes
2	No
7	N/A

8	Invalid
9	Missing

PA12Q02 (57) Father Qual – <ISCED 5B> Q12b	
Format: F1.0	Columns: 79-79
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA12Q03 (58) Father Qual – <ISCED 4> Q12c	
Format: F1.0	Columns: 80-80
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA12Q04 (59) Father Qual – <ISCED 3A> Q12d	
Format: F1.0	Columns: 81-81
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA13Q01 (60) PQ Mother occupation (ISCO) Q13	
Format: A4	Columns: 82-85
	See ST05Q01 in Appendix 7 for labels

PA14Q01 (61) Mother Qual – <ISCED 5A,6> Q14a	
Format: F1.0	Columns: 86-86
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA14Q02 (62) Mother Qual – <ISCED 5B> Q14b	
Format: F1.0	Columns: 87-87
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA14Q03 (63) Mother Qual – <ISCED 4> Q14c	
Format: F1.0	Columns: 88-88
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA14Q04 (64) Mother Qual – <ISCED 3A> Q14d	
Format: F1.0	Columns: 89-89
1	Yes
2	No
7	N/A
8	Invalid
9	Missing

PA15Q01 (65) Household income (relative to median) Q15	
Format: F1.0	Columns: 90-90
1	Less than < 0.5 median >
2	< 0.5 median > or more but less than < 0.75 median >
3	< 0.75 median > or more but less than < median >
4	< median > or more but less than < 1.25 median >
5	< 1.25 median > or more but less than < 1.5 median >
6	< 1.5 median > or more
7	N/A
8	Invalid
9	Missing

INCOME (66) Household income (national currency) Q15	
Format: A4	Columns: 91-94
1001	Less than 2000 leva
1002	2000 leva or more – less than 3000 leva
1003	3000 leva or more – less than 4000 leva
1004	4000 leva or more – less than 5000 leva
1005	5000 leva or more – less than 6000 leva
1006	6000 leva or more
1701	Less than COP$6000000
1702	COP$6000000 or more – less than COP$9000000
1703	COP$9000000 or more – less than COP$12000000
1704	COP$12000000 or more – less than COP$15000000
1705	COP$15000000 or more – less than COP$18000000
1716	COP$18000000 or more
1911	Less than 2000 kuna
1912	2000 kuna or more – less than 4000 kuna
1913	4000 kuna or more – less than 6000 kuna
1914	6000 kuna or more – less than 8000 kuna
1915	8000 kuna or more – less than 10000 kuna
1916	10000 kuna or more
2081	Less than 200000 Dkr
2082	200000 Dkr or more – less than 300000 Dkr
2083	300000 Dkr or more – less than 400000 Dkr
2084	400000 Dkr or more – less than 500000 Dkr
2085	500000 Dkr or more – less than 600000 Dkr
2086	600000 Dkr or more
2761	Less than 20000 euro
2762	20000 euro or more – less than 30000 euro
2763	30000 euro or more – less than 40000 euro
2764	40000 euro or more – less than 50000 euro
2765	50000 euro or more – less than 60000 euro
2766	60000 euro or more
3441	Less than HK$10000
3442	HK$10000 or more – less than HK$15000
3443	HK$15000 or more – less than HK$20000
3444	HK$20000 or more – less than HK$25000
3445	HK$25000 or more – less than HK$30000
3446	HK$30000 or more
3521	Less than 2250000 Ikr
3522	2250000 Ikr or more – less than 3375000 Ikr
3523	3375000 Ikr or more – less than 4500000 Ikr
3524	4500000 Ikr or more – less than 5625000 Ikr
3525	5625000 Ikr or more – less than 6750000 Ikr
3526	6750000 Ikr or more
4101	Less than 15000000 won
4102	15000000 won or more – less than 25000000 won
4103	25000000 won or more – less than 35000000 won
4104	35000000 won or more – less than 45000000 won
4105	45000000 won or more – less than 55000000 won
4106	55000000 won or more
4421	Less than 20000 euro
4422	20000 euro or more – less than 35000 euro
4423	35000 euro or more – less than 50000 euro
4424	50000 euro or more – less than 65000 euro
4425	65000 euro or more – less than 80000 euro
4426	80000 euro or more
4461	Less than MOP$72000
4462	MOP$72000 or more – less than MOP$144000
4463	MOP$144000 or more – less than MOP$216000
4464	MOP$216000 or more – less than MOP$288000
4465	MOP$288000 or more – less than MOP$360000
4466	MOP$360000 or more
5541	Less than NZ$30000
5542	NZ$30000 or more – less than NZ$45000
5543	NZ$45000 or more – less than NZ$60000
5544	NZ$60000 or more – less than NZ$75000
5545	NZ$75000 or more – less than NZ$90000
5546	NZ$90000 or more
6161	Less than 600 zlotych

6162	600 zlotych or more – less than 1200 zlotych
6163	1200 zlotych or more – less than 1800 zlotych
6164	1800 zlotych or more – less than 2400 zlotych
6165	2400 zlotych or more – less than 3000 zlotych
6166	3000 zlotych or more
6201	Less than 1000 euro
6202	1000 euro or more – less than 15000 euro
6203	15000 euro or more – less than 20000 euro
6204	20000 euro or more – less than 25000 euro
6205	25000 euro or more – less than 30000 euro
6206	30000 euro or more
6341	Less than QR 50000
6342	QR 50000 or more – less than QR 75000
6343	QR 75000 or more – less than QR 100000
6344	QR 100000 or more – less than QR 125000
6345	QR 125000 or more – less than QR 150000
6346	QR 150000 or more
7921	Less than YTL 6000
7922	YTL 6000 or more – less than YTL 12000
7923	YTL 12000 or more – less than YTL 24000
7924	YTL 24000 or more – less than YTL 48000
7925	YTL 48000 or more – less than YTL 72000
7926	YTL 72000 or more
9997	N/A
9998	Invalid
9999	Missing

PQBMMJ (67) PQ Occupational status Mother (SEI)	
Format: F2.0	**Columns: 95-96**
97	N/A
98	Invalid
99	Missing

PQBFMJ (68) PQ Occupational status Father (SEI)	
Format: F2.0	**Columns: 97-98**
97	N/A
98	Invalid
99	Missing

PQHISEI (69) PQ Highest parental occupational status (SEI)	
Format: F2.0	**Columns: 99-100**
97	N/A
98	Invalid
99	Missing

PQSRC_M (70) PQ Mother science-related career	
Format: F1.0	Columns: 101-101
0	No or indeterminate
1	Yes
7	N/A
8	Invalid
9	Missing

PQSRC_F (71) PQ Father science-related career	
Format: F1.0	Columns: 102-102
0	No or indeterminate
1	Yes
7	N/A
8	Invalid
9	Missing

PQSRC_E (72) PQ Either parent science-related career	
Format: F1.0	Columns: 103-103
0	No or indeterminate
1	Yes
7	N/A
8	Invalid
9	Missing

PQFISCED (73) PQ Educational level of father (ISCED)	
Format: F1.0	Columns: 104-104
0	Below ISCED 3A
1	ISCED 3A
2	ISCED 4
3	ISCED 5B
4	ISCED 5A or 6
7	N/A
8	Invalid
9	Missing

PQMISCED (74) PQ Educational level of mother (ISCED)	
Format: F1.0	Columns: 105-105
0	Below ISCED 3A
1	ISCED 3A
2	ISCED 4
3	ISCED 5B
4	ISCED 5A or 6
7	N/A
8	Invalid
9	Missing

PQHISCED (75) PQ Highest educational level of parents	
Format: F1.0	Columns: 106-106
0	Below ISCED 3A
1	ISCED 3A
2	ISCED 4
3	ISCED 5B
4	ISCED 5A or 6
7	N/A
8	Invalid
9	Missing

PQENPERC (76) PQ Perception of environmental issues PISA 2006 (WLE)	
Format: F9.4	Columns: 107-115
9997	N/A
9999	Missing

PQENVOPT (77) PQ Environmental optimism PISA 2006 (WLE)	
Format: F9.4	Columns: 116-124
9997	N/A
9999	Missing

PQGENSCI (78) PQ General value of science PISA 2006 (WLE)	
Format: F9.4	Columns: 125-133
9997	N/A
9999	Missing

PQPERSCI (79) PQ Personal value of science PISA 2006 (WLE)	
Format: F9.4	Columns: 134-142
9997	N/A
9999	Missing

PQSCCAR (80) Parents reports on science career motivation PISA 2006 (WLE)	
Format: F9.4	Columns: 143-151
9997	N/A
9999	Missing

PQSCHOOL (81) Parents perception of school quality PISA 2006 (WLE)	
Format: F9.4	Columns: 152-160
9997	N/A
9999	Missing

PQSCIACT (82) Science activities at age 10 PISA 2006 (WLE)	
Format: F9.4	Columns: 161-169
9997	N/A
9999	Missing

PQSCIMP (83) Parents view – importance of science PISA 2006 (WLE)	
Format: F9.4	Columns: 170-178
9997	N/A
9999	Missing

VER_PAR (84) Version parent database and date of release	
Format: A13	Columns: 179-191

APPENDIX 12
PISA 2006 QUESTIONNAIRE INDICES

Overview

The PISA 2006 context questionnaires included numerous items on student characteristics, student family background, student perceptions, school characteristics and perceptions of school principals. In 16 countries (optional) parent questionnaires were administered to the parents of the tested students.

Some of the items were designed to be used in analyses as single items (for example, gender). However, most questionnaire items were designed to be combined in some way so as to measure latent constructs that cannot be observed directly. For these items, transformations or scaling procedures are needed to construct meaningful indices.

Appendix 12 describes how student, school and parent questionnaire indices were constructed and validated. As in previous PISA surveys, two different kinds of indices can be distinguished:

- Simple indices: These indices were constructed through the arithmetical transformation or recoding of one or more items;
- Scale indices: These indices were constructed through the scaling of items. Typically, scale scores for these indices are estimates of latent traits derived through IRT scaling of dichotomous or Likert-type items.

Appendix 12 (i) outlines how simple indices were constructed, (ii) describes the methodology used for construct validation and scaling, (iii) details the construction and validation of scaled indices and (iv) illustrates the computation of the index on economic, social and cultural status (ESCS), including a discussion of some modifications from the PISA 2003 ESCS index. Some indices had already been used in previous PISA surveys and are constructed based on a similar scaling methodology (OECD 2005a). Most indices, however, were based on the elaboration of a questionnaire framework and are related to science as the major domain of the third PISA survey.

Simple questionnaire indices

Student questionnaire indices

Student age

The age of a student (*AGE*) was calculated as the difference between the year and month of the testing and the year and month of a student's birth. Data on student's age were obtained from both the questionnaire and the student tracking forms. If the month of testing was not know for a particular student, the median month of testing for that country was used in the calculation. The formula for computing *AGE* was

$$AGE = (100 + T_y - S_y) + \frac{(T_m - S_m)}{12}$$

where T_y and S_y are the year of the test and the year of the tested student's birth, respectively in two-digit format (for example "06" or "92"), and T_m and S_m are the month of the test and month of the student's birth respectively. The result is rounded to two decimal places.

Study programme indices

PISA 2006 collected data on study programmes available to 15-year-old students in each country. This information was obtained through the student tracking form and the student questionnaire. In the final database, all national programmes will be included in a separate variable (*PROGN*) where the first three digits are the ISO code for a country, the next two digits are the sub-national category, and the last two digits are the nationally specific programme code. All study programmes were classified using the international standard classification of education (ISCED) (OECD, 1999b). The following indices are derived from the data on study programmes: programme level (*ISCDL*) indicating whether students are on the lower or upper secondary level (ISCED 2 or ISCED 3); programme designation (*ISCEDD*) indicating the designation of the study programme (A = general programmes designed to give access to the next programme level, B = programmes designed to give access to vocational studies at the next programme level, C = programmes designed to give direct access to the labour market, M = modular programmes that combine any or all of these characteristics; and programme orientation (*ISCEDO*) indicating whether the programme's curricular content is general, pre-vocational or vocational.

Table A12.1
Mapping of ISCED to accumulated years of education

		ISCED 1	ISCED 2	ISCED 3B or 3C	ISCED 3A or 4	ISCED 5B	ISCED 5A or 6
OECD	Australia	6.0	10.0	11.0	12.0	14.0	15.0
	Austria	4.0	9.0	12.0	12.5	15.0	17.0
	Belgium	6.0	9.0	12.0	12.0	14.5	17.0
	Canada	6.0	9.0	12.0	12.0	15.0	17.0
	Czech Republic	5.0	9.0	11.0	13.0	16.0	16.0
	Denmark	6.0	9.0	12.0	12.0	15.0	17.0
	England, Wales & North. Ireland	6.0	9.0	12.0	13.0	15.0	16.0
	Finland	6.0	9.0	12.0	12.0	14.5	16.5
	France	5.0	9.0	12.0	12.0	14.0	15.0
	Germany	4.0	10.0	13.0	13.0	15.0	18.0
	Greece	6.0	9.0	11.5	12.0	15.0	17.0
	Hungary	4.0	8.0	10.5	12.0	13.5	16.5
	Iceland	7.0	10.0	13.0	14.0	16.0	18.0
	Ireland	6.0	9.0	12.0	12.0	14.0	16.0
	Italy	5.0	8.0	12.0	13.0	16.0	17.0
	Japan	6.0	9.0	12.0	12.0	14.0	16.0
	Korea	6.0	9.0	12.0	12.0	14.0	16.0
	Luxembourg	6.0	9.0	12.0	13.0	16.0	17.0
	Mexico	6.0	9.0	12.0	12.0	14.0	16.0
	Netherlands	6.0	10.0		12.0		16.0
	New Zealand	5.5	10.0	11.0	12.0	14.0	15.0
	Norway	6.0	9.0	12.0	12.0	14.0	16.0
	Poland		8.0	11.0	12.0	15.0	16.0
	Portugal	6.0	9.0	12.0	12.0	15.0	17.0
	Scotland	7.0	11.0	13.0	13.0	16.0	16.0
	Slovak Republic	4.5	8.5	12.0	12.0	13.5	17.5
	Spain	5.0	8.0	10.0	12.0	13.0	16.5
	Sweden	6.0	9.0	11.5	12.0	14.0	15.5
	Switzerland	6.0	9.0	12.5	12.5	14.5	17.5
	Turkey	5.0	8.0	11.0	11.0	13.0	15.0
	United States	6.0	9.0		12.0	14.0	16.0
Partners	Argentina	6.0	10.0	12.0	12.0	14.5	17.0
	Azerbaijan	4.0	9.0	11.0	11.0	14.0	17.0
	Brazil	4.0	8.0	11.0	11.0	14.5	16.0
	Bulgaria	4.0	8.0	12.0	12.0	15.0	17.5
	Chile	6.0	8.0	12.0	12.0	16.0	17.0
	Colombia	5.0	9.0	11.0	11.0	14.0	15.5
	Croatia	4.0	8.0	11.0	12.0	15.0	17.0
	Estonia	4.0	9.0	12.0	12.0	15.0	16.0
	Hong Kong-China	6.0	9.0	11.0	13.0	14.0	16.0
	Indonesia	6.0	9.0	12.0	12.0	14.0	15.0
	Israel	6.0	9.0	12.0	12.0	15.0	15.0
	Jordan	6.0	10.0	12.0	12.0	14.5	16.0
	Kyrgyzstan	4.0	8.0	11.0	10.0	13.0	15.0
	Latvia	3.0	8.0	11.0	11.0	16.0	16.0
	Liechtenstein	5.0	9.0	11.0	13.0	14.0	17.0
	Lithuania	3.0	8.0	11.0	11.0	15.0	16.0
	Macao-China	6.0	9.0	11.0	12.0	15.0	16.0
	Montenegro	4.0	8.0	11.0	12.0	15.0	16.0
	Qatar	6.0	9.0	12.0	12.0	15.0	16.0
	Romania	4.0	8.0	11.5	12.5	14.0	16.0
	Russian Federation	4.0	9.0	11.5	12.0		15.0
	Serbia	4.0	8.0	11.0	12.0	14.5	17.0
	Slovenia	4.0	8.0	11.0	12.0	15.0	16.0
	Chinese Taipei	6.0	9.0	12.0	12.0	14.0	16.0
	Thailand	6.0	9.0	12.0	12.0	14.0	16.0
	Tunisia	6.0	9.0	12.0	13.0	16.0	17.0
	Uruguay	6.0	9.0	12.0	12.0	15.0	17.0

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Highest occupational status of parents

Occupational data for both the student's father and student's mother were obtained by asking open-ended questions. The response were coded to four-digit ISCO codes (ILO,1990) and then mapped to the international socio-economic index of occupational status (*ISEI*) (Ganzeboom *et al.*, 1992). Three indices were obtained from these scores: father's occupational status (*BFMJ*); mother's occupational status (*BMMJ*); and the highest occupational status of parents (*HISEI*) which corresponds to the higher *ISEI* score of either parent or to the only available parent's *ISEI* score. For all three indices, higher *ISEI* scores indicate higher levels of occupational status.

Educational level of parents

Parental education is a second family background variable that is often used in the analysis of educational outcomes. Theoretically, it has been argued that parental education is a more relevant influence on a student's outcomes than is parental occupation. Like occupation, the collection of internationally comparable data on parental education poses significant challenges, and less work has been done on internationally comparable measures of educational outcomes than has been done on occupational status. The core difficulties with parental education relate to international comparability (education systems differ widely between countries and within countries over time), response validity (students are often unable to accurately report their parents' level of education) and, especially with increasing immigration, difficulties in the national mapping of parental qualifications gained abroad.

Parental education is classified using ISCED (OECD,1999). Indices on parental education are constructed by recoding educational qualifications into the following categories: (0) None; (1) ISCED 1 (primary education); (2) ISCED 2 (lower secondary); (3) ISCED Level 3B or 3C (vocational/pre-vocational upper secondary); (4) ISCED 3A (upper secondary) and/or ISCED 4 (non-tertiary post-secondary); (5) ISCED 5B (vocational tertiary); and (6) ISCED 5A, 6 (theoretically oriented tertiary and post-graduate). Indices with these categories were provided for the students' mother (*MISCED*) and the students' father (*FISCED*). In addition, the index on the highest educational level of parents (*HISCED*) corresponds to the higher ISCED level of either parent.

The index scores for highest educational level of parents were also recoded into estimated years of schooling (*PARED*). A mapping of ISCED levels of years of schooling is in Table A12.1.

Immigration background

As in PISA 2000 and PISA 2003, information on the country of birth of the students and their parents was collected. Included in the database are three country-specific variables relating to the country of birth of the student, mother, and father (*COBN_S, COBN_M* and *COBN_F*). Also, the items ST11Q01, ST11Q02 and ST11Q03 have been recoded for the database into the following categories: (1) country of birth is same as country of assessment, and (2) otherwise.

The index on immigrant background (*IMMIG*) is calculated from these variables, and has the following categories: (1) native students (those students who had at least one parent born in the country), (2) first-generation students (those students born outside the country of assessment and whose parents were also born in another country), and (3) second generation' students (those born in the country of assessment but whose parent(s) were born in another country). Students with missing responses for either the student or for both parents have been given missing values for this variable.

Language spoken at home

Similar to PISA 2003, students also indicated what language they usually spoke at home, and the database includes a variable (*LANGN*) containing country-specific codes for each language. In addition, the item ST12Q01 has be recoded for the international database into the following categories: (1) language at home is same as the language of assessment for that student, (2) language at home is a national language of the country but the student was assessed in a different language, and (3) language at home is another (foreign) language.

Expected occupational status

As in PISA 2000 and 2003, students were asked to report their expected occupation at age 30 and a description of this job. The responses were coded to four-digit ISCO codes (ILO, 1990) and then mapped to the *ISEI* index (Ganzeboom *et al.*, 1992). Recoding of ISCO codes into *ISEI* index results in scores for the students' expected occupational status (*BSMJ*), where higher scores of *ISEI* indicate higher levels of expected occupational status.

Blue-collar/white-collar parental occupation

As in 2003, the ISCO codes of parents were recoded into 4 categories: (1) white-collar high-skilled, (2) white-collar low-skilled, (3) blue-collar high-skilled, and (4) blue-collar low-skilled. Three variables are included, one indicating the mother's employment category (*MSECATEG*), another indicating father's employment category (*FSECATEG*), and another indicating the highest employment category of either parent (*HSECATEG*).

Table A12.2
ISCO major group white-collar/blue-collar classification

ISCO Major Group	White-collar/blue-collar classification
1	White-collar high-skilled
2	White-collar high-skilled
3	White-collar high-skilled
4	White-collar low-skilled
5	White-collar low-skilled
6	Blue-collar high-skilled
7	Blue-collar high-skilled
8	Blue-collar low-skilled
9	Blue-collar low-skilled

Science-related occupations for parents and students

The ISCO data were used to compute four variables indicating whether or not the student expects to have a science-related career at age 30 (*SRC_S*), whether their mother (*SRC_M*) or father (*SRC_F*) are in a science career, or whether either or both parents are in a science related career (*SRC_E*). Values of 1 on these indicate "yes", while values of 0 indicate "no or undetermined".

To reduce the amount of missing data for parents' career status, parents with the following responses for occupations were recoded to "no/undetermined': home makers, social beneficiaries and students. Furthermore, to reduce the amount of missing data on students' expected career status at age 30, students indicating "don't know" were recoded from missing to "no/undetermined". Also, students who responded to the items immediately subsequent to this question, but who did not respond to expected job at 30 were recoded to "no/undetermined'.

Since the ISCO coding scheme is rather broad for this purpose (*e.g.* some teaching professionals may be in a science-related career, but the scheme does not distinguish between teachers in different subject areas and disciplines), these science-related career variables should be interpreted as broad indicators rather than precise classifications. The ISCO occupation categories that were classified as science-related occupations are shown in Table A12.3.

Table A12.3
ISCO occupation categories classified as science-related occupations

ISCO Group Number	Occupation Category
1236	Computing services department managers
1237	Research and development department managers
211	Physicists, chemists and related professionals
2122	Statisticians
213	Computing professionals
214	Architects, engineers, professionals etc.
221	Life science professionals
222	Health professionals except nursing
223	Nursing and midwifery professionals
2442	Sociologists, anthropologists, professionals etc.
2445	Psychologists
2446	Social work professionals
311	Physical and engineering science associate professionals
313	Optical and electronic equipment operators
3143	Aircraft pilots, associate professionals etc.
3144	Air traffic controllers
3145	Air traffic safety technicians
315	Safety and quality inspectors
321	Life science, associate professionals etc.
322	Modern health professionals except nursing
323	Nursing and midwifery associate professionals

School questionnaire indices

School size

As in previous surveys, the PISA 2006 index of school size (*SCHSIZE*) contains the total enrolment at school based on the enrolment data provided by the school principal, summing the number of girls and boys at a school.

Class size

The average class size (*CLSIZE*) is derived from one of nine possible categories, ranging from "15 students or fewer" to "More than 50 students'. *CLSIZE* takes the midpoint of each response category, a value of 13 for the lowest category, and a value of 53 for the highest.

Proportion of girls enrolled at school

As in previous surveys, the PISA 2006 index on the proportion of girls at school (*PCGIRLS*) is based on the enrolment data provided by the school principal, dividing the number of girls by the total of girls and boys at a school.

School type

Schools are classified as either public or private according to whether a private entity or a public agency has the ultimate power to make decisions concerning its affairs. As in previous PISA surveys, the index on school type (*SCHLTYPE*) has three categories: (1) public schools controlled and managed by a public education authority or agency, (2) government-dependent private schools controlled by a non-government organisation or with a governing board not selected by a government agency which receive more than 50% of their core funding from government agencies, (3) government-independent private schools controlled by a non-government organisation or with a governing board not selected by a government agency which receive less than 50% of their core funding from government agencies.[1]

Availability of computers

As in PISA 2000 and PISA 2003, school principals were asked to report the number of computers available at school. However, the question wording was modified for 2006 where principals were asked to report on the total number of computers, the number of computers available for instruction and the number of computers connected to the Internet. The index of availability of computers (*RATCOMP*) is obtained by dividing the number of computers at school by the number of students at school. The overall ratio of computers to school size (*IRATCOMP*) was obtained by dividing the number of computers available for instruction at school by the number of students at school. The proportion of computers connected to the Internet (*COMPWEB*) was obtained by dividing the total number of computers connected to the web by the total number of computers.

Quantity of teaching staff at school

As in previous PISA surveys, school principals were asked to report the number of full-time and part-time teachers at school. However, the number of items was reduced in 2006 to capture only teachers in total, certified teachers, and teachers with an ISCED 5A qualification.

The student-teacher ratio (*STRATIO*) was obtained by dividing the school size by the total number of teachers. The number of part-time teachers is weighted by 0.5 and the number of full-time teachers is weighted by 1.0. The proportion of fully certified teachers (*PROPCERT*) was computed by dividing the number of fully certified teachers by the total number of teachers. The proportion of teachers who have an ISCED 5A qualification (*PROPQUAL*) was calculated by dividing the number of these kinds of teachers by the total number of teachers.

School selectivity

As in previous surveys, school principals were asked about admittance policies at their school. Among these policies, principals were asked how much consideration was given to the following factors when students are admitted to the school, based on a scale with the categories "not considered", "considered", "high priority", and "pre-requisite": students' academic record (including placement tests) and the recommendation of feeder schools.

1. Data on public/private school ownership in Australia are not included in the PISA 2006 database. In Austria, the question on funding was omitted and only for private schools information on government funding was provided to construct this index.

An index of school selectivity (*SELSCH*) was computed by assigning schools to four different categories: (1) schools where none of these factors is considered for student admittance; (2) schools considering at least one of these factors; (3) schools giving high priority to at least one of these factors; and (4) schools where at least one of these factors is a pre-requisite for student admittance.

Ability grouping

School principals were asked to report the extent to which their school organises instruction differently for student with different abilities. PISA 2003 included a similar question with two additional items which focused on mathematics classes. In 2006, this has been reduced to two items which ask about subject grouping in a more general sense. One item asked about the occurrence of ability grouping into different classes and the other regarding ability grouping within classes (with the response categories "For all subjects", "For some subjects" and "Not for any subject").

An index of ability grouping between or within classes (*ABGROUP*) was derived from the two items by assigning schools to three categories: (1) schools with no ability grouping for any subjects, (2) schools with at least one of these forms of ability grouping for some subjects and (3) schools with at least one of these two forms of ability grouping for all subjects.

School responsibility for resource allocation

An index of the relative level of responsibility of school staff in allocating resources (*RESPRES*) was derived from six items measuring the school principals' report on who has considerable responsibility for tasks regarding school management of resource allocation ("Selecting teachers for hire", "Firing teachers", "Establishing teachers' starting salaries", "Determining teachers' salaries increases", "Formulating the school budget", "Deciding on budget allocations within the school"). The index was calculated on the basis of the ratio of "yes" responses for principal or teachers to "yes" responses for central educational authority. Higher values on the scale indicate relatively higher levels of school responsibility in this area. The index was standardised to having an OECD mean of 0 and a standard deviation of 1 (for the pooled data with equally weighted country samples).[2]

School responsibility for curriculum and assessment

An index of the relative level of responsibility of school staff in issues relating to curriculum and assessment (*RESPCURR*) was computed from four items measuring the school principal's report concerning who had responsibility for curriculum and assessment ("Establishing student assessment policies", "Choosing which textbooks are used", "Determining course content", "Deciding which courses are offered"). The index was calculated on the basis of the ratio of "yes" responses for principal or teachers to "yes" responses for central education authorities. Higher values indicate relatively higher levels of school responsibility in this area. The index was standardised to having an OECD mean of zero and a standard deviation of one (for the pooled data with equally weighted country samples).[3]

Parent questionnaire indices

Educational level of parents

Administration of this instrument in PISA 2006 provided the opportunity to collect data on parental education directly from the parents in addition to the data provided by the student questionnaire. Similar to the student questionnaire data, parental education were classified using ISCED (OECD 1999). The question format differed from the one used in the student questionnaire as only four items were included with dichotomous response categories of Yes or No.

Indices were constructed by taking the highest level for father and mother and having the following categories: (0) None, (1) ISCED 3A (upper secondary) and/or ISCED 4 (non-tertiary post-secondary), (2) ISCED 5B (vocational tertiary), (3) ISCED 5A, 6 (theoretically oriented tertiary and post-graduate). Indices with these categories were computed for mother (*PQMISCED*) and father (*PQFISCED*). Highest Educational Level of Parents (*PQHISCED*) corresponds to the higher ISCED level of either parent.

2. The raw index was transformed as (*RESPRES*_raw-2.57)/2.2.

3. The raw index was transformed as (*RESPCURR*_raw-2.72)/1.8.

Occupational status of parents

Occupational data for both the student's father and student's mother were obtained by asking open-ended questions in a manner similar to the questions asked of students. The responses were coded to four-digit ISCO codes (ILO, 1990) and then mapped to the international socio-economic index of occupational status (ISEI) (Ganzeboom, de Graaf & Treiman, 1992). Three ISEI indices were computed from these scores.

Recoding of ISCO codes into ISEI gives scores for the mother's occupational status (*PQBMMJ*) and father's occupational status (*PQBFMJ*). The highest occupational level of parents (*PQHIISEI*) is the higher ISEI score of either parent or to the only available parent's ISEI score. Higher scores of ISEI will indicate higher level of occupational status.

Similar to the science-related career variables derived from the student questionnaire, three indicators were derived from the parent data: whether the mother (*PQSRC_M*) or father (*PQSRC_F*) is in a science-related career, and whether either or both of the parents is in a science-related career (*PQSRC_E*).

Questionnaire scale indices

Scaling procedures

Most questionnaire items were scaled using IRT scaling methodology (one-parameter Rasch model). See Chapter 16 in the PISA 2006 Technical Report (OECD, 2009) for the details inscaling.

International item parameters were obtained from calibration samples consisting of randomly selected sub-samples:

- For the calibration of student item parameters, sub-samples of 500 students were randomly selected within each OECD country sample. As final student weights had not been available at the time the calibration sample was drawn, the random selection was based on preliminary student weights obtained from the ratio between sampled and enrolled student within explicit sampling strata. The final calibration sample included data from 15,000 students;
- For the calibration of school item parameters, 100 schools were randomly selected within each OECD country sample. The random selection was based on school level weights in order to ensure that a representative sample of schools was selected from each country. School data from Luxembourg were not included due to of the small number of schools. Data from France were not available because the school questionnaire was not administered in France. The final calibration sample included data from 2 800 school principals.

Once international item parameter had been estimated from the calibration sample, weighted likelihood estimation (WLE) was used to obtain individual student scores. IRT scores were derived using ACER *ConQuest*® with pre-calibrated item parameters.

WLEs were transformed to an international metric with an OECD average of zero and an OECD standard deviation of one. Model fit and scale reliabilities for each of the indices are presented by country in Chapter 16 of the PISA 2006 Technical Report (OECD, 2009).

Student scale indices

Household possessions

Collecting household possessions as indicators of family wealth has received much attention in international studies in the field of education (Buchmann, 2000). Household assets are believed to capture wealth better than income because they reflect a more stable source of wealth.

In PISA 2006, students reported the availability of 13 different household items at home. In addition, countries added three specific household items that were seen as appropriate measures of family wealth within the country's context. A list of the country-specific household items is presented in Appendix 6 of the PISA 2006 Technical Report (OECD, 2009).

Four different indices were derived from these items: (i) family wealth possessions (*WEALTH*), (ii) cultural possessions (*CULTPOSS*), (iii) home educational resources (*HEDRES*) and (iiii) home possessions (*HOMEPOS*). The last index is a summary index of all household items and also included the variable indicating the number of books at home, but recoded into three categories: (0) 0-25 books, (1) 26-100 books, and (2) 101 or more books. *HOMEPOS* was also one of three components in the construction of the index on economic, social and cultural status (ESCS, see the section on ESCS index construction below). Table A12.4 shows the wording of items and their allocation to the four indices.

Table A12.4
Household possessions and home background indices

Item		Item is used to measure index			
		WEALTH	CULTPOSS	HEDRES	HOMEPOS
ST13	In your home, do you have:				
ST13Q01	A desk to study at			X	X
ST13Q02	A room of your own	X			X
ST13Q03	A quiet place to study			X	X
ST13Q04	A computer you can use for school work			X	
ST13Q05	Educational software			X	X
ST13Q06	A link to the Internet	X			X
ST13Q07	Your own calculator			X	X
ST13Q08	Classic literature (*e.g.* <Shakespeare>)		X		X
ST13Q09	Books of poetry		X		X
ST13Q10	Works of art (*e.g.* paintings)		X		X
ST13Q11	Books to help with your school work			X	X
ST13Q12	A dictionary			X	X
ST13Q13	A dishwasher (country-specific)	X			X
ST13Q14	A <DVD or VCR> player (country-specific)	X			X
ST13Q15	<Country-specific wealth item 1>	X			X
ST13Q16	<Country-specific wealth item 2>	X			X
ST13Q17	<Country-specific wealth item 3>	X			X
ST14	How many of these are there at your home?				
ST14Q01	Cellular phones	X			X
ST14Q02	Televisions	X			X
ST14Q03	Computers	X			X
ST14Q04	Cars	X			X
ST15	How many books are there in your home				X

Note: Item categories were "yes" (1) and "no" (2) for ST13, "None", "One", "Two" and "Three or more" for ST14, The categories for ST15 ("0-10 books", "11-25 books", "26-100 books", 101-200 books", "201-500 books" and "More than 500 books") were recoded into three categories ("0-25 books", 26-100 books" and "More than 100 books" ; Items in ST13 for were inverted for scaling and the first two categories of ST14Q01 and ST14Q02 were collapsed into one for scaling.

The *WEALTH* and *HOMEPOS* scales were constructed in two stages. A basket of common items was chosen (ST13Q02, ST13Q06, ST14Q01, ST14Q02, ST14Q03 and ST14Q04 for *WEALTH*, and in addition to these ST13Q01, ST13Q03, ST13Q05 to ST13Q12 and ST15Q01 for *HOMEPOS*) and item parameters were estimated for each country based on this item set. The sum of the set's item parameters was constrained to zero for each country. Next, these item parameters were anchored. The remaining country-specific items were added, and each country was scaled separately.

The other two scales derived from household possession items, *CULTPOSS* and *HEDRES*, were scaled in one step but the item parameters were allowed to vary by country.

Interest in and enjoyment of science learning

Eight items are used to measure general interest in science learning in PISA 2006. While the interest items which are embedded in the test instrument provide data on interest in specific contexts, the items here will provide data on students' interest in more general terms. The items were inverted for scaling and so, more positive values on this index indicate higher levels of interest in learning science.

Interest in science learning (INTSCIE)

Item	How much interest do you have in learning about the following <broad science> topics? (High interest / Medium interest / Low interest / No interest)
ST21Q01	a) Topics in physics
ST21Q02	b) Topics in chemistry
ST21Q03	c) The biology of plants
ST21Q04	d) Human biology
ST21Q05	e) Topics in astronomy
ST21Q06	f) Topics in geology
ST21Q07	g) Ways scientists design experiments
ST21Q08	h) What is required for scientific explanations

Note: All items were inverted for scaling.

Four items are used to measure enjoyment of science learning in PISA 2006. The items were inverted for scaling and so, more positive values on this index indicate higher levels of enjoyment of science.

Enjoyment of science (JOYSCIE)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST16Q01	a) I generally have fun when I am learning <broad science> topics
ST16Q02	b) I like reading about <broad science>
ST16Q03	c) I am happy doing <broad science> problems
ST16Q04	d) I enjoy acquiring new knowledge in <broad science>
ST16Q05	e) I am interested in learning about <broad science>

Note: All items were inverted for scaling.

Motivation to learn science

Five items measuring the construct of instrumental motivation were included in the PISA 2006 main study. The items were inverted for scaling and so, more positive values on this index indicate higher levels of instrumental motivation to learn science.

Instrumental motivation to learn science (INSTSCIE)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST35Q01	a) Making an effort in my <school science> subject(s) is worth it because this will help me in the work I want to do later on
ST35Q02	b) What I learn in my <school science> subject(s) is important for me because I need this for what I want to study later on
ST35Q03	c) I study <school science> because I know it is useful for me
ST35Q04	d) Studying my <school science> subject(s) is worthwhile for me because what I learn will improve my career prospects
ST35Q05	e) I will learn many things in my <school science> subject(s) that will help me get a job

Note: All items were inverted for scaling.

Expectations about tertiary science studies and working in science-related careers are another important aspect of student motivations to learning science. Four items measuring students' motivations to take up a science-related career were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of motivation to take up a science-related career.

Future-oriented science motivation (SCIEFUT)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST29Q01	a) I would like to work in a career involving <broad science>
ST29Q02	b) I would like to study <broad science> after <secondary school>
ST29Q03	c) I would like to spend my life doing advanced <broad science>
ST29Q04	d) I would like to work on <broad science> projects as an adult

Note: All items were inverted for scaling.

Self-related cognitions in science

Eight items measuring students' science self-efficacy (their confidence in performing science-related tasks) were included. These items cover important themes identified in the science literacy framework: identifying scientific questions, explaining phenomena scientifically and using scientific evidence. The items were inverted for scaling and so, more positive values on this index indicate higher levels of self-efficacy in science.

Six items on science self-concept were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of self-concept in science.

Science self-concept (SCSCIE)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST37Q01	a) Learning advanced <school science> topics would be easy for me
ST37Q02	b) I can usually give good answers to <test questions> on <school science> topics
ST37Q03	c) I learn <school science> topics quickly
ST37Q04	d) <School science> topics are easy for me
ST37Q05	e) When I am being taught <school science>. I can understand the concepts very well
ST37Q06	f) I can easily understand new ideas in <school science>

Note: All items were inverted for scaling.

Value of science

Five items measuring perceptions of the general value of science were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive students' perceptions of the general value of science.

General value of science (GENSCIE)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST18Q01	a) Advances in <broad science and technology> usually improve people's living conditions
ST18Q02	b) <Broad science> is important for helping us to understand the natural world
ST18Q04	d) Advances in <broad science and technology> usually help improve the economy
ST18Q06	f) <Broad science> is valuable to society
ST18Q09	i) Advances in <broad science and technology> usually bring social benefits

Note: All items were inverted for scaling.

Five items measuring perceptions of the personal value of science were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive positive students' perceptions of the general value of science.

Science-related activities

Student participation in non-compulsory activities related to science or choice of course combinations with an emphasis on this subject are important indicators of engagement. Furthermore, out-of-school activities relating to science can contribute considerably to students' engagement and learning in science.

Six items measuring students' activities related to science were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of students' science activities.

Science activities (SCIEACT)

Item	How often do you do these things? (Very often / Regularly / Sometimes / Never or hardly ever)
ST19Q01	a) Watch TV programmes about <broad science>
ST19Q02	b) Borrow or buy books on <broad science> topics
ST19Q03	c) Visit web sites about <broad science> topics
ST19Q04	d) Listen to radio programmes about advances in <broad science>
ST19Q05	e) Read <broad science> magazines or science articles in newspapers
ST19Q06	f) Attend a <science club>

Note: All items were inverted for scaling.

Environment and sustainable development

Five items measuring students' awareness of environmental issues were included in the student questionnaire. More positive values on this index indicate higher levels of students' awareness of environmental issues.

Awareness of environmental issues (ENVAWARE)

Item	How informed are you about the following environmental issues? (I have never heard of this / I have heard about this but I would not be able to explain what it is / I know something about this and could explain the general issue / I am familiar with this and I would be able to explain this well)
ST22Q01	a) The increase of greenhouse gases in the atmosphere
ST22Q02	b) Use of genetically modified organisms (<GMO>)
ST22Q03	c) Acid rain
ST22Q04	d) Nuclear waste
ST22Q05	e) The consequences of clearing forests for other land use

Six items measuring students' perception of environmental issues as a concern were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of students' concerns about environmental issues.

Perception of environmental issues (ENVPERC)

Item	Do you see the environmental issues below as a serious concern for yourself and/or others? (This is a serious concern for me personally as well as others / This is a serious concern for other people in my country but not me personally / This is a serious concern only for people in other countries / This is not a serious concern to anyone)
ST24Q01	a) Air pollution
ST24Q02	b) Energy shortages
ST24Q03	c) Extinction of plants and animals
ST24Q04	d) Clearing of forests for other land use
ST24Q05	e) Water shortages
ST24Q06	f) Nuclear waste

Note: All items were inverted for scaling.

Students' optimism regarding environmental issues was measured by six items in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of students' optimism about environmental issues.

Environmental optimism (ENVOPT)

Item	Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years? (Improve / Stay about the same / Get worse)
ST25Q01	a) Air pollution
ST25Q02	b) Energy shortages
ST25Q03	c) Extinction of plants and animals
ST25Q04	d) Clearing of forests for other land use
ST25Q05	e) Water shortages
ST25Q06	f) Nuclear waste

Note: All items were inverted for scaling.

Seven items measuring students' responsibility for sustainable development were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of students' responsibility for sustainable development.

Responsibility for sustainable development (RESPDEV)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST26Q01	a) It is important to carry out regular checks on the emissions from cars as a condition of their use
ST26Q02	b) It disturbs me when energy is wasted through the unnecessary use of electrical appliances
ST26Q03	c) I am in favour of having laws that regulate factory emissions even if this would increase the price of products
ST26Q04	d) To reduce waste, the use of plastic packaging should be kept to a minimum
ST26Q05	e) Industries should be required to prove that they safely dispose of dangerous waste materials
ST26Q06	f) I am in favour of having laws that protect the habitats of endangered species
ST26Q07	g) Electricity should be produced from renewable sources as much as possible, even if this increases the cost

Note: All items were inverted for scaling.

Science career preparation

Four items measuring students' perceptions of the usefulness of schooling as preparation for science-related careers were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of agreement with usefulness of schooling for this purpose.

School preparation for science career (CARPREP)

Item	How much do you agree with the statements below? (Strongly agree / Agree / Disagree / Strongly disagree)
ST27Q01	a) The subjects available at my school provide students with the basic skills and knowledge for a <science-related career>
ST27Q02	b) The <school science> subjects at my school provide students with the basic skills and knowledge for many different careers
ST27Q03	c) The subjects I study provide me with the basic skills and knowledge for a <science-related career>
ST27Q04	d) My teachers equip me with the basic skills and knowledge I need for a <science-related career>

Note: All items were inverted for scaling.

Four items measuring students' perceptions of being informed about science-related careers are included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of information about science-related careers.

Student information on science careers (CARINFO)

Item	How informed are you about these topics? (Very well informed / Fairly informed / Not well informed / Not informed at all)
ST28Q01	a) <Science-related careers> that are available in the job market
ST28Q02	b) Where to find information about <science-related careers>
ST28Q03	c) The steps a student needs to take if they want a <science-related career>
ST28Q04	d) Employers or companies that hire people to work in <science-related careers>

Note: All items were inverted for scaling.

Three items measuring students' reports on the frequency of student investigations in science lessons were included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of this type of science teaching.

Science teaching: student investigations (SCINVEST)

Item	When learning <school science> topics at school, how often do the following activities occur? (In all lessons / In most lessons / In some lessons / Never or hardly ever)
ST34Q08	h) Students are allowed to design their own experiments
ST34Q11	k) Students are given the chance to choose their own investigations
ST34Q16	p) Students are asked to do an investigation to test out their own ideas

Note: All items were inverted for scaling.

Five items measuring students' reports on the frequency of teaching in science lessons with a focus on applications are included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of this type of science teaching.

Science teaching: focus on models or applications (SCAPPLY)

Item	When learning <school science> topics at school, how often do the following activities occur? (In all lessons / In most lessons / In some lessons / Never or hardly ever)
ST34Q07	g) The teacher explains how a <school science> idea can be applied to a number of different phenomena (*e.g.* the movement of objects, substances with similar properties)
ST34Q12	l) The teacher uses science to help students understand the world outside school
ST34Q15	o) The teacher clearly explains the relevance of <broad science> concepts to our lives
ST34Q17	q) The teacher uses examples of technological application to show how <school science> is relevant to society

Note: All items were inverted for scaling.

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ICT familiarity

The ICT familiarity questionnaire was an optional instrument administered which was administered in 40 of the participating countries in PISA 2006, for which four scaled indices were computed.

As in PISA 2003, six items measuring the frequency of ICT use related to Internet and entertainment were included in the PISA 2006 student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of ICT Internet/entertainment use.

ICT Internet/entertainment use (INTUSE)

Item	How often do you use computers for the following reasons? (Almost every day / Once or twice a week / A few times a month / Once a month or less / Never)
IC04Q01	a) Browse the Internet for information about people, things, or ideas
IC04Q02	b) Play games
IC04Q04	d) Use the Internet to collaborate with a group or team
IC04Q06	f) Download software from the Internet to (including games)
IC04Q09	i) Download music from the Internet
IC04Q11	k) For communication (*e.g.* e-mail or "chat rooms")

Note: All items were inverted for scaling.

As in PISA 2003, six items measuring the frequency of ICT use related to programming and software packages are included in the PISA 2006 student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of ICT program/software use.

ICT program/software use (PRGUSE)

Item	How often do you use computers for the following reasons? (Almost every day / Once or twice a week / A few times a month / Once a month or less / Never)
IC04Q03	c) Write documents (*e.g.* with <Word® or WordPerfect®>)
IC04Q05	e) Use spreadsheets (*e.g.* <Lotus 1 2 3® or Microsoft Excel®>)
IC04Q07	g) Drawing, painting or using graphics programs
IC04Q08	h) Use educational software such as Mathematics programs
IC04Q10	j) Writing computer programs

Note: All items were inverted for scaling.

As in PISA 2003, items measuring students' confidence in doing ICT Internet tasks were included. However, a modified set of six items was used in the PISA 2006 student questionnaire where three items were already included in the previous cycle. The items were inverted for scaling and so, more positive values on this index indicate higher levels of ICT self-confidence in Internet tasks.

ICT self-confidence in Internet tasks (INTCONF)

Item	How often do you use computers for the following reasons? (I can do this very well by myself / I can do this with help from someone / I know what this means but I cannot do it / I don't know what this means)
IC05Q01	a) Chat online
IC05Q07	g) Search the Internet for information
IC05Q08	h) Download files or programs from the Internet
IC05Q09	i) Attach a file to an e-mail message
IC05Q13	m) Download music from the Internet
IC05Q15	o) Write and send e-mails

Note: All items were inverted for scaling.

As in PISA 2003, items measuring student's confidence in doing ICT high-level tasks were included in the PISA 2006 student questionnaire. The set of eight items used in the PISA 2006 main study is modified somewhat from the 2003 item set. The items were inverted for scaling and so, more positive values on this index indicate higher levels of ICT self-confidence in high-level ICT tasks.

ICT self-confidence in high-level ICT tasks (HIGHCONF)

Item	**How often do you use computers for the following reasons? (I can do this very well by myself / I can do this with help from someone / I know what this means but I cannot do it / I don't know what this means)**
IC05Q02	b) Use software to find and get rid of computer viruses
IC05Q03	c) Edit digital photographs or other graphic images
IC05Q04	d) Create a database (*e.g.* using <Microsoft Access®>)
IC05Q10	j) Use a word processor (*e.g.* to write an essay for school)
IC05Q11	k) Use a spreadsheet to plot a graph
IC05Q12	l) Create a presentation (*e.g.* using <Microsoft PowerPoint®>)
IC05Q14	n) Create a multi-media presentation (with sound, pictures, video)
IC05Q16	p) Construct a web page

Note: All items were inverted for scaling.

School questionnaire scale indices

The index on teacher shortage (*TCSHORT*) was derived from four items measuring the school principal's perceptions of potential factors hindering instruction at school. Similar items were used in PISA 2000 and 2003. More positive values on this index indicate higher rates of teacher shortage at a school.

Teacher shortage (TCSHORT)

Item	**Is your school's capacity to provide instruction hindered by any of the following? (Not at all / Very little / To some extent / A lot)**
SC14Q01	a) A lack of qualified science teachers
SC14Q02	b) A lack of qualified mathematics teachers
SC14Q03	c) A lack of qualified <test language> teachers
SC14Q04	d) A lack of qualified teachers of other subjects

The index on the school's educational resources (*SCMATEDU*) was computed on the basis of seven items measuring the school principal's perceptions of potential factors hindering instruction at school. Similar items were used in PISA 2000 and 2003 but question format and item wording were modified for PISA 2006. The items were inverted for scaling and so, more positive values on this index indicate higher levels of educational resources.

Quality of educational resources (SCMATEDU)

Item	**Is your school's capacity to provide instruction hindered by any of the following? (Not at all / Very little / To some extent / A lot)**
SC14Q07	g) Shortage or inadequacy of science laboratory equipment
SC14Q08	h) Shortage or inadequacy of instructional materials (*e.g.* textbooks)
SC14Q09	i) Shortage or inadequacy of computers for instruction
SC14Q10	j) Lack or inadequacy of Internet connectivity
SC14Q11	k) Shortage or inadequacy of computer software for instruction
SC14Q12	l) Shortage or inadequacy of library materials
SC14Q13	m) Shortage or inadequacy of audio-visual resources

Note: All items were inverted for scaling.

School principals are asked to report what activities to promote students' learning of science occur at their school. Items were coded (Yes=1, No=0) so that more positive values on this index indicate higher levels of school activities to promote the learning of science.

School activities to promote the learning of science (SCIPROM)

Item	**Is your school involved in any of the following activities to promote engagement with science among students in <national modal grade for 15-year-olds>? (Yes/No)**
SC20Q01	a) Science clubs
SC20Q02	b) Science fairs
SC20Q03	c) Science competitions
SC20Q04	d) Extracurricular science projects (including research)
SC20Q05	e) Excursions and field trips

School principals are asked to report what activities to promote students' learning of environmental topics occur at their school. Items will be coded (Yes=1, No=0) so that more positive values on this index indicate higher levels of school activities for learning environmental topics.

School activities for learning environmental topics (ENVLEARN)

Item	Does your school organise any of the following activities to provide opportunities to students in <national modal grade for 15-year-olds> to learn about environmental topics? (Yes/No)
SC22Q01	a) <Outdoor education>
SC22Q02	b) Trips to museums
SC22Q03	c) Trips to science and/or technology centres
SC22Q04	d) Extracurricular environmental projects (including research)
SC22Q05	e) Lectures and/or seminars (*e.g.* guest speakers)

Parent questionnaire scale indices

Parent questionnaire indices are only available for the 16 countries which chose to administer the optional parent questionnaire.

Six items measuring students' activities related to science at age 10 were included in the parent questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of students' science activities at age 10.

Science activities at age 10 (PQSCIACT)

Item	Thinking back to when your child was about 10 years old, how often would your child have done these things? (Very often / Regularly / Sometimes / Never)
PA02Q01	a) Watched TV programmes about science
PA02Q02	b) Read books on scientific discoveries
PA02Q03	c) Watched, read or listened to science fiction
PA02Q04	d) Visited web sites about science topics
PA02Q05	e) Attended a science club

Note: All items were inverted for scaling.

Seven items measuring parents' perceptions of the quality of school learning were included in the parent questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive parents' perception of school quality.

Parents' perception of school quality (PQSCHOOL)

Item	How much do you agree with the following statements? (Strongly agree / Agree / Disagree / Strongly disagree)
PA03Q01	a) Most of my child's school teachers seem competent and dedicated
PA03Q02	b) Standards of achievement are high in my child's school
PA03Q03	c) I am happy with the content taught and the instructional methods used in my child's school
PA03Q04	d) I am satisfied with the disciplinary atmosphere in my child's school
PA03Q05	e) My child's progress is carefully monitored by the school
PA03Q06	f) My child's school provides regular and useful information on my child's progress
PA03Q07	g) My child's school does a good job in educating students

Note: All items were inverted for scaling.

Four items measuring parents' views on the importance of science were included in the PISA 2006 parent questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive parents' views on importance of science.

Parents' views on importance of science (PQSCIMP)

Item	We are interested in what you think about the need for science skills in the job market today. How much do you agree with the following statements? (Strongly agree / Agree / Disagree / Strongly disagree)
PA04Q01	a) It is important to have good scientific knowledge and skills in order to get any good job in today's world
PA04Q02	b) Employers generally appreciate strong scientific knowledge and skills among their employees
PA04Q03	c) Most jobs today require some scientific knowledge and skills
PA04Q04	d) It is an advantage in the job market to have good scientific knowledge and skills

Note: All items were inverted for scaling.

Four items measuring parents' reports on science career motivation for their child were included in the PISA 2006 parent questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher frequencies of parents' reports on science career motivation. One item in this set (*PA05Q01* "Does anybody in your family (including you) work in a <science-related career>?") was not included in the scale since it is unrelated to the construct of career motivation of parents for their child.

Parents' reports on science career motivation (PQSCCAR)

Item	Please answer the questions below (Yes/No)
PA05Q02	b) Does your child show an interest to work in a <science-related career>?
PA05Q03	c) Do you expect your child will go into a <science-related career>?
PA05Q04	d) Has your child shown interest in studying science after completing <secondary school>?
PA05Q05	e) Do you expect your child will study science after completing <secondary school>?

Note: All items were inverted for scaling.

Five items measuring parents' perceptions of the general value of science were included in the PISA 2006 parent questionnaire; similar items were also included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive parents' view on general value of science.

Parents' view on general value of science (PQGENSCI)

Item	The following question asks about your views towards science. How much do you agree with the following statements? (Strongly agree / Agree / Disagree / Strongly disagree)
PA06Q01	a) Advances in <broad science and technology> usually improve people's living conditions
PA06Q02	b) <Broad science> is important for helping us to understand the natural world
PA06Q04	d) Advances in <broad science and technology> usually help improve the economy
PA06Q06	f) <Broad science> is valuable to society
PA06Q09	i) Advances in <broad science and technology> usually bring social benefits

Note: All items were inverted for scaling.

Four items measuring parents' perceptions of the personal value of science are included in the PISA 2006 parent questionnaire; similar items are included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate more positive parents' view on personnal value of science.

Parents' view on personal value of science (PQPERSCI)

Item	The following question asks about your views towards science. How much do you agree with the following statements? (Strongly agree / Agree / Disagree / Strongly disagree)
PA06Q03	c) Some concepts in <broad science> help me to see how I relate to other people
PA06Q05	e) There are many opportunities for me to use <broad science> in my everyday life
PA06Q07	g) <Broad science> is very relevant to me
PA06Q08	h) I find that <broad science> helps me to understand the things around me

Note: All items were inverted for scaling.

Six items measuring perception of environmental issues as a concern were included in the PISA 2006 parent questionnaire; similar items were also included in the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of parents' concerns about environmental issues.

Parents' perception of environmental issues (PQENPERC)

Item	Do you see the environmental issues below as a serious concern for yourself and/or others? (This is a serious concern for me personally as well as others/This is a serious concern for other people in my country but not me personally/This is a serious concern for people in other countries/This is not a serious concern to anyone)
PA07Q01	a) Air pollution
PA07Q02	b) Energy shortages
PA07Q03	c) Extinction of plants and animals
PA07Q04	d) Clearing of forests for other land use
PA07Q05	e) Water shortages
PA07Q06	f) Nuclear waste

Note: All items were inverted for scaling.

Six items measuring parents' optimism regarding environmental issues were included in the PISA 2006 parent questionnaire similar to items on the student questionnaire. The items were inverted for scaling and so, more positive values on this index indicate higher levels of parents' optimism about environmental issues.

Parents' environmental optimism (PQENVOPT)

Item	Do you think problems associated with the environmental issues below will improve or get worse over the next 20 years? (Improve / Stay about the same / Get worse)
PA08Q01	a) Air pollution
PA08Q02	b) Energy shortages
PA08Q03	c) Extinction of plants and animals
PA08Q04	d) Clearing of forests for other land use
PA08Q05	e) Water shortages
PA08Q06	f) Nuclear waste

Note: All items were inverted for scaling.

The PISA index of economic, social and cultural status (ESCS)

Computation of ESCS

The index of *ESCS* was used first in the PISA 2000 analysis and at that time was derived from five indices: highest occupational status of parents (*HISEI*), highest educational level of parents (in years of education according to ISCED), family wealth, cultural possessions and home educational resources (all three WLE estimates based on student reports on home possessions).

The *ESCS* for PISA 2003 was derived from three variables related to family background: highest parental education (in number of years of education according to ISCED classification), highest parental occupation (*HISEI* scores), and number of home possessions including books in the home.[4] The rationale for using these three components is that socio-economic status is usually seen as based on education, occupational status and income. As no direct income measure is available from the PISA data, the existence of household items is used as proxy for family wealth.

The *ESCS* has been slightly modified because: (i) there were more indicators available in the recent survey; and (ii) a consultation with countries regarding the mapping of ISCED levels to years of schooling led to minor changes in the indicator of parental education.

As in PISA 2003, the components comprising *ESCS* for 2006 are home possessions, *HOMEPOS* which comprises all items on the *WEALTH*, *CULTPOS* and *HEDRES* scales (except ST14Q04), as well as books in the home (ST15Q01) recoded into a three-level categorical variable (less than 25 books, 25-100 books, more than 100 books), the higher parental occupation (*HISEI*) and the higher parental education expressed as years of schooling (*PARED*).

4. Here, home possessions only included items from ST17, as well as books in the home (*ST19Q01*) which was recoded into a dichotomous item (0 = "Less than 100 books', 1 = "100 books or more") (see OECD, 2004, p. 283).

Missing values for students with missing data for only one component were imputed with predicted values plus a random component based on a regression on the other two variables. Variables with imputed values were then used for a principal component analysis with an OECD senate weight.

The *ESCS* scores were obtained as component scores for the first principal component with zero being the score of an average OECD student and one the standard deviation across equally weighted OECD countries. For partner countries, *ESCS* scores were obtained as

$$ESCS = \frac{\beta_1 HISEI' + \beta_\Sigma PARED' + \beta_\sigma HOMEPOS'}{\varepsilon_f}$$

where ${}_{1}$, ${}_{2}$ and ${}_{3}$ are the OECD factor loadings, *HISEI′, PARED′* and *HOMEPOS′* the "OECD-standardised" variables and ε_f is the eigenvalue of the first principal component.[5]

Consistency across cycles

Results for similar *ESCS* indices in 2003 and 2000 showed quite a high degree of consistency (see Schulz, 2006). Comparing *ESCS* mean scores per country shows that in spite of these differences there is a very high correlation of 0.98 between ESCS 2003 and ESCS 2006 country means.

Table A12.5
Factor loadings and internal consistency of ESCS 2006 in OECD countries

	Factor loadings			
	HISEI	PARED	HOMEPOS	Reliability[1]
Australia	0.80	0.78	0.67	0.59
Austria	0.81	0.78	0.71	0.64
Belgium	0.83	0.80	0.71	0.68
Canada	0.79	0.78	0.67	0.60
Czech Republic	0.84	0.78	0.70	0.65
Denmark	0.79	0.78	0.70	0.63
Finland	0.77	0.75	0.63	0.52
France	0.82	0.79	0.73	0.67
Germany	0.81	0.76	0.72	0.64
Greece	0.84	0.82	0.72	0.71
Hungary	0.83	0.85	0.77	0.74
Iceland	0.80	0.80	0.59	0.57
Ireland	0.81	0.79	0.74	0.67
Italy	0.84	0.81	0.73	0.71
Japan	0.72	0.77	0.68	0.53
Korea	0.76	0.81	0.75	0.66
Luxembourg	0.83	0.81	0.73	0.69
Mexico	0.85	0.86	0.82	0.80
Netherlands	0.82	0.78	0.75	0.68
New Zealand	0.79	0.76	0.69	0.59
Norway	0.78	0.77	0.66	0.55
Poland	0.87	0.86	0.74	0.73
Portugal	0.86	0.85	0.80	0.77
Slovak Republic	0.85	0.82	0.74	0.72
Spain	0.84	0.82	0.70	0.69
Sweden	0.77	0.73	0.70	0.57
Switzerland	0.80	0.78	0.68	0.62
Turkey	0.80	0.83	0.79	0.72
United Kingdom	0.78	0.75	0.71	0.60
United States	0.80	0.81	0.74	0.67
Median	**0.81**	**0.79**	**0.72**	**0.67**

1. Reliabilities (Standardised Cronbach's alpha) computed with weighted national samples.

5. Only one principal component with an eigenvalue greater than 1 was identified in each of the participating countries.

Consistency across countries

Using principal component analysis (PCA) to derive factor loading for each participating country provides insight into the extent to which there are similar relationships between the three components. Table A12.5 shows the PCA results for the OECD countries and Table A12.6 those for partner countries and economies. The tables also include the scale reliabilities for the *z*-standardised variables (Cronbach's Alpha).

Table A12.6
Factor loadings and internal consistency of ESCS 2006 in partner countries/economies

	Factor loadings			
	HISEI	PARED	HOMEPOS	Reliability[1]
Argentina	0.81	0.78	0.79	0.69
Azerbaijan	0.83	0.83	0.73	0.70
Brazil	0.82	0.83	0.80	0.73
Bulgaria	0.84	0.83	0.77	0.74
Chile	0.86	0.85	0.83	0.80
Colombia	0.82	0.82	0.79	0.73
Croatia	0.83	0.81	0.73	0.69
Estonia	0.81	0.77	0.72	0.63
Hong Kong-China	0.83	0.82	0.77	0.72
Indonesia	0.81	0.83	0.78	0.73
Israel	0.78	0.75	0.73	0.60
Jordan	0.83	0.83	0.75	0.73
Kyrgyzstan	0.76	0.76	0.71	0.57
Latvia	0.81	0.78	0.74	0.66
Liechtenstein	0.83	0.81	0.62	0.63
Lithuania	0.81	0.79	0.76	0.68
Macao-China	0.79	0.77	0.75	0.65
Montenegro	0.80	0.80	0.73	0.66
Qatar	0.82	0.86	0.55	0.60
Romania	0.82	0.75	0.80	0.69
Russian Federation	0.81	0.79	0.69	0.59
Serbia	0.84	0.84	0.72	0.71
Slovenia	0.84	0.84	0.71	0.71
Chinese Taipei	0.77	0.79	0.70	0.61
Thailand	0.85	0.84	0.82	0.78
Tunisia	0.86	0.85	0.83	0.79
Uruguay	0.83	0.81	0.81	0.74
Median	**0.82**	**0.81**	**0.75**	**0.69**

1. Reliabilities (Cronbach's alpha) computed with weighted national samples.

Comparing results from within-country PCA reveals that patterns of factor loadings are generally similar across countries. Only in a few countries somehow distinct patterns emerge, however, all three components contribute more or less equally to this index with factor loadings ranging from 0.55 to 0.87. Internal consistency ranges between 0.52 and 0.80, the median scale reliability for the pooled OECD countries is 0.67.

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PISA Data Analysis Manual

SAS® SECOND EDITION

The OECD Programme for International Student Assessment (PISA) surveys collected data on students' performances in reading, mathematics and science, as well as contextual information on students' background, home characteristics and school factors which could influence performance. The initial results for PISA 2000 is found in *Knowledge and Skills for Life – First Results from PISA 2000* (OECD, 2001), for PISA 2003 in *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004) and for PISA 2006 in *PISA 2006: Science Competencies for Tomorrow's World* (OECD, 2007).

This publication is an essential tool for researchers, as it provides all the information required to understand the PISA databases and perform analyses in accordance with the complex methodologies used to collect and process the data. It includes detailed information on how to analyse the PISA data, enabling researchers to both reproduce the published results and to undertake further analyses. In addition to the inclusion of the necessary techniques, the manual also includes a detailed account of the PISA 2006 database.

This publication is a revised edition of the *PISA 2003 Data Analysis Manual* (OECD, 2005). The chapters in the manual are expanded to cover various analytical issues in PISA in general, while applying examples from all available PISA surveys – PISA 2000, PISA 2003 and PISA 2006.

The publication includes:

- introductory chapters explaining the statistical theories and concepts required to analyse the PISA data, including full chapters on how to apply replicate weights and undertake analyses using plausible values;
- worked examples providing full syntax in SAS®; and
- a comprehensive description of the OECD PISA 2006 international database.

THE OECD PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT (PISA)

PISA is a collaborative process among the 30 member countries of the OECD and nearly 30 partner countries and economies. It brings together expertise from the participating countries and economies and is steered by their governments on the basis of shared, policy-driven interests. Its unique features include:

- *The literacy approach:* PISA defines each assessment area (science, reading and mathematics) not mainly in terms of mastery of the school curriculum, but in terms of the knowledge and skills needed for full participation in society.
- *A long-term commitment:* It enables countries to monitor regularly and predictably their progress in meeting key learning objectives.
- *The age-group covered:* By assessing 15-year-olds, *i.e.* young people near the end of their compulsory education, PISA provides a significant indication of the overall performance of school systems.
- *The relevance to lifelong learning:* PISA does not limit itself to assessing students' knowledge and skills but also asks them to report on their own motivation to learn, their beliefs about themselves and their learning strategies, as well as on their goals for future study and careers.

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