Edited by:
Michael O. Martin

Contributors:
Alka Arora
Juliane Barth
Steven J. Chrostowski
Dana Diaconu
Ebru Erberber
Pierre Foy
Joseph Galia
Eugenio J. Gonzalez
Ieva Johansone
Marc Joncas
Isaac Li
Ina V. S. Mullis
Oliver Neuschmidt
Maria Jose Ramirez
Milena Taneva

TIMSS

TIMSS 2003 User Guide

for the International Database

International Association
for the Evaluation of
Educational Achievement

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

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For more information about TIMSS contact:
TIMSS & PIRLS International Study Center
Lynch School of Education
Boston College
Chestnut Hill, MA 02467
United States

Tel: +1-617-552-1600
Fax: +1-617-552-1203
Email: timss@bc.edu
website: timss.bc.edu

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1 Overview of the TIMSS 2003 International Database

1.1 Introduction

To facilitate secondary analyses aimed at improving mathematics and science education, the TIMSS 2003 International Database makes available to researchers, analysts, and other users the data collected and processed by IEA's TIMSS 2003 project. This database comprises student achievement data in mathematics and science as well as student, teacher, school, and curricular background data for the 48 countries that participated in TIMSS 2003 at the eighth grade and 26 countries that participated in TIMSS 2003 at the fourth grade. The database includes data from over 360,000 students, about 25,000 teachers, about 12,000 school principals, and the National Research Coordinators of each country. All participating countries gave the IEA permission to release their national data.

IEA, the International Association for the Evaluation of Educational Achievement, has been conducting international comparative studies of student achievement in school subjects for more than 40 years. When it collected data for the first time in 1994-95, TIMSS (known then as the Third International Mathematics and Science Study) was the largest and most complex international study of student achievement ever conducted, including both mathematics and science at third, fourth, seventh and eighth grades, and the final year of secondary school. In 1999, TIMSS (by now renamed the Trends in International Mathematics and Science Study) again assessed eighth-grade students in both mathematics and science to measure trends in student achievement since 1995.

TIMSS 2003, the third data collection in the TIMSS cycle of studies, was administered at the eighth and fourth grades. For countries that participated in previous assessments, TIMSS 2003 provides three-cycle trends at the eighth grade (1995, 1999, 2003) and data over two points in time at the fourth grade (1995 and 2003). In countries new to the study, the 2003 results can help policy makers and practitioners assess their comparative standing and gauge the rigor and effectiveness of their mathematics and science programs.[1]

At the heart of the TIMSS 2003 International Database are the student achievement scores in mathematics and science, together with responses of students, teachers, and principals to the background questionnaires. Student

[1] See Mullis, Martin, Gonzalez, and Chrostowski (2004) for results in mathematics and Martin, Mullis, Gonzalez, and Chrostowski (2004) for results in science.

achievement scores and student questionnaire responses have been merged to facilitate secondary analyses. More specifically, the database includes the following for each country for which internationally comparable data are available:

- Students' responses to each of the mathematics and science items administered in the study
- Student achievement scores in mathematics and science
- Students' responses to the student questionnaires
- Teachers' responses to the teacher questionnaires
- Principals' responses to the school questionnaires
- National Research Coordinators' responses to the curriculum questionnaires.

This user guide describes the content and format of the data in the TIMSS 2003 International Database. Chapter 2 details aspects of the study that determine the structure and content of the database, and describes some of the database variables that were constructed to analyze and report the results of the study. Chapter 3 documents in detail the data files in the database, discusses the appropriate use of the files and variables, and draws attention to special considerations that arise from the complex design of the assessment. Chapters 4 and 5, present examples of analyses of the TIMSS 2003 data using, respectively, the SPSS and SAS statistical software systems.

The user guide is accompanied by three supplementary volumes: Supplement 1 comprises the international version of each of the TIMSS 2003 background questionnaires, Supplement 2 describes any national adaptations to the questions in each questionnaire, and Supplement 3 describes in detail how indices and other derived variables were constructed for reporting the TIMSS data.

TIMSS 2003 was an ambitious and demanding study, involving complex designs and procedures for assessing students' mathematics and science achievement, drawing student samples, and analyzing and reporting the data. In order to work effectively with the TIMSS data it is necessary to have an understanding of these characteristics of the study, which are described fully in the TIMSS 2003 Technical Report (Martin, Mullis, & Chrostowski, 2004). It is intended, therefore, that this user guide be used in conjunction with the technical report. Whereas the user guide describes the organization and content of the database, the technical report provides the rationale for the techniques used and for the variables created.

1.2 Participants in TIMSS 2003

Exhibit 1.1 lists all the countries that have participated in TIMSS in 1995, 1999, or 2003 at fourth or eighth grade. In all, 67 countries have participated in TIMSS at one time or another. Of the 49 countries that participated in TIMSS 2003, 48 participated at the eighth grade and 26 at the fourth grade. Yemen participated at the fourth but not the eighth grade. The exhibit shows that at the eighth grade, 23 countries also participated in TIMSS 1995 and TIMSS 1999. For these participants, trend data across three points in time are available. Eleven countries participated in TIMSS 2003 and TIMSS 1999 only, while three countries participated in TIMSS 2003 and TIMSS 1995. These countries have trend data for two points in time. Of the 12 new countries participating in the study, 11 participated at eighth grade and 2 at the fourth grade. Of the 26 countries participating in TIMSS 2003 at the fourth grade, 16 also participated in 1995, providing data at two points in time.

Exhibit 1.1 Countries Participating in TIMSS 2003, 1999, and 1995

Countries	Grade 8			Grade 4	
	2003	1999	1995	2003	1995
Argentina*	●	●			
Armenia	●			●	
Australia	●	●	●	●	●
Austria			●		●
Bahrain	●				
Belgium (Flemish)	●	●	●	●	
Belgium (French)			●		
Botswana	●				
Bulgaria	●	●	●		
Canada		●	●		●
Chile	●	●			
Chinese Taipei	●	●		●	
Colombia			●		
Cyprus	●	●	●	●	●
Czech Republic		●	●		●
Denmark			●		
Egypt	●				
England	●	●	●	●	●
Estonia	●				
Finland		●			
France			●		
Germany			●		
Ghana	●				

Exhibit 1.1 Countries Participating in TIMSS 2003, 1999, and 1995
(…Continued)

Greece			●		●
Hong Kong, SAR	●	●	●	●	●
Hungary	●	●	●	●	●
Iceland			●		●
Indonesia	●	●			
Iran, Islamic Rep. of	●	●	●	●	●
Ireland			●		●
Israel	●	●	●		●
Italy	●	●	●	●	●
Japan	●	●	●	●	●
Jordan	●	●			
Korea, Rep. of	●	●	●		●
Kuwait			●		●
Latvia	●	●	●	●	●
Lebanon	●				
Lithuania	●	●	●	●	
Macedonia, Rep. of	●	●			
Malaysia	●	●			
Moldova, Rep. of	●	●		●	
Morocco	●	●		●	
Netherlands	●	●	●	●	●
NewZealand	●	●	●	●	●
Norway	●		●	●	●
Palestinian Nat'l Auth.	●				
Philippines	●	●		●	
Portugal			●		●
Romania	●	●	●		
Russian Federation	●	●	●	●	
SaudiArabia	●				
Scotland	●		●	●	●
Serbia	●				
Singapore	●	●	●	●	●
Slovak Republic	●	●	●		
Slovenia	●	●	●	●	●
South Africa	●	●	●		
Spain			●		
Sweden	●		●		
Switzerland			●		

Exhibit 1.1 Countries Participating in TIMSS 2003, 1999, and 1995
(...Continued)

Syrian Arab Republic**	●				
Thailand		●	●		●
Tunisia	●	●		●	
Turkey		●			
United States	●	●	●	●	●
Yemen**				●	
Benchmarking Participants					
BasqueCountry, Spain	●				
IndianaState, US	●	●		●	
OntarioProvince, Can.***	●	●	●	●	●
QuebecProvince, Can.***	●	●	●	●	●

* Argentina administered the TIMSS 2003 data collection one year late, and did not score and process its data in time for inclusion in this report.

** Because the characteristics of their samples are not completely known, achievement data for Syrian Arab Republic and Yemen are presented in Appendix F of the International reports.

*** Ontario and Quebec participated in TIMSS 1999 and 1995 as part of Canada.

Following the success of the TIMSS 1999 benchmarking initiative in the United States,[2] in which 13 states and 14 school districts or district consortia administered the TIMSS 1999 assessment and compared their students' achievement to student achievement world wide, TIMSS 2003 included an international benchmarking program, whereby regions of countries could participate in the study to compare to international standards. TIMSS 2003 included four benchmarking participants at the eighth grade: the Basque Country of Spain, the U.S. state of Indiana, and the Canadian provinces of Ontario and Quebec. Indiana, Ontario, and Quebec participated also at the fourth grade. Having also participated in 1999, Indiana has data at two points in time at eighth grade. Ontario and Quebec participated also in 1995 and 1999, and so have trend data across three points in time at both grade levels.

Assessment Dates

TIMSS 2003 was administered near the end of the school year in each country. In countries in the Southern Hemisphere (where the school year typically ends in November or December) the assessment was conducted in October or November 2002. In the Northern Hemisphere, the school year typically ends in June; so in these countries the assessment was conducted in April, May, or June 2003.

[2] See Mullis, Martin, Gonzalez, O'Connor, Chrostowski, Gregory, Garden, and Smith (2001) for the results of the benchmarking in mathematics and Martin, Mullis, Gonzalez, O'Connor, Chrostowski, Gregory, Smith, and Garden (2001) for the results in science.

1.3 The TIMSS 2003 Mathematics and Science Assessment

As described in the TIMSS Assessment Frameworks and Specifications 2003 (Mullis, Martin, Smith, Garden, Gregory, Gonzalez, Chrostowski, and O'Connor, 2003), the TIMSS 2003 assessment of student achievement in mathematics and science was designed to measure trends in student achievement in mathematics and science at eighth and fourth grades. The assessment has ambitious coverage goals, reporting not only overall mathematics and science achievement scores, but also scores in important content areas in these subjects.

The mathematics and science assessment frameworks for TIMSS 2003 were framed by two organizing dimensions or aspects, a content domain and a cognitive domain. There were five content domains in mathematics (number, algebra,[3] measurement, geometry, and data) and five in science (life science, chemistry, physics, earth science, and environmental science)[4] that defined the specific mathematics and science subject matter covered by the assessment. The cognitive domains, four in mathematics (knowing facts and procedures, using concepts, solving routine problems, and reasoning) and three in science (factual knowledge, conceptual understanding, and reasoning and analysis) defined the sets of behaviors expected of students as they engaged with the mathematics and science content. Student achievement was reported in terms of performance in each content area as well as in mathematics and science overall.

The TIMSS 2003 eighth-grade assessment contained 383 items, 194 in mathematics and 189 in science (Smith Neidorf & Garden, 2004). The fourth-grade assessment contained 313 items, 161 in mathematics and 152 in science. Between one-third and two-fifths of the items at each grade level were in constructed-response format, requiring students to generate and write their own answers. The remaining questions used a multiple-choice format. In scoring the items, correct answers to most questions were worth one point. However, responses to some constructed-response questions (particularly those requiring extended responses) were evaluated for partial credit, with a fully correct answer being awarded two points. The total number of score points available for analysis thus somewhat exceeds the number of items.

Not all of the items in the TIMSS 2003 assessment were newly developed for 2003. To ensure reliable measurement of trends over time, the assessment included also items that had been used in the 1995 and 1999 assessments. For example, of the 426 score points available in the entire 2003 eighth-grade mathematics and science assessment, 47 came from items used also in 1995, 102 from items used also in 1999, and 267 from items used for the first time in 2003. At fourth grade, 70 score points came from 1995 items, and the remaining 267 from new 2003 items.

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[3] At the fourth grade, the algebra content domain was called Patterns and Relationships.

[4] At the fourth grade, there were just three content domains in science – Life Science, Physical Science, and Earth Science.

With the large number of mathematics and science items, it was not possible for every student to respond to all items. To ensure broad subject-matter coverage without overburdening individual students, TIMSS 2003, as in the 1995 and 1999 assessments, used a matrix-sampling technique that assigned each assessment item to one of a set of item blocks, and then assembled student test booklets by combining the item blocks according to a balanced design. Each student took one booklet containing both mathematics and science items. There were 12 student booklets at each grade level, with six blocks of items in each booklet.

Student Achievement Scores

Because the test booklet completed by each student contained only a subset of the mathematics and science items in the whole assessment item pool, each student essentially responded to just a part of the assessment, which posed a challenge in terms of determining individual student achievement scores. As described in Gonzalez, Galia, and Li (2004), TIMSS used a sophisticated psychometric scaling technique (known as item response theory scaling with conditioning and multiple imputation) to derive estimates for each student of the scores they would have received had they completed the entire assessment. These imputed student achievement scores were then used in analyzing and reporting the data.

Each student record in the TIMSS 2003 International Database contains imputed scores in mathematics and science, as well as in each of the content areas – number, algebra, measurement, geometry, and data in mathematics, and life science, chemistry, physics, earth science, and environmental science in science. Because each imputed score is a prediction based on limited information, it almost certainly includes some small amount of error. To allow analysts judge the effect of the imputation on their analyses, the TIMSS database provides five separate imputed estimates (known as "plausible values") for each score. Accordingly, an analysis may be replicated as many as five times, using a different score each time, and the results compared to judge the impact of the imputation process. The database also includes software that enables analysts using the SAS or SPSS software systems to combine the results of the five replications into a single result and to compute standard errors that incorporate both sampling and imputation error.

The TIMSS mathematics and science achievement scales were designed to provide reliable measures of student achievement spanning 1995, 1999, and 2003. The metric of the scale was established originally with the 1995 assessment. Treating equally all the countries that participated in 1995 at the eighth grade, the TIMSS scale average over those countries was set at 500 and the standard deviation at 100. The same applied for the fourth-grade assessment. Subsequently, the results from 1999 and 2003 were linked to the 1995 data so

that the scores from the three assessments were on the same scale and may be compared for analytic purposes (see Gonzalez, Galia, & Li, 2004).

1.4 TIMSS 2003 Background Questionnaires

By gathering information about students' educational experiences together with their mathematics and science achievement on the TIMSS assessment, it is possible to identify factors or combinations of factors related to high achievement. As in previous assessments, TIMSS in 2003 administered a broad array of questionnaires to collect data on the educational context for student achievement. For this assessment, a concerted effort was made to streamline and upgrade the questionnaires. The TIMSS 2003 contextual framework (Mullis, et al., 2003) articulated the goals of the questionnaire data collection and laid the foundation for the questionnaire development work. All of the questionnaire data are included in the TIMSS 2003 International Database.

The four types of background questionnaires used to collect information regarding the contexts in which students learn mathematics and science are described below:

- The **curriculum questionnaire,** completed by the National Research Coordinators with the assistance of their curriculum experts, requested information on the intended national curriculum in mathematics and science. Four versions of this questionnaire were administered: fourth-grade mathematics, fourth-grade science, eighth-grade mathematics, and eighth-grade science.

- The **school questionnaire** asked school principals or headmasters to provide information about the school contexts for the teaching and learning of mathematics and science. There were separate versions for fourth grade and eighth grade.

- The **teacher questionnaire,** completed by the mathematics and science teachers of sampled students, collected information about the teachers' preparation and professional development, their pedagogical activities, and the implemented curriculum. At fourth grade there was one questionnaire that addressed both mathematics and science, and at eighth grade there were separate versions for mathematics teachers and science teachers.

- The **student questionnaire**, completed by the fourth- and eighth-grade students who were tested, sought information about the students' home backgrounds and their experiences in learning mathematics and science. There were separate versions for fourth and eighth grades, and at eighth grade there were different versions for countries where eighth-grade

science is taught as a single subject and countries where it is taught as separate subjects (i.e., biology, chemistry, physics, and earth science).

The contents of the TIMSS 2003 main survey questionnaires are described in the TIMSS 2003 Technical Report (see Chrostowski, 2004). The international version of each of the TIMSS 2003 background questionnaires is described in Supplement 1 of this User Guide, and the documentation of the national adaptations to each questionnaire in Supplement 2. The indices and variables other than indices derived from the student, teacher, and school questionnaires, along with detailed descriptions and analysis notes, are provided in Supplement 3.

1.5 TIMSS 2003 Student Populations

TIMSS 2003 had as its intended target populations all students at the end of their eighth and fourth years of formal schooling in the participating countries. However, for comparability with previous TIMSS assessments, the formal definition for the eighth-grade population specified all students enrolled in the upper of the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing. This grade level was intended to represent eight years of schooling, counting from the first year of primary or elementary schooling, and was indeed the eighth grade in most countries.

Similarly, for the fourth-grade population, the formal definition specified all students enrolled in the upper of the two adjacent grades that contained the largest proportion of 9-year-olds. This grade level was intended to represent four years of schooling, counting from the first year of primary or elementary schooling, and was the fourth grade in most countries.

In each country, representative samples of students were selected using a two-stage sampling design. Although countries could, with prior approval, adapt the sampling design to local circumstances, in general countries selected at least 150 schools at the first stage using probability-proportional-to-size sampling. Countries could incorporate in their sampling design important reporting variables (for example, urbanicity or school type) as stratification variables. At the second stage, one or two classes (fourth- or eighth-grade as appropriate) were randomly sampled in each school. Generally, this resulted in a sample size of at least 4,000 students per country. Some countries opted to include more schools and classes, enabling additional analyses, which resulted in larger sample sizes.

Because TIMSS utilizes a complex sampling design, it is necessary to apply sampling weights when conducting analyses of the data. The sampling weights reflect the probability of selection of each school and student, take into account any stratification or disproportional sampling of subgroups, and include

adjustments for non-response (Joncas, 2004). All of the required sampling weights have been merged with the appropriate files and are included in the international database.

1.6 Analyzing the TIMSS 2003 Data

Because statistics generated from the international database are estimates of national performance based on samples of students, rather than the values that could be calculated if every student in every country had answered every question, it is important to have a way of quantifying the uncertainty associated with these statistics. In TIMSS, the jackknife procedure is used to provide a robust estimate of the standard error of each statistic presented in the International Reports. The TIMSS jackknife standard errors include both an error component due to sampling variation and an error component due to variation among the five plausible values generated for each student. The standard errors may be used to create confidence intervals for statistics computed from the TIMSS data.

The TIMSS 2003 international database includes a set of program macros in both SAS and SPSS that enable analysts to apply the jackknife algorithm to a range of analyses of school, teacher, and student variables.

1.7 Study Management and Organization

TIMSS 2003 was conducted under the auspices of the IEA. The study was directed by Michael O. Martin and Ina V.S. Mullis of the TIMSS & PIRLS International Study Center at Boston College, Lynch School of Education, where they also direct IEA's Progress in International Reading Literacy Study (PIRLS). The International Study Center was responsible for the design, development, and implementation of the study – including developing the assessment framework, assessment instruments, and survey procedures; ensuring quality in data collection; and analyzing and reporting the study results. Staff at the International Study Center worked closely with the organizations responsible for particular aspects of the study, the representatives of participating countries, and the TIMSS advisory committees.

In the IEA Secretariat, Hans Wagemaker, Executive Director, was responsible for overseeing fundraising and country participation. The IEA Secretariat also managed the ambitious translation verification effort conducted for the field test and main assessment and recruited international quality control monitors in each country. The IEA Data Processing Center (DPC) was responsible for processing and verifying the data from the participating countries and for constructing the international database. Working closely with the Data

Processing Center, Statistics Canada was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. Educational Testing Service in Princeton, New Jersey provided consultation on psychometric issues as well as technical support and software for scaling the achievement data. The Project Management Team, comprising the study directors and representatives from the International Study Center, IEA Secretariat and DPC, Statistics Canada, and Educational Testing Service, met regularly throughout the study to discuss the study's progress, procedures, and schedule.

Each participating country appointed a National Research Coordinator (NRC) and a national center responsible for all aspects of TIMSS 2003 within that country. The TIMSS & PIRLS International Study Center, in collaboration with the IEA Secretariat, DPC, and Statistics Canada, organized meetings of the NRCs several times a year to review study materials and procedures, and to provide training in student sampling, constructed-response item scoring, and data entry and database construction, and the use of the international database.

The TIMSS & PIRLS International Study Center was supported in its work by a number of advisory committees. The International Expert Panel in Mathematics and Science played a crucial role in developing the TIMSS 2003 frameworks and specifications for the assessment. The Mathematics and Science Item Development Task Forces coordinated the work of the National Research Coordinators in developing and reviewing the mathematics and science achievement items. The Science and Mathematics Item Review Committee reviewed and revised successive drafts of the achievement items and was an integral part of the scale anchoring process. The Questionnaire Item Review Committee revised the TIMSS context questionnaires for the 2003 assessment.

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2 Working With the TIMSS 2003 Data

2.1 The TIMSS 2003 Assessment Frameworks

The development of the TIMSS 2003 assessment was a collaborative process spanning a two-and-a-half-year period and involving mathematics and science educators and development specialists from all over the world. Central to this effort was a major updating and revision of the existing TIMSS assessment frameworks to address changes during the past decade in curricula and the way science is taught. The resulting publication, entitled TIMSS Assessment Frameworks and Specifications 2003, serves as the basis of TIMSS 2003 (Mullis, Martin, Smith, Garden, Gregory, Gonzalez, Chrostowski, and O'Connor, 2003).

As shown in Exhibit 2.1, the mathematics and science assessment frameworks for TIMSS 2003 have two organizing dimensions or aspects, a content domain and a cognitive domain. There are five content domains in mathematics (number, algebra, measurement, geometry, and data) and five in science (life science, chemistry, physics, earth science, and environmental science)[1] that define the specific mathematics and science subject matter covered by the assessment. The cognitive domains, four in mathematics (knowing facts and procedures, using concepts, solving routine problems, and reasoning) and three in science (factual knowledge, conceptual understanding, and reasoning and analysis) define the sets of behaviors expected of students as they engage with the mathematics and science content. In science, scientific inquiry was treated as an overarching assessment strand that overlaps all the fields of science and has both content- and skills-based components.

2.2 TIMSS 2003 Mathematics and Science Assessment Booklets

To address the mathematics and science topics specified in the frameworks, the pool of items and tasks included in the TIMSS assessment necessarily was extensive and would require much more testing time than could be allotted for individual students (about seven hours at grade 8 and five and one-half hours at grade 4). Therefore, as in the 1995 and 1999 assessments, TIMSS 2003 used a matrix-sampling technique that involved dividing the entire assessment pool into a set of unique item blocks, distributing these blocks across a set of

[1] At fourth grade, there were only three content domains

Exhibit 2.1 The Content and the Cognitive Domains of the Mathematics and Science Frameworks

Mathematics		Science	
Content Domain		**Content Domain**	
Grade 8	Number	Grade 8	Life Science
	Algebra		Chemistry
	Measurement		Physics
	Geometry		Earth Science
	Data		Environmental Science
Grade 4	Number	Grade 4**	Life Science
	Patterns and Relationships*		Physical Science
	Measurement		Earth Science
	Geometry		
	Data		
Cognitive Domain		**Cognitive Domain**	
	Knowing Facts and Procedures		Factual Knowledge
	Using Concepts		Conceptual Understanding
	Solving Routine Problems		Reasoning and Analysis
	Reasoning		

* At fourth grade, the algebra content domain is called patterns and relationships.

** At the fourth grade, there are only three content areas in science, namely life science, physical science, and earth science.

booklets, and rotating the booklets among the students. Each student took one booklet containing both mathematics and science items.[2]

Block and Booklet Design

The TIMSS design for 2003 divided the 313 items at fourth grade and 383 items at eighth grade into 28 item blocks at each grade, 14 mathematics blocks labeled M01 through M14, and 14 science blocks labeled S01 through S14. Each block contained mathematics items exclusively or science items exclusively. This general block design, shown in Exhibit 2.2, was the same for both grades, although the assessment time was 12 minutes for each fourth-grade block and 15 minutes for each eighth-grade block. At the eighth grade, six blocks in each subject (blocks 01 – 06) contained secure items from 1995 and 1999 to measure trends and eight blocks (07 – 14) contained new items developed for TIMSS 2003. Since fourth grade was not included in the 1999 assessment, trend items from 1995 only were available, and these were placed in the first three blocks. The remaining 11 blocks contained items new in 2003.

[2] See Mullis et al. (2003) for more information on the assessment booklet design.

Exhibit 2.2 General Design of the TIMSS 2003 Matrix-Sampling Blocks

Source of Items	Mathematics Blocks	Science Blocks
Trend Items (TIMSS 1995 or 1999)	M01	S01
Trend Items (TIMSS 1995 or 1999)	M02	S02
Trend Items (TIMSS 1995 or 1999)	M03	S03
Trend Items (TIMSS 1999)	M04	S04
Trend Items (TIMSS 1999)	M05	S05
Trend Items (TIMSS 1999)	M06	S06
New Replacement Items (TIMSS 2003)	M07	S07
New Replacement Items (TIMSS 2003)	M08	S08
New Replacement Items (TIMSS 2003)	M09	S09
New Replacement Items (TIMSS 2003)	M10	S10
New Replacement Items (TIMSS 2003)	M11	S11
New Replacement Items (TIMSS 2003)	M12	S12
New Replacement Items (TIMSS 2003)	M13	S13
New Replacement Items (TIMSS 2003)	M14	S14

In the TIMSS 2003 design, the 28 blocks of items were distributed across 12 student booklets, as shown in Exhibit 2.3. Each booklet consisted of six blocks of items. To enable linking between booklets, each block appeared in two, three, or four different booklets. The assessment time for individual students was 72 minutes at fourth grade and 90 minutes at eighth grade, which is comparable to that in the 1995 and 1999 assessments.

The booklets were organized into two three-block sessions (Parts I and II), with a break in between each part. Since the use of calculators was introduced for the first time in TIMSS 2003 at the eighth grade, this had an impact on the booklet design. To ensure that calculators could be used for the new items but not for the trend items from 1995 and 1999, the trend items (blocks 01 – 06) were placed in Part I of the test booklets to be completed without calculators before the break. After the break, calculators were allowed for the new items (blocks 07 – 12) at eighth grade but not fourth grade. To provide a more balanced design, however, two mathematics trend blocks (M05 and M06) and two science trend blocks (S05 and S06) also were placed in Part II of one booklet each.

Exhibit 2.3 Booklet Design for TIMSS 2003 – Grade 4 and Grade 8

	Assessment Blocks					
Student Booklet	**Part I**			**Part II**		
Booklet 1	M01	M02	S06	S07	M05	M07
Booklet 2	M02	M03	S05	S08	M06	M08
Booklet 3	M03	M04	S04	S09	M13	M11
Booklet 4	M04	M05	S03	S10	M14	M12
Booklet 5	M05	M06	S02	S11	M09	M13
Booklet 6	M06	M01	S01	S12	M10	M14
Booklet 7	S01	S02	M06	M07	S05	S07
Booklet 8	S02	S03	M05	M08	S06	S08
Booklet 9	S03	S04	M04	M09	S13	S11
Booklet 10	S04	S05	M03	M10	S14	S12
Booklet 11	S05	S06	M02	M11	S09	S13
Booklet 12	S06	S01	M01	M12	S10	S14

Assembling Item Blocks

As described in Smith Neidorf and Garden (2004), the assessment blocks were assembled to create a balance across blocks and booklets with respect to content domain, cognitive domain, and item format. Although a balance was achieved at the overall assessment level, the distribution of item types varied across blocks. The trend blocks from 1995 (blocks 01 – 03) contained mostly multiple-choice items, while the blocks containing the problem-solving and inquiry tasks had a higher proportion of constructed-response items. Each block contained an average of 12 score points at fourth grade and 15 score points at eighth grade. On average, there were 6-7 multiple-choice items, 4-5 short-answer items, and 0-1 extended-response items per block at the fourth grade. At the eighth grade, there were 8-9 multiple-choice items, 3-4 short-answer items, and 1-2 extended-response items per block, on average. Depending on the exact number of multiple-choice, short-answer, and extended-response items in each block, the total number of items in a block ranged from 10 to 13 at fourth grade and from 11 to 16 at eighth grade.

Exhibit 2.4 shows the distribution of score points across content and cognitive domains in the fourth-grade mathematics assessment. The percentage of score points across both content and cognitive categories is very close to the target percentages specified in the frameworks. Exhibit 2.5 shows the score-point distribution for the fourth-grade science assessment, as well as the score points in the scientific inquiry assessment strand. For both mathematics and science, items reflecting the full range of cognitive domains are included in each content domain. About 10 percent of the score points in science, covering a wide range of science content, also contribute to the scientific inquiry strand.

Exhibit 2.4 Distribution of Score Points in the TIMSS 2003 Mathematics Assessment by Content and Cognitive Domains – Grade 4

Content Domain	Cognitive Domain			Reasoning	Total Score Points	Percentage of Score Points
	Knowing Facts and Procedures	Using Concepts	Solving Routine Problems			
Number	15	17	27	9	68	40%
Patterns and Relationships	3	5	9	8	25	15%
Measurement	9	3	12	9	33	20%
Geometry	12	8	4	1	25	15%
Data	0	6	9	3	18	11%
Total Score Points	**39**	**39**	**61**	**30**	**169**	
Percentage of Score Points	**23%**	**23%**	**36%**	**18%**		

Exhibit 2.5 Distribution of Score Points in the TIMSS 2003 Science Assessment by Content and Cognitive Domains, and Scientific Inquiry Strand – Grade 4

Content Domain	Cognitive Domain			Total Score Points	Percentage of Score Points	Scientific Inquiry Score Points
	Factual Knowledge	Conceptual Understanding	Reasoning and Analysis			
Life Science	28	28	16	72	43%	4
Physical Science	16	26	17	59	35%	12
Earth Science	15	16	6	37	22%	1
Total Score Points	**59**	**70**	**39**	**168**		**17**
Percentage of Score Points	**35%**	**42%**	**23%**			

The block and booklet design for TIMSS 2003 ensured that the student booklets contained an appropriate balance of mathematics and science content. Exhibit 2.6 shows the number of mathematics and science score points available in each fourth-grade booklet. The number of score points per booklets ranges from 71 to 80, with an average of 75. In accordance with the frameworks, in booklets 1-6 about two-thirds of the score points come from mathematics items and one-third from science. Conversely, in booklets 7-12 about two-thirds of the score points come from science items and one-third from mathematics. All student booklets contain items from each of the mathematics and science content domains.

Exhibit 2.6 Maximum Number of Score Points in TIMSS 2003 in Each Booklet by Mathematics and Science Content Domain – Grade 4

	Booklet											
Content Domain	1	2	3	4	5	6	7	8	9	10	11	12
Mathematics												
Number	19	18	23	17	21	20	5	7	10	11	11	8
Patterns and Relationships	6	6	6	8	6	5	7	3	4	2	3	6
Measurement	12	13	7	9	11	12	6	8	2	3	5	6
Geometry	4	7	7	9	4	7	2	3	5	6	4	3
Data	8	5	6	5	4	3	4	3	2	2	4	2
Total in Mathematics	**49**	**49**	**49**	**48**	**46**	**47**	**24**	**24**	**23**	**24**	**27**	**25**
Science												
Life Science	13	10	13	13	9	11	18	22	19	21	29	24
Physical Science	6	9	10	8	7	10	12	14	20	25	14	17
Earth Science	8	10	4	4	9	7	18	16	11	7	10	9
Total in Science	**27**	**29**	**27**	**25**	**25**	**28**	**48**	**52**	**50**	**53**	**53**	**50**
Total Overall	**76**	**78**	**76**	**73**	**71**	**75**	**72**	**76**	**73**	**77**	**80**	**75**

Exhibit 2.7 shows the distribution of score points across content and cognitive domains in the TIMSS 2003 eighth-grade mathematics assessment. The percentage of score points is close to the target percentages for nearly all content and cognitive categories. Exhibit 2.8 shows the distribution of score points across content and cognitive domains in the eighth-grade science assessment, as well as the number of score points in each content domain that also pertain to the scientific inquiry assessment strand. The percentages of score points in the content and cognitive domains of the science assessment also are close to their targets. As with the fourth-grade assessment, items reflecting a range of cognitive domains are included in each of the mathematics and science content domains at the eighth grade. About 14 percent of the score points in science, covering a range of science content, also contribute to the scientific inquiry strand.

Exhibit 2.7 Distribution of Score Points in the TIMSS 2003 Mathematics Assessment by Content and Cognitive Domains – Eighth Grade

Content Domain	Cognitive Domain			Reasoning	Total Score Points	Percentage of Score Points
	Knowing Facts and Procedures	Using Concepts	Solving Routine Problems			
Number	15	11	27	7	60	28%
Algebra	13	12	10	18	53	25%
Measurement	9	2	15	8	34	16%
Geometry	7	8	10	9	34	16%
Data	1	6	14	13	34	16%
Total Score Points	**45**	**39**	**76**	**55**	**215**	
Percentage of Score Points	**21%**	**18%**	**35%**	**26%**		

Exhibit 2.8 Distribution of Score Points in the TIMSS 2003 Science Assessment by Content and Cognitive Domains and Scientific Inquiry Strand – Eighth Grade

Content Domain	Cognitive Domain			Total Score Points	Percentage of Score Points	Scientific Inquiry Score Points
	Factual Knowledge	Conceptual Understanding	Reasoning and Analysis			
Life Science	24	24	17	65	31%	8
Chemistry	7	16	11	34	16%	6
Physics	7	23	19	49	23%	9
Earth Science	12	13	8	33	16%	1
Environmental Science	9	4	17	30	14%	6
Total Score Points	**59**	**80**	**72**	**211**		**30**
Percentage of Score Points	**28%**	**38%**	**34%**			

Exhibit 2.9 shows the maximum number of score points in mathematics, science, and overall and the distribution of score points across the mathematics and science content domains for each booklet in the eighth-grade assessment. The total score points in each booklet ranged from 90 to 97, with an average of 94. As at the fourth grade, about two-thirds of score points are from mathematics items in booklets 1-6, and about two-thirds of score points are from science

Exhibit 2.9 Maximum Number of Score Points in TIMSS 2003 in Each Booklet by Mathematics and Science Content Domain – Eighth Grade

	Booklet											
Content Domain	1	2	3	4	5	6	7	8	9	10	11	12
	Mathematics											
Number	19	22	19	14	25	17	11	10	8	7	8	7
Algebra	12	12	15	22	7	15	4	6	9	6	7	9
Measurement	13	7	11	13	11	5	4	8	8	4	5	4
Geometry	8	11	11	7	14	10	5	4	5	4	5	5
Data	11	8	6	8	4	12	8	3	2	8	5	6
Total Mathematics	**63**	**60**	**62**	**64**	**61**	**59**	**32**	**31**	**32**	**29**	**30**	**31**
	Science											
Life Science	10	12	7	7	9	10	20	19	18	23	21	23
Chemistry	6	4	5	6	4	5	10	10	11	8	10	10
Physics	6	8	9	6	7	9	17	11	13	19	14	13
Earth Science	4	5	3	5	8	5	9	12	11	7	7	10
Environmental Science	6	4	9	4	4	3	7	10	11	11	8	8
Total Science	**32**	**33**	**33**	**28**	**32**	**32**	**63**	**62**	**64**	**68**	**60**	**64**
Total Overall	**95**	**93**	**95**	**92**	**93**	**91**	**95**	**93**	**96**	**97**	**90**	**95**

items in booklets 7-12. Each booklet covers the full range of mathematics and science content domains.

Item Release Policy

TIMSS 2003 is the third assessment in a series of regular four-year TIMSS studies, providing trend data from 1995 and 1999. As in previous assessments, the design for TIMSS 2003 and beyond (2007, 2011, etc.) provides for retaining some of the items for the measurement of trend and releasing some items into the public domain. In TIMSS 2003, half of the 14 assessment blocks in each subject were released after the assessment results for 2003 were published. The released blocks included all three mathematics and three science blocks containing trend items from 1995 (blocks M01 – M03, S01 – S03), one mathematics and one science block of trend items from 1999 (blocks M04 and S04)[3] and three blocks of new mathematics and science items and tasks developed for 2003 (blocks M09, M10, and M13; S09, S10, and S13). For TIMSS 2007, new items will be developed to take the place of the released items, and the release policy for future assessments will ensure that item blocks are cycled out after three assessments.

[3] At fourth grade, these blocks contain new 2003 items.

Scoring of Constructed-Response Items

In the TIMSS 2003 assessment, constructed-response items made up more than 40 percent of the total assessment time. Scoring guide development for the constructed-response items was a considerable effort and an integral part of the test development process for TIMSS 2003.

TIMSS 2003 used the same approach to scoring constructed-response items as the previous TIMSS assessments. As in TIMSS 1995 and 1999, both short-answer items and extended-response items were included in the assessment. Short-answer items typically were worth one score point and required a numerical response in mathematics or a brief descriptive response in science. Extended-response items were worth a maximum of two score points and required students to show their work or provide explanations using words and/or diagrams to demonstrate their conceptual and procedural knowledge. The generalized scoring guides for mathematics and science items developed for TIMSS 1999 (Exhibit 2.10) also were applied in TIMSS 2003.

Exhibit 2.10 TIMSS Generalized Scoring Guide for Mathematics and Science Items

Mathematics	Science
Extended-Response Items	
2 Points A two-point response is complete and correct. The response demonstrates a thorough understanding of the mathematical concepts and/or procedures embodied in the task. • Indicates that the student has completed the task, showing mathematically sound procedures • Contains clear, complete explanations and/or adequate work when required	**2 Points** A two-point response is complete and correct. The response demonstrates a thorough understanding of the science concepts and/or procedures embodied in the task. • Indicates that the student has completed all aspects of the task, showing the correct application of scientific concepts and/or procedures • Contains clear, complete explanations and/or adequate work when required
1 Point A one-point response is only partially correct. The response demonstrates only a partial understanding of the mathematical concepts and/or procedures embodied in the task. • Addresses some elements of the task correctly but may be incomplete or contain some procedural or conceptual flaws • May contain a correct solution with incorrect, unrelated, or no work and/or explanation when required • May contain an incorrect solution but applies a mathematically appropriate process	**1 Point** A one-point response is only partially correct. The response demonstrates only a partial understanding of the science concepts and/or procedures embodied in the task. • Addresses some elements of the task correctly but may be incomplete or contain some procedural or conceptual flaws • May contain a correct answer but with an incomplete explanation when required • May contain an incorrect answer but with an explanation indicating a correct understanding of some of the scientific concepts

Exhibit 2.10 TIMSS Generalized Scoring Guide for Mathematics and Science Items *(...Continued)*

Mathematics	Science
0 Points	**0 Points**
A zero-point response is completely incorrect, irrelevant, or incoherent.	A zero-point response is seriously inaccurate or inadequate, irrelevant, or incoherent.
Short-Answer Items	
1 Point	**1 Point**
A one-point response is correct. The response indicates that the student has completed the task correctly.	A one-point response is correct. The response indicates that the student has completed the task correctly.
0 Points	**0 Points**
A zero-point response is completely incorrect, irrelevant, or incoherent.	A zero-point response is completely incorrect, irrelevant, or incoherent.

Each constructed-response item had its own scoring guide that utilized a two-digit scoring scheme to provide diagnostic information. The first digit designated the correctness level of the response: 2 for a two-point response, 1 for a 1-point response, and 7 for an incorrect response. The second digit, combined with the first, represented a diagnostic code used to identify specific types of approaches, strategies, or common errors and misconceptions. A second digit of 0-5 was used for pre-defined international codes at each correctness level, while a second digit of 9 corresponded to "other" types of responses that fell within the appropriate correctness level but did not fit any of the pre-defined international codes. A special code (99) was used for completely blank responses. In addition to the international codes, second digit codes of 7 and 8 were available for use by national centers to monitor specific responses not already captured by the internationally-defined codes. The general TIMSS two-digit scoring scheme is summarized in Exhibit 2.11.

Exhibit 2.11 TIMSS Two-Digit Scoring Scheme for Constructed-Response Items

Two- Point Items			One-Point Items		
Correctness Level	**International Code(s)**		**Correctness Level**	**International Code(s)**	
Correct Responses	20 – 25:	category/method #1 - #5	Correct Responses	10 – 15:	category/method #1- #5
	29:	other correct method		19:	other correct method
Partial Responses	10 – 15:	category/method #1- #5	Incorrect Responses	70 – 75:	misconception/error #1- #5
	19:	other partial method		79:	other error
Incorrect Responses	70 – 75:	misconception/error #1 - #5	Blank	99	
	79:	other error			
Blank	99				

2.3 TIMSS 2003 Mathematics and Science Achievement Scores

Because of its complex assessment design, with each student responding only to the items in a single booklet and not the entire assessment, TIMSS relies primarily on item response theory (IRT) scaling methods to measure trends in students' mathematics and science achievement (Martin, et al., 2004; Gonzalez, Galia, & Li, 2004). The IRT analyses provide common mathematics and science scales on which student performance across countries and over time may be compared.

In TIMSS 2003, the mathematics and science results were summarized using a family of 2-parameter and 3-parameter IRT models for dichotomously-scored items (right or wrong), and generalized partial credit models for items with 0, 1, or 2 available score points. The IRT scaling method produces a score by averaging the responses of each student to the items that he or she took in a way that takes into account the difficulty and discriminating power of each item. As with any method of scaling student achievement, measurement is most reliable when a student responds to a large number of items, and is less reliable when the number of items is small. In the matrix-sampling approach adopted by TIMSS, with each student responding to a limited number of items, and given TIMSS' ambitious reporting goals – scales for two subjects (mathematics and science) and for five content domains in each subject – each student may respond to just a few items related to a particular scale.

To improve reliability, the TIMSS scaling methodology draws on information about students' background characteristics as well as their responses to the achievement items. This approach, known as "conditioning," enables reliable scores to be produced even though individual students responded to relatively small subsets of the total mathematics or science item pool. Rather than estimating student scores directly, TIMSS combines information about item characteristics, student responses to the items that they took, and student background information to estimate student achievement distributions.

Having determined the overall achievement distribution, TIMSS estimates each student's achievement on the entire assessment conditional on the student's responses to the items that they took and the student's background characteristics. Because there is some error inherent in this imputation process, TIMSS draws five such estimates, or "plausible values," for each student on each of the scales. Each student, therefore, has five estimates of his or her achievement on the TIMSS mathematics and science scales. Analyses may be replicated with each of the five plausible values to assess the impact of imputation error. Additionally, the SAS and SPSS macros that accompany the TIMSS 2003 international database may be used to combine the results from the five replicated analyses to compute various statistics and their standard errors.

The TIMSS mathematics and science achievement scales were designed to provide reliable measures of student achievement spanning 1995, 1999, and 2003. The metric of the scale was established originally with the 1995 assessment. Treating equally all the countries that participated in 1995 at the eighth grade, the TIMSS scale average over those countries was set at 500 and the standard deviation at 100. The same applied for the fourth-grade assessment. Since the countries varied in size, each country was weighted to contribute equally to the mean and standard deviation of the scale. The average and standard deviation of the scale scores are arbitrary and do not affect scale interpretation. To preserve the metric of the original 1995 scale, the 1999 eighth-grade assessment was scaled using students from the countries that participated in both 1995 and 1999. Then students from the countries that tested in 1999 but not 1995 were assigned scores on the basis of the scale.

At the eighth grade, TIMSS developed the 2003 scale in the same way as in 1999, preserving the metric first with students from countries that participated in both 1999 and 2003, and then assigning scores on the basis of the scale to students tested in 2003 but not the earlier assessment. At fourth grade, because there was no assessment in 1999, the 2003 and 1995 data were linked directly together using students from countries that participated in both assessments, and the students tested in 2003 but not 1995 were assigned scores on the basis of the scale.

In addition to the scales for mathematics and science overall, TIMSS created IRT scales for each of the mathematics and science content domains for the 2003 data. These included number, algebra, measurement, geometry, and data in mathematics; and life science, chemistry, physics, earth science, and environmental science in science.[4] However, insufficient common items were used in 1995 and 1999 to establish reliable IRT content area scales for trend purposes.

Achievement Scores in the Student Files

The principal measures of student achievement in mathematics and science contained in the TIMSS 2003 international database are the plausible values described above. As shown in Exhibits 2.12 and 2.13, the first letter of the variable name identifies the student population. Eighth-grade variables begin with the letter "B" and fourth-grade variables with the letter "A." This convention has been followed with other background and derived variables and files included in the database.

[4] At fourth grade there are just three science content scales: life science, physical science, and earth science.

Exhibit 2.12 Plausible Value Variables for TIMSS 2003 Mathematics and Science Scales at Eighth Grade

Variable	Scale
BSMMAT01 – BSMMAT05	Mathematics Overall
BSMFNS01 – BSMFNS05	Number
BSMALG01 – BSMALG05	Algebra
BSMMEA01 –BSMMEA5	Measurement
BSMGEO01 – BSMGEO05	Geometry
BSMDAP01 –BSMDAP5	Data
BSSSCI01 – BSSSCI05	Science Overall
BSSLIS01 – BSSLIS05	Life Science
BSSCHE01 – BSSCHE05	Chemistry
BSSPHY01 – BSSPHY05	Physics
BSSEAS01 – BSSEAS05	Earth Science
BSSERI01 – BSSERI05	Environmental Science

Exhibit 2.13 Plausible Values Variables for TIMSS 2003 Mathematics and Science Scales at Fourth Grade

Variable	Scale
ASMMAT01 – ASMMAT05	Mathematics Overall
ASMFNS01 – ASMFNS05	Number
ASMALG01 – ASMALG05	Patterns and Relationships
ASMMEA01 – ASMMEA05	Measurement
ASMGEO01 – ASMGEO05	Geometry
ASMDAP01 – ASMDAP05	Data
ASSSCI01 – ASSSCI05	Science Overall
ASSLIS01 – ASSLIS05	Life Science
ASSPHY01 – ASSPHY05	Physical Science
ASSEAS01 – ASSEAS05	Earth Science

In addition to the plausible values for mathematics and science content domains and overall that are the principal indicators of student achievement, the TIMSS database includes three interim achievement scores for each subject and grade that were computed as part of the data processing effort.

Raw Scores

ASMSCPT, BSMSCPT

Number of raw score points obtained by the student on the mathematics items, for fourth and eighth grades.

ASSSCPT, BSSSCPT

Number of raw score points obtained by the student on the science items, for fourth and eighth grades.

After the achievement items were scored (1 for correct, 0 for incorrect for multiple choice items; 0, 1, or 2 points in the case of the constructed-response items), raw scores were computed by adding the number of points obtained by each student over all the items in the student's test book. Because the raw score is dependent on the number of items in the student's test book, and since this number varies from test book to test book, the raw scores are not comparable across booklets, and so are of limited utility. Their main value in the database is as a validity check for analysts who wish to apply a different scoring approach to the TIMSS items. Raw scores for the individual students can be found in the Student Background and Student Achievement data files.

Standardized Raw Scores

ASMSTDR, BSMSTDR

Standardized mathematics raw score, for fourth and eighth grades.

ASSSTDR, BSSSTDR

Standardized science raw score, for fourth and eighth grades.

Because of the difficulty in making any comparisons across the test booklets using only the number of raw score points obtained on a set of items, raw scores were standardized by booklet to provide a simple score that could be used in comparisons across booklets in the same year in preliminary analyses. The standardized score was computed so that the weighted mean score within each booklet in a country was equal to 50, and the weighted standard deviation was equal to 10. The standardized raw scores for the individual students can be found in the Student Background and Student Achievement data files.

National Rasch Scores

ASMNRSC, BSMNRSC

National Rasch Mathematics Score.

ASSNRSC, BSSNRSC

National Rasch Science Score.

The national Rasch scores were computed to facilitate preliminary item analyses that were conducted prior to the TIMSS 2003 IRT scaling. Their main purpose was to provide a preliminary measure of overall mathematics or science achievement that could be used as a criterion variable in studies of item discrimination. The national Rasch scores were standardized to have a mean score of 150 and a standard deviation of 10 within each country. Because each country has the same mean score and dispersion, these scores are not useful for international comparisons.

National Rasch scores can be found in the Student Background and Student Achievement data files.

International Benchmarks of Achievement

To help users of the TIMSS achievement results understand what performance on the TIMSS mathematics and science achievement scales means in terms of the mathematics and science students know and can do, TIMSS identified four points on the scales to serve as international benchmarks. As shown in Exhibit 2.14, the benchmark scores are 625, 550, 475, and 400, corresponding to the Advanced International Benchmark, the High International Benchmark, the Intermediate International Benchmark, and the Low International Benchmark, respectively. TIMSS used a technique known as scale anchoring to summarize and describe student achievement at these four points on the mathematics and science scales. The TIMSS 2003 International Mathematics and Science Reports (Mullis, et al., 2004; Martin, et al., 2004) present the results of this scale anchoring, and report the percentage of students in each country reaching each of the international benchmarks.

To facilitate analysts in using the international benchmarks in secondary analysis, the TIMSS 2003 international database contains a set of variables indicating

Exhibit 2.14 TIMSS 2003 International Benchmarks for Eighth and Fourth Grade Mathematics and Science

Scale Score	International Benchmark
625	Advanced International Benchmark
550	High International Benchmark
475	Intermediate International Benchmark
400	Low International Benchmark

which international benchmark the student reached. There is a benchmark variable for each plausible value for each of mathematics and science at fourth and eighth grades. The benchmark variables are as follows:

ASMIBM01-5; BSMIBM01-5

International Mathematics Benchmarks reached at fourth and eighth grades, for each of the five plausible values.

ASSIBM01-5: BSSIBM01-5

International Science Benchmarks reached at fourth and eighth grades, for each of the five plausible values.

The following codes are used for the benchmark variables:

Code 1	Student performed below the Low International Benchmark.
Code 2	Student performed at or above the Low International Benchmark, but below the Intermediate International Benchmark.
Code 3	Student performed at or above the Intermediate International Benchmark but below the High International Benchmark.
Code 4	Student performed at or above the High International Benchmark but below the Advanced International Benchmark.
Code 5	Student performed at or above the Advanced International Benchmark.

2.4 The TIMSS 2003 Background Questionnaires

For a fuller appreciation of what the TIMSS achievement results mean and how they may be used to improve student learning in mathematics and science, it is important to understand the contexts in which students learn. Therefore, TIMSS collected extensive information about the contexts for learning mathematics and science by administering a range of background questionnaires. Four types of background questionnaires were used in TIMSS 2003 to gather information at various levels of the educational system: (i) curriculum questionnaires addressed issues of system-wide curriculum design and support and curricular emphasis in mathematics and science; (ii) a school questionnaire asked school principals/headmasters of the students tested to provide information about curricular and instructional arrangements, school resources, and school climate; (iii) teacher questionnaires asked mathematics and science teachers of the students tested about their preparation to teach, their teaching activities and approaches, their attitudes toward teaching the subject matter, and the

curriculum that is implemented in the classroom; and (iv) a questionnaire for the students tested sought information about their home backgrounds, their attitudes toward learning mathematics and science, and their experiences in learning these subjects.

The questionnaires were based on the contextual framework included in the TIMSS Assessment Frameworks and Specifications 2003 (Mullis et al., 2003). The contextual framework specifies the major characteristics of the educational and social contexts to be studied and identifies the areas to be addressed in the background questionnaires. Questionnaires were developed at both the fourth and eighth grades.

- The **curriculum questionnaire** addressed issues of the intended national curriculum in mathematics and science. Four versions of this questionnaire were administered: fourth-grade mathematics, fourth-grade science, eighth-grade mathematics, and eight-grade science.

- The **school questionnaire** asked school principals or headmasters to provide information about the school contexts for the teaching and learning of mathematics and science. There were separate versions for fourth grade and eighth grade.

- The **teacher questionnaire** collected information about the teachers' preparation and professional development, their pedagogical activities, and the implemented curriculum. At fourth grade there was one questionnaire that addressed both mathematics and science, and at eighth grade there were separate versions for mathematics teachers and science teachers.

- The **student questionnaire** sought information about the students' home backgrounds and their experiences in learning mathematics and science. There were separate versions for fourth grade and eighth grade, and at eighth grade there were different versions for countries where eighth-grade science is taught as a single integrated subject and countries where it is taught as separate subjects (i.e., biology, chemistry, physics, earth science).

The fourth- and eighth-grade ***curriculum questionnaires*** for mathematics and science were addressed to National Research Coordinators, who were asked to supply information about their nation's mathematics and science curricula in the target grades, drawing on the expertise of curriculum specialists in their countries. The curriculum questionnaires were designed to collect basic information about the organization of and support for the intended mathematics

and science curriculum in each country, and whether the mathematics and science topics included in the TIMSS 2003 assessment were included in the country's intended curriculum through the target grade. The four versions of the curriculum questionnaire were the same in structure and very similar in content, with the mathematics and science versions tailored to the subject matter and grade level wherever necessary. One notable difference was that the eighth-grade science curriculum questionnaire included a question asking whether eighth-grade science was taught as a single integrated subject or as separate science subjects.

Some of the central questions addressed in the curriculum questionnaire included:

- Is there a national curriculum in mathematics/science at the target grade?
- Does the country administer public examinations in mathematics/science that have consequences for individual students?
- What methods are used to support and monitor implementation of the national mathematics/science curriculum?
- How does the national curriculum address the issue of students with different levels of ability?
- What aspects of the teaching and learning of mathematics/science are emphasized in the national curriculum?
- What are the requirements for becoming a mathematics/science teacher, and is there a process to license or certify teachers?
- Are the topics included in the TIMSS 2003 assessment included in the national curriculum, and if so, for what proportion of students, and at what grades are the topics intended to be taught?

The complete contents of the TIMSS 2003 mathematics and science curriculum questionnaires at fourth and eighth grades are described in Exhibit 2.15.

Exhibit 2.15 Content of the TIMSS 2003 Mathematics and Science Curriculum Questionnaires at the Eighth and Fourth Grades

Item Number					
Mathematics Grade 8	Mathematics Grade 4	Science Grade 8	Science Grade 4	Item Content	Description
1	1	1	1	National curriculum	Whether the country has a national mathematics/science curriculum at the target grade, the year introduced, and whether under revision
-	-	2	-	Separate sciences	Whether science is taught as separate subjects by eighth grade, and the specific subjects and grades taught
2	2	3	2	Public examinations	Whether the country administers public examinations in mathematics/science that have consequences for individual students, the authority that administers such examinations, and the grades at which they are given
3	3	4	3	Methods used to help implement the national curriculum	Whether the country uses various methods to help monitor implementation of the national mathematics/science curriculum at the target grade
4	4	5	4	Specification of instructional time	Whether the national curriculum specifies the percentage of instructional time intended to be devoted to mathematics/science at various grades, and the percentage of time designated
5	5	6	5	Differentiation of the curriculum	How the national mathematics/ science curriculum at the target grade addresses the issue of students with different levels of ability
6	6	7	6	Emphasis on approaches and processes	How much emphasis the national mathematics/science curriculum at the target grade places on various approaches and processes
7	7	-	-	Policy on calculator use	Whether the national mathematics curriculum contains statements/policies on the use of calculators at the target grade, and a brief description of such policies
-	-	8	7	Policy on emphasis given scientific inquiry	Whether the national science curriculum contains statements/ policies about the emphasis that should be placed on scientific inquiry at the target grade, and a brief description of such policies

Exhibit 2.15 Content of the TIMSS 2003 Mathematics and Science Curriculum Questionnaires at the Eighth and Fourth Grades
(...Continued)

Item Number					
Mathematics Grade 8	Mathematics Grade 4	Science Grade 8	Science Grade 4	Item Content	Description
8	8	9	8	Policy on computer use	Whether the national mathematics/science curriculum contains statements/policies on the use of computers at the target grade, and a brief description of such policies
9	9	10	9	Preparation of teachers in how to teach the intended curriculum	Whether mathematics/science teachers at the target grade receive specific preparation in how to teach the intended curriculum as part of their pre-service or in-service education, and a brief description of such preparation
10	10	11	10	Teaching requirements	Whether mathematics/ science teachers at the target grade must fulfill various requirements in order to teach
11	11	12	11	Licensure process	Whether there is a process to license or certify mathematics/ science teachers at the target grade, and what entity licenses the teachers
12	12	13	12	The teaching of the TIMSS topics	Whether the TIMSS mathematics/science topics are included in the national curriculum through the target grade, the proportion of students intended to be taught the topics, and the grade(s) at which the topics are intended to be taught

The fourth- and eighth-grade ***school questionnaires*** were to be completed by the school principal or headmaster of each school sampled for the study. They were designed to collect information concerning some of the major factors thought to influence student achievement in mathematics and science. The fourth- and eighth-grade versions of the school questionnaire are nearly identical, although two of the questions are tailored to the appropriate grade. The school questionnaire was designed to be completed in about 30 minutes.

Some of the main questions addressed in the school questionnaire were:

- What is the school climate like?
- What are the school's expectations of parents?

- How does the school organize mathematics/science instruction for students with different levels of ability?
- How difficult was it to fill mathematics/science teaching vacancies, and were any incentives used to recruit or retain teachers?
- What types of professional development activities did mathematics/science teachers engage in?
- How safe is the school environment?
- Is the school's capacity to provide instruction affected by a shortage of various resources?
- What is the availability of computers for educational purposes in the school, and how many have access to the Internet?

The complete contents of the TIMSS 2003 school questionnaires at fourth and eighth grades are described in Exhibit 2.16.

Exhibit 2.16 Content of the TIMSS 2003 School Questionnaires at the Eighth and Fourth Grades

Item Number			
Grade 8	Grade 4	Item Content	Description
1	1	Grade levels	Grade range of the school
2	2	Enrollment	Total school enrollment in all grades and in the target grade
3	3	Community size	Size of the community in which the school is located
4	4	Absenteeism	Percentage of students absent from school on a typical school day
5	5	Stability/ mobility of student body	Percentage of students enrolled at the beginning of the school year who were still enrolled at the time of testing, and percentage of students who enrolled after the beginning of the school year
6	6	Students' background	Percentage of students who come from economically disadvantaged or affluent homes, and percentage of students whose native language is the language of the test
7	7	School climate	Principal's perception of teachers' job satisfaction and expectations for student achievement; of parental support and involvement; and of students' regard for school property and desire to do well in school
8	8	Principal's experience	Number of years as a principal of this school

Exhibit 2.16 Content of the TIMSS 2003 School Questionnaires at the Eighth and Fourth Grades *(…Continued)*

Item Number			
Grade 8	Grade 4	Item Content	Description
9	9	Principal's time allocation	Percentage of time principal spends on various activities across the school year
10	10	Parental involvement	Whether the school expects parents to participate in various activities
11	11	Instructional time	Number of days per year and days per week the school is open for instruction, and number of hours of instructional time in a typical day
12	12	Differentiation of mathematics curriculum	How the school organizes mathematics instruction for students with different levels of ability
13	13	Tracking in mathematics	Whether the students are grouped by ability in their mathematics classes
14	14	Enrichment/ remedial mathematics	Whether the school offers enrichment and remedial courses in mathematics
15	15	Differentiation of science curriculum	How the school organizes science instruction for students with different levels of ability
16	16	Tracking in science	Whether the students are grouped by ability in their science classes
17	17	Enrichment/ remedial science	Whether the school offers enrichment and remedial courses in science
18	18	Teacher vacancies	Difficulty in filling teacher vacancies in mathematics, science, and computer science/ information technology (4th grade version does not ask about specific subjects)
19	19	Incentives for teachers	Whether the school uses incentives to recruit or retain teachers in mathematics, science, and/or other subjects (4th grade version does not ask about specific subjects)
20	20	Professional development	Frequency with which teachers participated in various types of professional development activities during the school year
21	21	Teacher evaluation	Whether the school uses various procedures in evaluating mathematics and science teachers
22	22	Student behavior	Frequency and severity of various problematic student behaviors occurring in the school
23	23	Instructional resources	Degree to which the school's capacity to provide instruction is affected by shortages or inadequacy of various resources
24	24	Computers	Number of computers available for educational purposes, and proportion of computers with access to the Internet

Exhibit 2.16 Content of the TIMSS 2003 School Questionnaires at the Eighth and Fourth Grades *(...Continued)*

Item Number			
Grade 8	Grade 4	Item Content	Description
25	25	Technology support	Whether there is anyone available to help teachers use information and communication technology for teaching and learning, and description of that person

The ***teacher questionnaires*** were designed to gather information about the classroom contexts for the teaching and learning of mathematics and science, and about the implemented curriculum in these subjects. For each participating school at the fourth grade, there was one teacher questionnaire addressed to the classroom teacher of the sampled class. At eighth grade, for each sampled school a single mathematics class was sampled for the TIMSS 2003 assessment. The mathematics teacher of that class was asked to complete a mathematics teacher questionnaire, and the science teacher(s) of the students in that class was asked to complete a science teacher questionnaire, which paralleled that for the mathematics teacher. Although the general background questions were essentially the same for all versions, questions pertaining to instructional practices, content coverage, and teachers' views about teaching the subject matter were tailored toward mathematics or science. Many questions, such as those related to classroom characteristics and activities, and homework and assessment, were answered with respect to the specific classes of the sampled TIMSS students. Because the fourth- and eighth-grade versions of the teacher questionnaire were designed to be similar in length, and because the fourth-grade version included questions about both mathematics and science, some questions had to be eliminated or shortened in the fourth-grade version.

Some of the primary questions addressed in the teacher questionnaire were:

- What is teachers' educational background, and do they have a teaching license or certificate?
- How many years of pre-service teacher training did teachers have, and how many years have they been teaching?
- How ready do teachers feel they are to teach various topics at the target grade?
- What types of professional development have teachers participated in?
- What is the teaching load of teachers, and how do they spend their time both during and outside the formal school day (eighth grade only)?
- What are teachers' attitudes toward teaching the subject matter, and their perceptions regarding school climate and school safety?

- What instructional activities are provided to the students in the TIMSS class, and how do the students spend their time during their mathematics and science lessons?
- Do various student- and resource-related factors limit how teachers instruct the students in the TIMSS class (eighth grade only)?
- What percentages of time are devoted to the various mathematics and science content areas in teaching the TIMSS class?
- When have the students in the TIMSS class been taught the topics included in the TIMSS 2003 assessment?
- Do students have calculators available to them, and how do they use them (mathematics only)?
- Do students have computers available to them, and how do they use them?
- How much homework is assigned to students?
- How often are students given a test or examination, and what types of questions are included (eighth grade only)?

The TIMSS 2003 teacher questionnaires were designed to take about 45 minutes to complete. The complete contents of the TIMSS 2003 teacher questionnaires are described in Exhibit 2.17 for the eighth grade and in Exhibit 2.18 for the fourth grade.

Exhibit 2.17 Content of the TIMSS 2003 Mathematics and Science Teacher Questionnaires at the Eighth Grade

Item Number		Item Content	Description
Mathematics Teacher Questionnaire	Science Teacher Questionnaire		
1	1	Age	Teacher's age
2	2	Gender	Teacher's gender
3	3	Teaching experience	Number of years as a teacher
4	4	Formal education	Highest level of formal education completed by the teacher
5	5	Teacher training	Number of years of pre-service teacher training completed by the teacher
6	6	Major area of study	Teacher's major area of study during post-secondary education
7	7	Teaching requirements	Requirements the teacher had to satisfy in order to become a teacher
8	8	Teaching license	Whether the teacher has a teaching license or certificate, and the type of license
9	9	Preparation to teach	How ready the teacher feels to teach the topics included in the TIMSS mathematics/science test
10	10	Teaching load	Number of periods for which the teacher is formally scheduled per week for various activities, and number of minutes in a period
11	11	Extra working time	Number of hours teacher spends on teaching-related activities outside the formal school day
12	12	Teacher interactions	Frequency of various types of interactions the teacher has with colleagues
13	13	Professional development	Whether the teacher participated in various types of professional development activities
14	14	Attitudes toward subject	Teacher's beliefs about the nature of mathematics/science and how the subject should be taught.
15	15	School setting	Teacher's perceptions about the adequacy of the school facility and about school safety
16	16	School climate	Teacher's perception of teachers' job satisfaction and expectations for student achievement; of parental support and involvement; and of students' regard for school property and desire to do well in school
17	17	Class size	Number of students in the sampled class
18	18	Time spend teaching subject	Minutes per week the teacher teaches mathematics/science to the sampled class
19	19	Textbook	Whether a textbook(s) is used as a primary or supplementary resource
20	20	Student learning activities	Percentage of time students spend doing various learning activities in a typical week

Exhibit 2.17 Content of the TIMSS 2003 Mathematics and Science Teacher Questionnaires at the Eighth Grade *(...Continued)*

Item Number		Item Content	Description
Mathematics Teacher Questionnaire	Science Teacher Questionnaire		
21	21	Content-related activities	Frequency with which the teacher asks students to do various content-related activities in mathematics/science
22	22	Factors limiting teaching	Extent to which the teacher perceives various student and resource factors to limit teaching
23	23	Emphasis on content areas	Percentage of time spent on mathematics/ science content areas over the course of the year
24	24	Topic coverage	When the students were taught the TIMSS mathematics/science topics, by content area
25	-	Calculator use policy	Whether the students are permitted to use calculators during mathematics lessons
26	-	Calculator availability	Proportion of students that have access to calculators during mathematics lessons
27	-	Graphing calculator availability	Proportion of students that have access to graphing calculators during mathematics lessons
28	-	Calculator use	Frequency with which the students use calculators for various learning activities
29	-	Calculators in test/exams	How often the students are allowed to use calculators during tests or examinations
30	25	Computer availability	Whether the students have access to computers during mathematics/science lessons and whether computers have access to Internet
31	26	Computer use	Frequency with which the students use computers for various learning activities
32	27	Homework	Whether the teacher assigns mathematics/ science homework
33	28	Frequency of homework	How often the teacher assigns mathematics/ science homework
34	29	Amount of homework	Number of minutes it would take an average student to complete a mathematics/science homework assignment
35	30	Type of homework	Frequency with which the teacher assigns various types of homework
36	31	Use of homework	How often the teacher uses mathematics/ science homework for various purposes
37	32	Assessment	Frequency with which the teacher gives a mathematics/science test or examination
38	33	Question format	Item formats the teacher typically uses in mathematics/science tests or examinations

Exhibit 2.17 Content of the TIMSS 2003 Mathematics and Science Teacher Questionnaires at the Eighth Grade *(...Continued)*

Item Number		Item Content	Description
Mathematics Teacher Questionnaire	Science Teacher Questionnaire		
39	34	Type of questions	Types of questions the teacher uses in mathematics/ science tests or examinations

Exhibit 2.18 Content of the TIMSS 2003 Teacher Questionnaire at the Fourth Grade

Item Number	Item Content	Description
1	Age	Teacher's age
2	Gender	Teacher's gender
3	Teaching experience	Number of years as a teacher
4	Formal education	Highest level of formal education completed by the teacher
5	Teacher training	Number of years of pre-service teacher training completed by the teacher
6	Major area of study	Teacher's major area of study during post-secondary education
7	Teaching requirements	Requirements the teacher had to satisfy in order to become a teacher
8	Teaching license	Whether the teacher has a teaching license or certificate, and the type of license
9	School climate	Teacher's perception of teachers' job satisfaction and expectations for student achievement; of parental support and involvement; and of students' regard for school property and desire to do well in school
10	School setting	Teacher's perceptions about the adequacy of the school facility and about school safety
11	Teacher interactions	Frequency of various types of interactions the teacher has with colleagues
12	Preparation to teach mathematics	How ready the teacher feels to teach the topics included in the TIMSS mathematics test
13	Professional development in mathematics	Whether the teacher participated in various types of professional development activities for mathematics teaching
14	Mathematics class size	Number of students in the sampled class for mathematics, and number of those in the fourth grade
15	Time spend teaching mathematics	Minutes per week the teacher teaches mathematics to the sampled class
16	Mathematics textbook	Whether a textbook(s) is used as a primary or supplementary resource in teaching mathematics
17	Student learning activities in mathematics	Percentage of time students spend doing various learning activities in a typical week of mathematics lessons

Exhibit 2.18 Content of the TIMSS 2003 Teacher Questionnaire at the Fourth Grade *(...Continued)*

Item Number	Item Content	Description
18	Calculator use policy	Whether the students are permitted to use calculators during mathematics lessons
19	Calculator availability	Proportion of students that have access to calculators during mathematics lessons
20	Calculator use	Frequency with which the students use calculators for various learning activities
21	Calculators in test/ exams	How often the students are allowed to use calculators during tests or examinations
22	Computer availability for mathematics	Whether the students have access to computers during mathematics lessons and whether computers have access to the Internet
23	Computer use in mathematics	Frequency with which the students use computers for various learning activities in mathematics
24	Mathematics content-related activities	Frequency with which the teacher asks students to do various content-related activities in mathematics
25	Emphasis on mathematics content areas	Percentage of time spent on mathematics content areas over the course of the year
26	Mathematics topic coverage	When the students were taught the TIMSS mathematics topics, by content area
27	Mathematics homework	Whether the teacher assigns mathematics homework
28	Frequency of mathematics homework	How often the teacher assigns mathematics homework
29	Amount of mathematics homework	Number of minutes it would take an average student to complete a mathematics homework assignment
30	Preparation to teach science	How ready the teacher feels to teach the topics included in the TIMSS science test
31	Professional development in science	Whether the teacher participated in various types of professional development activities for science teaching
32	Science class size	Number of students in the sampled class for science, and number of those in the fourth grade
33	Time spend teaching science	Minutes per week the teacher teaches science to the sampled class
34	Science textbook	Whether a textbook(s) is used as a primary or supplementary resource in teaching science
38	Student learning activities in science	Percentage of time students spend doing various learning activities in a typical week of science lessons
35	Computer availability for science	Whether the students have access to computers during science lessons and whether computers have access to the Internet
36	Computer use in science	Frequency with which the students use computers for various learning activities in science
37	Science content-related activities	Frequency with which the teacher asks students to do various content-related activities in science

Exhibit 2.18 Content of the TIMSS 2003 Teacher Questionnaire at the Fourth Grade *(...Continued)*

Item Number	Item Content	Description
39	Preparation to teach science	How ready the teacher feels to teach the topics included in the TIMSS science test
40	Science homework	Whether the teacher assigns science homework
41	Frequency of science homework	How often the teacher assigns science homework
42	Amount of science homework	Number of minutes it would take an average student to complete a science homework assignment

Each student in the sampled fourth- and eighth-grade TIMSS classes completed a ***student questionnaire***, which sought information about the student's home background and resources for learning, their attitudes about mathematics and science, and their experiences in learning these subjects. The fourth- and eighth-grade versions of the student questionnaire were thematically and organizationally similar to each other. Some questions were identical in the two versions, while for other questions the language was simplified in the fourth-grade version or the specific content of the question was altered to be appropriate to the fourth grade. The fourth-grade questionnaire was shorter in length than the eighth-grade version.

Two versions of the eighth-grade questionnaire were used, a general science version intended for countries where eighth-grade science is taught as a single integrated subject, and a separate science subjects version intended for countries where eighth-grade science is taught as separate subjects (e.g., biology, earth science, chemistry, physics); countries administered the version that was consistent with the way in which science instruction was organized at the eighth grade. In the general science version, science-related questions pertaining to students' attitudes and classroom activities were based on single questions asking about "science," to which students were to respond in terms of the "general or integrated science" course they were taking. In the separate science subjects version, the same questions were asked about each science subject area, and students were to respond with respect to each science course they were taking. This structure accommodated the diverse systems that participated in TIMSS. Although the two versions differed with respect to the science questions, the general background and mathematics-related questions were identical across the two forms.

The student questionnaire was designed to gather information on some of the major factors thought to influence student achievement in mathematics and

science. Some of the central questions addressed in the student questionnaire included:

- What are students' general demographic backgrounds – age, gender, native language, country of origin, household size?
- What are the resources for learning in the students' homes?
- What is the educational attainment of the students' parents, and what are the students' own educational aspirations?
- What is students' affinity for learning mathematics and science, and how do they perceive success in and the utility of learning mathematics and science?
- What types of learning activities do students engage in in their mathematics and science lessons?
- Do students use a computer, where, and for what learning activities?
- What are students' perceptions about school climate and school safety?
- How do students spend their time outside of school?
- How much homework do students do?

The TIMSS 2003 student questionnaires were designed to take about 30 minutes to complete. The complete contents of the TIMSS 2003 student questionnaires are described in Exhibit 2.19 for the eighth grade and in Exhibit 2.20 for the fourth grade.

Exhibit 2.19 Content of the TIMSS 2003 Student Questionnaire at the Eighth Grade

Item Number		Item Content	Description
General Science Version	Separate Science Subjects Version		
1	1	Age	Month and year of student's birth
2	2	Gender	Student's gender
3	3	Language	Student's frequency of use of the language of the test at home
4	4	Books in the home	Number of books in the student's home
5	5	Home possessions	Educational resources and general possessions in the student's home
6	6	Parents' education	Highest level of education completed by mother and father

Exhibit 2.19 Content of the TIMSS 2003 Student Questionnaire at the Eighth Grade *(...Continued)*

Item Number		Item Content	Description
General Science Version	Separate Science Subjects Version		
7	7	Educational expectations	Level of education the student expects to complete
8	8	Liking mathematics	How much the student likes and feels competent at mathematics
9	9	Valuing mathematics	Importance and value the student attributes to mathematics
10	10	Learning activities in mathematics	Frequency with which student does various learning activities in mathematics lessons
11	-	Liking science	How much the student likes and feels competent at science
12	-	Valuing science	Importance and value the student attributes to science
13	-	Learning activities in science	Frequency with which student does various learning activities in science lessons
-	11	Study biology	Whether the student is studying biology this year
-	12	Liking biology	How much the student likes and feels competent at biology
-	13	Valuing biology	Importance and value the student attributes to biology
-	14	Learning activities in biology	Frequency with which student does various learning activities in biology lessons
-	15	Study earth science	Whether the student is studying earth science this year
-	16	Liking earth science	How much the student likes and feels competent at earth science
-	17	Valuing earth science	Importance and value the student attributes to earth science
-	18	Learning activities in earth science	Frequency with which student does various learning activities in earth science lessons
-	19	Study chemistry	Whether the student is studying chemistry this year
-	20	Liking chemistry	How much the student likes and feels competent at chemistry
-	21	Valuing chemistry	Importance and value the student attributes to chemistry
-	22	Learning activities in chemistry	Frequency with which student does various learning activities in chemistry lessons

Exhibit 2.19 Content of the TIMSS 2003 Student Questionnaire at the Eighth Grade *(...Continued)*

Item Number		Item Content	Description
General Science Version	Separate Science Subjects Version		
-	23	Study physics	Whether the student is studying physics this year
-	24	Liking physics	How much the student likes and feels competent at physics
-	25	Valuing physics	Importance and value the student attributes to physics
-	26	Learning activities in physics	Frequency with which student does various learning activities in physics lessons
14	27	Computers	Whether student uses a computer, where uses it, and frequency with which student uses a computer for various educational activities
15	28	School climate	Student's affinity for school, and perception of other students' motivation in school and teachers' expectations and care of students
16	29	Safety in school	Whether the student experienced being the object of problematic behaviors by other students
17	30	Out-of-school activities	Frequency with which student does various non-academic activities and homework outside of school
18	31	Extra lessons/ tutoring	Frequency of extra lessons or tutoring in mathematics and science
19	32	Mathematics homework	Frequency and amount of mathematics homework
20	32	Science homework	Frequency and amount of science homework
21	33	Persons living in home	Number of people living at home
22	34	Parents born in country	Whether mother and father were born in country
23	35	Student born in country	Whether student was born in country, and if not age at which student emigrated

Exhibit 2.20 Content of the TIMSS 2003 Student Questionnaire at the Fourth Grade

Item Number	Item Content	Description
1	Age	Month and year of student's birth
2	Gender	Student's gender
3	Language	Student's frequency of use of the language of the test at home
4	Books in the home	Number of books in the student's home
5	Home possessions	Educational resources and general possessions in the student's home
6	Liking mathematics	How much the student likes and feels competent at mathematics
7	Learning activities in mathematics	Frequency with which student does various learning activities in mathematics lessons
8	Liking science	How much the student likes and feels competent at science
9	Learning activities in science	Frequency with which student does various learning activities in science lessons
10	Computers	Whether student uses a computer, where uses it, and frequency with which student uses a computer for various educational activities
11	School climate	Student's affinity for school, and perception of other students' motivation in school and teachers' expectations and care of students
12	Safety in school	Whether the student experienced being the object of problematic behaviors by other students
13	Out-of-school activities	Frequency with which student does various non-academic activities and homework outside of school
14	Extra lessons	Frequency of extra lessons or tutoring in mathematics and science
15	Mathematics homework	Frequency and amount of mathematics homework
16	Science homework	Frequency and amount of science homework
17	Persons living in home	Number of people living at home
18	Parents born in country	Whether mother and father were born in country
19	Student born in country	Whether student was born in country, and if not age at which student emigrated

2.5 Working with TIMSS 2003 Questionnaire Data

Student Questionnaire Data

In general, working with the data from the student questionnaire is fairly straightforward. For example, most of the exhibits in the TIMSS 2003 international reports (Mullis, et al., 2004; Martin, et al., 2004) present weighted percentages of students in each country for each response category, together with the mean

achievement (mathematics or science) of those students. International averages are also displayed for each category.

Teacher Questionnaire Data

Because the assignment of the teacher questionnaires was based on participating students, teacher responses do not necessarily represent all of the teachers of the target grade in each of the TIMSS countries. Rather, they represent teachers of the representative samples of students assessed. It is important to note that when using the TIMSS data, the student is always the unit of analysis, even when information from the teacher questionnaires is being reported. Using the student as the unit of analysis makes it possible to describe the instruction received by representative samples of students. Although this approach may provide a different perspective from that obtained by simply collecting information from teachers, it is consistent with the TIMSS goals of illuminating students' educational contexts and performance.

In most countries, students at fourth grade are taught all subjects by a single classroom teacher. Following this model, there was a single teacher questionnaire for teachers of fourth-grade students, comprising a section on teacher background characteristics and attitudes, a section on mathematics instruction, and a section on science instruction.

At the eighth-grade level, mathematics and science are not generally taught by the same teachers. Accordingly, there was a questionnaire for mathematics teachers and another for science teachers, the two questionnaires having some general questions in common but using different subject matter related questions. The procedure was to sample a mathematics class from each participating school, administer the test to those students, and ask the mathematics and science teachers of those students to complete a teacher questionnaire. In countries with different teachers for each of the science subjects, this included all science teachers of the students in the sampled classes.

The teacher questionnaires were divided into two sections: Section A asked about teachers' general background and Section B asked class-specific questions about instructional practices. Where teachers taught more than one mathematics or science class to the sampled students, they were to complete only one Section A but a separate Section B for each class taught. Thus, the information about instruction was tied directly to the students tested and the specific mathematics and science classes in which they were taught.

The data obtained from the science teachers can be used in two ways. Some of the general information can be used together for all science teachers in each country. The data for information specific to the science subject, such as preparation to teach the sciences, instructional time in the sciences, and

emphasis on experiments, should most likely be treated separately both for the general/integrated science and for the separate science subject area teachers. Tracking information provided by schools has been included in the database (ITCOURSE) and can be used to identify teachers by the type of course taught to the sampled students - mathematics, physics, biology, chemistry, earth science, or integrated science.

Another consequence of the TIMSS design was that since students were usually taught mathematics and science by different teachers and sometimes were taught one subject by more than one teacher, they had to be linked to more than one teacher for reporting purposes. When a student is taught a subject by more than one teacher, the student's sampling weight is distributed among those teachers. The student's contribution to student population estimates thus remains constant regardless of the number of teachers. This is consistent with the policy of reporting attributes of teachers and their classrooms in terms of the percentages of students taught by teachers with these attributes. Some analyses of this type might involve computing the sum or determining the highest value reported across all of a student's teachers for one subject area. The composite values obtained can then be used to produce the reported student-weighted statistics (e.g., total instructional time in the subjects and the degree of content coverage in mathematics or science).

School Questionnaire Data

The principals of the participating schools in TIMSS completed questionnaires on the school contexts in which the learning and teaching of mathematics and science occurred. Although schools constituted the first stage of sampling and were chosen randomly, the TIMSS school sample was designed to optimize the student sample, not to provide an optimal sample of schools.[5] The school sample in most countries is relatively small, about 150 schools at each grade level, and because schools generally were sampled with probabilities proportional to size, large schools tend to occur in the sample more frequently than in the school population. It is possible to analyze the school data in isolation using the school weights described later in this chapter, but in general the school-level data are most usefully studied as attributes of school context for the students and using the student as the unit of analysis.

Summary Indices and Derived Variables from Questionnaire Data

As described by Ramirez and Arora (2004), TIMSS 2003 collected data on many hundreds of variables from the students, teachers, principals, and NRCs that participated in the study. The purpose of these data is to help policymakers, curriculum specialists, researchers, and others better understand the performance of their educational systems. In addition to the data on the original

[5] See Foy and Joncas (2004) for a description of the TIMSS 2003 sampling design.

questions asked in the various questionnaires, TIMSS created a range of indices and derived variables that summarized the data in ways that highlighted the relationship with mathematics and science achievement.

For example, a three-level index of Good School and Class Attendance was constructed from principals' ratings of the extend to which three student behaviors – arriving late at school, absenteeism, and skipping classes – were a problem in the school. Students were assigned to the high level of the index if their principal reported that all three behaviors were not a problem. Students were assigned the low level of the index if their principal indicated that two or more of the behaviors were a serious problem or two behaviors were a minor problem and a third a serious problem. Students whose principals reported other combinations of responses were assigned to the medium category.

The international version of each of the TIMSS 2003 background questionnaires is described in Supplement 1 of this User Guide, and the documentation of the national adaptations to each questionnaire in Supplement 2. The indices and other derived variables are listed in Exhibits 2.21 to 2.24 below, for the eighth and fourth grades, respectively. Detailed descriptions and analysis notes for the derived variables are provided in Supplement 3.

Exhibit 2.21 Summary Indices in TIMSS 2003 International Database for the Eighth Grade

Variable Name	Description	Levels
bsdmhw	Index of Time Students Spend Doing Mathematics Homework (TMH)	1=high, 2=medium, 3=low
bsdmscl	Index of Students' Self-Confidence in Learning Mathematics (SCM)	1=high, 2=medium, 3=low
bsdmsv	Index of Students' Valuing Mathematics (SVM)	1=high, 2=medium, 3=low
bsdgpss	Index of Students' Perception of Being Safe in the Schools (SPBSS)	1=high, 2=medium, 3=low
bsdshw	Index of Time Students Spend Doing Science Homework (TSH)	1=high, 2=medium, 3=low
bsdbhw	Index of Time Students Spend Doing Life Science Homework (TSH)	1=high, 2=medium, 3=low
bsdehw	Index of Time Students Spend Doing Earth Science Homework (TSH)	1=high, 2=medium, 3=low
bsdchw	Index of Time Students Spend Doing Chemistry Homework (TSH)	1=high, 2=medium, 3=low
bsdphw	Index of Time Students Spend Doing Physics Homework (TSH)	1=high, 2=medium, 3=low
bsdssv	Index of Students Valuing Science (SVS)	1=high, 2=medium, 3=low
bsdbsv	Index of Students Valuing Life Science (SVB)	1=high, 2=medium, 3=low
bsdesv	Index of Students Valuing Earth S (SVE)	1=high, 2=medium, 3=low
bsdcsv	Index of Students Valuing Chemist (SVC)	1=high, 2=medium, 3=low
bsdpsv	Index of Students Valuing Physics (SVP)	1=high, 2=medium, 3=low
bsdsscl	Index of Students' Self-Confidence in Learning Science (SCS)	1=high, 2=medium, 3=low

Exhibit 2.21 Summary Indices in TIMSS 2003 International Database for the Eighth Grade *(...Continued)*

Variable Name	Description	Levels
bsdbscl	Index of Students' Self-Confidence in Learning Life Science (SCB)	1=high, 2=medium, 3=low
bsdescl	Index of Students' Self-Confidence in Learning Earth Science (SCE)	1=high, 2=medium, 3=low
bsdcscl	Index of Students' Self-Confidence in Learning Chemistry (SCC)	1=high, 2=medium, 3=low
bsdpscl	Index of Students' Self-Confidence in Learning Physics (SCP)	1=high, 2=medium, 3=low
btdmlt	Index of Teachers' Reports on Teaching Mathematics Classes with Few or No Limitations on Instruction due to Student Factors (MCWL)	1=high, 2=medium, 3=low
btdmh	Index Teachers' Emphasis on Mathematics Homework (EMH)	1=high, 2=medium, 3=low
btdmch	Index Mathematics Teachers' Perception of School Climate (MTPSC)	1=high, 2=medium, 3=low
btdmcu	Index of Mathematics Teachers' Perception of Safety in the Schools (MTPSS)	1=high, 2=medium, 3=low
btdsch	Index Science Teachers' Perception of School Climate (STPSC)	1=high, 2=medium, 3=low
btdscu	Index Science Teachers' Perception of Safety in the School (STPSS)	1=high, 2=medium, 3=low
btdslt	Index of Teachers' Reports on Teaching Science Classes with Few or No Limitations on Instruction due to Student Factors (SCWL)	1=high, 2=medium, 3=low
btdsh	Index Teachers' Emphasis on Science Homework (ESH)	1=high, 2=medium, 3=low
bcdgch	Index Principals' Perception of School Climate (PPSC)	1=high, 2=medium, 3=low
bcdmst	Index of Availability of School Resources for Mathematics Instruction (ASRMI)	1=high, 2=medium, 3=low
bcdgsp	Index Good School and Class Attendance (GSCA)	1=high, 2=medium, 3=low
bcdsst	Index of Availability of School Resources for Science Instruction (ASRSI)	1=high, 2=medium, 3=low

Exhibit 2.22 Derived Variables Other Than Indices in TIMSS 2003 International Database for the Eighth Grade

Derived Variable Name	Description	Levels
bsdgedup	Highest Level of Education of Either Parent	1=Finished University or Equivalent or Higher 2=Finished Post-Secondary Vocational/Technical Education but Not University 3=Finished Upper Secondary Schooling 4=Finished Lower Secondary Schooling 5=Finished Some Primary or Lower Secondary or Did Not Go to School 6=Do Not Know
bsdgasp	Students' Educational Aspirations Relative to Parents' Educational Level	1=Finish University and Either Parent Went to University or Equivalent 2=Finish University but Neither Parent Went to University or Equivalent 3=Not Finish University Regardless of Parents' Education 4=Do Not Know Regardless of Parents' Education
bsdgcavl	Use of Computer	1=Use Computer Both at Home and School 2=Use Computer at Home but Not at School 3=Use Computer at School but Not at Home 4=Use Computer Only at Places Other Than Home and School 5=Do Not Use Computers at All
btdmstud	Class Size for Mathematics Instruction	1=1-24 Students 2=25-32 Students 3=33-40 Students 4=41 or More Students
btdmtonu	Summary of Students Taught Number Mathematics Topics	Min 0, max 10
btdmtoal	Summary of Students Taught Algebra Mathematics Topics	Min 0, max 6
btdmtome	Summary of Students Taught Measurement Mathematics Topics	Min 0, max 8
btdmtoge	Summary of Students Taught Geometry Mathematics Topics	Min 0, max 13
btdmtoda	Summary of Students Taught Data Mathematics Topics	Min 0, max 8

Exhibit 2.22 Derived Variables Other Than Indices in TIMSS 2003 International Database for the Eighth Grade *(...Continued)*

Derived Variable Name	Description	Levels
btdmtoov	Summary of Students Taught Overall Mathematics Topics	Min 0, max 45
btdmtelc	Mathematics Teacher Has Full License or Certification	1=yes, 2=no
btdgmhy	Average Yearly Mathematics Instructional Time (hrs)	
btdgmpt	Mathematics Time As Percent of Total Instructional Time	Min 0, Max 100
btdstelc	Science Teacher Has Full License or Certification	1=yes, 2=no
btdsstud	Class Size for Science Instruction	1=1-24 Students 2=25-32 Students 3=33-40 Students 4=41 or More Students
btdstobi	Summary of Students Taught Life Science Topics	Min 0, max 12
btdstoch	Summary of Students Taught Chemistry Science Topics	Min 0, max 8
btdstoph	Summary of Students Taught Physics Science Topics	Min 0, max 10
btdstoea	Summary of Students Taught Earth Science Topics	Min 0, max 11
btdstoen	Summary of Students Taught Environ Science Topics	Min 0, max 3
btdstoov	Summary of Students Taught Overall Science Topics	Min 0, max 44
btdgshy	Average Yearly Science Instructional Time (hrs)	
btdgspt	Science Time As Percent of Total Instructional Time	Min 0, Max 100

Exhibit 2.22 Derived Variables Other Than Indices in TIMSS 2003 International Database for the Eighth Grade *(...Continued)*

Derived Variable Name	Description	Levels
bcdgtitd	Number of Hours of School per Year	Min 480, max 1872
bcdgdw	Number of Days of School per Week	Min 4, max 6
bcdwkyr	Number of Weeks of School per Year	Min 30, max 48
bcdgdwf	Number of Fractional Days of School per Week	Min 4, max 6

Exhibit 2.23 Summary Indices in TIMSS 2003 International Database for the Fourth Grade

Variable Name	Description	Levels
asdmhw	Index of Time Students Spend Doing Mathematics Homework (TMH)	1=high, 2=medium, 3=low
asdmscl	Index of Students' Self-Confidence in Learning Mathematics (SCM)	1=high, 2=medium, 3=low
asdgpss	Index of Students' Perception of Being Safe in the Schools (SPBSS)	1=high, 2=medium, 3=low
asdshw	Index of Time Students Spend Doing Science Homework (TSH)	1=high, 2=medium, 3=low
asdsscl	Index of Students' Self-Confidence in Learning Science (SCS)	1=high, 2=medium, 3=low
atdmh	Index of Teachers' Emphasis on Mathematics Homework (EMH)	1=high, 2=medium, 3=low
atdgch	Index of Mathematics Teachers' Perception of School Climate (TPSC)	1=high, 2=medium, 3=low
atdgcu	Index of Mathematics Teachers' Perception of Safety in the Schools (TPSS)	1=high, 2=medium, 3=low
atdsh	Index Teachers' Emphasis on Science Homework (ESH)	1=high, 2=medium, 3=low
acdgch	Index of Principals' Perception of School Climate (PPSC)	1=high, 2=medium, 3=low
acdmst	Index of Availability of School Resources for Mathematics Instruction (ASRMI)	1=high, 2=medium, 3=low
acdgsp	Index of Good School and Class Attendance (GSCA)	1=high, 2=medium, 3=low
acdsst	Index of Availability of School Resources for Science Instruction (ASRSI)	1=high, 2=medium, 3=low

Exhibit 2.24 Derived Variables Other Than Indices in TIMSS 2003 International Database for the Fourth Grade

Derived Variable Name	Description	Levels
asdgcavl	Use of Computer	1=Use Computer Both at Home and School 2=Use Computer at Home but Not at School 3=Use Computer at School but Not at Home 4=Use Computer Only at Places Other Than Home and School 5=Do Not Use Computers at All
atdmstud	Class Size for Mathematics Instruction	1=1-19 Students 2=20-26 Students 3=27-32 Students 4=33 or More Students
atdmtanu	Summary of Students Taught Number Mathematics Topics	Min 0, max 12
atdmtape	Summary of Students Taught Patterns, Equations, Relationships Mathematics Topics	Min 0, max 6
atdmtame	Summary of Students Taught Measure Mathematics Topics	Min 0, max 6
atdmtage	Summary of Students Taught Geometry Mathematics Topics	Min 0, max 11
atdmtada	Summary of Students Taught Data Mathematics Topics	Min 0, max 7
atdmtaov	Summary of Students Taught Overall Mathematics Topics	Min 0, max 42
atdmprep	Preparation to Teach Mathematics	1=Education with Specialization in Mathematics 2=Mathematics 3= Education with Specialization in Science 4=Science 5= Education with Specialization in Language/Reading or in Other Subject 6=Other
atdgtelc	Have Full Teaching License or Certificate	1=yes, 2=no
atdgmhy	Average Yearly Mathematics Instructional Time (hrs)	

Exhibit 2.24 Derived Variables Other Than Indices in TIMSS 2003 International Database for the Fourth Grade *(...Continued)*

Derived Variable Name	Description	Levels
atdgmpt	Mathematics Time As Percent of Total Instructional Time	Min 0, Max 100
atdsstud	Class Size for Science Instruction	1=1-19 Students 2=20-26 Students 3=27-32 Students 4=33 or More Students
atdstali	Summary of Students Taught Life Science Topics	Min 0, max 10
atdstaph	Summary of Students Taught Physical Science Topics	Min 0, max 13
atdstaea	Summary of Students Taught Earth Science Topics	Min 0, max 9
atdstaov	Summary of Students Taught Overall Science Topics	Min 0, max 32
atdsprep	Preparation to Teach Science	1=Education with Specialization in Science 2= Science 3= Education with Specialization in Mathematics 4= Mathematics 5= Education with Specialization in Language/Reading or in Other Subject 6=Other
atdgshy	Average Yearly Science Instructional Time (hrs)	
atdgspt	Science Time As Percent of Total Instructional Time	Min 0, Max 100
acdgtitd	Number of Hours of School per Year	Min 480, max 1872
acdgdw	Number of Days of School per Week	Min 4, max 6
acdwkyr	Number of Weeks of School per Year	Min 30, max 48
acdgdwf	Number of Fractional Days of School per Week	Min 4, max 6

2.6 Using Sampling Weights in Analyzing the TIMSS 2003 Data

An important characteristic of the TIMSS studies, and one that has crucial implications for data analysis, is that they use data from carefully-drawn random samples of schools, classes, and students to make inferences about the mathematics and science achievement of the fourth- and eighth-grade student populations in the participating countries (see Foy and Joncas, 2004). For analyses based on these sample data to accurately reflect populations attributes, it is necessary that they take the design of the sample into account. This is accomplished in part by assigning a sampling weight to each respondent in the sample, and weighting the respondent by its sampling weight in all analyses. The sampling weight properly accounts for the sample design, takes into account any stratification or disproportional sampling of subgroups, and includes adjustments for non-response (see Joncas, 2004).

Because the students within each country were selected using probability sampling procedures, the probability of each student being selected as part of the sample is known. The sampling weight is the inverse of this selection probability. In a properly selected and weighted sample, the sum of the weights for the sample approximates the size of the population. In TIMSS, the sum of the sampling weights of all students in a country is an estimate of the size of the fourth- or eighth-grade student population in that country. The student sampling weight, known as TOTWGT in the international database, must be used whenever student population estimates are required. The use of TOTWGT ensures that the various subgroups that constitute the sample are properly and proportionally represented in the computation of population estimates, and that the sample size will be inflated to approximate the size of the population.

Although TOTWGT has desirable properties, it also has drawbacks for some analyses. Because TOTWGT sums to the student population size in each country, analyses using TOTWGT that combine countries will have more students from larger countries and fewer from smaller countries, which may not be desirable for some purposes. For cross-country analyses in which each country should be treated equally, TIMSS provides SENWGT, a transformation of TOTWGT that results in a sample size of 500 in each country. Additionally, since TOTWGT inflates sample sizes to approximate the population size, software systems that use sample size to compute significance tests will give misleading results for analyses weighted by TOTWGT. To avoid this problem, TIMSS provides HOUWGT, a transformation of TOTWGT that ensures that the weighted sample corresponds to the actual sample size in each country. SENWGT and HOUWGT are described more fully below.

Sampling Weights Included in the Student Data Files

Each student's sampling weight (TOTWGT) is a composite of six factors: three weighting factors corresponding to the stages of the sampling design (school, class, and student – WGTFAC1, WGTFAC2, and WGTFAC3), and three adjustment factors for non-participation at each of these stages – WGTADJ1, WGTADJ2, and WGTADJ3, as described below. The variables described in this section are included in both the Student Background and Student Achievement files (see next chapter). The meaning and interpretation of the weights in each of these files is the same.

WGTFAC1 School Weighting Factor

This variable is the inverse of the probability of selection for the school where the student is enrolled.

WGTADJ1 School Non-participation Adjustment

This is an adjustment that is applied to WGTFAC1 to account for non-participating schools in the sample. Multiplying WGTFAC1 by WGTADJ1 gives the sampling weight for the school, adjusted for non-participation.

WGTFAC2 Class Weighting Factor

This is the inverse of the probability of selection of the classroom within the school.

WGTADJ2 Classroom Non-participation Adjustment

This is an adjustment that is applied to WGTFAC2 to account for non-participating classrooms or classrooms where student participation was less than 50 percent. Multiplying WGTFAC2 by WGTADJ2 gives the second-stage sampling weight, adjusted for non-participation.

WGTFAC3 Student Weighting Factor

This is the inverse of the probability of selection of an individual student within a sampled classroom. In the usual TIMSS case, where entire classrooms were sampled intact, the value was set to one for all students in the classroom. In a few countries, however, students were sampled within classrooms as a third sampling stage: in these cases the value of WGTFAC3 was greater than one.

WGTADJ3 Student Weighting Adjustment

This is an adjustment applied to the variable WGTFAC3 to account for non-participating students in the sampled classroom. Multiplying WGTFAC3 by WGTADJ3 gives the student-within-classroom sampling weight, adjusted for non-participation.

TOTWGT Total Student Weight

TOTWGT is obtained by multiplying the variables WGTFAC1, WGTADJ1, WGTFAC2, WGTADJ2, WGTFAC3, and WGTADJ3 for each student. The sum of these weights within a sample provides an estimate of the size of the population.

A key property of a sampling weight is that the same population estimates for means and proportions (although not the total or the number of units) will be obtained from any weighting variable that is proportional to the original weight (TOTWGT). For example, the sampling weights for a large country could be divided by a constant to make them smaller, and the weights of a smaller country could be multiplied by a constant to make them bigger. Regardless of which constant is used within a country, the weighted estimates of the means and proportions obtained from each of these proportional transformations of the weights will be exactly the same.

SENWGT Senate Weight

The SENWGT sampling weight is TOTWGT multiplied by 500 divided by the sum of the weights over all students in the target grade in each country. This results in a sample size of 500 in each country. SENWGT may be used in cross-country analyses in which each country should be treated equally. When SENWGT is used as the sampling weight for international estimates, the contribution of each country is the same, regardless of the size of the population.

HOUWGT House Weight

The HOUWGT sampling weight is TOTWGT multiplied by the ratio of the sample size (the number of students, n) in each country divided by the sum of the weights over all students in the target grade. HOUWGT may be used when the actual sample size is required for performing significance tests. Although some statistical computer software packages allow the sample size to be used as the divisor in the computation of standard errors, others will use the sum of the weights, which results in severely deflated standard errors for the statistics if TOTWGT is used as the weighting variable. HOUWGT

is the preferred sampling weight for analyses using such software. Because of the clustering effect in most TIMSS samples, it may also be desirable to apply a correction factor such as a design effect to the HOUWGT variable.

Weight Variables Included in the Student-Teacher Linkage Files

The individual student sampling weights generally should be used when you want to obtain estimates at the student level. The exception is when student and teacher data are to be analyzed together. In this case, a separate set of weights have been computed to account for the fact that a student could have more than one teacher. This set of weights is included in the Student-Teacher Linkage file and is listed below.

TCHWGT

This weight is computed by dividing the sampling weight for the student by the number of teachers that the student has. This weight should be used to obtain estimates regarding students and their teachers.

MATWGT

This weight is computed by dividing the sampling weight for the student by the number of mathematics teachers that the student has. This weight should be used to obtain estimates regarding students and their teachers.

SCIWGT

This weight is computed by dividing the sampling weight for the student by the number of science teachers that the student has. This weight should be used to obtain estimates regarding students and their teachers.

The Student-Teacher Linkage file also includes variables that indicate the number of teachers the student has.

Weight Variables Included in the School Data Files

As described earlier in this chapter, the schools in the TIMSS sample constituted the first stage of sampling and were chosen randomly. However, the school sample was designed to optimize the student sample rather than provide an optimal sample of schools, and is rather small in most countries – about 150 schools at each grade level. Also, because schools generally were sampled with

probabilities proportional to size, large schools tend to occur in the sample more frequently than in the school population. Despite these concerns, it is possible to conduct analyses at the school level using the TIMSS data, provided the SCHWGT variable is used as a sampling weight.

SCHWGT School-level Weight

The school sampling weight SCHWGT is the inverse of the probability of selection of the school, multiplied by its corresponding non-participation adjustment factor. It is the product of WGTFAC1 and WGTADJ1.

2.7 Using the Jackknife to Estimate Sampling and Imputation Variance

When analyzing data from complex designs such as TIMSS, it is important to compute realistic error variance estimates for the statistics of interest. In TIMSS, this error variance comes from two sources: the sampling process and the imputation process.

Estimating Sampling Variance

The TIMSS 2003 sampling design applied a stratified multistage cluster-sampling technique to the problem of selecting efficient and accurate samples of students while working with schools and classes. This design capitalized on the structure of the student population (i.e., students grouped in classes within schools) to derive student samples that permitted efficient and economical data collection. Unfortunately, however, such a complex sampling design complicates the task of computing standard errors to quantify sampling variability, as the computational formulas derived from assumptions of simple random sampling generally underestimate the true variability in the data. To avoid this problem, TIMSS uses the jackknife repeated replication technique (JRR) (Wolter, 1985), one of a class of techniques that estimates sampling error through repeated resampling of the ogiginally-sampled data. The jackknife was chosen by TIMSS because it is computationally straightforward and provides approximately unbiased estimates of the sampling errors of means, totals, and percentages.

The variation on the JRR technique used in TIMSS 2003 is described in Johnson and Rust (1992). It assumes that the primary sampling units, or PSUs (these are almost always schools in TIMSS) can be paired in a manner consistent with the sample design, with each pair regarded as members of a pseudo-stratum for variance estimation purposes. When used in this way, the JRR technique appropriately accounts for the combined effect of the between- and within-PSU contributions to the sampling variance. The JRR approach entails systematically

assigning pairs of schools to sampling zones, and randomly selecting one of these schools to have its contribution doubled and the other to have its contribution zeroed, so as to construct a number of "pseudo-replicates" of the original sample (also known as "jackknife" replicates). The statistic of interest is computed once for the entire original sample, and once again for each pseudo-replicate sample. The variation between the estimates for each of the replicate samples and the original sample estimate is the jackknife estimate of the sampling error of the statistic.

The following variables capture the information necessary to estimate correct standard errors using the JRR technique:

JKZONE

The variable JKZONE identifies the sampling zone to which the student's school is assigned. Zones typically contain two schools (PSUs), and because the basic TIMSS sampling plan calls for 150 schools, TIMSS uses 75 sampling zones in total. The JKZONE variable was constructed by the TIMSS sampling consultants at Statistics Canada. Working through each country's list of sampled schools, they assigned the first and second schools to the first sampling zone, the third and fourth schools to the second zone, and so on. Where a country had more than 150 schools, zones were expanded to accommodate the extra schools, as necessary. The JKZONE variable is included in both Student Background and Student Achievement data files.

JKREP

The variable JKREP identifies the school (PSU) within each zone. It can have a value of either 0 or 1. The values were randomly assigned so that they can be used to indicate the school to have its weights zeroed (records with JKREP=0) and the school to have its weights doubled (records with JKREP=1) during the jackknife procedure. The JKREP variable is included in both Student Background and Student Achievement data files.

The JRR algorithm used in TIMSS 2003 assumes that there are H sampling zones within each country (where H is 75 or less), each containing two sampled schools selected independently. The JRR variance estimate of a statistic t from the sample for a country is given by the following equation:

$$Var_{jrr}(t) = \sum_{h=1}^{H} [t(J_h) - t(S)]^2$$

where H is the number of zones in the sample for the country. The term t(S) corresponds to the statistic t for the whole sample (computed using appropriate sampling weights). The element $t(J_h)$ denotes the same statistic using the h^{th} jackknife replicate. This is computed using all cases except those in the h^{th} zone of the sample; for those in the h^{th} zone, all records with JKREP of 0 are ignored, and all records with JKREP of 1 are included twice. In practice, this is accomplished by recoding to zero the sampling weights for the records to be excluded from the replication, and multiplying by two the weights of the records to be included twice.

The computation of the JRR variance estimate for any statistic in TIMSS 2003 required the computation of the statistic up to 76 times for any given country: once to obtain the statistic for the full sample, and up to 75 times to obtain the statistics for each of the jackknife replicates. If a country had a sample of less than 150 schools, there would be less than 75 jackknife replicates.

Estimating Imputation Variance

Because the TIMSS 2003 item pool was far too extensive to be administered in its entirety to any one student, a matrix-sampling design was adopted whereby each student was given a single test booklet containing only a part of the assessment. The results for all of the booklets were then aggregated using item response theory to provide results for the entire assessment. Since each student responded to just a subset of the assessment items, multiple imputation (the generation of "plausible values") was used to derive reliable estimates of student performance on the assessment as a whole. TIMSS followed the customary procedure of generating five imputations or plausible values for each student and using the variability among them as a measure of this imputation uncertainty, or error.

The procedure for estimating the imputation variance using plausible values is the following (Mislevy, R.J., Beaton, A.E., Kaplan, B., and Sheenan, K.M., 1992). First compute the statistic t, for each set of M plausible values (in TIMSS, M is 5). The statistics t_m, where m = 1, 2, …, 5, can be anything estimable from the data, such as a mean, the difference between means, percentiles, and so forth.

Once the statistics are computed, the imputation variance is then computed as:

$$Var_{imp} = (1 + 1/M)\, Var(t_1, \ldots, t_M)$$

and is the variance of the M estimates computed using each plausible value.

The standard errors of the mathematics and science proficiency statistics reported by TIMSS include both sampling and imputation variance components. These standard errors were computed using the following formula:

$$Var(t_{pv}) = Var_{jrr}(t_1) + Var_{imp}$$

where $Var_{jrr}(t_1)$ is the sampling variance for the first plausible value and Var_{imp} is the imputation variance. The standard error is the square root of $Var(t_{pv})$.

SAS and SPSS macros that may be used to calculate these jackknife standard errors are provided with the TIMSS 2003 International Database and described later in this user guide.

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3 Content and Format of Database Files

3.1 Overview

The TIMSS 2003 international database contains achievement data and student, teacher, and school background data collected in the 49 countries that participated in TIMSS 2003. In total, the database contains responses of over 365,000 students, 38,000 teachers, and 12,000 school principals. This chapter describes the content and format of the database. Following this overview, the chapter is organized in six major sections corresponding to the types of files included in the database. Within each section, the contents of the files are described. These file types are:

Data Files

The TIMSS 2003 data files reflect the result of an extensive series of data management and quality control steps taken to ensure the international comparability, quality, accuracy, and general utility of the database in order to provide a strong foundation for secondary analyses. They contain responses to background questionnaires administered to students, their teachers, and the principals of their schools. As part of the international data files, variables derived for reporting in the international reports are also included. The database also contains student achievement data and scoring reliability data, as well as the responses to national curriculum questionnaires provided by the National Research Coordinators.

Codebook Files

Codebook files document the structure of each of the data files as well as information about the format of the variables in each of the data files.

Data Almanacs

Data Almanac files contain weighted summary statistics for each participating country on each achievement item and each variable in the student, teacher, and school background questionnaires.

Program Files

Several program files are provided for use in secondary analyses, including Data Access Control Files for converting the raw data files provided in ASCII format into SAS or SPSS files; SAS and SPSS macro programs for computing statistics from the plausible values discussed in Chapter 2 using the jackknife repeated replication method; and SAS and SPSS macro programs for converting achievement item response codes to score values used in the computation of international scores.

Item Information Files

The Item Information files contain information about the cognitive test items, including item identification, item type, scoring key, number of points, label, and content and cognitive domains.

Test-Curriculum Matching Analysis Files

TIMSS 2003 asked each country to indicate which items on the assessment, if any, were not included in its curriculum. Using these data, Test-Curriculum Matching Analysis (TCMA) files were created that enable each country to compare its performance to that of all the other countries on only those items appropriate for its curriculum. Also, the performance of its students on items judged appropriate for the curricula in other countries can be compared.

The following sections describe each of the file types and how they can be used to access and analyze the TIMSS international data.

3.2 The Data Files

Data files are provided for each country that participated in TIMSS and for which internationally comparable data are available.

There are five basic types of data files in the TIMSS International Database:

- Background files with information from students, their mathematics teachers, their science teachers, and the principals of their schools. These also include student mathematics and science scores (plausible values) on the assessment.
- Achievement files with responses to the items on the TIMSS test
- Constructed-Response Scoring Reliability files
- Student Teacher-Linkage files

- Curriculum Questionnaire files.

These files and the variables contained in each are described below.

Data File and Variable Naming Conventions

Before describing the various data files, this section presents the file and variable-naming conventions used in the TIMSS database. It also describes how the variables are organized in the database.

Data File Naming Convention

The filenames of the data files included with this database consist of an eight character string followed by a three character file extension, and use the following conventions:

- The first character of the files is "B" for the eighth grade and "A" for the fourth grade.
- The second character indicates the source or level of the information in the file:

C	indicates a school-level file
T	indicates a teacher-level file
S	indicates a student-level file
U	indicates a curriculum questionnaire file.

- The third character indicates the type of data in the file. The following abbreviations are used:

A	Student Achievement Booklets
G	General Background Questionnaires (School, Student and Curriculum Questionnaires), and the General Teacher Questionnaire for the fourth grade
M	Mathematics Teacher Background Questionnaires
R	Constructed-Response Scoring Reliability (scoring reliability sample of student test booklets)
S	Science Teacher Background Questionnaires
T	Student-Teacher Linkage Files.

- Characters four through six identify the country using a three-character alphanumeric country abbreviation following the ISO coding scheme. Exhibits 3.2 and 3.3 list the ISO codes for each participating country. The Curriculum Questionnaire files use the three-letter combinations

MAT and SCI to represent their contents as Mathematics and Science respectively.

- The seventh and eighth characters indicate the study cycle:

M1	stands for the 1995 files
M2	stands for the 1999 files
M3	stands for the 2003 files

- The three-character file extensions used for the data files are as follows:

.RAW	indicates ASCII data
.EXP	indicates SAS export data
.SAV	indicates SPSS data
.XLS	indicates Excel format for the Curriculum Questionnaire files.

For each file type, a separate data file is provided for each participating country. For TIMSS 2003 we also have SAS export and SPSS system files (extensions .EXP and .SAV). Files are not provided for countries for which data are not available. There are separate Curriculum Questionnaire files by grade and subject in Excel format, with all contributing countries' data included. The file names in Exhibit 3.1 illustrate the naming conventions for each of the data files across the three TIMSS survey cycles.

Exhibit 3.1 TIMSS Data Files

File Type	1995 Files	1999 Files	2003 Files
Student Achievement Files	BSA<Country>M1, ASA<Country>M1	BSA<Country>M2	BSA<Country>M3, ASA<Country>M3
Student Background Files	BSG<Country>M1, ASG<Country>M1	BSG<Country>M2	BSG<Country>M3, ASG<Country>M3
Teacher Background Files (M is for Mathematics, S is for Science)	BTM<Country>M1, BTS<Country>M1, ATG<Country>M1	BTM<Country>M2, BTS<Country>M2	BTM<Country>M3, BTS<Country>M3, ATG<Country>M3
School Background File	BCG<Country>M1, ACG<Country>M1	BCG<Country>M2	BCG<Country>M3, ACG<Country>M3
Student – Teacher Linkage File	BST<Country>M1, AST<Country>M1	BST<Country>M2	BST<Country>M3, AST<Country>M3
Student Achievement Scoring Reliability File	BSR<Country>M1, ASR<Country>M1	BSR<Country>M2	BSR<Country>M3, ASR<Country>M3
Curriculum Questionnaire File			BUGMATM3, BUGSCIM3, AUGMATM3, AUGSCIM3

The three-character abbreviations used for each TIMSS country are listed in Exhibits 3.2 and 3.3, along with a numeric code for each country that is used to identify the country in the data files (see the following section discussing identification variables). Each file that is available within a country is annotated with a "•" in Exhibits 3.2 and 3.3. Although Exhibits 3.2 and 3.3 also show the files available in TIMSS 1995 and 1999, these files are not included in the TIMSS 2003 database.[1]

[1] The TIMSS 1995 and 1999 Databases can be downloaded from www.timss.bc.edu to perform trend analyses.

Exhibit 3.2 Country Identification and Availability of Data Files for the Eighth Grade

Country	ISO Code	Numeric Code	BSG 95	BSA 95	BTM 95	BTS 95	BST 95	BCG 95	BSG 99	BSA 99	BTM 99	BTS 99	BST 99	BCG 99	BSR 99	BSG 03	BSA 03	BTM 03	BTS 03	BST 03	BCG 03	BSR 03
Armenia	ARM	051														●	●	●	●	●	●	●
Australia	AUS	036	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bahrain	BHR	048														●	●	●	●	●	●	●
Belgium (Flemish)	BFL	956	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Botswana	BWA	072														●	●	●	●	●	●	●
Bulgaria	BGR	100		●					●	●	●	●	●	●	●	●	●	●	●	●	●	●
Chile	CHL	152							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Chinese Taipei	TWN	158							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Cyprus	CYP	196	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Egypt	EGY	818														●	●	●	●	●	●	●
England	ENG	926	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Estonia	EST	233														●	●	●	●	●	●	●
Ghana	GHA	288														●	●	●	●	●	●	●
Hong Kong, SAR	HKG	344	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hungary	HUN	348	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Indonesia	IDN	360							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Iran, Islamic Rep. of	IRN	364	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Israel	ISR	376	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Italy	ITA	380	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Japan	JPN	392	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Jordan	JOR	400							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Korea, Rep. of	KOR	410	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Latvia	LVA	428	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Lebanon	LBN	422														●	●	●	●	●	●	●
Lithuania	LTU	440	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Macedonia, Rep. of	MKD	807							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Malaysia	MYS	458							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Moldova, Rep. of	MDA	498							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Morocco	MAR	504							●	●	●	●	●	●	●	●	●	●	●	●	●	●
Netherlands	NLD	528	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
New Zealand	NZL	554	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Norway	NOR	578	●	●	●	●	●	●								●	●	●	●	●	●	●
Palestinian Nat'l Auth.	PSE	275														●	●	●	●	●	●	●
Philippines	PHL	608							●	●	●	●	●	●	●	●	●	●	●	●	●	●

"●" Indicates that file is available.

Exhibit 3.2 Country Identification and Availability of Data Files for the Eighth Grade
(…Continued)

Country	ISO Code	Numeric Code	BSG 95	BSA 95	BTM 95	BTS 95	BST 95	BCG 95	BSG 99	BSA 99	BTM 99	BTS 99	BST 99	BCG 99	BSR 99	BSG 03	BSA 03	BTM 03	BTS 03	BST 03	BCG 03	BSR 03
Romania	ROM	642	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Russian Federation	RUS	643	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Saudi Arabia	SAU	682														●	●	●	●	●	●	●
Scotland	SCO	927	●	●	●	●	●	●								●	●	●	●	●	●	●
Serbia	SCG	891														●	●	●	●	●	●	●
Singapore	SGP	702	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovak Republic	SVK	201	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Slovenia	SVN	705	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
South Africa	ZAF	710	●	●					●	●						●	●	●	●	●	●	●
Sweden	SWE	752	●	●	●	●	●	●								●	●	●	●	●	●	●
Syrian Arab Republic	SYR	760														●	●	●	●	●	●	●
Tunisia	TUN	788							●	●	●	●	●	●	●	●	●	●	●	●	●	●
United States	USA	840	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Benchmarking Participants																						
Basque Country, Spain	BSQ	3724														●	●	●	●	●	●	●
Indiana State, US	UIN	11800							●	●	●	●	●	●		●	●	●	●	●	●	●
Ontario Province, Can.	COT	9132	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Quebec Province, Can.	CQU	9133	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●

"●" Indicates that file is available.

Exhibit 3.3 Country Identification and Availability of Data Files for the Fourth Grade

Country	ISO Code	Numeric Code	ASG 95	ASA 95	ATG 95	AST 95	ACG 95	ASG 03	ASA 03	ATG 03	AST 03	ACG 03	ASR 03
Armenia	ARM	051						●	●	●	●	●	●
Australia	AUS	036	●	●	●	●	●	●	●	●	●	●	●
Belgium (Flemish)	BFL	956						●	●	●	●	●	●
Chinese Taipei	TWN	158						●	●	●	●	●	●
Cyprus	CYP	196	●	●	●	●	●	●	●	●	●	●	●
England	ENG	926	●	●	●	●	●	●	●	●	●	●	●
Hong Kong, SAR	HKG	344	●	●	●	●	●	●	●	●	●	●	●
Hungary	HUN	348	●	●	●	●	●	●	●	●	●	●	●
Iran, Islamic Rep. of	IRN	364	●	●	●	●	●	●	●	●	●	●	●

"●" Indicates that file is available.

Exhibit 3.3 Country Identification and Availability of Data Files for the Fourth Grade *(…Continued)*

Country	ISO Code	Numeric Code	ASG 95	ASA 95	ATG 95	AST 95	ACG 95	ASG 03	ASA 03	ATG 03	AST 03	ACG 03	ASR 03
Italy	ITA	380	●	●	●	●	●	●	●	●	●	●	●
Japan	JPN	392	●	●	●	●	●	●	●	●	●	●	●
Latvia	LVA	428	●	●	●	●	●	●	●	●	●	●	●
Lithuania	LTU	440						●	●	●	●	●	●
Moldova, Rep. of	MDA	498						●	●	●	●	●	●
Morocco	MAR	504						●	●	●	●	●	●
Netherlands	NLD	528	●	●	●	●	●	●	●	●	●	●	●
New Zealand	NZL	554	●	●	●	●	●	●	●	●	●	●	●
Norway	NOR	578	●	●	●	●	●	●	●	●	●	●	●
Philippines	PHL	608						●	●	●	●	●	●
Russian Federation	RUS	643						●	●	●	●	●	●
Scotland	SCO	927	●	●	●	●	●	●	●	●	●	●	●
Singapore	SGP	702	●	●	●	●	●	●	●	●	●	●	●
Slovenia	SVN	705	●	●	●	●	●	●	●	●	●	●	●
Tunisia	TUN	788						●	●	●	●	●	●
United States	USA	840	●	●	●	●	●	●	●	●	●	●	●
Yemen	YEM	887											
Benchmarking Participants													
Indiana, US	UIN	11800						●	●	●	●	●	●
Ontario Province, Can.	COT	9132	●	●	●	●	●	●	●	●	●	●	●
Quebec Province, Can.	CQU	9133	●	●	●	●	●	●	●	●	●	●	●

"●" Indicates that file is available.

All TIMSS data files are provided in ASCII, SAS export, and SPSS format. The Curriculum Questionnaire files are provided in Excel format. All details of the file structure are provided in the codebook files that correspond to each of the data files.[2] The use of these codebooks is described later in this chapter.

Background Variable Naming Convention

International background variables obtained from the student, mathematics teacher, science teacher, school and curriculum questionnaires are provided in the corresponding background data files. In general, the background variables are provided for all countries where the data are considered internationally comparable. In a few cases, some slightly modified specific country options

[2] The curriculum questionnaire files do not have codebooks.

were retained in the international variables. The Codebook files contain the international background variable names, descriptive labels, response code definitions, formats, and field locations corresponding to each questionnaire item.

In addition to the background variables contained in the questionnaires, a number of derived variables were computed for use in the international report. These derived variables, many of which use data from more than one source, are also included in the International Database for use in secondary analyses. The derived variables can be used to reproduce the values shown in the international report tables by applying the appropriate school, teacher or student filters and weights.

The naming convention for the background variables permits the identification of the survey population and data source based on 7- or 8-character codes. These are the variables that capture the responses given to the survey instruments (background questionnaires). The following convention is followed in naming these variables:

- The first character indicates the population. "B" is used to indicate eighth grade, and "A" is used to indicate fourth grade.
- The second character indicates the type of respondent. The following abbreviations are used:

C	School Principal
T	Teacher
S	Student.

- The third character indicates the type of question. The following abbreviations are used:

B	Background Questionnaire
D	Derived Variable.

- The fourth character indicates the subject or topic to which a questionnaire item refers. The following abbreviations are used[3]:

G	General Questionnaire Item (not subject specific)
M	Questionnaire item related to Mathematics
S	Questionnaire item related to General Science (including Environmental Science)
B	Questionnaire item related to Biology or Life Science
E	Questionnaire Item related to Earth Science
C	Questionnaire item related to Chemistry
P	Questionnaire item related to Physics.

[3] Please note that "B," "P," "E," and "C" are only used in the student background data file for variables corresponding to questions about separate sciences asked in the separate science version of the student questionnaire.

- For Background Questionnaire variables in TIMSS data files, the fifth through eighth characters indicate a question name and are unique to each variable.

The variable names in the curriculum questionnaire files follow a different naming convention. They are identical to their location code, as described in the following section.

Background Variable Location Convention

To help identify the location of the background variables in the corresponding background questionnaire, a convention has been developed that identifies the questionnaire and location within the questionnaire for each variable. This convention is followed in the Data Almanacs and in the description of the variables included in the Supplements to this User Guide (provided on the database DVD). Following this questionnaire convention, each questionnaire has been assigned a unique identification code as shown in Exhibit 3.4. This unique code is followed by the sequence number of the question within the questionnaire. For example, if the location of a variable is indicated as SQ1-06, this refers to the Question 6 in the student background questionnaire.

Exhibit 3.4 Background Questionnaire Variable Location Conventions

Questionnaire	Location Code
Student Questionnaire	SQ2-*** for 8th grade general science SQ2S-*** for 8th grade specific science, SQ1-*** for 4th grade
Teacher Questionnaire	TQM2-*** for 8th grade mathematics TQS2-*** for 8th grade science, TQ1-*** for 4th grade
School Questionnaire	SCQ2-*** for 8th grade, SCQ1-*** for 4th grade
Curriculum Questionnaire	CQM2q*** for 8th grade mathematics, CQM1q*** for 4th grade mathematics CQS2q*** for 8th grade science, CQS1q*** for 4th grade science

*** = the sequential numbering of the question location in the questionnaire.

Achievement Item Naming Convention

The achievement item variable names are based on 7- or 8-character alphanumeric codes according to the general definitions given below.

For the TIMSS test items, the following convention was used:

- The first character indicates the subject of the item. The code "M" is used for Mathematics, and "S" is used for Science.
- The second and third character indicates the assessment year when the item was first used in TIMSS. The code "01" is used for TIMSS 1995, "02" is used for TIMSS 1999, "03" is used for TIMSS 2003. Additionally, the characters "F" and "C" are used in place of the "0" for "free" items and "calculator" items, respectively. The calculator items are described in Sections 2.3 and 2.6 and the "free" items are described in Sections 10.5 and 11.3 of the TIMSS 2003 Technical Report (Martin, Mullis, & Chrostowski, 2004).
- The fourth character indicates the population for which the item was developed originally. The code "2" is used for TIMSS eighth grade, and "1" is used for the fourth grade.

- The fifth, sixth, and seventh characters are a sequential item number ranging from 001 and possibly up to 999.
- The eighth character indicates the item part. This was used only for constructed-response items. In general a constructed-response item asked one question, but in a few cases two or three questions were asked. This character was used when more than one question was asked as part of an item. In some cases for analysis purposes two of these questions were collapsed into one variable. The individual parts and the collapsed variables are all included in the database. The following codes were used:

A	First question in the item
B	Second question in the item
D	Derived variables based on combined scores of either parts A and B when appropriate

As an example, the variable M012001A is the eighth grade mathematics item number 001, Part A, first administered in TIMSS 1995; the item S022249D is the eighth grade science item number 249, derived from combining two of the responses to item S022249, and was first administered in TIMSS 1999.

Coding Convention

A series of conventions also were adopted to code the data included in the data files. This section describes such conventions.

Background Item Response Code Values

The values assigned to each of the background item variables depend on the item format and the number of options available. For the multiple-choice items, one-digit numerical values are used to correspond to the response option. This number corresponds to the sequence of the letter in the alphabet. For example, response option A is represented with a 1, response option B with a 2, etc. Constructed-response items such as "number of students in a class" are coded with the actual number given as a response to the question.

Achievement Item Response Code Values

The values assigned to each of the achievement item variables also depend on the item format. For the multiple-choice items, one-digit numerical values of 1-5 are used to correspond to the response options A through E. For these items, the correct response is included as part of the item-variable label in the codebook files and program code is included as part of the database to score these items.

For the constructed-response achievement test items, two-digit numerical codes are used that correspond to the diagnostic scoring rubrics used to determine fully-correct, partially-correct, and incorrect responses for each item. As described in Chapter 1 of the TIMSS 2003 Technical Report (Martin, Mullis, & Chrostowski, 2004)., the correctness score level may be determined by the first digit of these codes (codes 20 through 29 are worth 2 points; 10 through 19 are worth 1 point; and 70 through 79 are worth 0 points).

For some constructed-response items, students are asked to provide an answer with supporting work, or to provide two reasons, examples, consequences, etc. The two parts of the answer (parts A and B) are scored separately. In addition to the score given for each part contained in the part A and part B variables, the total score for the item as a whole is derived. The total score for the item is contained in an associated derived variable, indicated by a final character of D. For example, derived variable S012135D contains the combined score for item parts S012135A and S012135B. For the majority of these items, each item part is worth one point, and the derived variables have the following code values:

Code 20	Full credit (1 point on both parts A and B);
Code 10	Partial credit (1 point on either part A or B);
Code 70	No credit (0 points on both parts A and B).

In addition to the correctness score information, specific missing codes are defined as described in the next section. Since all achievement item variables are included for all students in the achievement files regardless of which test booklet they completed, a "Not Administered" code is given to all items that were not included in the test booklet assigned to each student.[4]

Missing Code Values

All variable values in the TIMSS international data files are numeric. Some values are reserved for missing data codes. The missing data values often depend on the field width of the variable and the variable type. However, the curriculum questionnaire files employ a single missing code value, -9, to represent all missing data.

Omitted Response Codes (ASCII: 9, 99, 999, … ; SAS: . ; SPSS: 9, 99, 999, …[5])

Omitted response codes are used for questions/items that a student, parent, teacher, or school principal should have answered but did not answer. These are coded as "Omitted" in the codebooks. For questionnaire data, no differentiation has been made between items left blank and items with invalid answers, such as checking two or more response options in a categorical question, or unreadable or uninterpretable responses

[4] See Chapter 1 for a presentation of the TIMSS test design.
[5] In TIMSS 1999 and TIMSS 1995, omitted responses were coded to sysmis in SPSS.

to constructed-response questions. In a few cases, data received from a country in an invalid or inconsistent way were also recoded to "Omitted." For achievement items, an omitted response code was given only in cases in which the item was left blank; a special code was used for invalid answers as described below. The length of the omitted response code given to a variable in the ASCII file depends on the number of characters needed to represent the variable. In all cases the space necessary to represent the variable was filled with 9's.

Uninterpretable Response Codes (ASCII: 7; SAS: .I; SPSS: 7)

For the multiple-choice achievement test items, separate codes were established to distinguish between totally blank responses (omitted) and uninterpretable or invalid responses. For these items, cases where more than one response option was checked, or where an uninterpretable response was given, were coded with a 7.

Not Administered Codes (ASCII: 8, 98, 998, ... ; SAS: .A ; SPSS: sysmis)

Special codes were given for items that were not administered to distinguish these cases from data that are missing due to non-response. The specific not administered code value given depends on the length of the field for the variable. In general, the "Not Administered" code was used when an item was not administered as part of the questionnaire or test instruments either by design, such as in the case of some of the test items, or unintentionally, such as when the item was left out of the instrument or misprinted. The "Not Administered" codes are used in the following cases:

- Achievement item not assigned to the student – only one of the twelve rotated achievement booklets used in the TIMSS study was assigned to each student. All variables corresponding to items in booklets not assigned a student were coded to "Not Administered."
- Instrument not received / instrument lost – where a respondent did not receive the instruments assigned to him/her, or the instruments were lost after administration, all items were coded to "Not Administered."
- Student absent from session – where a student or individual was not present for a particular testing session, all variables referring to that session were coded to "Not Administered."
- Item left out or misprinted – where a particular question or item (or a whole page) was misprinted or not available to the student, teacher, or principal, the corresponding variables where coded to "Not Administered."

- Achievement items omitted or mistranslated in student test booklets – Any item identified during the translation verification or item analysis processes as having a translation error, such that the nature of the question was altered was coded to "Not Administered."

- Background questionnaire items were omitted – Variables corresponding to questions in the student, teacher, or school background questionnaires that were considered not applicable in some countries were not included in their questionnaires.

- Background questionnaire items were mistranslated or not internationally comparable – In some cases, questions in the international version of the questionnaires were mistranslated or modified to fit the national situation. Whenever possible, modified background questionnaire items were recoded to match as closely as possible the international version of the items. This could not be done in all cases, however, and some national data were recoded to "Not Administered" in order to include only the internationally comparable data.

Not Applicable Response Codes (ASCII: 6, 96,... ; SAS: .B ; SPSS: 6, 96,...)

The "Not Applicable" response codes are used only for the background questionnaire items in which responses are dependent on a filter question. The specific "Not Applicable" code given depends on the number of characters needed to represent the variable, as described above for the "Omitted" response codes.

Not Reached Item Codes (ASCII: 6 ; SAS: .R ; SPSS: 6)

The "Not Reached" item codes are used only for achievement items. Items left blank at the end of each testing session were considered to be not reached. These responses are distinguished from the omitted responses, as they are handled differently during the item calibration process.

Types of Variables Included in the Data Files

Identification Variables

In all background files, several identification variables are included that provide information used to identify countries, students, teachers, or schools. These variables are used to link cases between the different data files. The identification variables have the prefix ID and are listed below.

The identification variables included in student, teacher, and school files are the following:

IDCNTRY

Five-digit country identification code. This variable should always be used as one of the link variables whenever files are linked within and across countries.

IDPOP

Identifies the population. The value is set to 1 for the fourth grade and 2 for the eighth grade.

IDSCHOOL

Identification number that uniquely identifies the school within each country. These codes for the school are not unique across countries. Schools across countries can be uniquely identified only by the IDCNTRY and IDSCHOOL combination.

Additional identification variables in the student files include the following:

IDCLASS

Identification number that uniquely identifies the sampled class within the school. The variable IDCLASS has a hierarchical structure and is formed by concatenating the variable IDSCHOOL and a two- digit sequential number identifying the sampled classroom. Classrooms can be uniquely identified in the database by the combination of IDCNTRY and IDCLASS.

IDSTUD

Identification number that uniquely identifies each sampled student in the country. The variable IDSTUD also has a hierarchical structure and is formed by concatenating the variable IDCLASS and a two-digit sequential number within each classroom. Students can be uniquely identified in the database by the combination of IDCNTRY and IDSTUD.

IDBOOK

Identifies the specific test booklet (1-12) that was administered to the student.

Additional identification variables in the teacher files include the following:

IDTEACH

Identification number that uniquely identifies a teacher within a school. It has a hierarchical structure formed by the combination IDSCHOOL and a two-digit sequential number within each school. Teachers can be uniquely identified in the database by the combination if IDCNTRY and IDTEACH.

IDLINK

This variable uniquely identifies the class for which the teacher answered the questionnaire. The combination of variables IDCNTRY, IDTEACH, and IDLINK uniquely identifies a teacher-class combination in the database.

In the Student Background file, the IDSTUD variable provides a unique identification number to identify each student within each country. Since teachers may teach more than one class, the IDTEACH and IDLINK combinations in the Teacher Background files provide a unique identification for each teacher teaching a specific class. Teacher background variables are linked to appropriate students using the Student-Teacher Linkage file. The variable IDSCHOOL, contained in all three background files, is a unique identification number for each school within a country that may be used to link school background data to corresponding students or teachers.

Linking and Tracking Variables

Information about students, teachers, and schools provided by the survey tracking forms[6] is incorporated in the linking and tracking variables. These variables have prefixes of IL or IT.

Linking and tracking variables in the Student Background Files include the following:

ITSEX	Gender of each student as stated in the student tracking form.
ITBIRTHM and ITBIRTHY	Month and year of birth of each student as stated in the student tracking forms.
ITDATEM and ITDATEY	Month and year of testing for each student.
ITLANG[7]	Language of testing for each student. Set to 1 for all countries that tested in a single language.

[6] Survey tracking forms are listings of students, teachers, or schools used for sampling and administration purposes.
[7] See Supplement 2 for a list of the languages included in each country.

	For countries that administered the test in more than one language, codes of 1, 2 and 3 were used to correspond to the order of the languages shown in Supplement 2.
ITCOURSE[8]	Tracking variable indicating the type of course taught by teachers: Mathematics = 1; Physics = 2; Biology = 3; Chemistry = 4; Earth science = 5; Integrated science (including Environmental Science) = 6; Mathematics and Integrated science (for the fourth grade) = 7; Physical Science (which combines Physics & Chemistry)[9] = 8; Life Science (which combines Biology & Earth Science)[10] = 9; and other country-specific science courses = 10, 11 or 12. This variable was also used to identify teachers for inclusion in separate science panels in the international reports' exhibits (1999 and 2003 only).
ILRELIAB	Linking variable indicating the inclusion status of each student in the reliability file containing double-coded constructed-response items. The following codes are used:
Code 1	Student questionnaire used for reliability analysis
Code 0	Student questionnaire NOT used for reliability analysis

Selection Variables

These variables are used to select cases for particular analyses. In the student files and in the Student-Teacher linkage files the following variables are included:

INTMS03	Students with INTMS03 set to "1" participated in the TIMSS 2003 achievement test and who are part of the TIMSS 2003 international sample. Otherwise this variable is set to zero.
INTMS99	In both the TIMSS 2003 and the TIMSS 1999 data sets, students with INTMS99 set to "1" participated in the TIMSS 1999 achievement test and are part of the TIMSS 1999 international sample. Otherwise this variable is set to zero.
INTMS95	In the TIMSS 2003, TIMSS 1999, and TIMSS 1995

[8] See Supplement 2 for a list of the ITCOURSE values used in each country.
[9] Student background data are entered and reported in the Physics variables.
[10] Student background data are entered and reported in the Biology variables.

	data sets, students with INTMS95 set to "1" participated in the TIMSS 1995 achievement test and are part of the TIMSS 1995 international sample. Otherwise this variable is set to zero.

Sampling and Weighting Variables

Several sampling and weighting variables are included in the student data files. These variables are described in the previous chapter and in Chapter 9 of the TIMSS 2003 Technical Report (Martin, Mullis, & Chrostowski, 2004). The variables are the following:

WGTFAC1	School Weighting Factor. This variable is included in the Student and in the School Background data files.
WGTADJ1	School Weighting Adjustment. This variable is included in the Student and in the School Background data files.
WGTFAC2	Class Weighting Factor. This variable is included in the Student Background data files.
WGTADJ2	Class Weighting Adjustment. This variable is included in the Student Background data files.
WGTFAC3	Student Weighting Factor. This variable is included in the Student Background data files.
WGTADJ3	Student Weighting Adjustment. This variable is included in the Student Background data files.
TOTWGT	Total Student Weight. This variable is included in the Student Background data files.
SENWGT	Student Senate Weight. This variable is included in the Student Background data files.
HOUWGT	Student House Weight. This variable is included in the Student Background data files.
TCHWGT	Overall Teacher Weight. This variable is included in the Student-Teacher Linkage data files.
MATWGT	Mathematics Teacher Weight. This variable is included in the Student-Teacher Linkage data files.
SCIWGT	Science Teacher Weight. This variable is included in the Student-Teacher Linkage data files.
SCHWGT	School-level Weight. This variable is included in the School Background data file.

JKZONE	The sampling zone or stratum to which the student's school is assigned. This variable is included in the School Background, Student Background and Student-Teacher Linkage data files.
JKREP	The primary sampling unit to which the student is assigned. This variable is included in the School Background, Student Background and Student-Teacher Linkage data files.

Achievement Variables

Several achievement variables are also included in the Student data files. These variables are described in Chapter 2. The achievement variables included, for both the eighth and fourth grades, are the following:

BSMMAT01-5, ASMMAT01-5	Mathematics Overall: Plausible Values 1-5, fourth and eighth grades
BSMFNS01-5, ASMFNS01-5	Number: Plausible Values 1-5, fourth and eighth grades
BSMALG01-5	Algebra: Plausible Values 1-5, eighth grades
ASMALG01-5	Patterns and Relationships: Plausible Values 1-5, fourth grades
BSMMEA01-5, ASMMEA01-5	Measurement: Plausible Values 1-5, fourth and eighth grades
BSMGEO01-5, ASMGEO01-5	Geometry: Plausible Values 1-5, fourth and eighth grades
BSMDAP01-5, ASMDAP01-5	Data: Plausible Values 1-5, fourth and eighth grades
BSSSCI01-5, ASSSCI01-5	Science Overall: Plausible Values 1-5, fourth and eighth grades
BSSLIS01-5, ASSLIS01-5	Life Science: Plausible Values 1-5, fourth and eighth grades
BSSCHE01-5	Chemistry: Plausible Values 1-5, eighth grades
BSSPHY01-5	Physics: Plausible Values 1-5, eighth grades
ASSPHY01-5	Physical Science: Plausible Values 1-5, fourth grades
BSSEAS01-5, ASSEAS01-5	Earth Science: Plausible Values 1-5, fourth and eighth grades
BSSERI01-5	Environmental Science: Plausible Values 1-5, eighth grades

BSMSCPT,ASMSCPT	Number of raw score points obtained on the mathematics items, fourth and eighth grades
BSSSCPT,ASSSCPT	Number of raw score points obtained on the science items, fourth and eighth grades
BSMSTDR,ASMSTDR	Standardized mathematics raw scores, fourth and eighth grades
BSSSTDR,ASSSTDR	Standardized science raw scores, fourth and eighth grades
BSMNRSC,ASMNRSC	National Rasch Mathematics Scores, fourth and eighth grades
BSSNRSC,ASSNRSC	National Rasch Science Scores, fourth and eighth grades
BSMIBM01-5,ASMIBM01-5	International Mathematics Benchmarks reached with plausible values, fourth and eighth grades
BSSIBM01-5,ASSIBM01-5	International Science Benchmarks reached with plausible values, fourth and eighth grades

TIMSS Background Data Files

There are three different types of TIMSS background files – Student, Teacher, and School. These are described below.

Student Background File

Students who participated in TIMSS were administered a background questionnaire with questions related to home background, school experiences, and attitudes to mathematics and science. The Student Background file contains students' responses to these questions. It also contains students' mathematics and science achievement scores (plausible values) to facilitate analyses of relationships between background characteristics and achievement. Two versions of the student questionnaire were administered in TIMSS for the eighth grade. One version was for educational systems where science is taught as an integrated subject (general science version). The other version was for educational systems where the sciences (biology or life science, earth science, physics, chemistry, and environmental science) are taught separately (separate science version).

At the fourth grade, there was a single version of the student questionnaire, tailored toward general science. For eighth-grade students who were administered the general science version, questions that were given only in the separate science version were coded as not administered. For students who were assigned the separate science version, questions that were asked only in the general science version were coded as not administered. The Student

Background files also contain a series of identification variables, link variables, sampling variables, achievement variables, and the derived variables that were used for the creation of the international reports.

Teacher Background File

The mathematics and science teachers of the eighth-grade students that were sampled for TIMSS were administered at least one questionnaire with questions pertaining to their background and their teaching practices in the classes of the sampled students. Each teacher was asked to respond to a questionnaire for each class taught that contained sampled students. The Teacher Background files contain one record for each of the classes taught either by a mathematics or a science teacher. If a teacher taught more than one class, they were expected to complete only one part A (general background questions) and a separate part B (class-specific questions) for each class they taught. In some cases, although the teacher was to respond to more than one questionnaire, responses to only one were obtained. In these cases, there were as many records entered in the teacher file as classes were taught by the teacher, and the background information in part A from the complete questionnaire was entered into these teacher records. There were two questionnaires administered in TIMSS for the eighth grade–one for the mathematics teachers and one for the science teachers. The data from these questionnaires are found in separate files. Variable names for questions asked in both questionnaires are the same. At the fourth grade, the situation was more straightforward, with a single teacher questionnaire requesting information on both mathematics and science.

In the Teacher Background data files at both grade levels, each teacher has an unique identification number (IDTEACH) and a Teacher Link Number (IDLINK) that is specific to the class taught by the teacher and to which the information in the data record corresponds. The IDTEACH and IDLINK combination uniquely identifies a teacher teaching a specific class. So, for example, students linked to teachers identified by the same IDTEACH but different IDLINK are taught by the same teacher but in different classes. The Teacher Background files cannot be merged directly with the student data files and they do not contain sampling information or achievement scores. It is important to note that the teachers in the Teacher Background data files do not constitute a representative sample of teachers in a country, but rather are the teachers who taught a representative sample of students. The teacher data should therefore be thought of as attributes of the students to which it is linked, and should be analyzed only in conjunction with the Student-Teacher Linkage file. As well as the responses of the teachers to the background questions, the Teacher Background data files contain the identification and link variables necessary to merge them with schools and students.

School Background File

The principals or administrators of the schools in the TIMSS sample were administered a school background questionnaire with questions about school policy, resources, and environment. The School Background data file contains the responses given to the questions in this questionnaire. That file also contains a series of identification variables, link variables, and sampling variables. The school data files can be merged with the student data files by using the country and school identification variables.

Student Achievement Data Files

Student achievement files contain the student responses to the mathematics and science achievement items in the TIMSS achievement test.

Students who participated in TIMSS were administered one of twelve test booklets with questions in both mathematics and science. Some of these questions were multiple-choice questions and some were constructed-response. The achievement test data files contain the answers to the multiple-choice questions and the codes assigned by the scorers to the student responses for constructed-response questions. Items not included in the students test booklet were coded as "not administered". The number of the test booklet (1-12) administered to the student is coded in the variable IDBOOK. The student achievement data files also contain a series of identification variables, sampling variables, and achievement scores. The data contained in this file can be linked to the student background data files by using the variables IDCNTRY and IDSTUD.

Scoring Reliability Data Files

The scoring reliability files for fourth and eighth grades contain data that can be used to investigate the within-country reliability of the TIMSS constructed-response item scoring. The scoring reliability files contain one record for each booklet that was double scored during the scoring reliability exercise of the constructed-response items.

For each constructed-response item in the achievement test, the following three variables are included:

- Original Score (two-digit score assigned by the first scorer)
- Second Score (two-digit score assigned by second scorer)
- Response Score Agreement (degree of agreement between the two scorers)

It should be noted that the Second Score data were used only to evaluate the within-country sampling reliability and were not used in computing the achievement scores reflected in the Student Background files and the international reports.

Scoring Reliability Variable Naming Convention

The variable names for the Original Score, Second Score, and Agreement Score variables are based on the same general naming system as that for the achievement item variables shown earlier. The second character in the variable name differentiates the three reliability variables:

0	Original Score (e.g. M012001)
R	Second Score Variable (e.g. MR12001)
I	Agreement Score Variable (e.g. MI12001)

Reliability Score Values

The values contained in both the Original Score and Second Score variables are the two-digit diagnostic codes obtained using the TIMSS scoring rubrics. The Agreement Score variable may have one of three values depending on the degree of agreement between the two scorers:

Code 0	Identical codes (both digits in the original and second scores)
Code 1	Identical score level but different diagnostic code (first digits are the same; second digits are different)
Code 2	Different score level (first digits are different)

In general, the values contained in the Original Scores are identical to those contained in the Student Achievement test files. In some cases, however, the response codes for specific items were recoded after a review of the international item statistics revealed inconsistencies in the original coding guides or showed that the original codes were not functioning as desired. The recoded diagnostic code values were used in computing the achievement scores reflected in the international reports, and the response codes in the Student Achievement test files reflect the recoded values. However, the Original Scores in the scoring reliability files contain the original unrecoded response codes.

In addition to the scoring reliability variables, the reliability files also include identification variables to aid in case identification. Some tracking variables are also included that were used in conducting the scoring reliability study within each country.

Student-Teacher Linkage Files

The Student-Teacher Linkage files for TIMSS contain information required to link the student and teacher files and to compute appropriately weighted teacher-level data for use in student-level analyses.

The Student-Teacher Linkage files contain one entry per student-teacher linkage combination in the data. In many cases, students are linked to more than one mathematics and/or science teacher, and in these cases there will be one record for each student-teacher link. In addition, in some countries many students may also have more than one teacher for each of the two subject areas. For instance, if three teachers are linked to a student, there are three entries in the file corresponding to that student.

Curriculum Questionnaire Files

The Curriculum Questionnaire files for TIMSS contain information provided by the National Research Coordinators of the participating countries on the intended Mathematics and Science curricula at both target grades in their country. There are four curriculum questionnaire files: fourth-grade Mathematics, fourth-grade Science, eighth-grade Mathematics and eighth-grade Science.

The Curriculum Questionnaire files are in Excel format, with each file containing one entry per country.

National Data Issues Affecting the Use of International Data Files

In some cases, resources were not available to resolve database issues for specific countries in time for either the release of the international reports or the production of the international data files for TIMSS 2003. As a result, some international data are modified or not available for some countries. These general database issues as they pertain to the TIMSS 2003 data are documented below on a country-by-country basis. Similar database issues pertaining to the 1995 and 1999 databases are documented in the 1999 User Guide since they impact the ability to perform trend analyses in some cases.

Armenia

In Armenia, the separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Belgium (Flemish)

In Belgium (Flemish), eighth-grade students are enrolled in three science courses (physics, biology, and earth science). In some schools there are natural science and/or scientific work courses. In these cases, national codes 11 and 12 are used for ITCOURSE.

Bulgaria

In Bulgaria, there are eighth-grade classes where students study only mathematics and no science. In these cases, dummy records were created for the missing science teachers based on the missing ITCOURSE values for each student. Appropriate weights and student-teacher links were assigned and all background variables were set to Not Administered for the missing science teachers.

Chinese Taipei

In Chinese Taipei, eighth-grade students were asked about physical science, and the data pertain to their physics/chemistry course. There are no biology, or earth science courses. The general/integrated science questionnaire was administered to the eighth grade students.

Cyprus

In Cyprus, the separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Indonesia

In Indonesia, eighth-grade students are enrolled in two science courses (physics and biology) and, therefore, the separate science questionnaire was administered to these students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Israel

In Israel, the general/integrated science questionnaire was administered to the eighth-grade students. However, there were some separate science teachers answering the science teacher questionnaire. The student data are entered and reported in the general/integrated science variables.

Lebanon

In Lebanon, eighth-grade biology pertains to life and earth science courses. In this case, code 9 is used for ITCOURSE. The separate science questionnaire was administered to the eighth-grade students. However, there were some separate science teachers answering the science teacher questionnaire. The student data are entered and reported in the separate science variables.

Macedonia

In Macedonia, the separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Moldova

In some schools, there is a combined Biology/Chemistry course. In these cases, a national code 10 is used for ITCOURSE. The separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers and some mathematics teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Morocco

In Morocco, eighth- grade biology pertains to life science (biology/earth science), and eighth-grade physics pertains to physical science (physics/ chemistry). In these cases, codes 8 and 9 are used for ITCOURSE. There were some missing ITCOURSE values for science teachers since there is no information available on the science course taught by these teachers.

Philippines

In the Philippines, eighth-grade general/integrated science students study only biology. The student data are entered and reported in the general/ integrated science variables.

Slovak Republic

In the Slovak Republic, the separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The ITCOURSE values are set to Not Administered for these teachers and the data were not used for the International Report.

Sweden

In Sweden, the separate science questionnaire was administered to the eighth-grade students. However, there were some general/integrated science teachers answering the science teacher questionnaire. The student data are entered and reported in the separate science variables.

Syrian Arab Republic

The Syrian Arab Republic adopted classroom sampling procedures that did not meet the TIMSS sampling standards, and therefore their data were summarized in appendices of the International Reports.

Yemen

Yemen adopted classroom sampling procedures that did not meet the TIMSS sampling standards, and therefore their data were summarized in appendices of the International Reports.

3.3 Codebook Files

All information related to the structure of the data files as well as the source, format, descriptive labels, and response option codes for all variables are contained in codebook files. One codebook file is provided for each of the data files listed earlier.

The naming convention of the codebook files is as follows:

- The first character of the file name is "B" for eighth grade data and "A" for fourth grade data.
- The second character indicates the source or level of the information in the file:

C	indicates a school level file
T	indicates a teacher level file
S	indicates a student level file

- The third character indicates the subject and/or type of the data in the file. The following abbreviations are used, listed in alphabetical order:

A	Student Achievement Files
G	General Background Questionnaires (School, Student, and fourth grade Teacher Questionnaires)
M	Mathematics Teacher Background Questionnaire
R	Constructed-Response Scoring Reliability (scoring reliability sample of Student Test booklets)
S	Science Teacher Background Questionnaire
T	Student-Teacher Linkage File

- The next three characters identify the file as a codebook and it is always "CBK".

- The seventh and eighth characters indicate the study cycle

M1	stands for the 1995 achievement files
M2	stands for the 1999 achievement files
M3	stands for the 2003 achievement files

- The three-character file extensions used for the codebook files were the following:

.CDT	Codebook in ASCII text format
.SDB	Codebook in Dbase format

Accessing the Codebook Files

The codebook file types are included in the database DVD. The ASCII format codebooks can be read and edited with any text editor or word processing software that can read files of their size, and can be printed after some minor formatting. Using a mono-spaced font and a font size and page layout combination that will accommodate 132 characters per line is suggested. The information for each variable is presented in several lines of text. The lines for each variable are properly labeled.

Using the Codebooks

The variables in the codebooks appear ordered by variable name within sections for each codebook type. The major sections of each codebook type are as follows:

Student, Teacher, and School Background File Codebooks

- Identification Variables
- Tracking/Linking Variables
- International Background Variables (in order of questionnaire item location)
- Sampling Variables (Student and School Files only)
- Mathematics and Science Achievement Score Variables (Student Files only)
- Derived Variables

Student Achievement Test File Codebooks

- Identification Variables
- Tracking/Linking Variables
- Mathematics and Science Achievement Item Variables (in order by item within clusters)
- Sampling Variables
- Mathematics and Science Achievement Score Variables

Student-Teacher Linkage File Codebooks

- Identification Variables
- Teacher Linking Variables
- Sampling Variables
- Mathematics and Science Achievement Score Variables

Reliability File Codebooks

- Identification Variables
- Tracking Variables
- Reliability Variables (organized into sets of three variables described previously in order by item within cluster)

The fields of the ASCII format codebooks are as follows:

Variable Number: The first column (Var. No.) contains a sequential number for each variable in the codebook file.

Question: The second column describes the source of the variable (e.g., for variables from a background questionnaire, this is the questionnaire and question number).

Variable Name: The third column (Variable Name) contains the variable name. The naming system is described in the previous sections on the contents of data files.

Variable Label: The fourth column (Variable Label) contains a variable label of up to 40 characters providing descriptive information about the variable. For multiple-choice achievement items, the variable label includes the correct response option enclosed in brackets. During data analysis, the variable labels enhance understanding of the results.

Code: The fifth column (Code) contains the codes used for variable values. For variables where numeric data are supplied in response to constructed-response questions, the keyword VALUE is entered in the Code column. For categorical variables, all possible response options are listed. Any missing codes described in Section 3.2 are also included for either non-categorical or categorical variables. For example, for multiple-choice achievement items, the code options are A, B, C, D, and E while for the constructed-response achievement items, the code options are the two-digit numerical codes described in Chapter 2.

Option: The sixth column (Option) includes a textual description of each response option. For variables containing non-categorical data, it contains an explanation of the values contained in the variable.

Location/Format: The seventh column presents the location and format of each variable in the ASCII-format raw data files. The location/format indicates the pattern used to write each value of a non-categorical or categorical variable, with a general structure of XX-YY / <N or C> ZZ.Z.

The numbers preceding the forward slash (/) indicate the location of the variable and refer to its position in the raw data file (starting (XX) - ending (YY) column positions). The <N or C> after the slash identifies the variable as non-categorical (N) or categorical (C). The numeric codes after the forward slash (ZZ.Z) indicates the total number of digits (including the decimal point) and the number of decimal places associated with each variable (e.g. 2.0 = 2 integer digits, 0 decimal places; 6.2 = six total digits: 3 integer digits, decimal point, and two decimal digits).

3.4 Data Almanacs

Data Almanac Files contain weighted summary statistics for each participating country on each achievement item and on each variable in the student, teacher, and school background questionnaires as well as on derived variables based on these questionnaires. Separate data almanacs are included for the background variables and for the achievement item variables. The data almanac files corresponding to each variable type are listed in Exhibit 3.5 and are described in the following sections.

The naming convention of the almanac files is as follows:

- The first character of the files name is "B" for the eighth grade and "A" for the fourth grade.
- The second character indicates the source or level of the information in the file:

S	indicates a background, student level almanac
I	indicates an achievement item almanac

- The third, fourth and fifth characters identify the file as an almanac and they are always "ALM".
- The sixth and seventh characters identify the information contained in the almanacs. The following codes are used:

1_	Student Background Questionnaire with Mathematics Achievement
2_	Student Background Questionnaire with Science Achievement
3_	School Background Questionnaire with Mathematics Achievement
4_	School Background Questionnaire with Science Achievement
5_	Mathematics Teacher Background Questionnaire with Mathematics Achievement
7_	Science Teacher Background Questionnaire with Science Achievement
9_	Mathematics and Science Teacher Background Questionnaire with Mathematics and Science Achievement (only for the fourth grade)
5M	Mathematics Item Almanacs
5S	Science Item Almanacs
7M	Mathematics Trend Item Almanacs
7S	Science Trend Item Almanacs

- The last two characters in the file name indicates the study cycle. The following codes are used:

M1	stands for the 1995 almanac files
M2	stands for the 1999 almanac files
M3	stands for the 2003 almanac files

- Three character file extensions are used to indicate the file type, as follows:

.DOC	Almanacs in MS Word format
.LST	Almanacs in ASCII format
.PDF	Almanacs in PDF format

Exhibit 3.5 Data Almanac Files for TIMSS 2003

Almanac File	Contents
BSALM1_M3, ASALM1_M3	Student Background with Mathematics Achievement, fourth and eighth grades
BSALM2_M3, ASALM2_M3	Student Background with Science Achievement, fourth and eighth grades
BSALM3_M3, ASALM3_M3	School Background with Mathematics Achievement, fourth and eighth grades
BSALM4_M3, ASALM4_M3	School Background with Science Achievement, fourth and eighth grades
BSALM5_M3, ASALM5_M3	Mathematics Teacher Background with Mathematics Achievement, fourth and eighth grades
BSALM7_M3, ASALM7_M3	Science Teacher Background with Science Achievement, fourth and eighth grades
BIALM5MM3, AIALM5MM3	Percent of Responses by Item Category for the Mathematics items, fourth and eighth grades
BIALM5SM3, AIALM5SM3	Percent of Responses by Item Category for the Science items, fourth and eighth grades
BIALM7MM3, AIALM7MM3	Percent of Responses by Item Category for the Mathematics trend items, fourth and eighth grades
BIALM7SM3, AIALM7SM3	Percent of Responses by Item Category for the Science trend items, fourth and eighth grades

The data almanacs are provided as PDF files, which may be read with Adobe Acrobat Reader 4.0 or higher, and as ASCII formatted files (LST) and MS Word format files (DOC), which may be read and edited with any text editor or word processing software that can read files of their size.

The files display student-weighted summary statistics, by grade, for each participating country on each variable. The almanacs also display the international averages for each variable, with each country weighted equally.

Background Item Data Almanacs

Background data almanacs include all student, teacher, and school background variables as well as derived variables based on these. The data presented in the almanacs use the student as the unit of analysis, even if the information originated in the teacher or school questionnaire items. Therefore, the weighted

percentages in the teacher and school almanacs reflect the percentage of students to whom the data apply.

There are two types of displays in the background data almanacs, depending on whether data are categorical (have a small number of discrete values) or continuous.

The display for categorical variables includes:

- Sample size (number of students, teachers or schools included in the sample)
- Number of valid cases (counts of students, teachers or schools for whom valid data were obtained)
- Weighted percentages of students corresponding to each valid response option (percentages based only on the students with valid data)
- Weighted percentages of students for whom none of the valid response options were selected (the variable is coded as "Not Administered" or "Omitted")
- Weighted mean achievement values of students corresponding to each valid response option (means based only on the students with valid data) and for whom none of the valid response options were selected.

In cases where a question was coded Not Applicable because of the response to an earlier filter question, the percentage of students for whom the variable is coded as Not Applicable is also displayed. The percent Not Applicable is based on only the students with valid data. The last line in the almanac displays the international average in each category of response.

The display for continuous variables includes:

- Sample size (number of students, teachers or schools in the sample)
- Number of valid cases (counts of students, teachers or schools with valid data)
- Weighted percentages of students for whom the variable is coded as "Not Administered", "Not Applicable", or "Omitted"
- The mean, mode, minimum, maximum, and the 5^{th} , 10^{th} , 25^{th} , 50^{th} , 75^{th} , 90^{th}, and 95^{th} percentiles across students
- The last line in the almanac displays the international averages.

The background data almanacs also display for each variable the question as it was asked, its location in the corresponding questionnaire, and its variable name in the data file.

Achievement Item Data Almanacs

Achievement item data almanacs provide summary statistics for every mathematics and science achievement item included in the assessment. There are two types of displays in the almanacs, depending on whether the item is a multiple-choice item or a constructed-response item. The statistics displayed in these almanacs are defined below:

- **N:** The number of students to whom the item was administered.
- **A, B, C, D and E:** Used for multiple-choice items only, these represent the percent of students choosing each one of the response options for the item. Not reached items are included in the denominator for these calculations.
- **Scoring Guide Codes (10, 11, 70, 71, etc.):** Used for constructed-response items only, these represent the percent of student responses assigned each of the codes in the scoring rubric for the test item. Not reached items are excluded from the denominator for these calculations.
- **V1, V2:** Used only for the constructed-response items, these indicate the percent of students that scored 1 point or better on the item (V1) and 2 points or better (V2).
- **Other Incorrect:** Used for multiple-choice items, it indicates the percent of students who omitted or gave an invalid response to the item.
- **Diff (Item Difficulty):** The percent of students that responded correctly to the item. This was used only for the multiple-choice items.
- **Invalid:** Used for multiple-choice items only, this indicates the percent of students that gave an invalid response to the item (e.g., multiple selections).
- **Not Reached:** Indicates the percent of students that did not reach the test item.
- **Omit:** Indicates the percent of students that omitted the test item.
- **Girl (% Right), Boy (% Right):** This indicates the percent of girls and boys that obtained the maximum score on the item.

3.5 Program Files

These kinds of program files are provided for use in analyses of the TIMSS data files:

- Data Access Control Files
- Jackknife Statistics Program Files
- Scoring Program Files

The Data Access Control files allow a user to convert the ASCII-format raw data files into SAS data sets or SPSS system files. This might prove useful should there be compatibility issues reading the SAS and SPSS data files already provided.

The Jackknife statistics program files are used to compute the statistics as well as the standard errors associated with these statistics, using the jackknife repeated replication method discussed in Chapter 2.

The Scoring Program files allow a user to convert achievement item response codes to the score values used in the computation of international scores. For all program files, two versions are provided: one for SAS programs and one for SPSS programs. The file extension (SAS or SPS) is used to identify the respective SAS and SPSS program files.

Chapters 4 and 5 further describe the SAS and SPSS program files and how they are used, with specific examples from the TIMSS student, teacher, and school data.

3.6 Test-Curriculum Matching Analysis Data Files

TIMSS 2003 developed international tests of mathematics and science that reflect, as far as possible, the various curricula of the participating countries. The subject matter coverage of these tests was reviewed by the TIMSS 2003 Subject Matter Item Replacement Committee, which consisted of mathematics and science educators and practitioners from around the world, and the tests were approved for use by the National Research Coordinators (NRCs) of the participating countries.

Although the tests were developed to represent an agreed-upon framework and were intended to have as much in common across countries as possible, it was inevitable that the match between the TIMSS 2003 test and the science curriculum would not be the same in all countries. To restrict test items to just those topics included in the curricula of all participating countries and covered in the same sequence would severely limit test coverage and restrict the research questions that the study is designed to address. The tests, therefore,

inevitably have some items measuring topics unfamiliar to some students in some countries.

The Test-Curriculum Matching Analysis (TCMA) was conducted to investigate the appropriateness of the TIMSS 2003 science test for the eighth- and fourth-grade students in the participating countries. TCMA also shows how student performance for individual countries varies when based only on the test questions that are judged to be relevant to their own curricula.

To address this issue, TIMSS 2003 asked each country to indicate which items on the tests were included in its curriculum. For each country, TIMSS 2003 computed the average percentage correct on those items only for that country and all other countries. This allowed each country to select only those items on the tests that were included in its curriculum and to compare the performance of their students on those items with that of the students in the other participating countries. However, in addition to comparing the performance of all countries on the set of items chosen by each country, the Test-Curriculum Matching Analysis (TCMA) also shows each country's performance on the items chosen by each of the other countries. In these analyses, each country was able to see not only the performance of all countries on the items appropriate for its curriculum, but also the performance of its students on items judged appropriate for the curriculum in other countries. The analytical method of the TCMA is described in Beaton and Gonzalez (1997).

The files that contain data indicating the item selection status given by each country, at each grade level are located in the subdirectory called TCMA in the database. The Test Curriculum Matching Analysis files are:

BTCMAMM3.CSV	2003 Mathematics item selection for the eighth grade
BTCMASM3.CSV	2003 Science item selection for the eighth grade
ATCMAMM3.CSV	2003 Mathematics item selection for the fourth grade
ATCMASM3.CSV	2003 Science item selection for the fourth grade

These files are in text format, with their fields separated by commas. The first two records for each file contain the labels for each field in the file. The item variable names are included in the first record. The corresponding item block locations are included in the second record. Each row in the file contains a country's selection status for all items in the appropriate subject area:

Code 1	Item Included
Code 0	Item Not included

3.7 Item Information Files

Item Information files are provided to enable users of the database to readily produce summaries of item characteristics and cross-reference the different item identification numbers (e.g., mathematics and science achievement item block location, original item variable name (1995 or 1999), and new item variable name (2003 permanent ID). The Item Information files include the following information:

- Permanent ID number for the item
- Item Name and Block Location in the corresponding year
- Subject (Mathematics or Science)
- Item Type (Multiple choice or Constructed Response)
- Response Key (correct response option for multiple-choice items only)
- Maximum Points (maximum score points possible on the item)
- Whether the item was used for scaling or not
- Release status for the year
- Number of options
- Content Domain
- Item Label
- Cognitive Domain

There are two Item Information files containing this information for the test items. These files are located in the subdirectory called ITEMS for the corresponding population. The two Item Information files are:

BITINFM3	Item Information for the 2003 Eighth-grade Assessment
AITINFM3	Item Information for the 2003 Fourth-grade Assessment.

These files are in Excel spreadsheet format, with one record for each achievement item part.

4 Performing Analyses with the TIMSS Data Using SPSS

4.1 Overview

This chapter presents some basic examples of analyses that can be performed with the TIMSS 2003 International Database using the sampling weights and achievement scores discussed in previous chapters. It also describes the SPSS programs used to conduct such analyses, and their results. The analyses presented here are simple in nature, and are designed primarily to familiarize you with the different files and their structure, as well as the relevant variables that need to be included in most analyses. The programs compute the percent of students in specified subgroups, the mean mathematics or science achievement in those groups, and the proper standard errors for the percent and mean statistics. Additionally, some examples of linear regression analyses are presented. All of these analyses, based on student, teacher and school data, replicate analyses that are included in the TIMSS 2003 Science International Report. You are invited to compare the results from these analyses to the Exhibits in the reports, and are encouraged to practice analyzing the TIMSS data by trying to replicate the Exhibits that are presented in the international reports.[1]

In our examples, we use macros written for SPSS that can be used to perform any of the analyses that are described below. These are general procedures that can be used for many purposes, provided you have some basic knowledge of the SPSS macro language. If you have some programming experience in this statistical package, then you will be able to make the necessary modifications to the macros to obtain the desired results.

4.2 Contents of the TIMSS 2003 Database DVD

The DVD that accompanies this User Guide contains the TIMSS 2003 data. It has the following internal file structure:

- A main directory identifying the study (TIMSS2003).
- Within the main directory, there are eight sub-directories.

[1] See Mullis, Martin, Gonzalez, and Chrostowski (2004) for results in mathematics and Martin, Mullis, Gonzalez, and Chrostowski (2004) for results in science.

DATA:	Contains data files in SPSS, SAS and ASCII formats
PROGRAMS:	Contains SPSS and SAS programs
CODEBOOKS:	Contains codebook files
ALMANACS:	Contains data almanacs
TCMA:	Contains Test–Curriculum Matching Analysis Data
ITEMS:	Contains the Item Information files
CURRICULUM:	Contains the Curriculum Questionnaire data
REPORTS :	Contains all international reports, this User Guide and its supplements.

The directory names on the DVD and the file names generally follow the DOS naming convention: file names with up to eight characters, followed by a three-character extension (as in FILENAME.EXT). Files with the same names are complementary to each other, and the extension identifies their function or type. The extensions used in the files contained on the DVD are the following.

.SAS	SAS Control file or program
.SPS	SPSS Control file or program
.RAW	ASCII Data file
.SAV	SPSS System file
.EXP	SAS Export file
.LST	Almanac in ASCII format
.DOC	Almanac in MS Word format
.PDF	Almanac in PDF format
.CDT	Codebook in Printout format
.SDB	Codebook in Dbase format
.CSV	Test Curriculum Matching Analysis file
.XLS	Curriculum Questionnaire data and Item Information files in Excel format.

The DATA sub-directory contains the TIMSS data files in ASCII, SAS and SPSS formats. The data files that are in this directory are described in Chapter 3 of this guide. Each file type has two corresponding control files in the PROGRAMS sub-directory. One of these reads the ASCII data file and creates a SAS data set, the other reads the ASCII data file and creates an SPSS system file. This chapter will focus on the files that can be used with SPSS.

The following programs can also be found in the PROGRAMS sub-directory:

ASASCRM3.SPS and BSASCRM3.SPS

These files contain SPSS programs that can be used to convert the response codes to the cognitive items to their corresponding correctness score levels. The use of these programs is described in this chapter.

JOIN.SPS

This SPSS program combines files of the same type from more than one country. The use of this program is described in this chapter.

JACKGEN.SPS

This macro program in SPSS can be used to compute weighted percentages of students within defined groups, and their means on a specified continuous variable. This macro also generates replicate weights and computes jackknife repeated replication (JRR) standard errors for the percentages and mean estimates. The analysis variable can be any continuous variable. The use of this macro programs is described later in this chapter. When computing mean achievement scores based on plausible values, you will need to use the macro JACKPV.SPS.

JACKPV.SPS

This macro program in SPSS can be used to compute weighted percentages of students within defined groups, and their mean achievement scores using the available plausible values. This macro also generates replicate weights and computes the JRR standard errors for the percentages and mean achievement scores. This macro should be used when multiple plausible values are used in the analysis.

JACKREG.SPS

This macro program in SPSS can be used to compute weighted regression coefficients and their standard errors within defined groups. It also computes descriptive statistics on the variables. This macro can be used with any analysis variable, but it does not make use of the five plausible values.

JACKREGP.SPS

This macro program in SPSS can be used to compute weighted regression coefficients and their standard errors within defined groups when using plausible values as the achievement scores. It also computes descriptive statistics on the variables.

Each of the four macros above has a corresponding sample program that calls the respective macros and prints out the results. They are discussed later in this chapter.

EXAMPLE1.SPS, EXAMPLE2.SPS, EXAMPLE3.SPS, EXAMPLE4.SPS

These are the programs used in the examples presented later in this chapter.

4.3 Creating SPSS System Files

The DVD contains SPSS control code to read each one of the ASCII data files and create SPSS system files. Each of these control files contains information on the location of each variable in the file, its format, a descriptive label for each variable and its categories (in the case of categorical variables), and code for handling missing data. The control files have been created to facilitate access to the data on a country by country basis. They should be used to create SPSS system files if the SPSS system files provided on the DVD are not compatible for a specific computer platform or configuration.

The command lines in the control files should be edited to produce programs that will create SPSS system files for any specified countries. While most of the program code is functional as provided, you will need to edit input and output directories and the list of desired countries. Performing analyses that require data from more than one country will necessitate adding or appending the respective data files into a larger one. These control files will create separate files for each desired country. These individual country files can then be joined into a single data set using the JOIN program described later in this chapter.

Alternatively, you can access the data and compute the necessary statistics on a country by country basis, reading one file at a time and moving on to the next country's data. The method you choose will depend greatly on the storage and processing capacity of the computer system you use. For the examples presented in this User Guide, we have combined the data files of individual countries into one large data file that contains all the data for all participating countries. The three-character country identifier for this file is "ALL".

When creating an SPSS system file of a specific type, you should do the following:

1. Open the SPSS control file for the appropriate file type, for example BSGTMSM3.SPS.

2. In the line that reads "!let !datpath = !unquote("<path>")", you should enter the path where the raw data are located.

3. In the line that reads "!let !savpath = !unquote("<path>")", you should enter the path where you want to store the SPSS system file that you will be creating.

4. In the line that reads "create country =" at the end of the file, you should enter the three-character identification code for each country whose data you want to create. If you leave this line unedited, the data for all countries listed will be created.

5. Submit the code for processing. After processing is complete, you will find the SPSS system file(s) in the location you specified in step 3.

In the extract presented in Exhibit 4.1, the Student Background data for Australia, Belgium (Flemish), Bulgaria, England and the United States will be read from the directory "D:\TIMSS2003\Data\Raw_Data\". Separate SPSS system files for each country will be stored in the directory "D:\TIMSS2003\Data\SPSS_Data\" under the name BSG<country>M3. Only the sections that need to be modified are presented in this exhibit.

Exhibit 4.1 Extract from SPSS Control Code for Creating Student Background SPSS System Files

```
SET DECIMAL = DOT.

define create (country=!charend('/')).

!let !datpath = !unquote("D:\TIMSS2003\Data\Raw_Data\").
!let !savpath = !unquote("D:\TIMSS2003\Data\SPSS_Data\").

!do !cty !in(!country).

!let !indata  = !concat('"',!datpath,bsg,!cty,'m3.dat"').
!let !savdata = !concat('"',!savpath,bsg,!cty,'m3.sav"').

*NOTE: Assignment of variable names.

data list file = !indata

.
.
.

save outfile = !savdata.

!doend
!enddefine

create country = AUS BFL BGR ENG USA.
```

4.4 Scoring the Items

There were several types of items administered as part of the TIMSS tests. There were multiple-choice items, in which the students were asked to select one of four or five options as the correct response. The responses to these items are coded with one digit. The codes used to represent the responses to these items are as follows:

Code 1	Option A
Code 2	Option B
Code 3	Option C
Code 4	Option D
Code 5	Option E
Code 6	Not reached
Code 7	Invalid response (chose more than one of the options available)
Code 8	Not administered
Code 9	No response although the item was administered and was reached (i.e., item was omitted)

There were also constructed-response items where the students were asked to construct a response to a question, rather than choosing an answer from a list of options. The answers to these questions were scored by scorers trained to use the two-digit scoring rubrics described in Chapter 2 of this guide. The first digit of the two-digit code indicates the score given to the question, and the second digit in conjunction with the first provides diagnostic information on the specific answer given by the student. The codes used to represent the responses to these items are the following:

Codes 30 to 39	Three-point answer. Second digit provides diagnostic information.
Codes 20 to 29	Two-point answer. Second digit provides diagnostic information.
Codes 10 to 19	One-point answer. Second digit provides diagnostic information.
Codes 70 to 79	Zero-point answer. Second digit provides diagnostic information.
Code 96	Not reached.
Code 98	Not administered.

The achievement data files contained on the DVD include information on the answers given to each item administered to a student. You might want to work with these item data after they are recoded to the right-wrong format, in the case of multiple-choice items, or to the level of correctness in the case of the constructed-response items. For this purpose, we have included on the DVD two SPSS programs, one for each population, which will allow you to recode the items from the achievement test to their right-wrong or correctness-level format. These programs contain a macro called SCOREIT and the necessary call to this macro so that all the items in the specified file are scored. This program will convert the response option codes for multiple-choice items to dichotomous score levels (0 or 1) based on scoring keys. For the constructed-response items, the two-digit codes will be converted to the corresponding correctness score level (3, 2, 1, 0) based on the value of the first digit, as described in Chapter 2.

Two files are included to provide control code to perform the recodes of the test items in the achievement test file:

ASASCRM3	TIMSS 2003 Fourth Grade Achievement files
BSASCRM3	TIMSS 2003 Eighth Grade Achievement files

When using these programs, you must first consider the recoding scheme that is desired. For example, under certain circumstances you might want to recode the not reached responses as incorrect (codes 6 and 96), whereas under other circumstances you might want to recode these responses as not administered

or invalid. In the case of TIMSS, not reached responses were recoded as not administered (and effectively as missing responses) for the purpose of calibrating the items. But the not reached responses were then recoded as incorrect when scoring the item for the individual countries, and for the purpose of calculating the scale scores for the individuals. By default, the scoring program provided with the database recodes the items coded as not reached and those left blank as incorrect responses.

To use the SCOREIT macro, you should adapt the program code in either of the programs ASASCRM3 (fourth grade) or BSASCRM3 (eighth grade). You should do the following:

1. Open the appropriate control file, for example BSASCRM3.SPS.
2. In the line that reads "file = "<path>\BSA<country>M3.sav"", you should enter the path where the SPSS system file you want to recode is located and the three-character code for the country of interest.
3. In the "save outfile" line at the very end of the program, you should enter the path where you want to store the scored SPSS system file that you will be creating and the three-character code for the country of interest.
4. Submit the code for processing.

Both of these programs recode the items onto themselves, so if you want to preserve the original answers and codes assigned to the questions, then the file with the recoded item variables should be saved under a different file name, or in a different directory. A copy of the program that scores the items in SPSS is presented in Exhibit 4.2.

Exhibit 4.2 Extracted Sections of SPSS Program SCOREIT Used to Convert Cognitive Item Response Codes to Correctness-Score Levels

```
SET MPRINT=ON.
define SCOREIT  (Type          = !charend('/')       /
                 Item          = !charend('/')       /
                 RIGHT         = !charend('/')       /
                 nr            = !charend('/')       /
                 na            = !charend('/')       /
                 om            = !charend('/')       /
                 other         = !charend('/')       ).

.
.
.

!enddefine.

* Get the student achievement data .
add files /
file = "<path>\BSA<country>M3.sav" .

SCOREIT  Type = MC  /
         Item = <list items where option A is the correct one> /
         RIGHT  = 1  /  nr  = 6  /  na  = sysmis  /  om  = 9  /  other  = 7.

SCOREIT  Type = MC  /
         Item = <list items where option B is the correct one> /
         RIGHT = 2  /  nr  = 6  /  na  = sysmis  /  om  = 9  /  other  = 7.

SCOREIT  Type = MC  /
         Item = <list items where option C is the correct one> /
         RIGHT = 3  /  nr  = 6  /  na  = sysmis  /  om  = 9  /  other  = 7.

SCOREIT  Type = MC  /
         Item = <list items where option D is the correct one> /
         RIGHT = 4  /  nr  = 6  /  na  = sysmis  /  om  = 9  /  other  = 7.

SCOREIT  Type = MC  /
         Item = <list items where option E is the correct one> /
         RIGHT = 5  /  nr  = 6  /  na  = sysmis  /  om  = 9  /  other  = 7.

SCOREIT  Type = OE  /
         Item = <list open-ended items> /
         RIGHT =  0 /  nr  = 96 /  na  = sysmis /  om  = 99 /  other  = 90 .

execute.

* Save the student data .
save outfile = "<path>\BSA<country>M3.sav" .
```

4.5 Joining Files

The programs presented until now produce a single SPSS system file per country. The DVD provides a special program called JOIN.SPS that joins individual country files into a single aggregated file. This program facilitates joint analyses for more than one country. This program can only join SPSS system files of the same type, for example BSG files.

To create an SPSS system file with more than one country's data, you should do the following:

1. Open the control file JOIN.SPS.
2. At the end of the program, you should list all the countries of interest in the parameter "country".
3. You should specify the file type in the parameter "type".
4. You should specify the sorting variables in the parameter "sortvar".
5. You should specify the path where all files are located in the parameter "path".
6. Submit the code for processing.

An example of the JOIN program is presented in Exhibit 4.3. This example joins all the BSG files for all countries. All individual country files are located in the directory "D:\TIMSS2003\Data\SPSS_Data". The resulting file will also be located in this directory and will be called BSGALLM3. The resulting file will be sorted by IDCNTRY and IDSTUD.

Exhibit 4.3 Contents of SPSS Program JOIN Used to Join Files of the Same Type for More Than One Country

```
* Combines all selected countries in one SPSS sav file .
SET DECIMAL = DOT .

set mexpand=on .
define JOIN     (country       = !charend('/') /
                 type          = !charend('/') /
                 sortvar       = !charend('/') /
                 path          = !charend('/') ) .

!onexpand .

add files
!do !cty !in(!country)
 !concat('  file = "',!path,'\',!type,!cty,'m3.sav"') /
!doend .

sort cases by !sortvar .

save outfile = !concat('"',!path,'\',!type,'ALLm3.sav"')

!enddefine

* Insert the countries, the file type, sorting variables and the path.
JOIN country = ARM AUS BFL BGR BHR BWA CHL COT CQU CYP
               EGY ENG BSQ EST GHA HKG HUN IDN IRN ISR
               ITA JOR JPN KOR LBN LTU LVA MAR MDA MKD
               MYS NLD NOR NZL PSE PHL ROM RUS SAU SCO
               SGP SVK SVN SWE TUN TWN USA UIN SCG ZAF /
     type    = BSG /
     sortvar = IDCNTRY IDSTUD /
     path    = D:\TIMSS2003\Data\SPSS_Data .
```

4.6 Basic Analyses with the TIMSS Data: Means, Percentages, Regression Coefficients and their JRR Standard Errors

In this section, four macros that can be used to compute the correct standard errors are described, including examples in which these macros are used to replicate Exhibits in the TIMSS 2003 international reports and almanacs.

Computing Means and Their JRR Standard Errors with Plausible Values (JACKPV.SPS)

This section presents example SPSS code that can be used to compute the JRR standard errors for mean achievement scores based on plausible values and percentages. This code is provided in the form of an SPSS macro, called JACKPV.SPS, that computes the percentages of students within subgroups defined by a set of classification variables, the JRR standard errors of these percentages, the mean achievement scores for the groups using plausible values, and the JRR standard errors of these means including the sampling and imputation variance components.

The JACKPV.SPS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of a set of plausible values.

3. Computes the percentages of students within each group, their mean achievement scores based on the plausible values, and their respective standard errors. The resulting working file FINAL contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the name of the plausible values and how many there are, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You also need to specify the data file that contains the data to be processed.

You need to know some basic SPSS macro language in order to use JACKPV.SPS. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro should be included in every batch. If you are using SPSS interactively then the macro should be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro should be included once again. Once the macro is included in a specific session, the word "JACKPV" should not be used within that session because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SPSS:

```
include "<path>jackpv.sps".
```

where <path> points to the specific drive and directory where the macro JACKPV.SPS can be found. The macro requires that several parameters be specified when it is invoked. These parameters are:

INFILE — The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It

	is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file. This can be a single variable, or a list of variables. The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country. At least one variable has to be specified, usually IDCNTRY.
ROOTPV	This is the prefix used to identify the set of plausible values for the achievement scale of interest. This corresponds to the first 7 characters of the plausible values variable name. For example, the root of the overall science plausible values is "BSSSCI0," the root of the geometry plausible values is "BSMGEO0."
NPV	This is the number of plausible values that will be used for the analysis. Generally you will want to use all five plausible values for the analysis, although in some circumstances fewer can be used. You should always use at least two plausible values for any analysis.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75, the maximum possible value. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If

the data from two or more countries are being used for an analysis, then the largest number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.

WGT — The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SPSS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a slash. For example, if the macro is invoked using

```
include "D:\TIMSS2003\Programs\SPSS_Programs\jackpv.sps" .

jackpv
       infile   = BSGALLM3      /
       cvar     = IDCNTRY ITSEX /
       rootpv   = BSMMAT0       /
       npv      = 5             /
       jkz      = JKZONE        /
       jkr      = JKREP         /
       njkz     = 75            /
       wgt      = TOTWGT .
```

it will compute the eighth grade mean mathematics achievement scores using five plausible values and their respective standard errors for boys and girls within each country, using the variable TOTWGT as the sampling weight. It will also compute the percentages of boys and girls within each country, and their respective standard errors. The data will be read from the data set BSGALLM3, and the standard errors will be computed based on 75 replicate weights.

The file that contains the results is called FINAL and is saved to the default directory being used by SPSS. The variables that are contained in this results file are:

Classification Variables

All classification variables are kept in the results file. In the example there are two classification variables: IDCNTRY and ITSEX. There is one record for each combination of the categories for these variables.

Weight Variable

Contains the sum of weights within each group defined by the classification variables. In the example this variable is called TOTWGT.

N

Contains the number of valid cases within each group defined by the classification variables. In the example this is the number of boys and girls in each country's sample.

MNX

Contains the weighted mean achievement scores, based only on the first plausible value, for each group defined by the classification variables.

MNX_SE

Contains the JRR standard errors of the weighted mean achievement scores, based only on the first plausible value. This does not include the imputation error that should be computed when using plausible values.

MNPV

Contains the weighted mean achievement scores, based on all plausible values.

MNPV_SE

Contains the JRR standard errors of the weighted mean achievement scores, based on all plausible values. These standard errors contain both the sampling and the imputation variance components.

PCT

Contains the weighted percentages of students in the groups for the last classification variable listed, within the specific combination of the categories defined by the remaining classification variables. In the example it is the percentage of boys and girls within each country.

PCT_SE

Contains the JRR standard errors of PCT values.

The content of the FINAL file can be printed using an SPSS procedure of choice. An example call to this macro, and a printout of the results file, is presented in Exhibit 4.4.The code is included in the file called SampleJackPV.SPS.

Exhibit 4.4 Extract of SPSS Control Code and Output File for Using the Macro JACKPV.SPS

```
add files
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGARMM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGAUSM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBFLM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBGRM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBHRM3.SAV" .

select if not(missing(ITSEX)) .

value labels
 IDCNTRY
          <list all country codes and country names>

save outfile = BSGALLM3 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackpv.sps" .

jackpv
       infile   = BSGALLM3      /
       cvar     = IDCNTRY ITSEX /
       rootpv   = BSMMAT0       /
       npv      = 5             /
       jkz      = JKZONE        /
       jkr      = JKREP         /
       njkz     = 75            /
       wgt      = TOTWGT .

* Print the results .
print formats IDCNTRY ITSEX n (F6.0) TOTWGT (f10.0) mnpv mnpv_se pct pct_se
(f6.2) .

report format = list automatic
 / var = IDCNTRY (label) ITSEX (label) n TOTWGT mnpv mnpv_se pct pct_se .
```

COUNTRY ID	*SEX OF STUDENTS*	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
AUSTRALIA	GIRL	2443	131600	498.59	5.79	51.13	2.25
AUSTRALIA	BOY	2348	125807	511.10	5.79	48.87	2.25
BAHRAIN	GIRL	2025	5317	417.32	2.37	50.43	.44
BAHRAIN	BOY	2174	5226	384.79	2.42	49.57	.44
ARMENIA	GIRL	3003	28625	482.86	3.29	52.76	.66
ARMENIA	BOY	2696	25630	472.78	3.42	47.24	.66
BULGARIA	GIRL	2015	42247	475.65	5.48	48.23	1.33
BULGARIA	BOY	2102	45356	476.66	4.33	51.77	1.33
BELGIUM FLEMISH	GIRL	2620	37887	531.72	3.53	53.64	2.09
BELGIUM FLEMISH	BOY	2350	32751	542.49	3.75	46.36	2.09

In this example, the mean eighth grade mathematics achievement scores, based on all five plausible values, and their respective standard errors are calculated separately for boys and girls by country. In the results listing, we can see that there are entries for each country and gender combination. The first column has the country name and the second column indicates the gender of the students. The third column has the number of valid cases by country and gender and the fourth column has the total sum of weights by country and gender. The fifth and sixth columns report the mean eighth grade mathematics achievement score, based on all five plausible values, by country and gender and its standard error. The last two columns report the weighted percentage of girls and boys in each country and their respective standard errors.

From the first few lines of the results in Exhibit 4.4, we can say that in Australia there are 2,443 girls in the sample representing 131,600 students in the whole population. The mean mathematics score for the girls, based on the five plausible values, is 498.59 with a standard error of 5.79. Girls made up 51.13% of Australia's student population. Additionally, Australia sampled 2,348 boys representing 125,807 students in the whole population. The mean mathematics score for the boys, based on the five plausible values, is 511.10 with a standard error of 5.79. Boys made up 48.87% of Australia's student population.

Computing Means and Their JRR Standard Errors without Plausible Values (JACKGEN.SPS)

This section presents example SPSS code that can be used to compute the JRR standard errors for means of variables other than plausible values and percentages. This code is provided in the form of an SPSS macro, called JACKGEN.SPS, that computes the percentages of students within subgroups defined by a set of classification variables, the JRR standard errors of these percentages, the means on a variable of choice for the groups, and the JRR standard errors of these means. Although you can compute weighted percentages and means using other basic SPSS commands, the macro JACKGEN.SPS computes the proper JRR standard errors for these means and percentages.

This macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of a specified analysis variable.

3. Computes the percentages of students within each group, their mean on the analysis variable, and their respective standard errors. The resulting working file FINAL contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, one analysis variable, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SPSS macro language in order to use JACKGEN.SPS. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro needs to be included in every batch. If you are using SPSS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKGEN" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SPSS:

```
include "<path>jackgen.sps".
```

where <path> points to the specific drive and directory where the macro JACKGEN.SPS can be found. The macro requires that several parameters be specified when it is invoked. These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file. This can be a single variable, or a list of variables. The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country. At least one variable has to be specified, usually IDCNTRY.

DVAR	This is the variable for which means are to be computed. Only one variable can be listed here. If you want to examine results for two different variables, then the macro needs to be invoked separately to generate each table.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries are being used for an analysis, then the larger number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SPSS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a slash. For example, if the macro is invoked using

```
include "D:\TIMSS2003\Programs\SPSS_Programs\jackgen.sps" .

jackgen
      infile    = BSGALLM3     /
      cvar      = IDCNTRY      /
      dvar      = BSDAGE       /
      njkz      = 75           /
      jkz       = JKZONE       /
      jkr       = JKREP        /
      wgt       = TOTWGT .
```

it will compute the eighth grade mean ages and their respective standard errors within each country, using the variable TOTWGT as the sampling weight. The data will be read from the SPSS system file BSGALLM3 and the standard errors will be computed based on 75 replicate weights.

The file that contains the results is called FINAL and is saved to the default directory being used by SPSS. The variables that are contained in this results file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

Weight Variable

Contains the sum of weights within each group defined by the classification variables.

N

Contains the number of valid cases within each group defined by the classification variables.

MNX

Contains the weighted means of the variable DVAR for each group defined by the classification variables.

MNX_SE

Contains the JRR standard errors of the MNX values.

PCT

Contains the weighted percentages of students in the groups for the classification variable listed last, within the specific combination of the categories defined by the groups initially. In the example it is the weighted percentage of students by country.

PCT_SE

Contains the JRR standard errors of PCT values.

The contents of the FINAL file can be printed using an SPSS procedure of choice. An example call to this macro, and an extract of the results file, is presented in Exhibit 4.5. The code is included in the file called SampleJackGen.SPS.

Exhibit 4.5 Extract of SPSS Control Code and Output File for Using the Macro JACKGEN.SPS

```
add files
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGARMM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGAUSM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBFLM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBGRM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBHRM3.SAV" .

select if not(missing(BSDAGE)) .

value labels
 IDCNTRY
          <list all country codes and county names>

save outfile = BSGALLM3 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackgen.sps" .

jackgen
      infile    = BSGALLM3     /
      cvar      = IDCNTRY      /
      dvar      = BSDAGE       /
      njkz      = 75           /
      jkz       = JKZONE       /
      jkr       = JKREP        /
      wgt       = TOTWGT .

* Print the results .
print formats IDCNTRY n (f6.0) TOTWGT (f10.0) mnx mnx_se pct pct_se (f6.2) .

report format = list automatic
 / var = IDCNTRY (label) n TOTWGT mnx mnx_se pct pct_se .

*COUNTRY ID*              N        TOTWGT      MNX     MNX_SE    PCT     PCT_SE
_________________________  ______  __________  ______  ______  ______  ______

AUSTRALIA                  4531       245526    13.88     .01   52.43     .86
BAHRAIN                    4195        10533    14.07     .01    2.25     .05
ARMENIA                    5693        54216    14.88     .01   11.58     .38
BULGARIA                   4107        87402    14.89     .01   18.66     .58
BELGIUM FLEMISH            4970        70637    14.12     .02   15.08     .45
```

In this example, the variable BSDAGE is used to calculate the mean age of the eighth grade students in each country. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country name, the second column has the number of valid cases in each sample after selecting only those cases where BSDAGE is not missing, and the third column is the total sum of weights by country. This is followed by the mean age of the eighth grade students and its standard error.

From the first line of the results in Exhibit 4.5, we can say that in Australia there were 4,531 eighth grade students in the sample representing 245,526 students in the whole population, with a mean age of 13.88 and a standard error of 0.01. The sum of weights for Australia represents 52.43% of all sums of weights for the countries involved in the analysis. The standard error of this percentage is 0.86.

Computing Regression Coefficients and Their JRR Standard Errors without Plausible Values (JACKREG.SPS)

This section presents example SPSS code that can be used to compute regression coefficients and their JRR standard errors. This code is provided in the form of an SPSS macro, called JACKREG.SPS, which performs a multiple linear regression between the specified dependent and independent variables within subgroups defined by a set of classification variables, as well as the regression coefficients and their JRR standard errors.

If you wish to conduct regression analyses using plausible values as the dependent variable, refer to JACKREGP.SPS described in the next section.

The JACKREG.SPS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of all specified analysis variables.

3. Performs a multiple linear regression within each group, and computes the regression coefficients and their respective standard errors. The resulting working file REG contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the analysis variables, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SPSS macro language in order to use the macro. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro needs to be included in every batch. If you are using SPSS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKREG" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SPSS:

```
include "<path>jackreg.sps".
```

where <path> points to the specific drive and directory where the macro JACKREG.SPS can be found.The macro requires that several parameters be specified when it is invoked.These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file.This can be a single variable, or a list of variables.The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country.At least one variable has to be specified, usually IDCNTRY.
XVAR	This is a list of independent variables that will be used as predictors of the dependent variable specified in DVAR.The independent variables can be continuous or categorical. For example, it could be the variable ITSEX as originally coded in the data files, or dummy coded as 1 or 0.
DVAR	This is the dependent variable that will be predicted by the variable or variables specified by the XVAR parameter. Only one variable can be listed here. If you want to use the same set of predictor variables to predict two different variables, then the macro needs to be invoked separately to generate each set of results.
JKZ	The variable that captures the assignment of cases to sampling zones.The name of this variable in all TIMSS files is JKZONE.

JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries are being used for an analysis, then the larger number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SPSS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a slash. For example, if the macro is invoked using

```
include "D:\TIMSS2003\Programs\SPSS_Programs\jackreg.sps" .

jackreg
   infile       = BSGALLM3     /
   cvar         = IDCNTRY      /
   xvar         = REGSEX       /
   dvar         = BOOK         /
   njkz         = 75           /
   jkz          = JKZONE       /
   jkr          = JKREP        /
   wgt          = TOTWGT .
```

it will perform a multiple linear regression with the variable REGSEX as a predictor of the number of books at home, and the standard errors of the regression coefficients will be computed based on 75 replicate weights.

The file that contains the results is called REG and is saved to the default directory being used by SPSS. The variables that are contained in this results file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

N

Contains the number of valid cases within each group defined by the classification variables.

Mult_RSQ

The squared multiple correlation coefficient for the model within each group.

SS_Res, SS_Reg, SS_Total

The residual, regression, and total sums of squares for the model within each group.

Regression Coefficients and Standard Errors (B## and B##.SE)

These are the regression coefficients for each of the predictor variables in the model and their respective JRR standard errors. The coefficient zero (B00) is the intercept for the model. The other coefficients receive a sequential number starting with 01. This sequential number corresponds to the order of the variables in the list of variables specified in the parameter XVAR.

The contents of the REG file can be printed using an SPSS procedure of choice. An example call to this macro, and an extract of the results file, is presented in Exhibit 4.6. The code is included in the file called SampleJackReg.SPS.

Exhibit 4.6 Extract of SPSS Control Code and Output File for Using the Macro JACKREG.SPS

```
add files
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGARMM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGAUSM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBFLM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBGRM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBHRM3.SAV" .

select if not(missing(ITSEX)) .

compute REGSEX = ITSEX - 1 .

recode BSBGBOOK (1=5) (2=18) (3=63) (4=151) (5=251) into BOOK .

variable labels
  BOOK 'BOOKS AT HOME - Categorized' .

value labels
  BOOK      5 '5 Books at home'
           18 '18 Books at home'
           63 '63 Books at home'
          151 '151 Books at home'
          251 '251 Books at home' /
  IDCNTRY
          <list all country codes and county names>

save outfile = BSGALLM3

include "D\TIMSS2003\Programs\SPSS_Programs\jackreg.sps" .

jackreg
   infile       = BSGALLM3     /
   cvar         = IDCNTRY      /
   xvar         = REGSEX       /
   dvar         = BOOK         /
   njkz         = 75           /
   jkz          = JKZONE       /
   jkr          = JKREP        /
   wgt          = TOTWGT .

* Print the results .
print formats IDCNTRY n (f6.0) mult_rsq (f5.3) ss_total ss_reg (f10.0)
              b00 b00.se b01 b01.se (f6.2) .

list vars = IDCNTRY n mult_rsq ss_total ss_reg b00 b00.se b01 b01.se .

IDCNTRY      N MULT_RSQ     SS_TOTAL     SS_REG    B00    B00.SE    B01    B01.SE

     36   4663   0.002    2056635596    4451708   129.26   3.24     8.42   4.06
     48   4162   0.001      76995110      60535    92.17   2.14    -4.81   2.88
     51   5558   0.000     430338454      17825    91.67   3.32     1.16   2.85
    100   3996   0.001     785508028     897904   120.51   4.66    -6.51   4.30
    956   4888   0.000     416292531        533    78.80   2.12     0.18   3.35
```

In this example, the variable REGSEX is created by subtracting one from the variable ITSEX. As a result, the girls receive a code of 0 and the boys receive a code of 1 on this variable. The variable BOOK is created to convert the responses to number of books. In this regression model, the variable REGSEX is

used to predict the values of the variable BOOK by country. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country code and the second column has the number of valid cases in each country. The multiple R squared is listed for each country, followed by the sums of squares for the model, and the regression coefficients and their standard errors. Because of the way in which the variable REGSEX is coded, the intercept B00 is the mean value for the variable BOOK for the girls and B00_SE is its standard error. The first regression coefficient (B01) is the difference in the mean value of the variable BOOK between girls and boys, and B01_SE is its JRR standard error.

From the first line of the results in Exhibit 4.6, we can say that in Australia (IDCNTRY=36) valid data were available for 4,663 cases. The squared multile correlation coefficient between gender and books at home is 0.002, with girls having on average 129.26 books at home and boys having on average 8.42 books more than girls. This difference is statistically significant, which can be determined by dividing the value of B01 by its standard error and comparing the result to the appropriate critical value.

Computing Regression Coefficients and Their JRR Standard Errors with Plausible Values (JACKREGP.SPS)

This section presents example SPSS code that can be used to compute regression coefficients and their JRR standard errors using plausible values as the dependent variable. This code is provided in the form of an SPSS macro, called JACKREGP.SPS, which performs a multiple linear regression between a set of plausible values specified as a dependent variable, and independent variables within subgroups defined by a set of classification variables, as well as the regression coefficients and their JRR standard errors.

The JACKREGP.SPS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of all specified analysis variables.

3. Performs a multiple linear regression within each group, and computes the regression coefficients and their respective standard errors. The resulting working file REG contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the analysis variables including the set of plausible values, the number of replicate weights to be generated, the variables that contain the jackknife replication

information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SPSS macro language in order to use the macro. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro needs to be included in every batch. If you are using SPSS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKREGP" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SPSS:

```
include "<path>jackregp.sps".
```

where <path> points to the specific drive and directory where the macro JACKREGP.SPS can be found. The macro requires that several parameters be specified when it is invoked. These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file. This can be a single variable, or a list of variables. The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country. At least one variable has to be specified, usually IDCNTRY.

XVAR	This is a list of independent variables which will be used as predictors of the dependent variable specified as a set of plausible values in ROOTPV. The independent variables can be continuous or categorical. For example, it could be the variable ITSEX as originally coded in the data files, or dummy coded as 1 or 0.
ROOTPV	This is the prefix used to identify the set of plausible values for the achievement scale of interest. This corresponds to the first 7 characters of the plausible values variable name. For example, the root of the overall science plausible values is "BSSSCI0," the root of the geometry plausible values is "BSMGEO0."
NPV	This is the number of plausible values that will be used in the analysis. Generally you will want to use all five plausible values for the analysis, although in some circumstances fewer can be used. You should always use at least two plausible values for any analysis.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR error estimates. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75, the maximum possible value. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries is being used for an analysis, then the larger number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.

WGT — The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SPSS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a slash. For example, if the macro is invoked using

```
include "D:\TIMSS2003\Programs\SPSS_Programs\jackregp.sps" .

jackregp
   infile       = BSGALLM3     /
   cvar         = IDCNTRY      /
   xvar         = REGSEX       /
   rootpv       = BSMMAT0      /
   npv          = 5            /
   njkz         = 75           /
   jkz          = JKZONE       /
   jkr          = JKREP        /
   wgt          = TOTWGT .
```

it will perform a multiple linear regression with the variable REGSEX as a predictor of the mathematics plausible values, and the standard errors of the regression coefficients will be computed based on 75 replicate weights.

The file that contains the results is called REG and is saved in the default directory being used by SPSS. The variables that are contained in this file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

N

Contains the number of valid cases within each group defined by the classification variables.

Mult_RSQ

The squared multiple correlation coefficient for the model within each group.

SS_Res, SS_Reg, SS_Total

The residual, regression, and total sums of squares for the model within each group.

Regression Coefficients and Standard Errors (B## and B##.SE)

These are the regression coefficients for each of the predictor variables in the model and their respective JRR standard errors. The coefficient zero (B00) is the intercept for the model. The other coefficients receive a sequential number starting with 01. This sequential number corresponds to the order of the variables in the list of variables specified in the parameter XVAR.

The contents of the REG file can be printed using a SPSS procedure of choice. An example call to this macro, and an extract of the results file, is presented in Exhibit 4.7. The code is included in the file called SampleJackRegP.SPS.

Exhibit 4.7 Extract of SPSS Control Code and Output File for Using the Macro JACKREGP.SPS

```
add files
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGARMM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGAUSM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBFLM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBGRM3.SAV"
 / file = "D:\TIMSS2003\Data\SPSS_Data\BSGBHRM3.SAV" .

select if not(missing(ITSEX)) .

compute REGSEX = ITSEX - 1 .

value labels
 IDCNTRY
          <list all country codes and county names>

save outfile = BSGALLM3

include "D\TIMSS2003\Programs\SPSS_Programs\jackregp.sps" .

jackregp
   infile       = BSGALLM3     /
   cvar         = IDCNTRY      /
   xvar         = REGSEX       /
   rootpv       = BSMMAT0      /
   npv          = 5            /
   njkz         = 75           /
   jkz          = JKZONE       /
   jkr          = JKREP        /
   wgt          = TOTWGT .

* Print the results .
print formats IDCNTRY n (f6.0) mult_rsq (f5.3) ss_total ss_reg (f12.0)
              b00 b00.se b01 b01.se (f6.2) .

list vars = IDCNTRY n mult_rsq ss_total ss_reg b00 b00.se b01 b01.se .

IDCNTRY      N MULT_RSQ     SS_TOTAL       SS_REG    B00    B00.SE   B01    B01.
SE

     36   4791    .006    1711442579     10114110   498.59   5.79   12.51   7.04
     48   4199    .045      61405486      2791933   417.32   2.37  -32.54   3.34
     51   5699    .004     378269349      1380629   482.86   3.29  -10.08   2.97
    100   4117    .000     619290982        44393   475.65   5.48    1.01   4.70
    956   4970    .005     381570675      2053629   531.72   3.53   10.77   4.82
```

In this example, the variable REGSEX is once again created by subtracting one from the variable ITSEX. As a result, the girls receive a code of 0 and the boys receive a code of 1 on this variable. In this regression model, the variable REGSEX is used to predict the mathematics achievement by country using all five plausible values. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country code and the second column has the number of valid cases in each country. The multiple R squared is listed for each country, followed by the sums of squares for the model, and the regression coefficients and their standard errors. Because

of the way in which the variable REGSEX is coded, the intercept B00 is the mean mathematics achievement for the girls and B00_SE is its standard error. The first regression coefficient (B01) is the difference in the mean mathematics achievement between girls and boys, and B01_SE is its JRR standard error.

From the first line of the results in Exhibit 4.7, we can say that in Australia (IDCNTRY=36) valid data was available for 4,791 cases. The squared multiple correlation coefficient between gender and mathematics achievement is 0.006 with girls achieving on average 498.59 in mathematics and boys scoring on average 12.51 points higher. This difference is not statistically significant.

4.7 Replicating Analyses from the TIMSS 2003 International Reports: Student-Level

Many analyses of the TIMSS data can be undertaken using student-level data. We have already presented some examples in the previous sections when explaining how to use the macros provided with the data files. We now proceed to work through additional examples of actual analyses from the TIMSS 2003 international reports, where all the required steps are undertaken, including the invocation of the appropriate SPSS macros.

Example of Student-Level Analysis without Plausible Values

In our first example, we wish to replicate the analysis of eighth graders' reports on the average number of hours spent reading a book for enjoyment during their leisure time on a normal school day. The results, originally presented in Exhibit 4.8 of the TIMSS 2003 International Science Report, are reproduced in Exhibit 4.8. Since we only want to report the average number of hours, which does not require any plausible values, we need to use the macro JACKGEN.

Exhibit 4.8 Sample Exhibit for Student-Level Analysis without Plausible Values Taken From the TIMSS 2003 International Science Report (Exhibit 4.8)

Countries	Average Hours Spent Each Day*							
	Watch Television and Videos	Play Computer Games	Play or Talk with Friends	Do Jobs at Home	Play Sports	Read a Book for Enjoyment	Use the Internet	Work at a Paid Job
Armenia	1.8 (0.03)	r 0.9 (0.03)	r 1.6 (0.03)	r 0.4 (0.02)	r 1.2 (0.03)	r 1.6 (0.03)	r 0.7 (0.03)	r 1.0 (0.04)
Australia	2.0 (0.03)	0.9 (0.02)	1.7 (0.04)	1.0 (0.02)	1.6 (0.03)	0.7 (0.02)	1.3 (0.04)	0.4 (0.03)
Bahrain	2.0 (0.03)	1.2 (0.02)	1.6 (0.03)	1.2 (0.02)	1.5 (0.03)	0.9 (0.02)	1.4 (0.03)	0.6 (0.02)
Belgium (Flemish)	2.1 (0.03)	1.0 (0.03)	1.9 (0.03)	0.9 (0.02)	1.6 (0.03)	0.5 (0.01)	1.3 (0.03)	0.2 (0.02)
Botswana	1.4 (0.03)	0.5 (0.02)	2.1 (0.04)	2.3 (0.03)	1.5 (0.02)	1.8 (0.03)	0.7 (0.02)	0.6 (0.03)
Bulgaria	2.5 (0.04)	1.1 (0.04)	2.6 (0.05)	1.5 (0.03)	1.2 (0.04)	0.7 (0.03)	1.0 (0.04)	0.3 (0.02)
Chile	2.2 (0.02)	0.7 (0.02)	2.3 (0.02)	1.5 (0.02)	1.8 (0.03)	0.6 (0.01)	0.7 (0.02)	0.3 (0.02)
Chinese Taipei	1.7 (0.03)	1.4 (0.04)	1.4 (0.03)	0.7 (0.01)	1.0 (0.02)	1.0 (0.02)	1.4 (0.04)	0.2 (0.01)
Cyprus	2.1 (0.03)	1.3 (0.02)	2.1 (0.03)	1.0 (0.03)	1.7 (0.03)	0.9 (0.02)	1.2 (0.02)	0.6 (0.02)
Egypt	0.8 (0.02)	0.7 (0.02)	0.8 (0.02)	1.3 (0.03)	1.1 (0.02)	1.0 (0.02)	0.6 (0.02)	0.6 (0.02)
Estonia	2.3 (0.03)	1.1 (0.03)	2.8 (0.03)	1.1 (0.02)	1.4 (0.03)	0.7 (0.02)	1.5 (0.04)	0.4 (0.02)
Ghana	0.7 (0.02)	0.6 (0.02)	1.2 (0.03)	1.5 (0.03)	1.3 (0.02)	1.7 (0.03)	0.8 (0.03)	0.8 (0.03)
Hong Kong, SAR	2.3 (0.03)	2.0 (0.04)	1.6 (0.03)	0.7 (0.01)	1.0 (0.02)	1.1 (0.02)	2.0 (0.03)	0.1 (0.01)
Hungary	2.1 (0.03)	1.1 (0.03)	2.2 (0.03)	1.1 (0.02)	1.5 (0.03)	0.8 (0.02)	0.6 (0.03)	0.2 (0.02)
Indonesia	1.5 (0.03)	0.5 (0.02)	1.3 (0.03)	2.2 (0.03)	1.1 (0.02)	1.1 (0.02)	0.3 (0.02)	0.8 (0.03)
Iran, Islamic Rep. of	1.6 (0.03)	0.4 (0.02)	1.4 (0.03)	1.5 (0.03)	1.4 (0.04)	1.0 (0.02)	0.2 (0.02)	0.7 (0.05)
Israel	2.5 (0.04)	1.9 (0.03)	2.3 (0.03)	1.4 (0.03)	1.6 (0.03)	0.9 (0.02)	1.8 (0.04)	0.6 (0.02)
Italy	1.8 (0.03)	1.0 (0.02)	2.6 (0.03)	1.1 (0.03)	1.8 (0.03)	0.7 (0.02)	0.6 (0.02)	0.9 (0.02)
Japan	2.7 (0.03)	0.9 (0.02)	1.6 (0.04)	0.6 (0.01)	1.3 (0.03)	0.9 (0.02)	0.6 (0.02)	0.1 (0.01)
Jordan	1.5 (0.03)	0.9 (0.03)	1.2 (0.03)	1.3 (0.03)	1.2 (0.03)	0.9 (0.02)	0.6 (0.03)	0.6 (0.03)
Korea, Rep. of	1.7 (0.03)	1.5 (0.03)	1.8 (0.03)	0.7 (0.01)	0.7 (0.02)	0.6 (0.01)	1.7 (0.03)	0.1 (0.01)
Latvia	2.4 (0.03)	1.0 (0.02)	2.8 (0.03)	1.6 (0.03)	1.3 (0.03)	0.8 (0.03)	0.8 (0.03)	0.5 (0.02)
Lebanon	1.8 (0.04)	1.3 (0.03)	1.6 (0.04)	1.3 (0.03)	1.6 (0.03)	1.0 (0.02)	1.0 (0.03)	0.8 (0.03)
Lithuania	2.1 (0.03)	1.1 (0.03)	2.6 (0.04)	1.6 (0.04)	1.1 (0.03)	0.6 (0.02)	0.7 (0.03)	0.3 (0.02)
Macedonia, Rep. of	2.3 (0.04)	1.3 (0.03)	2.2 (0.03)	1.6 (0.03)	1.8 (0.03)	1.0 (0.02)	0.9 (0.03)	0.7 (0.03)
Malaysia	2.1 (0.04)	0.8 (0.03)	1.5 (0.03)	1.7 (0.02)	1.1 (0.02)	1.2 (0.02)	0.6 (0.02)	0.3 (0.02)
Moldova, Rep. of	1.9 (0.04)	0.7 (0.03)	2.0 (0.04)	2.2 (0.06)	1.3 (0.03)	1.1 (0.03)	0.7 (0.03)	0.5 (0.03)
Morocco	1.3 (0.04)	2.3 (0.06)	1.3 (0.03)	1.8 (0.03)	1.5 (0.03)	r 1.3 (0.03)	r 2.6 (0.06)	r 2.8 (0.06)
Netherlands	2.1 (0.05)	1.2 (0.04)	2.0 (0.05)	0.8 (0.02)	1.7 (0.04)	0.5 (0.02)	1.5 (0.04)	0.8 (0.05)
New Zealand	2.1 (0.04)	1.0 (0.04)	1.8 (0.05)	1.0 (0.02)	1.5 (0.03)	0.7 (0.03)	1.3 (0.04)	0.6 (0.03)
Norway	2.2 (0.03)	1.2 (0.03)	2.7 (0.03)	1.0 (0.03)	1.8 (0.03)	0.6 (0.02)	1.2 (0.03)	0.7 (0.02)
Palestinian Nat'l Auth.	1.2 (0.02)	0.7 (0.02)	1.3 (0.03)	1.5 (0.03)	1.1 (0.03)	1.0 (0.02)	0.5 (0.02)	0.6 (0.03)
Philippines	1.6 (0.04)	0.6 (0.02)	1.7 (0.03)	1.9 (0.03)	1.4 (0.02)	1.2 (0.02)	0.5 (0.03)	0.8 (0.04)
Romania	2.0 (0.04)	0.9 (0.03)	2.1 (0.03)	1.7 (0.05)	1.3 (0.03)	1.0 (0.03)	0.8 (0.04)	0.5 (0.04)
Russian Federation	2.0 (0.03)	1.0 (0.03)	2.5 (0.04)	1.6 (0.03)	1.3 (0.02)	1.1 (0.03)	0.4 (0.02)	0.2 (0.02)
Saudi Arabia	1.6 (0.05)	1.1 (0.03)	1.3 (0.03)	1.5 (0.04)	1.2 (0.04)	0.9 (0.02)	0.8 (0.05)	0.8 (0.03)
Scotland	2.2 (0.03)	1.4 (0.04)	2.7 (0.03)	0.8 (0.02)	1.7 (0.03)	0.6 (0.02)	1.4 (0.03)	0.5 (0.03)
Serbia	2.1 (0.03)	1.0 (0.03)	2.1 (0.03)	1.3 (0.03)	1.7 (0.03)	0.8 (0.02)	0.6 (0.03)	0.3 (0.02)
Singapore	2.3 (0.02)	1.4 (0.02)	1.7 (0.02)	0.7 (0.02)	1.4 (0.02)	0.9 (0.02)	1.6 (0.02)	0.2 (0.02)
Slovak Republic	2.5 (0.03)	1.1 (0.03)	2.8 (0.03)	1.5 (0.03)	1.9 (0.04)	0.9 (0.02)	0.6 (0.03)	0.4 (0.02)
Slovenia	2.2 (0.03)	1.3 (0.03)	2.0 (0.03)	1.2 (0.03)	1.7 (0.03)	0.8 (0.02)	1.1 (0.03)	0.4 (0.02)
South Africa	1.5 (0.03)	0.7 (0.02)	2.0 (0.03)	1.8 (0.03)	1.6 (0.02)	1.6 (0.03)	0.8 (0.02)	0.8 (0.02)
Sweden	2.1 (0.03)	1.1 (0.03)	2.8 (0.03)	1.0 (0.02)	1.6 (0.03)	0.6 (0.02)	1.7 (0.04)	0.4 (0.02)
Tunisia	1.4 (0.02)	0.8 (0.03)	1.5 (0.02)	1.9 (0.03)	1.5 (0.02)	1.3 (0.02)	0.7 (0.02)	0.6 (0.02)
United States	2.2 (0.03)	1.1 (0.02)	2.4 (0.03)	1.2 (0.02)	1.8 (0.02)	0.7 (0.01)	1.8 (0.03)	0.6 (0.02)
¶ England	2.0 (0.04)	1.1 (0.04)	2.4 (0.05)	0.8 (0.03)	1.4 (0.05)	0.5 (0.02)	1.4 (0.04)	0.5 (0.04)
International Avg.	1.9 (0.00)	1.1 (0.00)	1.9 (0.00)	1.3 (0.00)	1.4 (0.00)	0.9 (0.00)	1.0 (0.00)	0.6 (0.00)
Benchmarking Participants								
Basque Country, Spain	1.6 (0.04)	0.9 (0.03)	2.4 (0.04)	0.9 (0.03)	1.5 (0.03)	0.7 (0.02)	0.8 (0.03)	0.4 (0.03)
Indiana State, US	2.2 (0.06)	1.0 (0.04)	2.4 (0.06)	1.2 (0.04)	1.8 (0.04)	0.7 (0.03)	1.7 (0.04)	0.6 (0.05)
Ontario Province, Can.	2.1 (0.04)	1.2 (0.04)	2.0 (0.04)	0.9 (0.02)	1.7 (0.03)	0.8 (0.02)	1.9 (0.04)	0.6 (0.03)
Quebec Province, Can.	2.0 (0.03)	1.4 (0.03)	2.0 (0.04)	0.9 (0.02)	1.7 (0.04)	0.6 (0.02)	1.5 (0.04)	0.6 (0.02)

To replicate the results in this exhibit, we need to undertake several steps. After reviewing the codebooks and the questionnaire information, we observe that the variable BSBGREBO contains information on the number of hours spent reading for enjoyment before or after school (see Supplement 1 for a copy of the student background questionnaire), and this variable is found in the Student Background data file. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no national adaptations were made, we can continue with our analysis without any modifications.

We then proceed to read from the Student Background file our variable of interest (BSBGREBO), the student sampling weight (TOTWGT), the variables that contain the jackknife replication information (JKZONE and JKREP), and the variable containing the country identification code (IDCNTRY). In this analysis, we will use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used the JOIN program, described earlier in this chapter, to join the eighth grade Student Background files for all countries into a single file called BSGALLM3.

In general, analyses involving all available countries are quite feasible with a powerful desktop computer; however, you need to keep in mind that computing and storage requirements for these types of analyses can be quite demanding.

The SPSS program code is presented in Exhibit 4.9 and is included on the DVD under the name EXAMPLE1.SPS. The results obtained from this program are displayed in Exhibit 4.10. We have included as part of the program the corresponding value labels and format statements so that the different categories or groups are labeled appropriately.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BSBGREBO.

In general, to perform student-level analyses of this type using the Student Background data files, you should do the following:

- Identify the variables of interest in the Student Background files and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Student Background files, including the sampling weights, the JRR replication information, and any other variables used in the selection of cases.
- Use the macro JACKGEN with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 4.9 SPSS Control Statements for Performing Student-Level Analyses without Plausible Values (EXAMPLE1.SPS)

```
get file =  "D:\TIMSS2003\Data\SPSS_Data\BSGALLM3.SAV".

select if not(missing(BSBGREBO)).

recode BSBGREBO (1=0) (2=0.5) (3=1.5) (4=3) (5=4.5) (else=sysmis) into BSBGREBO.

value labels
IDCNTRY
  51 'ARMENIA'    36 'AUSTRALIA'              956 'BELGIUM FLEMISH'   100 'BULGARIA'
  48 'BAHRAIN'    72 'BOTSWANA'              9132 'CANADA ONTARIO'   9133 'CANADA QUEBEC'
 152 'CHILE'     196 'CYPRUS'                818 'EGYPT'             926 'ENGLAND'
3724 'BASQUE'    233 'ESTONIA'               288 'GHANA'             344 'HONG KONG'
 348 'HUNGARY'   360 'INDONESIA'             364 'IRAN'              376 'ISRAEL'
 380 'ITALY'     400 'JORDAN'                392 'JAPAN'             410 'KOREA'
 422 'LEBANON'   440 'LITHUANIA'             428 'LATVIA'            504 'MOROCCO'
 498 'MOLDOVA'   807 'MACEDONIA'             458 'MALAYSIA'          528 'NETHERLANDS'
 578 'NORWAY'    554 'NEW ZEALAND'           275 'PALESTINE'         608 'PHILIPPINES'
 642 'ROMANIA'   643 'RUSSIAN FEDERATION'    682 'SAUDI ARABIA'      927 'SCOTLAND'
 702 'SINGAPORE' 703 'SLOVAK REPUBLIC'       705 'SLOVENIA'          752 'SWEDEN'
 760 'SYRIA'     788 'TUNISIA'               158 'CHINESE TAIPEI'    840 'UNITED STATES'
 887 'YEMEN'     891 'SERBIA AND MONTENEGRO' 710 'SOUTH AFRICA'    11800 'INDIANA US' .

save outfile = STUDENT1 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackgen.sps" .

jackgen
      infile    = STUDENT1     /
      cvar      = IDCNTRY      /
      dvar      = BSBGREBO     /
      njkz      = 75           /
      jkz       = jkzone       /
      jkr       = jkrep        /
      wgt       = TOTWGT .

* Sort the results .
sort cases by IDCNTRY .

* Print the results .
print formats n (f6.0) TOTWGT (f10.0) mnx mnx_se pct pct_se (f6.2) .

report format = list automatic
 / var   = IDCNTRY (label)  n TOTWGT mnx mnx_se pct pct_se .
```

Exhibit 4.10 Extract of SPSS Computer Output for Performing Student-Level Analyses without Plausible Values (EXAMPLE 1)

COUNTRY ID	N	TOTWGT	MNX	MNX_SE	PCT	PCT_SE
AUSTRALIA	4609	248940	.69	.02	1.29	.04
BAHRAIN	4051	10177	.89	.02	.05	.00
ARMENIA	4697	45299	1.59	.03	.23	.01
BOTSWANA	4665	32840	1.79	.03	.17	.00
BULGARIA	3842	81651	.74	.03	.42	.01
CHILE	6291	261935	.62	.01	1.36	.03
CHINESE TAIPEI	5363	296886	1.03	.02	1.54	.03
CYPRUS	3790	8720	.93	.02	.05	.00
ESTONIA	3903	20266	.68	.02	.10	.00
PALESTINE	5158	62339	.98	.02	.32	.01
GHANA	4524	243471	1.75	.03	1.26	.05
HONG KONG	4914	81716	1.06	.02	.42	.01
HUNGARY	3200	97457	.80	.02	.50	.01
INDONESIA	5452	2186548	1.06	.02	11.32	.24
IRAN	4815	1332910	1.00	.02	6.90	.15
ISRAEL	4076	81016	.90	.02	.42	.01
ITALY	4229	562078	.68	.02	2.91	.05
JAPAN	4801	1255020	.86	.02	6.50	.06
JORDAN	4257	91377	.85	.02	.47	.01
KOREA	5266	566354	.62	.01	2.93	.05
LEBANON	3467	52587	1.05	.02	.27	.01
LATVIA	3524	32618	.78	.03	.17	.00
LITHUANIA	4383	41668	.57	.02	.22	.01
MALAYSIA	5278	411531	1.15	.02	2.13	.05
MOLDOVA	3875	59224	1.12	.03	.31	.01
MOROCCO	2540	176187	1.32	.03	.91	.03
NETHERLANDS	2861	176429	.50	.02	.91	.03
NEW ZEALAND	3595	54534	.72	.03	.28	.01
NORWAY	3977	59045	.64	.02	.31	.01
PHILIPPINES	6754	1362283	1.22	.02	7.05	.17
ROMANIA	3917	280384	.96	.03	1.45	.03
RUSSIAN FEDERATION	4499	1853726	1.13	.03	9.60	.41
SAUDI ARABIA	4059	309671	.91	.02	1.60	.07
SINGAPORE	5980	52964	.89	.02	.27	.00
SLOVAK REPUBLIC	4150	74563	.86	.02	.39	.01
SLOVENIA	3498	22485	.82	.02	.12	.00
SOUTH AFRICA	8133	708468	1.60	.03	3.67	.09
SWEDEN	4071	104366	.63	.02	.54	.01
TUNISIA	4680	174690	1.30	.02	.90	.01
MACEDONIA	3523	23466	1.00	.02	.12	.00
EGYPT	6479	1216237	1.00	.02	6.30	.13
UNITED STATES	8671	3359064	.69	.01	17.39	.25
SERBIA AND MONTENEGRO	4024	82070	.76	.02	.42	.01
ENGLAND	2631	616594	.53	.02	3.19	.10
SCOTLAND	3396	56784	.59	.02	.29	.01
BELGIUM FLEMISH	4849	68852	.47	.01	.36	.01
BASQUE	2470	18394	.70	.02	.10	.00
CANADA ONTARIO	4074	141318	.80	.02	.73	.03
CANADA QUEBEC	4253	78813	.59	.02	.41	.01
INDIANA US	2144	74604	.69	.03	.39	.01

In this example, each country's mean value for BSBGREBO is reported for the eighth grade. The results are presented by country. The countries are identified in the first column and the second column reports the number of valid cases.

The third column reports the sum of weights of these students, followed by the mean for BSBGREBO and its respective standard error. The last two columns report the weighted percentages of students in the population and their respective standard errors.

From the first line in Exhibit 4.10, we can say that in Australia valid data were available for 4,609 cases. These sampled students represent a population of 248,940 students. Australian students spend, on average, 0.69 hours reading for enjoyment before or after school. The standard error of this mean is 0.02.

Example of Student-Level Analysis with Plausible Values

In this second example, we wish to replicate another one of the results presented in the international reports. We are interested in looking at the eighth graders' reports on the number of books in their home and their science achievement. These results, originally presented in Exhibit 4.4 of the TIMSS 2003 International Science Report, are reproduced in Exhibit 4.11. Since the results in this Exhibit are based on plausible values, we need to use the macro JACKPV.

Exhibit 4.11 Sample Exhibit for Student-Level Analysis with Plausible Values Taken From the TIMSS 2003 International Science Report (Exhibit 4.4)

Countries	More than 200 Books		101-200 Books		26-100 Books		11-25 Books		0-10 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	20 (1.0)	478 (5.1)	13 (0.6)	475 (4.2)	28 (0.7)	467 (3.6)	24 (0.9)	453 (4.8)	15 (0.9)	433 (5.2)
Australia	31 (1.4)	553 (4.1)	23 (0.8)	540 (3.4)	30 (1.0)	517 (4.8)	11 (0.8)	493 (5.8)	5 (0.5)	464 (8.7)
Bahrain	17 (0.5)	450 (2.7)	14 (0.6)	457 (3.4)	31 (0.8)	445 (2.1)	26 (0.8)	423 (3.0)	11 (0.5)	420 (5.0)
Belgium (Flemish)	12 (0.6)	539 (4.0)	15 (0.6)	538 (2.6)	34 (0.9)	524 (2.7)	25 (0.8)	503 (4.0)	14 (0.7)	477 (5.7)
Botswana	4 (0.5)	407 (14.6)	5 (0.3)	402 (7.4)	13 (0.6)	395 (6.2)	30 (0.9)	368 (3.4)	48 (1.3)	348 (3.0)
Bulgaria	28 (1.3)	494 (8.2)	18 (0.9)	484 (6.0)	25 (1.1)	481 (5.9)	15 (0.7)	470 (6.3)	14 (1.6)	449 (11.8)
Chile	5 (0.4)	484 (6.4)	7 (0.4)	458 (5.8)	27 (0.9)	437 (3.5)	37 (0.9)	402 (2.6)	23 (1.2)	374 (3.5)
Chinese Taipei	15 (1.0)	616 (3.5)	14 (0.6)	602 (3.8)	30 (0.7)	582 (3.2)	24 (0.9)	552 (3.8)	17 (0.9)	515 (4.2)
Cyprus	11 (0.5)	472 (5.0)	16 (0.7)	458 (3.5)	35 (0.8)	453 (3.0)	27 (0.7)	427 (3.3)	11 (0.5)	391 (4.6)
Egypt	6 (0.4)	447 (8.9)	6 (0.4)	438 (9.5)	18 (0.7)	440 (5.3)	38 (0.8)	424 (4.2)	33 (1.2)	415 (3.8)
Estonia	45 (1.2)	567 (2.9)	18 (0.6)	552 (3.6)	23 (0.7)	543 (3.1)	11 (0.6)	528 (3.8)	3 (0.3)	516 (7.4)
Ghana	10 (0.6)	259 (11.1)	6 (0.4)	276 (13.8)	16 (0.7)	277 (8.2)	34 (1.0)	264 (6.3)	34 (1.5)	246 (6.4)
Hong Kong, SAR	9 (0.6)	576 (5.6)	8 (0.4)	574 (4.2)	27 (0.6)	565 (3.0)	28 (0.7)	555 (3.6)	28 (0.7)	538 (4.2)
Hungary	31 (1.2)	578 (3.2)	22 (0.7)	551 (3.5)	29 (1.0)	531 (3.1)	13 (0.6)	499 (4.5)	5 (0.7)	466 (7.7)
Indonesia	1 (0.2)	~ ~	3 (0.3)	449 (9.6)	19 (0.7)	431 (5.1)	45 (0.9)	416 (4.4)	32 (1.0)	416 (4.3)
Iran, Islamic Rep. of	7 (0.5)	492 (6.1)	5 (0.3)	483 (5.2)	17 (0.8)	468 (3.5)	31 (0.8)	454 (2.6)	39 (1.3)	437 (2.6)
Israel	22 (0.9)	511 (4.1)	22 (0.7)	507 (3.9)	33 (0.8)	487 (3.6)	17 (0.8)	460 (4.2)	6 (0.4)	448 (7.5)
Italy	19 (0.9)	524 (4.2)	14 (0.6)	502 (4.7)	25 (0.7)	497 (3.8)	29 (0.7)	474 (4.0)	13 (0.7)	457 (5.5)
Japan	17 (0.7)	584 (3.2)	17 (0.5)	567 (2.9)	32 (0.8)	552 (2.3)	22 (0.6)	539 (2.4)	13 (0.7)	517 (3.3)
Jordan	9 (0.6)	499 (7.9)	8 (0.5)	509 (7.2)	28 (0.9)	496 (4.1)	33 (0.9)	470 (4.2)	23 (0.8)	449 (4.3)
Korea, Rep. of	19 (0.8)	596 (2.2)	22 (0.7)	572 (2.3)	33 (0.8)	556 (2.2)	10 (0.6)	533 (2.9)	15 (0.7)	514 (3.0)
Latvia	28 (1.3)	532 (3.6)	25 (0.8)	517 (3.1)	31 (1.1)	504 (3.2)	12 (0.7)	491 (4.1)	4 (0.4)	479 (7.0)
Lebanon	8 (0.6)	421 (8.9)	8 (0.8)	446 (8.6)	25 (1.0)	423 (5.0)	36 (1.1)	384 (5.2)	23 (1.4)	353 (5.2)
Lithuania	12 (0.8)	551 (4.5)	15 (0.7)	537 (4.2)	34 (0.9)	525 (2.3)	30 (1.1)	503 (2.7)	10 (0.7)	483 (6.4)
Macedonia, Rep. of	8 (0.7)	471 (7.8)	8 (0.6)	489 (6.6)	28 (0.9)	476 (3.9)	40 (1.2)	443 (3.9)	17 (0.8)	401 (5.9)
Malaysia	5 (0.5)	557 (6.4)	9 (0.6)	540 (5.2)	28 (0.8)	524 (3.6)	40 (1.0)	501 (3.4)	17 (0.9)	482 (4.7)
Moldova, Rep. of	8 (0.8)	507 (5.2)	9 (0.6)	494 (5.9)	23 (1.0)	483 (4.3)	37 (1.2)	467 (4.6)	23 (1.1)	452 (5.1)
Morocco	5 (0.6)	410 (10.3)	4 (0.3)	403 (8.8)	21 (0.9)	404 (3.6)	38 (1.0)	392 (3.4)	33 (1.4)	399 (3.6)
Netherlands	21 (1.4)	567 (4.4)	19 (0.9)	556 (3.8)	31 (1.3)	535 (3.2)	19 (1.2)	508 (5.3)	10 (0.8)	492 (5.7)
New Zealand	25 (1.5)	556 (7.4)	22 (1.1)	537 (4.4)	31 (1.0)	512 (4.5)	14 (0.8)	490 (4.4)	8 (0.7)	453 (7.8)
Norway	27 (1.2)	515 (2.6)	22 (0.7)	504 (2.8)	33 (0.9)	493 (3.1)	11 (0.6)	463 (4.6)	7 (0.4)	441 (7.0)
Palestinian Nat'l Auth.	7 (0.5)	446 (7.1)	6 (0.4)	457 (6.8)	24 (0.7)	456 (4.4)	36 (0.8)	432 (3.6)	27 (1.0)	421 (3.7)
Philippines	3 (0.3)	373 (13.1)	4 (0.3)	423 (12.3)	17 (0.8)	418 (7.8)	34 (0.8)	381 (5.7)	43 (1.0)	356 (5.6)
Romania	12 (1.2)	516 (7.2)	13 (1.1)	508 (5.3)	29 (1.2)	479 (4.3)	27 (1.4)	451 (5.9)	20 (1.7)	435 (9.0)
Russian Federation	21 (1.3)	538 (3.5)	26 (0.9)	526 (4.1)	32 (1.4)	512 (4.2)	17 (1.1)	481 (5.0)	4 (0.5)	458 (9.4)
Saudi Arabia	10 (0.7)	422 (7.4)	9 (0.9)	414 (6.0)	25 (1.0)	410 (4.9)	33 (1.1)	391 (4.5)	23 (1.4)	382 (4.3)
Scotland	17 (1.0)	564 (4.8)	16 (0.7)	541 (4.3)	29 (0.8)	516 (3.6)	21 (1.0)	480 (3.3)	16 (0.9)	460 (4.8)
Serbia	6 (0.5)	509 (4.7)	9 (0.5)	518 (5.3)	27 (1.0)	490 (3.8)	38 (1.0)	458 (2.5)	21 (1.1)	428 (4.0)
Singapore	14 (0.5)	631 (4.1)	16 (0.5)	607 (4.2)	33 (0.7)	589 (3.7)	24 (0.7)	546 (6.1)	12 (0.7)	508 (6.9)
Slovak Republic	12 (0.8)	564 (4.7)	18 (0.8)	547 (4.1)	41 (0.9)	520 (3.0)	24 (1.1)	481 (3.2)	5 (0.5)	440 (7.5)
Slovenia	13 (0.7)	545 (4.5)	15 (0.7)	542 (3.2)	38 (0.9)	527 (2.2)	27 (0.7)	502 (3.5)	8 (0.6)	474 (4.7)
South Africa	6 (0.5)	315 (20.7)	5 (0.4)	316 (22.1)	14 (0.7)	288 (13.6)	31 (0.9)	241 (6.0)	44 (1.3)	218 (4.5)
Sweden	32 (1.3)	558 (3.2)	21 (0.6)	537 (3.0)	27 (0.9)	511 (3.0)	14 (0.7)	481 (4.4)	6 (0.6)	472 (6.2)
Tunisia	4 (0.4)	433 (7.8)	6 (0.5)	426 (6.3)	22 (0.9)	415 (3.1)	44 (1.1)	400 (2.0)	23 (1.1)	392 (2.3)
United States	24 (0.9)	569 (3.6)	18 (0.5)	552 (3.4)	28 (0.6)	527 (2.9)	18 (0.6)	493 (3.3)	13 (0.6)	469 (4.6)
¶ England	24 (1.1)	588 (5.7)	18 (1.0)	564 (6.5)	27 (1.0)	541 (4.4)	17 (0.9)	520 (4.8)	13 (1.1)	487 (5.0)
International Avg.	15 (0.1)	506 (1.0)	13 (0.1)	498 (1.0)	27 (0.1)	483 (0.7)	26 (0.1)	458 (0.7)	18 (0.1)	438 (1.0)
Benchmarking Participants										
Basque Country, Spain	25 (1.4)	514 (4.6)	20 (0.9)	505 (4.6)	36 (1.3)	481 (3.2)	15 (0.8)	462 (4.3)	5 (0.5)	435 (9.3)
Indiana State, US	19 (1.6)	566 (6.4)	17 (0.9)	552 (5.7)	32 (1.0)	537 (4.4)	19 (1.0)	510 (5.8)	14 (1.2)	477 (6.3)
Ontario Province, Can.	28 (1.6)	560 (3.1)	21 (0.9)	539 (3.3)	31 (1.1)	523 (3.7)	14 (0.9)	507 (5.1)	7 (0.6)	497 (5.0)
Quebec Province, Can.	13 (0.8)	553 (4.6)	16 (0.9)	551 (4.9)	33 (0.9)	535 (3.2)	24 (1.1)	519 (3.3)	14 (0.7)	501 (4.3)

To replicate the results in this exhibit, we need to undertake several steps. After reviewing the codebooks and the questionnaire information, we observe that the variable BSBGBOOK contains information on the number of books in the home (see Supplement 1 for a copy of the student background questionnaire), and this variable is found in the Student Background data file. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no national adaptations were made, we can continue with our analysis without any modifications.

We then proceed to read from the Student Background file our variable of interest (BSBGBOOK), the science achievement plausible values (BSSSCI01-BSSSCI05), the student sampling weight (TOTWGT), the variables that contain the jackknife replication information (JKZONE and JKREP), and the variable containing the country identification code (IDCNTRY). In this analysis, we will again use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries.

The SPSS program code is presented in Exhibit 4.12 and is included on the DVD under the name EXAMPLE2.SPS. Selected results obtained from this program are displayed in Exhibit 4.13. We have included as part of the program the corresponding value labels and format statements so that the different categories or groups are labeled appropriately.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BSBGBOOK.

In general, to perform student-level analyses involving plausible values and using the Student Background data files, you should do the following:

- Identify the variables of interest in the Student Background file and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Student Background files, including the achievement scores, sampling weights, the JRR replication information, and any other variables used in the selection of cases.
- Use the macro JACKPV with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 4.12 SPSS Control Statements for Performing Student-Level Analyses with Plausible Values (EXAMPLE2.SPS)

```
get file =  "D:\TIMSS2003\Data\SPSS_Data\BSGALLM3.SAV".

select if not(missing(BSBGBOOK)).

value labels
 BSBGBOOK      1 "None or very few (0-10)"
               2 "For 1 shelf (11-25)"
               3 "For 1 bookcase (26-100)"
               4 "For 2 bookcases (101-200)"
               5 "For 3 or more bookcases (>200)" /
IDCNTRY
  51 'ARMENIA'    36 'AUSTRALIA'              956 'BELGIUM FLEMISH'   100 'BULGARIA'
  48 'BAHRAIN'    72 'BOTSWANA'              9132 'CANADA ONTARIO'   9133 'CANADA QUEBEC'
 152 'CHILE'     196 'CYPRUS'                818 'EGYPT'             926 'ENGLAND'
3724 'BASQUE'    233 'ESTONIA'               288 'GHANA'             344 'HONG KONG'
 348 'HUNGARY'   360 'INDONESIA'             364 'IRAN'              376 'ISRAEL'
 380 'ITALY'     400 'JORDAN'                392 'JAPAN'             410 'KOREA'
 422 'LEBANON'   440 'LITHUANIA'             428 'LATVIA'            504 'MOROCCO'
 498 'MOLDOVA'   807 'MACEDONIA'             458 'MALAYSIA'          528 'NETHERLANDS'
 578 'NORWAY'    554 'NEW ZEALAND'           275 'PALESTINE'         608 'PHILIPPINES'
 642 'ROMANIA'   643 'RUSSIAN FEDERATION'    682 'SAUDI ARABIA'      927 'SCOTLAND'
 702 'SINGAPORE' 703 'SLOVAK REPUBLIC'       705 'SLOVENIA'          752 'SWEDEN'
 760 'SYRIA'     788 'TUNISIA'               158 'CHINESE TAIPEI'    840 'UNITED STATES'
 887 'YEMEN'     891 'SERBIA AND MONTENEGRO' 710 'SOUTH AFRICA'    11800 'INDIANA US' .

save outfile = STUDENT2 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackpv.sps" .

jackpv
       infile   = STUDENT2            /
       cvar     = IDCNTRY BSBGBOOK    /
       rootpv   = BSSSCI0             /
       npv      = 5                   /
       jkz      = JKZONE              /
       jkr      = JKREP               /
       njkz     = 75                  /
       wgt      = TOTWGT .

sort cases by IDCNTRY.

* Print the results .
print formats n (f6.0) TOTWGT (f10.0) mnpv mnpv_se pct pct_se (f6.2).

report format = list automatic
 / var   = BSBGBOOK (label) n TOTWGT mnpv mnpv_se pct pct_se
 / break = IDCNTRY (label) .
```

Exhibit 4.13 Extract of SPSS Computer Output for Performing Student-Level Analyses with Plausible Values (EXAMPLE 2)

COUNTRY ID	GEN\NR OF BOOKS IN YOUR HOME	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ARMENIA	None or very few (0-10)	798	8025	433.20	5.17	15.14	.94
	For 1 shelf (11-25)	1246	12595	453.07	4.75	23.77	.87
	For 1 bookcase (26-100)	1621	14899	467.14	3.59	28.12	.71
	For 2 bookcases (101-200)	781	7047	474.69	4.21	13.30	.64
	For 3 or more bookcases (>200)	1112	10426	478.40	5.06	19.67	1.00
AUSTRALIA	None or very few (0-10)	248	13527	463.86	8.67	5.38	.50
	For 1 shelf (11-25)	477	27603	493.11	5.77	10.98	.77
	For 1 bookcase (26-100)	1369	74730	516.78	4.82	29.72	.96
	For 2 bookcases (101-200)	1104	57620	540.00	3.38	22.92	.82
	For 3 or more bookcases (>200)	1465	77934	553.16	4.09	31.00	1.38
.							
.							
.							
NORWAY	None or very few (0-10)	247	3959	441.31	7.04	6.59	.41
	For 1 shelf (11-25)	453	6815	462.59	4.58	11.35	.60
	For 1 bookcase (26-100)	1307	19661	492.55	3.05	32.74	.86
	For 2 bookcases (101-200)	902	13223	504.34	2.80	22.02	.69
	For 3 or more bookcases (>200)	1144	16393	514.52	2.63	27.30	1.15
UNITED STATES	None or very few (0-10)	1157	436292	468.96	4.62	12.82	.58
	For 1 shelf (11-25)	1619	623310	493.21	3.28	18.32	.59
	For 1 bookcase (26-100)	2441	936415	526.81	2.90	27.52	.62
	For 2 bookcases (101-200)	1573	603150	552.40	3.41	17.73	.50
	For 3 or more bookcases (>200)	2010	803597	568.95	3.65	23.62	.90

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable BSBGBOOK. The results are presented by country and each value of the variable BSBGBOOK. The countries and the five response options are presented in the first and second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values and its respective standard error. The last two columns report the weighted percentages of students within each category and their respective standard errors.

From the first few lines in Exhibit 4.13, we can say that in Armenia the 1,112 students (19.67%) who reported having more than 200 books have a mean science achievement of 478.40 with a standard error of 5.06; while the 798 students (15.14%) who reported having none or very few books (0-10) have a mean science achievement of 433.20 with a standard error of 5.17.

4.8 Performing Analyses with Teacher-Level Variables

The TIMSS 2003 teachers do not constitute representative samples of teachers. Rather, they are the teachers for nationally representative samples of students. Therefore, it is appropriate that statements about the teachers be made only in terms of how many students are taught by teachers of one kind or another, and not in terms of how many teachers in a country have one attribute or another.

When analyzing teacher data, it is first necessary to link the students with their respective teachers. Each eighth grade student record in the Student Background file can link to as many as six different teachers in the Teacher Background file. There are usually fewer student-teacher links at the fourth grade. To facilitate the linking between students and their teachers, the Student-Teacher Linkage file was created and is part of the International Database. This file is called BST<COUNTRY>M3 for the eighth grade and AST<COUNTRY>M3 for the fourth grade. The Student-Teacher Linkage file contains one record for each student-teacher combination, with the appropriate identification variables.

Each record in the Student-Teacher Linkage file also contains the number of mathematics and science teachers for the student and a set of weights that can be used when conducting analyses with these data. Student achievement plausible values, sampling weights, and JRR replication information have been added to the Student-Teacher Linkage file in order to simplify the merging process for analyses that link teacher variables to student achievement. For such analyses, it is necessary to merge only the Teacher Background file with the Student-Teacher Linkage file. For analyses linking teacher variables to other student variables, it is also necessary to merge the Student Background file with the Teacher Background file after it has been combined with the Student-Teacher Linkage file.

Conducting analyses with teacher data requires some extra steps. As our third example, we will investigate the age of the science teachers who teach the eighth grade students in each of the TIMSS countries. In particular, we will investigate the percentage of eighth grade students who are taught by teachers from specified age groups (BTBGAGE), and the mean science achievement of these students taught by those teachers. The results are found in the Science Teacher Background Data Almanac (BSALM7_M3) for questionnaire item TQS2-1, as shown in Exhibits 4.14 and 4.15. The percentages also appear in Exhibit 6.3 of the TIMSS 2003 International Science Report.

Exhibit 4.14 Sample Data Almanac Sheet for Teacher-Level Analysis (Percentages)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
Science Teacher Background Data Almanac - 8th Grade

Question : How old are you?
Location : TQS2-1 (BTBGAGE)

Country	Sample	Valid N	1.UNDER 25 %	2.25-29 %	3.30-39 %	4.40-49 %	5.50-59 %	6.60 OR OLDER %	Not Administered %	Omitted %
Armenia	772	649	2.3	7.5	27.0	35.6	20.2	7.4	16.7	0.3
Australia	520	411	5.7	17.6	22.6	32.8	19.4	1.9	15.8	1.2
Bahrain	147	147	1.4	25.5	58.0	13.8	1.2	.	0.0	0.0
Belgium (Flemish)	641	609	14.8	16.4	23.1	27.7	17.5	0.5	4.1	0.9
Botswana	146	136	6.2	50.2	35.0	6.0	1.3	1.2	5.4	2.3
Bulgaria	770	594	1.4	6.6	24.8	34.2	29.6	3.4	17.8	0.5
Chile	214	211	.	5.0	19.8	38.8	31.6	4.7	0.8	0.0
Chinese Taipei	151	149	3.7	14.0	38.5	25.3	17.5	1.1	1.6	0.0
Cyprus	472	472	1.1	9.2	20.7	46.8	22.3	.	0.0	0.0
Egypt	217	217	2.7	13.3	59.1	23.5	1.4	.	0.0	0.0
England	503	271	5.1	17.4	26.9	28.1	22.0	0.6	42.6	0.3
Estonia	521	502	4.9	6.1	15.7	34.8	23.4	15.1	3.1	0.2
Ghana	152	142	8.8	41.3	30.3	13.1	5.8	0.8	7.1	0.0
Hong Kong, SAR	131	129	9.8	20.6	42.2	18.6	8.8	.	0.0	1.8
Hungary	627	605	1.8	7.2	19.6	39.9	27.4	4.1	3.7	0.0
Indonesia	278	276	1.2	14.8	50.3	26.2	7.0	0.5	0.3	0.3
Iran, Islamic Rep.	181	180	4.9	11.9	42.2	36.2	4.8	.	0.2	0.0
Israel	308	287	2.3	11.8	35.0	30.0	20.4	0.5	3.5	0.5
Italy	217	216	.	2.7	7.5	31.0	56.5	2.3	0.0	0.5
Japan	146	145	4.3	9.9	29.8	38.3	16.0	1.7	0.7	0.0
Jordan	140	140	7.5	25.5	45.0	15.4	6.5	.	0.0	0.0
Korea, Rep. of	357	256	2.4	12.8	40.7	39.8	4.4	.	28.3	0.0
Latvia	438	406	2.5	6.4	24.1	32.8	24.2	10.0	7.0	0.0
Lebanon	306	303	17.9	27.0	27.4	20.0	6.8	0.7	1.0	0.6
Lithuania	999	921	3.3	7.6	25.6	33.6	23.7	6.2	9.4	0.1
Macedonia, Rep. of	595	578	0.8	3.2	16.5	29.0	42.9	7.5	2.9	0.0
Malaysia	150	149	3.5	22.2	39.1	31.2	4.0	.	0.9	0.0
Moldova, Rep. of	505	428	8.8	9.3	14.9	24.5	30.9	11.6	11.5	0.3
Morocco	145	140	1.2	16.1	29.4	46.0	7.3	.	2.1	0.0
Netherlands	377	323	3.9	14.1	19.8	30.7	28.0	3.4	13.9	0.0
New Zealand	176	166	7.2	7.7	33.6	30.9	19.2	1.4	2.7	2.2
Norway	179	171	1.0	17.0	24.6	21.7	32.5	3.2	3.5	1.3
Palestinian Nat'l	145	144	10.1	25.2	35.8	21.2	7.2	0.6	0.7	0.0
Philippines	137	131	4.2	19.8	31.7	24.4	19.0	1.0	3.9	0.7
Romania	712	699	4.9	15.1	20.0	21.8	34.2	4.0	1.3	0.0
Russian Federation	855	843	6.2	10.2	22.6	29.0	24.8	7.2	1.9	0.2
Saudi Arabia	172	168	11.2	33.8	37.4	15.6	2.0	.	1.4	0.0
Scotland	677	387	4.2	8.5	13.3	34.3	37.2	2.5	38.3	0.0
Serbia and Montene	702	660	0.6	6.9	21.8	25.8	39.4	5.5	4.2	0.0
Singapore	336	333	5.3	28.3	26.6	19.3	19.5	1.0	0.6	0.4
Slovak Republic	599	585	3.5	12.6	20.1	24.9	31.5	7.4	1.9	0.0
Slovenia	528	492	1.4	6.9	30.8	41.9	17.3	1.7	6.0	0.0
South Africa	255	222	2.3	22.1	51.3	20.0	4.3	.	11.5	0.8
Sweden	647	581	2.5	13.0	29.4	21.6	24.1	9.5	7.2	0.3
Syrian Arab Republ	240	199	16.7	11.6	51.6	15.2	4.9	.	13.6	1.6
Tunisia	150	148	1.4	22.9	45.3	18.6	11.0	0.7	0.7	0.7
United States	1090	924	2.4	12.5	23.3	31.4	27.0	3.5	10.7	1.8
International Avg.	398	358	4.9	15.5	30.4	27.7	18.9	3.8	6.6	0.4
Basque Country, Sp	124	114	.	9.3	28.6	49.1	12.6	0.3	5.4	0.4
Indiana State, US	285	270	2.5	14.2	14.9	32.4	31.2	4.8	0.3	2.7
Ontario Province,	206	186	1.1	24.6	31.4	23.5	19.4	0.1	5.9	1.9
Quebec Province, C	442	330	6.3	21.6	32.8	23.4	15.3	0.8	11.1	1.5

Exhibit 4.15 Sample Data Almanac Sheet for Teacher-Level Analysis (Means)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
Science Teacher Background Data Almanac - 8th Grade

Question : How old are you?
Location : TQS2-1 (BTBGAGE)

Country	Sample	Valid N	1.UNDER 25 Mean	2.25-29 Mean	3.30-39 Mean	4.40-49 Mean	5.50-59 Mean	6.60 OR OLDER Mean	Not Administered Mean	Omitted Mean
Armenia	772	649	490.9	460.1	458.9	466.9	458.0	465.7	455.7	432.8
Australia	520	411	521.3	513.9	527.3	537.5	520.6	515.7	528.7	545.2
Bahrain	147	147	450.9	441.2	437.5	434.8	436.6	.	.	.
Belgium (Flemish)	641	609	515.4	506.6	521.6	525.4	502.9	541.8	495.3	546.7
Botswana	146	136	353.3	359.6	368.0	376.1	352.6	365.0	391.7	358.9
Bulgaria	770	594	488.5	479.8	470.7	479.6	482.2	475.5	482.5	461.1
Chile	214	211	.	427.7	434.6	411.5	400.7	402.4	391.1	.
Chinese Taipei	151	149	593.2	573.7	564.2	582.4	561.7	517.5	624.5	.
Cyprus	472	472	447.5	434.3	443.2	438.4	443.8	.	.	.
Egypt	217	217	436.9	410.0	419.7	429.8	412.2	.	.	.
England	503	271	516.1	553.8	541.6	548.1	575.3	537.2	533.7	524.9
Estonia	521	502	555.8	550.7	552.8	554.7	549.2	549.6	549.2	628.2
Ghana	152	142	275.6	254.6	243.5	243.1	272.1	371.0	279.3	.
Hong Kong, SAR	131	129	545.5	559.6	555.8	557.9	553.2	.	.	576.5
Hungary	627	605	535.4	540.6	546.6	542.9	537.6	557.4	550.8	.
Indonesia	278	276	436.3	419.3	420.7	423.0	442.0	442.0	483.3	350.9
Iran, Islamic Rep.	181	180	426.6	439.6	453.2	460.1	467.8	.	433.1	.
Israel	308	287	489.2	503.0	480.8	487.7	499.1	459.4	457.8	486.9
Italy	217	216	.	510.4	484.0	484.4	495.5	479.2	.	415.6
Japan	146	145	557.9	547.7	552.2	549.5	555.5	596.6	541.8	.
Jordan	140	140	455.7	469.1	481.8	471.7	478.9	.	.	.
Korea, Rep. of	357	256	542.5	558.4	557.7	562.5	558.9	.	555.9	.
Latvia	438	406	498.3	501.4	512.8	515.1	512.5	515.0	509.0	.
Lebanon	306	303	370.8	382.9	399.5	418.2	398.1	423.4	376.7	374.6
Lithuania	999	921	524.5	525.5	520.2	515.5	517.6	520.1	527.5	534.2
Macedonia, Rep. of	595	578	340.6	449.4	448.6	439.7	455.2	458.8	472.5	.
Malaysia	150	149	478.0	501.0	508.9	524.2	503.2	.	493.8	.
Moldova, Rep. of	505	428	458.8	480.6	477.4	472.9	465.8	474.7	482.2	499.5
Morocco	145	140	395.1	402.9	395.2	400.1	400.1	.	415.0	.
Netherlands	377	323	530.1	541.7	542.2	534.1	532.0	544.7	531.8	.
New Zealand	176	166	511.7	492.4	540.4	507.3	523.9	513.7	440.2	565.2
Norway	179	171	516.0	497.2	484.8	498.1	493.9	500.6	498.7	502.2
Palestinian Nat'l	145	144	435.9	443.1	429.7	431.0	449.9	414.3	442.1	.
Philippines	137	131	494.3	367.0	361.2	385.7	389.4	313.8	323.1	492.8
Romania	712	699	476.2	463.1	461.0	474.9	473.2	473.4	457.4	.
Russian Federation	855	843	510.0	513.2	512.3	509.5	520.7	510.0	532.8	447.8
Saudi Arabia	172	168	379.9	396.1	403.9	399.7	379.7	.	418.6	.
Scotland	677	387	501.8	514.2	520.5	515.8	517.1	500.0	504.7	.
Serbia and Montene	702	660	480.5	469.6	473.7	462.9	466.7	462.1	477.6	.
Singapore	336	333	587.0	573.3	568.6	590.0	578.6	615.9	599.4	643.7
Slovak Republic	599	585	517.2	512.5	519.4	519.2	514.0	523.4	491.8	.
Slovenia	528	492	524.4	514.8	518.7	523.0	524.4	519.8	507.3	.
South Africa	255	222	244.6	236.0	221.5	268.0	451.5	.	235.1	292.4
Sweden	647	581	492.1	529.0	528.4	520.4	524.5	528.4	516.0	521.0
Syrian Arab Republ	240	199	395.1	394.6	415.1	412.9	428.6	.	413.9	426.5
Tunisia	150	148	403.9	396.4	399.0	411.8	423.1	424.7	408.7	378.0
United States	1090	924	530.2	530.6	520.9	536.3	540.5	495.9	498.3	492.4
International Avg.	398	358	471.8	471.1	472.3	475.6	479.6	486.0	471.4	479.1
Basque Country, Sp	124	114	.	503.2	495.7	483.7	491.4	459.0	473.6	439.9
Indiana State, US	285	270	520.1	510.3	521.8	535.8	542.0	529.8	512.9	506.3
Ontario Province,	206	186	500.1	538.4	533.3	539.5	526.2	466.3	528.0	484.9
Quebec Province, C	442	330	523.0	541.4	524.3	535.2	542.7	493.0	519.8	496.6

As before, we first proceed to identify the variables relevant to the analysis in the appropriate files, and review the documentation on any specific national adaptations to the questions of interest (Supplements 1 and 2). Since we are using teacher-level variables, we need to look in the teacher file and the Student-Teacher Linkage file to find the variables. From the teacher file, we will need the variable that contains the information on the science teachers' age (BTBGAGE), the variable that identifies the country (IDCNTRY), and the two variables that will allow us to link the teacher information to the student data (IDTEACH and IDLINK).

For the eighth grade, there is one teacher file for the mathematics teachers and a second teacher file for the science teachers. If you want to look only at mathematics teachers, then you will need to use the mathematics teacher file (BTM<COUNTRY>M3); if your interest is in the science teachers then you will need to use the science teacher file (BTS<COUNTRY>M3); but if your interest is in the mathematics and science teachers combined, both these files need to be combined by adding one file to the other. In doing so, it is important to keep in mind that although there are variables in common between these two files, most of them are not.

In our example, our teacher variable of interest (BTBGAGE) is a categorical variable with six categories. However, we want to categorize the teachers into four groups: less than 30 years old, 30-39 years old, 40-49 years old, and 50 years or older. When reading the teacher file, we will use SPSS commands to collapse the six values into four categories and label them accordingly. We then proceed to read the necessary information from the Student-Teacher Linkage file. From this file we need the country identification (IDCNTRY) and the two variables that will allow us to link the student information to the teacher data (IDTEACH and IDLINK). We also need the science achievement plausible values (BSSSCI01-BSSSCI05), and the jackknife replication information (JKZONE and JKREP). We need to use the weight variable appropriate for science teacher variables (SCIWGT). If you are investigating the mathematics teachers, then the weight variable MATWGT should be used; if you are interested in analyzing mathematics and science teachers combined, the weight variable TCHWGT should be used.

The two files are merged into one file that will then be used with the JACKPV macro. These two files are merged using the variables IDCNTRY, IDTEACH, and IDLINK. The combination of values for these three variables is unique within the teacher data, but is repeated in the Student-Teacher Linkage file as many times as the specific teacher teaches students in a class. After the files are merged, the macro JACKPV is used and the results can be printed.

In this analysis, we will again use the eighth grade data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used

the JOIN program, described earlier in this chapter, to join the Science Teacher Background files for all available countries into a single Science Teacher Background file called BTSALLM3. The JOIN program was used a second time to join all the Student-Teacher Linkage files into a single one called BSTALLM3.

The SPSS program code for this example is presented in Exhibit 4.16 and is included on the DVD under the name EXAMPLE3.SPS. Selected results obtained from this program are displayed in Exhibit 4.17. In this program, the variable TCHAGE is created by collapsing the categorical variable BTBGAGE into only four categories.

Note that one of the steps in this program is to select only those science teachers who have non-missing data in the variable of interest TCHAGE.

In general, to perform teacher-level analyses using the Teacher Background data files, you should do the following:

- Identify the variables of interest in the appropriate Teacher Background files and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Teacher Background files. If you are investigating mathematics and science teachers combined, then the files for these teachers need to be added to each other.
- Retrieve the relevant variables from the Student-Teacher Linkage files. This includes the country and teacher identification information (IDCNTRY, IDTEACH, and IDLINK), the achievement scores, the JRR replication information, and the appropriate sampling weights. If the analysis is to be based on mathematics teachers only, then the weight variable to use is MATWGT. If the analysis is to be based on the science teachers only, then the weight variable to be used is SCIWGT. If the analysis is to be based on the science and mathematics teachers combined, then the weight variable to be used is TCHWGT.
- Merge the Teacher Background files with the Student-Teacher Linkage files using the variables IDCNTRY, IDTEACH and IDLINK.
- Use the macro JACKGEN, or JACKPV if plausible values are involved, with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 4.16 SPSS Control Statement for Performing Teacher-Level Analysis (EXAMPLE3.SPS)

```
get file =  "D:\TIMSS2003\Data\SPSS_Data\BTSALLM3.SAV".
recode BTBGAGE (1,2=1) (3=2) (4=3) (5,6=4) (else=sysmis) into TCHAGE .
sort cases by IDCNTRY IDTEACH IDLINK .
save outfile = TEACHER .

get file =  "D:\TIMSS2003\Data\SPSS_Data\BSTALLM3.SAV".
select if SCIWGT > 0 .
sort cases by IDCNTRY IDTEACH IDLINK.
save outfile= STDTCH.

match files
  / file=STDTCH
  / table=TEACHER
  / by IDCNTRY IDTEACH IDLINK.

select if not(missing(TCHAGE)).

value labels
 TCHAGE        1 "Less than 30 years old"
               2 "30-39 years old"
               3 "40-49 years old"
               4 "50 years or older" /
IDCNTRY
  51 'ARMENIA'    36 'AUSTRALIA'              956 'BELGIUM FLEMISH'   100 'BULGARIA'
  48 'BAHRAIN'    72 'BOTSWANA'              9132 'CANADA ONTARIO'   9133 'CANADA QUEBEC'
 152 'CHILE'     196 'CYPRUS'                818 'EGYPT'             926 'ENGLAND'
3724 'BASQUE'    233 'ESTONIA'               288 'GHANA'             344 'HONG KONG'
 348 'HUNGARY'   360 'INDONESIA'             364 'IRAN'              376 'ISRAEL'
 380 'ITALY'     400 'JORDAN'                392 'JAPAN'             410 'KOREA'
 422 'LEBANON'   440 'LITHUANIA'             428 'LATVIA'            504 'MOROCCO'
 498 'MOLDOVA'   807 'MACEDONIA'             458 'MALAYSIA'          528 'NETHERLANDS'
 578 'NORWAY'    554 'NEW ZEALAND'           275 'PALESTINE'         608 'PHILIPPINES'
 642 'ROMANIA'   643 'RUSSIAN FEDERATION'    682 'SAUDI ARABIA'      927 'SCOTLAND'
 702 'SINGAPORE' 703 'SLOVAK REPUBLIC'       705 'SLOVENIA'          752 'SWEDEN'
 760 'SYRIA'     788 'TUNISIA'               158 'CHINESE TAIPEI'    840 'UNITED STATES'
 887 'YEMEN'     891 'SERBIA AND MONTENEGRO' 710 'SOUTH AFRICA'    11800 'INDIANA US' .

save outfile = MERGED3 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackpv.sps" .

jackpv infile   = MERGED3        /
       cvar     = IDCNTRY TCHAGE /
       rootpv   = BSSSCI0        /
       npv      = 5              /
       jkz      = JKZONE         /
       jkr      = JKREP          /
       njkz     = 75             /
       wgt      = SCIWGT .

sort cases by IDCNTRY .

* Print the results .
print formats n (f6.0) SCIWGT (f10.0) mnpv mnpv_se pct pct_se (F6.2) .

report format = list automatic
 / var = TCHAGE (label) n SCIWGT mnpv mnpv_se pct pct_se
 / break = IDCNTRY (label) .
```

Exhibit 4.17 Extract of SPSS Computer Output for Performing Teacher-Level Analysis (EXAMPLE 3)

COUNTRY ID	TCHAGE	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ARMENIA	Less than 30 years old	1778	4392	467.22	7.48	9.78	1.45
	30 – 39 years old	5162	12146	458.93	5.20	27.04	2.02
	40 – 49 years old	6475	16006	466.90	4.12	35.64	2.26
	50 years or older	5174	12369	460.08	4.29	27.54	1.74
AUSTRALIA	Less than 30 years old	1035	49869	515.66	7.05	23.34	3.25
	30 – 39 years old	1110	48223	527.35	5.88	22.57	2.52
	40 – 49 years old	1309	70160	537.52	6.81	32.84	3.77
	50 years or older	866	45374	520.17	8.89	21.24	3.21
.							
.							
.							
NORWAY	Less than 30 years old	726	10478	498.21	5.74	17.96	3.26
	30 – 39 years old	1030	14363	484.85	5.26	24.62	3.35
	40 – 49 years old	856	12658	498.10	5.33	21.70	3.32
	50 years or older	1337	20832	494.52	3.21	35.71	4.36
UNITED STATES	Less than 30 years old	1090	448839	530.54	6.15	14.88	2.28
	30 – 39 years old	1932	702160	520.86	6.74	23.29	2.44
	40 – 49 years old	2375	945533	536.32	5.75	31.36	3.14
	50 years or older	2378	918958	535.40	6.17	30.47	2.92

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable TCHAGE. The results are presented by country and each value of the variable TCHAGE. The countries and the four age groups are presented in the first and the second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values and its respective standard error. The last two columns report the weighted percentages of students within each teacher age group and their respective standard errors.

From the first few lines of Exhibit 4.14, we can say that in Armenia the 1,778 students (9.78%) with teachers less than 30 years old have a mean science achievement of 467.22 with a standard error of 7.48; while the 5,174 students (27.54%) with teachers 50 years or older have a mean science achievement of 460.08 with a standard error of 4.29.

4.9 Performing Analyses with School-Level Variables

TIMSS 2003 has representative samples of schools and so it is possible to compute weighted numbers of schools with particular characteristics for providing reasonable estimates of percentages and averages across primary or middle schools in each country. However, the school samples were designed to optimize the student samples and the student-level estimates. For this reason, it is preferable to analyze school-level variables as attributes of students, rather than as elements in their own right. The following example describes school-level analyses based on student-weighted data.

For student-weighted analyses, the school-level data are analyzed to make statements about the number of students attending schools with one characteristic or another, rather than the number of schools with one characteristic or another. When school-level variables are analyzed, we recommend that you merge the selected school-level variables with the student-level file, and then use the sampling and weight information contained in the student-level file to make the desired statements. The example presented in this section describes how this can be accomplished using SPSS.

As our fourth example, we wish to investigate the percentage of eighth grade students who attend schools in areas of different population sizes (BCBGCOMU), and their mean science achievement. The results are found in the School Background Data Almanac by Science Achievement (BSALM4_M3) for questionnaire item SCQ2-3, as shown in Exhibits 4.18 and 4.19.

Exhibit 4.18 Sample Data Almanac Sheet for School-Level Analysis (Percentages)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
School Background Data Almanac by SCIENCE Achievement - 8th Grade

Question : How many people live in the city, town, or area where your school is located?
Location : SCQ2-3 (BCBGCOMU)

Country	Sample	Valid N	1.MORE THAN 500000 PEOPLE %	2.10000 TO 500000 PEOPLE %	3.50001 TO 100000 PEOPLE %	4.15001 TO 50000 PEOPLE %	5.3001 TO 15000 PEOPLE %	6.FEWER THAN 3000 PEOPLE %	Not Administered %	Omitted %
Armenia	149	122	16.9	8.1	4.6	16.7	32.0	21.6	16.8	2.9
Australia	207	185	35.2	17.0	12.4	16.3	15.4	3.7	8.4	2.7
Bahrain	67	58	9.1	2.9	12.9	35.1	33.4	6.6	0.0	8.7
Belgium (Flemish)	144	136	2.9	8.6	14.9	54.3	19.3	.	2.6	3.4
Botswana	146	131	2.5	3.7	13.2	28.3	32.3	20.0	10.0	1.6
Bulgaria	164	160	12.5	18.4	14.9	13.4	17.8	22.9	1.1	0.9
Chile	195	193	21.3	29.1	14.1	15.6	9.5	10.4	0.7	0.5
Chinese Taipei	150	148	25.9	34.5	18.1	17.2	3.7	0.6	0.0	1.5
Cyprus	59	57	.	23.0	19.4	13.3	41.7	2.5	1.3	1.9
Egypt	217	210	17.2	12.3	10.0	21.3	29.9	9.3	0.0	2.4
England	87	58	19.3	21.3	27.9	15.0	14.6	1.9	32.6	1.4
Estonia	151	143	3.2	26.3	11.1	15.3	25.0	19.2	5.0	0.7
Ghana	150	140	19.5	10.8	6.7	8.4	35.1	19.6	6.2	1.7
Hong Kong, SAR	125	115	37.9	51.9	3.2	7.0	.	.	5.0	3.5
Hungary	155	147	13.0	14.5	7.4	22.5	23.0	19.6	5.7	0.0
Indonesia	150	148	22.5	5.5	11.2	16.8	36.1	7.9	0.0	1.1
Iran, Islamic Rep.	181	177	25.4	18.9	10.2	11.5	18.2	15.8	0.0	2.2
Israel	146	139	4.0	22.5	14.9	26.6	26.6	5.3	1.9	2.6
Italy	171	170	12.2	9.9	14.2	23.1	35.3	5.3	0.0	0.7
Japan	146	144	24.3	39.2	11.8	15.8	8.1	0.7	0.0	1.2
Jordan	140	140	23.1	5.9	12.8	14.8	30.0	13.4	0.0	0.0
Korea, Rep. of	149	146	48.4	26.1	9.0	10.8	4.7	1.0	0.0	2.3
Latvia	140	129	20.9	5.4	4.9	11.8	27.7	29.2	8.8	0.0
Lebanon	152	148	19.7	11.9	6.4	18.8	28.5	14.7	0.0	2.1
Lithuania	143	128	6.8	21.5	5.1	18.0	21.7	26.9	9.6	0.7
Macedonia, Rep. of	147	144	12.8	4.2	18.5	17.6	37.0	9.9	0.8	1.9
Malaysia	150	150	9.3	15.7	15.2	26.6	29.4	3.7	0.0	0.0
Moldova, Rep. of	149	112	15.1	3.0	.	17.0	37.6	27.3	18.3	3.0
Morocco	131	82	4.8	0.5	9.4	17.8	42.8	24.6	32.0	5.6
Netherlands	130	121	4.3	23.2	23.6	44.9	4.1	.	4.5	1.7
New Zealand	169	156	20.9	21.3	12.7	18.9	21.1	5.2	3.5	5.5
Norway	138	134	5.8	13.1	7.5	31.9	36.4	5.3	2.0	0.5
Palestinian Nat'l	145	142	5.3	14.4	20.3	19.1	30.8	10.2	0.0	2.1
Philippines	137	132	13.3	13.3	22.4	15.7	18.7	16.6	1.2	1.7
Romania	148	146	13.6	20.4	6.2	12.4	17.3	30.0	1.7	0.0
Russian Federation	214	211	20.6	20.0	10.1	10.6	15.9	22.8	0.0	1.4
Saudi Arabia	155	148	32.2	12.4	4.4	15.7	11.3	24.0	0.4	3.6
Scotland	128	86	8.3	14.6	14.6	23.7	34.9	4.0	30.2	3.0
Serbia and Montene	149	146	9.2	17.2	11.8	24.2	24.9	12.7	1.9	0.0
Singapore	164	161	100.0	.	.	.	.	.	1.7	0.0
Slovak Republic	179	176	1.7	9.7	15.0	27.0	22.1	24.5	0.8	0.9
Slovenia	174	155	2.3	12.2	1.3	15.8	38.6	29.9	9.2	0.0
South Africa	255	219	15.3	7.2	11.9	22.2	29.0	14.3	8.0	2.8
Sweden	159	149	7.7	18.9	12.9	27.2	26.2	7.1	5.5	0.5
Syrian Arab Republ	134	114	6.7	9.1	9.1	24.5	40.8	9.9	12.3	1.6
Tunisia	150	146	2.7	4.9	12.5	41.9	38.1	.	0.7	2.0
United States	232	200	11.4	13.2	12.3	31.3	20.9	10.9	12.1	1.0
International Avg.	154	143	16.7	15.6	12.1	20.7	25.5	13.6	5.6	1.8
Basque Country, Sp	115	114	5.4	35.7	11.9	24.5	21.7	0.7	0.4	0.0
Indiana State, US	54	50	13.3	13.1	12.0	17.9	30.7	13.1	0.0	6.1
Ontario Province,	186	181	37.7	26.3	8.4	7.2	11.1	9.3	2.1	0.0
Quebec Province, C	175	162	20.3	18.2	16.0	20.0	22.7	2.8	5.5	2.6

Exhibit 4.19 Sample Data Almanac Sheet for School-Level Analysis (Means)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
School Background Data Almanac by SCIENCE Achievement - 8th Grade

Question : How many people live in the city, town, or area where your school is located?
Location : SCQ2-3 (BCBGCOMU)

Country	Sample	Valid N	1.MORE THAN 500000 PEOPLE Mean	2.10000 TO 500000 PEOPLE Mean	3.50001 TO 100000 PEOPLE Mean	4.15001 TO 50000 PEOPLE Mean	5.3001 TO 15000 PEOPLE Mean	6.FEWER THAN 3000 PEOPLE Mean	Not Administered Mean	Omitted Mean
Armenia	149	122	474.6	473.3	484.5	468.3	455.4	435.6	462.5	508.9
Australia	207	185	532.3	529.4	525.7	526.7	527.1	511.9	512.5	521.8
Bahrain	67	58	428.2	450.1	429.0	435.5	440.7	449.9	.	450.4
Belgium (Flemish)	144	136	454.5	499.3	516.1	517.2	531.6	.	504.7	497.2
Botswana	146	131	378.7	458.1	380.3	361.8	355.4	343.4	379.7	382.4
Bulgaria	164	160	466.8	471.9	493.0	476.3	456.4	501.8	461.7	476.1
Chile	195	193	440.2	415.5	415.9	414.3	396.1	363.5	386.2	350.3
Chinese Taipei	150	148	582.6	574.5	563.8	561.0	534.7	533.9	.	601.2
Cyprus	59	57	.	442.2	447.2	449.5	435.6	429.8	463.5	445.4
Egypt	217	210	437.4	431.5	456.9	409.9	408.7	402.6	.	428.1
England	87	58	519.2	565.5	557.8	553.2	541.5	549.3	534.4	536.2
Estonia	151	143	546.0	561.0	541.6	551.9	549.3	552.4	551.3	539.7
Ghana	150	140	261.6	301.4	335.3	265.5	230.6	210.9	301.3	356.5
Hong Kong, SAR	125	115	566.3	546.3	545.7	546.3	.	.	587.9	570.2
Hungary	155	147	562.4	553.4	550.1	553.5	527.7	523.4	546.2	.
Indonesia	150	148	437.2	441.6	421.8	423.5	404.1	423.8	.	405.1
Iran, Islamic Rep.	181	177	471.7	472.8	452.9	447.9	433.8	428.7	.	446.9
Israel	146	139	501.2	502.0	489.1	482.8	480.0	487.7	496.2	478.3
Italy	171	170	483.9	504.2	498.1	475.7	493.3	523.6	.	410.7
Japan	146	144	559.8	555.8	540.1	544.4	545.5	556.4	.	544.5
Jordan	140	140	492.1	480.0	473.4	477.9	462.1	469.4	.	.
Korea, Rep. of	149	146	563.9	555.8	553.8	557.1	527.2	524.4	.	573.9
Latvia	140	129	519.4	530.8	502.7	527.6	509.3	504.4	506.0	.
Lebanon	152	148	401.3	399.7	397.0	415.5	374.4	386.0	.	385.1
Lithuania	143	128	544.0	528.4	514.7	525.4	517.6	506.3	514.8	511.4
Macedonia, Rep. of	147	144	494.0	477.1	449.8	456.8	433.5	432.6	388.6	438.0
Malaysia	150	150	528.5	520.7	513.4	507.6	503.4	486.3	.	.
Moldova, Rep. of	149	112	481.7	466.5	.	477.2	469.9	465.0	471.7	501.6
Morocco	131	82	405.9	422.7	378.2	393.5	396.4	398.4	396.3	411.2
Netherlands	130	121	493.9	537.5	524.9	543.1	544.1	.	537.1	549.8
New Zealand	169	156	516.2	524.9	540.6	516.9	517.3	503.9	480.0	526.0
Norway	138	134	503.6	494.9	505.4	491.0	492.7	502.5	470.0	457.1
Palestinian Nat'l	145	142	440.7	448.4	427.7	428.0	430.9	448.9	.	472.9
Philippines	137	132	392.8	405.1	381.4	389.9	351.2	357.4	293.5	414.3
Romania	148	146	486.0	493.8	478.4	488.3	453.2	449.3	405.0	.
Russian Federation	214	211	534.1	530.6	502.7	509.7	494.7	500.3	.	508.5
Saudi Arabia	155	148	407.3	397.5	385.2	396.5	396.0	386.9	339.0	416.9
Scotland	128	86	507.3	501.6	513.1	512.6	525.9	574.1	499.2	498.5
Serbia and Montene	149	146	508.1	478.7	473.3	468.2	452.5	445.7	475.5	.
Singapore	164	161	577.3	.	.	.	.	.	609.6	.
Slovak Republic	179	176	538.4	537.9	543.0	518.4	507.8	494.9	511.2	588.5
Slovenia	174	155	515.4	523.1	539.0	519.2	523.2	517.5	516.6	.
South Africa	255	219	282.6	318.9	320.4	226.4	197.6	183.8	294.0	265.3
Sweden	159	149	521.4	529.6	523.4	527.9	520.5	521.6	514.2	542.1
Syrian Arab Republ	134	114	435.6	420.1	421.9	410.4	396.1	409.8	429.7	394.4
Tunisia	150	146	392.6	406.7	420.3	403.9	396.9	.	408.7	424.1
United States	232	200	523.0	505.6	538.4	536.7	532.9	541.8	500.0	537.2
International Avg.	154	143	480.7	482.3	477.0	471.5	459.4	458.1	463.2	470.9
Basque Country, Sp	115	114	490.9	495.3	489.2	486.5	480.9	484.9	425.3	.
Indiana State, US	54	50	523.0	514.9	539.2	511.7	550.0	540.3	.	503.1
Ontario Province,	186	181	532.9	534.5	537.5	535.2	529.8	526.0	533.0	.
Quebec Province, C	175	162	534.0	532.2	525.5	543.5	526.1	544.8	512.9	508.6

The first step in our analysis is to identify the variables of interest in the appropriate files and review the documentation on specific national adaptations to the questions of interest (Supplements 1 and 2). We observe that the variable BCBGCOMU in the School Background file contains information on the size of the community where the schools are located. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no adaptations were made, we can continue with our analysis without any modifications.

We then read from the School Background file the variables relevant to our analysis. In this case, we will need our variable of interest (BCBGCOMU) and the country and school identification information (IDCNTRY and IDSCHOOL). These last two variables will allow us to merge the school data to the student data. We then read the variables of interest from the Student Background file. We will need the country and school identification information (IDCNTRY and IDSCHOOL), which will allow us to merge the student data to the school data. We will also need the international science achievement plausible values (BSSSCI01-BSSSCI05), the student sampling weight (TOTWGT), and the variables that contain the jackknife replication information (JKZONE and JKREP).

We then proceed to merge the school information with the student information using the variables IDCNTRY and IDSCHOOL, and then use the macro JACKPV to obtain the percentages of students and their mean science achievement scores within each category of the variable BCBGCOMU by country.

In this analysis, we will again use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used the JOIN program, described earlier in this chapter, to join the School Background files for all available countries into a single School Background file called BCGALLM3. The JOIN program was used a second time to join all the Student Background files into a single one called BSGALLM3.

The SPSS program code for this example is presented in Exhibit 4.20 and is included on the DVD under the name EXAMPLE4.SPS. Selected results obtained from this program are displayed in Exhibit 4.21.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BCBGCOMU.

In general, to perform student-weighted school-level analyses using the School Background files, you should do the following:

- Identify the variables of interest in the School Background file and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the School Background file.
- Retrieve the relevant variables from the Student Background file, including the achievement scores, sampling weights, JRR replication information, and any other variables used in the selection of cases.
- Merge the School Background files with the Student Background files using the variables IDCNTRY and IDSCHOOL.
- Use the macro JACKGEN, or JACKPV if plausible values are involved, with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 4.20 SPSS Control Statements for Performing Student-Weighted Analyses with School-Level Variables (EXAMPLE4.SPS)

```
get file =  "D:\TIMSS2003\Data\SPSS_Data\BCGALLM3.SAV".
sort cases by IDCNTRY IDSCHOOL .
save outfile = SCHOOL .

get file =  "D:\TIMSS2003\Data\SPSS_Data\BSGALLM3.SAV".
sort cases by IDCNTRY IDSCHOOL.
save outfile = STUDENT .

match files
  / file= STUDENT
  / table= SCHOOL
  / by IDCNTRY IDSCHOOL.

select if not(missing(BCBGCOMU)).

value labels
  BCBGCOMU     1 'More than 500000 people'
               2 '100001 to 500000 people'
               3 '50001 to 100000 people'
               4 '15001 to 50000 people'
               5 '3001 to 15000 people'
               6 'Fewer than 3000 people'/
IDCNTRY
  51 'ARMENIA'    36 'AUSTRALIA'              956 'BELGIUM FLEMISH'   100 'BULGARIA'
  48 'BAHRAIN'    72 'BOTSWANA'              9132 'CANADA ONTARIO'   9133 'CANADA QUEBEC'
 152 'CHILE'     196 'CYPRUS'                818 'EGYPT'             926 'ENGLAND'
3724 'BASQUE'    233 'ESTONIA'               288 'GHANA'             344 'HONG KONG'
 348 'HUNGARY'   360 'INDONESIA'             364 'IRAN'              376 'ISRAEL'
 380 'ITALY'     400 'JORDAN'                392 'JAPAN'             410 'KOREA'
 422 'LEBANON'   440 'LITHUANIA'             428 'LATVIA'            504 'MOROCCO'
 498 'MOLDOVA'   807 'MACEDONIA'             458 'MALAYSIA'          528 'NETHERLANDS'
 578 'NORWAY'    554 'NEW ZEALAND'           275 'PALESTINE'         608 'PHILIPPINES'
 642 'ROMANIA'   643 'RUSSIAN FEDERATION'    682 'SAUDI ARABIA'      927 'SCOTLAND'
 702 'SINGAPORE' 703 'SLOVAK REPUBLIC'       705 'SLOVENIA'          752 'SWEDEN'
 760 'SYRIA'     788 'TUNISIA'               158 'CHINESE TAIPEI'    840 'UNITED STATES'
 887 'YEMEN'     891 'SERBIA AND MONTENEGRO' 710 'SOUTH AFRICA'    11800 'INDIANA US' .

save outfile = MERGED4 .

include "D:\TIMSS2003\Programs\SPSS_Programs\jackpv.sps" .

jackpv
       infile   = MERGED4             /
       cvar     = IDCNTRY BCBGCOMU    /
       rootpv   = BSSSCI0             /
       npv      = 5                   /
       jkz      = JKZONE              /
       jkr      = JKREP               /
       njkz     = 75                  /
       wgt      = TOTWGT .

* Sort the results .
sort cases by IDCNTRY BCBGCOMU .

* Print the results .
print formats n (f6.0) TOTWGT (f10.0) mnpv mnpv_se pct pct_se (F6.2) .

report format = list automatic
 / var = BCBGCOMU (label) n TOTWGT mnpv mnpv_se pct pct_se
 / break = IDCNTRY (label) .
```

Exhibit 4.21 Extract of SPSS Computer Output for Performing Student-Weighted Analyses with School-Level Variables (EXAMPLE 4)

COUNTRY ID	GEN\TYPE OF COMMUNITY	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ARMENIA	More than 500000 people	844	7404	474.60	5.67	16.90	2.78
	100001 to 500000 people	489	3555	473.32	9.05	8.12	2.14
	50001 to 100000 people	292	2035	484.47	15.59	4.65	1.92
	15001 to 50000 people	754	7337	468.27	6.76	16.75	3.78
	3001 to 15000 people	1716	14000	455.38	6.85	31.96	4.32
	Fewer than 3000 people	713	9473	435.57	7.09	21.63	3.44
AUSTRALIA	More than 500000 people	1366	80685	532.32	7.22	35.24	4.09
	100001 to 500000 people	842	38918	529.37	10.95	17.00	3.70
	50001 to 100000 people	548	28317	525.72	14.80	12.37	2.86
	15001 to 50000 people	705	37412	526.70	12.25	16.34	2.77
	3001 to 15000 people	559	35212	527.09	7.61	15.38	3.23
	Fewer than 3000 people	270	8385	511.89	4.77	3.66	1.36
.							
.							
.							
NORWAY	More than 500000 people	281	3434	503.55	12.52	5.76	2.06
	100001 to 500000 people	725	7815	494.87	6.06	13.10	2.81
	50001 to 100000 people	402	4495	505.44	8.18	7.54	2.44
	15001 to 50000 people	1295	19015	491.00	3.20	31.88	4.06
	3001 to 15000 people	1206	21713	492.75	4.16	36.40	3.79
	Fewer than 3000 people	108	3175	502.48	7.10	5.32	2.27
UNITED STATES	More than 500000 people	951	340114	523.04	11.63	11.35	2.05
	100001 to 500000 people	1053	396476	505.56	8.98	13.24	2.33
	50001 to 100000 people	1041	369343	538.39	8.96	12.33	2.33
	15001 to 50000 people	2274	936639	536.72	6.05	31.27	3.71
	3001 to 15000 people	1659	626613	532.89	8.02	20.92	3.06
	Fewer than 3000 people	701	326297	541.76	7.43	10.89	2.09

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable BCBGCOMU. The results are presented by country and each value of the variable BCBGCOMU. The countries and the six community types are presented in the first and the second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values, and its respective standard error. The last two columns report the weighted percentages of students within each category and their respective standard errors.

From the first few lines of Exhibit 4.21, we can say that in Armenia 844 students (16.9%), who represent 7,404 students in the population, responded that they live in a city of more than 500,000 people. These students have a mean science achievement of 474.60 with a standard error of 5.67.

5 Performing Analyses with the TIMSS Data Using SAS

5.1 Overview

This chapter presents some basic examples of analyses that can be performed with the TIMSS 2003 International Database using the sampling weights and achievement scores discussed in previous chapters. It also describes the SAS programs used to conduct such analyses, and their results. The analyses presented here are simple in nature, and are designed primarily to familiarize you with the different files and their structure, as well as the relevant variables that need to be included in most analyses. The programs compute the percent of students in specified subgroups, the mean mathematics or science achievement in those groups, and the proper standard errors for the percent and mean statistics. Additionally, some examples of linear regression analyses are presented. All of these analyses, based on student, teacher and school data, replicate analyses that are included in the TIMSS 2003 Science International Report. You are invited to compare the results from these analyses to the Exhibits in the reports, and are encouraged to practice analyzing the TIMSS data by trying to replicate the Exhibits that are presented in the international reports.[1]

In our examples, we use macros written for SAS that can be used to perform any of the analyses that are described below. These are general procedures that can be used for many purposes, provided you have some basic knowledge of the SAS macro language. If you have some programming experience in this statistical package, then you will be able to make the necessary modifications to the macros to obtain the desired results.

5.2 Contents of the TIMSS 2003 Database DVD

The DVD that accompanies this User Guide contains the TIMSS 2003 data. It has the following internal file structure:

- A main directory identifying the study (TIMSS2003).
- Within the main directory, there are eight sub-directories.

[1] Documentation regarding the computational methods used to obtain any derived variables included in the international reports is presented in Supplement 3

DATA:	Contains data files in SPSS, SAS and ASCII formats
PROGRAMS:	Contains SPSS and SAS programs
CODEBOOKS:	Contains codebook files
ALMANACS:	Contains data almanacs
TCMA:	Contains Test–Curriculum Matching Analysis Data
ITEMS:	Contains the Item Information files
CURRICULUM:	Contains the Curriculum Questionnaire data
REPORTS :	Contains all international reports, this User Guide and its supplements.

The directory names on the DVD and the file names generally follow the DOS naming convention: file names with up to eight characters, followed by a three-character extension (as in FILENAME.EXT). Files with the same names are complementary to each other, and the extension identifies their function or type. The extensions used in the files contained on the DVD are the following.

.SAS	SAS Control file or program
.SPS	SPSS Control file or program
.RAW	ASCII Data file
.SAV	SPSS System file
.EXP	SAS Export file
.LST	Almanac in ASCII format
.DOC	Almanac in MS Word format
.PDF	Almanac in PDF format
.CDT	Codebook in Printout format
.SDB	Codebook in Dbase format
.CSV	Test Curriculum Matching Analysis file
.XLS	Curriculum Questionnaire data and Item Information files in Excel format.

The DATA sub-directory contains the TIMSS data files in ASCII, SAS and SPSS formats. The data files that are in this directory are described in Chapter 3 of this guide. Each file type has two corresponding control files in the PROGRAMS sub-directory. One of these reads the ASCII data file and creates a SAS data file, the other reads the ASCII data file and creates an SPSS system file. This chapter will focus on the files that can be used with SAS.

The following programs can also be found in the PROGRAMS sub-directory:

ASASCRM3.SAS and BSASCRM3.SAS

These files contain SAS programs that can be used to convert the response codes to the cognitive items to their corresponding correctness score levels. The use of these programs is described in this chapter.

CONVERT.SAS

This SAS program converts the SAS Export files found on the DVD into SAS data files. All programs and macros described in this chapter require that the SAS Export files be converted into SAS data files. The use of this program is described in this chapter.

JOIN.SAS

This SAS program combines files of the same type from more than one country. The use of this program is described in this chapter.

JACKGEN.SAS

This macro program in SAS can be used to compute weighted percentages of students within defined groups, and their means on a specified continuous variable. This macro also generates replicate weights and computes jackknife repeated replication (JRR) standard errors for the percentages and mean estimates. The analysis variable can be any continuous variable. The use of this macro programs is described later in this chapter. When computing mean achievement scores based on plausible values, you will need to use the macro JACKPV.SSS.

JACKPV.SAS

This macro program in SAS can be used to compute weighted percentages of students within defined groups, and their mean achievement scores using the available plausible values. This macro also generates replicate weights and computes the JRR standard errors for the percentages and mean achievement scores. This macro should be used when multiple plausible values are used in the analysis.

JACKREG.SAS

This macro program in SAS can be used to compute weighted regression coefficients and their standard errors within defined groups. It also computes descriptive statistics on the variables. This macro can be used with any analysis variable, but it does not make use of the five plausible values.

JACKREGP.SAS

This macro program in SAS can be used to compute weighted regression coefficients and their standard errors within defined groups when using plausible values as the achievement scores. It also computes descriptive statistics on the variables.

Each of the four macros above has a corresponding sample program that calls the respective macros and prints out the results. These are discussed later in this chapter.

EXAMPLE1.SAS, EXAMPLE2.SAS, EXAMPLE3.SAS, EXAMPLE4.SAS

These are the programs used in the examples presented later in this chapter.

5.3 Creating SAS Data Files

The DVD contains SAS control code to read each one of the ASCII data files and create SAS data files. Each of these control files contains information on the location of each variable in the file, its format, a descriptive label for each variable and its categories (in the case of categorical variables), and code for handling missing data. The control files have been created to facilitate access to the data on a country by country basis. They should be used to create SAS data files directly if the SAS export files provided on the DVD are not compatible for a specific computer platform or configuration.

The command lines in the control files should be edited to produce programs that will create SAS data files for any specified countries. While most of the program code is functional as provided, you will need to edit input and output directories and the list of desired countries. Performing analyses that require data from more than one country will necessitate adding or appending the respective data files into a larger one. These control files will create separate files for each desired country. These individual country files can then be joined into a single data file using the JOIN program described later in this chapter.

Alternatively, you can access the data and compute the necessary statistics on a country by country basis, reading one file at a time and moving on to the

next country's data. The method you choose will depend greatly on the storage and processing capacity of the computer system you use. For the examples presented in this User Guide, we have combined the data files of individual countries into one large data file that contains all the data for all participating countries. The three-character country identifier for this file is "ALL".

When creating a SAS data file of a specific type, you should do the following:

1. Open the SAS control file for the appropriate file type, for example BSGTMSM3.SAS .

2. In the line that reads "%LET CTY = …", you should enter the three-character identification code for each country whose data you want to create. If you leave this line unedited, the data for all countries listed will be created.

3. In the line that reads "LIBNAME libdat…", you should enter the path where you want to store the SAS data files that you will be creating.

4. In the line that reads "FILENAME rawinp…", you should enter the path where the raw data are located.

5. Submit the code for processing. After processing is complete, you will find the SAS data files in the location you specified in step 3.

In the extract presented in exhibit 5.1, the Student Background data for Australia, Belgium (Flemish), Bulgaria, England and the United States will be read from the directory "D:\ TIMSS2003\DATA\Raw_Data\". Separate SAS data files will be stored in the directory "D:\TIMSS2003\DATA\SAS_Data\" under the name BSG<country>M3. Only the sections that need to be modified are presented in this exhibit.

Exhibit 5.1 Extract from SAS Control Code for Creating Student Background SAS Data files

```
%let cty = AUS BFL BGR ENG USA ;

*library where the SAS data files are written to;

LIBNAME libdat "D:\TIMSS2003\Data\SAS_Data" ;

%macro doit;
   %let i = 1;
      %do %while(%length(%scan(&cty,&i)));
            %let ccode = %lowcase(%scan(&cty,&i));

%let fname= BSG&ccode.m3;

*NOTE: file-specification of the input raw-data file ;

FILENAME rawinp "D:\TIMSS2003\Data\RAW_Data\&fname..RAW" ;

%PUT INFO: data set definition ;
%PUT INFO: data set definitions have to be modified ;

*Output data set ;
data libdat.&fname;

.
.
.

RUN ;

%let i = %eval(&i + 1);
%end;

%mend doit;

%doit;
```

5.4 Scoring the Items

There were several types of items administered as part of the TIMSS tests. There were multiple-choice items, in which the student was asked to select one of four or five options as the correct response. The responses to these items are coded with one digit. The codes used to represent the responses to these items are as follows.

Code 1	Option A
Code 2	Option B
Code 3	Option C
Code 4	Option D
Code 5	Option E
Code 6	Not reached
Code 7	Invalid response (chose more than one of the options available)

Code 8	Not administered
Code 9	No response although the item was administered and was reached (i.e. item was omitted)

There were also constructed-response items where the students were asked to construct a response to a question, rather than choosing an answer from a list of options. The answers to these questions were scored by scorers trained to use the two-digit scoring rubrics described in chapter 2 of this guide. The first digit of the two-digit code indicates the score given to the question, and the second digit in conjunction with the first provides diagnostic information on the specific answer given by the student. The codes used to represent the responses to these items are the following:

Codes 30 to 39	Three-point answer. Second digit provides diagnostic information
Codes 20 to 29	Two-point answer. Second digit provides diagnostic information
Codes 10 to 19	One-point answer. Second digit provides diagnostic information
Codes 70 to 79	Zero-point answer. Second digit provides diagnostic information
Code 96	Not reached
Code 98	Not administered

The achievement data files contained on the DVD include information on the answers given to each item administered to a student. You might want to work with these item data after they are recoded to the right-wrong format, in the case of multiple-choice items, or to the level of correctness in the case of the constructed-response items. For this purpose, we have included on the DVD two SAS programs, one for each population, which will allow you to recode the items from the achievement test to their right-wrong or correctness-level format. These programs contain a macro called SCOREIT and the necessary call to this macro so that all the items in the specified file are scored. This program will convert the response option codes for multiple-choice items to dichotomous score levels (0 or 1) based on scoring keys. For the constructed-response items the two-digit codes will be converted to the corresponding correctness score level (3, 2, 1, 0) based on the value of the first digit, as described in Chapter 2.

Two files are included to provide control code to perform the recodes of the test items in the achievement test file:

ASASCRM3	TIMSS 2003 Fourth Grade Achievement files
BSASCRM3	TIMSS 2003 Eighth Grade Achievement files

When using these programs, you must first consider the recoding scheme that is desired. For example, under certain circumstances you might want to recode the not reached responses as incorrect (codes 6 and 96), whereas under other circumstances you might want to recode these responses as not administered or invalid. In the case of TIMSS, not reached responses were recoded as not administered (and effectively as missing responses) for the purpose of calibrating the items. But the not-reached responses were then recoded as incorrect when scoring the item for the individual countries, and for the purpose of calculating the scale scores for the individuals. By default, the scoring program provided with the database recodes the items coded as not reached and those left blank as incorrect responses.

To use the SCOREIT macro, you need to adapt the program code in either of the programs ASASCRM3 (fourth grade) or BSASCRM3 (eighth grade). You should do the following:

1. Open the appropriate control file, for example BSASCRM3.SAS.
2. In the line that reads "LIBNAME libdat "<path>";", you should enter the path where the SAS data file you want to recode is located.
3. In the line that reads "DATA libdat.BSA<country>M3;", you should enter the 3-character code for the country whose data you are scoring.
4. In the line that reads "SET libdat.BSA<country>M3;", you should enter the 3-character code for the country whose data you are scoring.
5. Submit the code for processing

Both of these programs recode the items onto themselves, so if you want to preserve the original answers and codes assigned to the questions, then the file with the recoded item variables should be saved under a different file name, or in a different directory. A copy of the program that scores the items in SAS is presented in Exhibit 5.2.

Exhibit 5.2 Extracted Sections of SAS Program SCOREIT Used to Convert Cognitive Item Response Codes to Correctness-Score Levels

```
%MACRO SCOREIT(ITEM,TYPE,RIGHT,NR,NA,OM,OTHER) ;

.
.
.

%MEND SCOREIT ;

* Specify the location of the SAS data files;
LIBNAME libdat "<path>";

* Get the student achievement data;
DATA libdat.BSA<country>M3;
     SET libdat.BSA<country>M3;

%LET ARIGHT  = <list items where option A is the correct one> ;
%LET BRIGHT  = <list items where option B is the correct one> ;
%LET CRIGHT  = <list items where option C is the correct one> ;
%LET DRIGHT  = <list items where option D is the correct one> ;
%LET ERIGHT  = <list items where option E is the correct one> ;
%LET OPENEND = <list open-ended items> ;

.
.
.

RUN;
```

5.5 Converting Files

The DVD provides a special program called CONVERT.SAS that simply converts the SAS Export files provided on the DVD to SAS data files. This conversion is necessary since all the SAS macros and SAS procedures presented in this chapter require the use of SAS data files. SAS data files can also be created from the raw data files, as described in section 5.3.

To convert a SAS Export file to a SAS data file, you should to do the following:

1. Open the control file CONVERT.SAS.
2. At the begining of the program, you should list all the countries of interest in the parameter "cty".
3. You should specify the file type in the parameter "type".
4. You should specify the path where the SAS export files are located in the parameter "exppath".
5. You should specify the path where the SAS data files will be located in the parameter "datpath".

An example of the CONVERT program is presented in Exhibit 5.3.This example converts the SAS Export files of type BSG for all countries.All SAS export files are located in the directory "D:\TIMSS2003\Data\SAS_Data".The SAS data files will also be located in this directory.

Exhibit 5.3 Contents of SAS Program CONVERT Used to Convert SAS Export Files Into SAS Data Files

```
* This program converts SAS export files to SAS data sets ;

options nonotes ;

* Insert the countries ;
%let cty = ARM AUS BFL BGR BHR BWA COT CQU CHL CYP
           EGY ENG BSQ EST GHA HKG HUN IDN IRN ISR
           ITA JOR JPN KOR LBN LTU LVA MAR MDA MKD
           MYS NLD NOR NZL PSE PHL ROM RUS SAU SCO
           SGP SVK SVN SWE SYR TUN TWN USA UIN SCG
           YEM ZAF ;

* Insert the file type ;
%let type = BSG ;

* Insert the path for the export files following the format x:\xxx\ ;
%let exppath = D:\TIMSS2003\Data\SAS_Data\ ;

* Insert the path for the data files following the format x:\xxx\ ;
%let datpath = D:\TIMSS2003\Data\SAS_Data\ ;

%macro convertit;

%let i = 1;
%do %while(%length(%scan(&cty,&i)));
    %let ccode = %lowcase(%scan(&cty,&i));
    proc cimport file="&exppath.&type.&ccode.M3.exp" data="&datpath.&type.&ccode.M3" ;
    %let i = %eval(&i + 1);
%end;

run;

%mend convertit;

%convertit;
```

5.6 Joining Files

The programs presented until now produce a single SAS data file per country. The DVD provides a special program called JOIN.SAS that joins individual country files into a single aggregated file. This program facilitates joint analyses for more than one country. This program can only join SAS data files of the same type, for example BSG files.

To create a SAS data file with more than one country's data, you should do the following:

1. Open the control file JOIN.SAS.
2. At the begining of the program, you should list all the countries of interest in the parameter "cty".
3. You should specify the file type in the parameter "type".
4. You should specify the sorting variables in the parameter "sortvar".
5. You should specify the path where all files are located in the "libname" statement.
6. Submit the code for processing.

An example of the JOIN program is presented in Exhibit 5.4. This example joins all the BSG files for all countries. All individual country files are located in the directory "D:\TIMSS2003\Data\SAS_Data". The resulting file will also be located in this directory and will be called BSGALLM3. The resulting file will be sorted by IDCNTRY and IDSTUD.

Exhibit 5.4 Contents of SAS Program JOIN Used to Join Files of the Same Type for More Than One Country

```
* This program joins SAS data sets of all selected countries into
  one SAS data set ;

options nonotes ;

* Insert the countries ;
%let cty = ARM AUS BFL BGR BHR BWA COT CQU CHL CYP
           EGY ENG BSQ EST GHA HKG HUN IDN IRN ISR
           ITA JOR JPN KOR LBN LTU LVA MAR MDA MKD
           MYS NLD NOR NZL PSE PHL ROM RUS SAU SCO
           SGP SVK SVN SWE TUN TWN USA UIN SCG ZAF ;

* Insert the file type ;
%let type = BSG ;

* Insert the sorting variables ;
%let sortvar = IDCNTRY IDSTUD ;

* Insert the path ;
libname libdat "D:\TIMSS2003\Data\SAS_Data" ;

%macro doit;

data &type.ALLM3;
 set
     %let i = 1;
     %do %while(%length(%scan(&cty,&i)));
       %let ccode = %lowcase(%scan(&cty,&i));
          libdat.&type.&ccode.M3
       %let i = %eval(&i + 1);
     %end;
run;

proc sort data=&type.ALLM3 out = libdat.&type.ALLM3;
  by &sortvar;

run;

%mend doit;

%doit;
```

5.7 Basic Analyses with the TIMSS Data: Means, Percentages, Regression Coefficients and Their JRR Standard Errors

In this section, four macros that can be used to compute the correct standard errors are described, including examples in which these macros are used to replicate tables in the TIMSS 2003 international reports and almanacs.

Computing Means and Their JRR Standard Errors with Plausible Values (JACKPV.SAS)

This section presents example SAS code that can be used to compute the JRR standard errors for mean achievement scores based on plausible values and percentages. This code is provided in the form of a SAS macro, called JACKPV.SAS, that computes the percentages of students within subgroups defined by a set of classification variables, the JRR standard errors of these percentages, the mean achievement scores for the groups using plausible values, and the JRR standard errors of these means including the sampling and imputation variance components.

The JACKPV.SAS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of a set of plausible values.

3. Computes the percentages of students within each group, their mean achievement scores based on the plausible values, and their respective standard errors. The resulting working file FINAL contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the name of the plausible values and how many there are, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that be processed.

You need to know some basic SAS macro language in order to use JACKPV.SAS. The macro should be included in the program file where it is going to be used.

If you are operating in batch mode, then the macro should be included in every batch. If you are using SAS interactively then the macro should be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro should be included once again. Once the macro is included in a specific session, the word "JACKPV" should not be used within that session because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SAS:

```
%include "<path>jackpv.sas" ;
```

where <path> points to the specific drive and directory where the macro JACKPV.SAS can be found. The macro requires that several parameters be specified when it is invoked. These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file. This can be a single variable, or a list of variables. The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country. At least one variable has to be specified, usually IDCNTRY.
ROOTPV	This is the prefix used to identify the plausible values for the achievement scale of interest. This corresponds to the first 7 characters of the plausible values variable name. For example, the root of the overall science plausible values is "BSSSCI0," the root of the geometry plausible values is "BSMGEO0."

NPV	This is the number of plausible values that will be used for the analysis. Generally you will want to use all five plausible values for the analysis, although in some circumstances fewer can be used. You should always use at least two plausible values for any analysis.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75, the maximum possible value. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries are being used for an analysis, then the largest number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used in the analysis, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis in parenthesis, each separated by a comma. For example, if the macro is invoked using

```
%jackpv (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSMMAT0, 5, BSGALLM3) ;
```

it will compute the eighth grade mean mathematics achievement scores using five plausible values and their respective standard errors for boys and girls within each country, using the variable TOTWGT as the sampling weight. It will also compute the percentages of boys and girls within each country, and their respective standard errors. The data will be read from the data file BSGALLM3, and the standard errors will be computed based on 75 replicate weights.

The file that contains the results is called FINAL and is saved to the default directory being used by SAS. The variables that are contained in this results file are:

Classification Variables

All classification variables are kept in the results file. In the example there are two classification variables: IDCNTRY and ITSEX. There is one record for each combination of the categories for these variables.

Weight Variable

Contains the sum of weights within each group defined by the classification variables. In the example this variable is called TOTWGT.

N

Contains the number of valid cases within each group defined by the classification variables. In the example this is the number of boys and girls in each country's sample.

MNX

Contains the weighted achievement scores, based only on the first plausible value, for each group defined by the classification variables.

MNX_SE

Contains the JRR standard errors of the weighted achievement scores, based only on the first plausible value. This does not include the imputation error that should be computed when using plausible values.

MNPV

Contains the weighted achievement scores, based on the all plausible values.

MNPV_SE

Contains the JRR standard errors of the weighted achievement scores, based on the all plausible values. These standard errors contain both the sampling and the imputation variance components.

PCT

Contains the weighted percentages of students in the groups for the last classification variable listed, within the specific combination of the categories defined by the remaining classification variables. In the example it is the percentage of boys and girls within each country.

PCT_SE

Contains the standard errors of PCT values.

The contents of the FINAL file can be printed using a SAS procedure of choice. An example call to this macro, and a printout of the results file is presented in Exhibit 5.5. The code is included in the file called SampleJackPV.SAS.

Exhibit 5.5 Extract of SAS Control Code and Output File for Using the Macro JACKPV.SAS

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackpv.sas" ;

data BSGALLM3 ;
 set bm3.BSGARMM3
     bm3.BSGAUSM3
     bm3.BSGBFLM3
     bm3.BSGBGRM3
     bm3.BSGBHRM3 ;

 where nmiss(ITSEX) = 0 ;

proc format library=work ;
 value country
    < list all country codes and country names >
 value sex
     1 = 'Girl'
     2 = 'Boy' ;

%jackpv (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSMMAT0, 5, BSGALLM3) ;

* Print the results ;
proc print data=final noobs ;
 var IDCNTRY ITSEX n TOTWGT mnpv mnpv_se pct pct_se ;
 format IDCNTRY country. ITSEX sex. n 6.0 TOTWGT 10.0 mnpv mnpv_se pct pct_se 6.2 ;

run ;
```

IDCNTRY	ITSEX	N	TOTWGT	mnpv	mnpv_se	pct	pct_se
AUSTRALIA	Girl	2443	131600	498.59	5.79	51.13	2.25
AUSTRALIA	Boy	2348	125807	511.10	5.79	48.87	2.25
BAHRAIN	Girl	2025	5317	417.32	2.37	50.43	0.44
BAHRAIN	Boy	2174	5226	384.79	2.42	49.57	0.44
ARMENIA	Girl	3003	28625	482.86	3.29	52.76	0.66
ARMENIA	Boy	2696	25630	472.78	3.42	47.24	0.66
BULGARIA	Girl	2015	42247	475.65	5.48	48.23	1.33
BULGARIA	Boy	2102	45356	476.66	4.33	51.77	1.33
BELGIUM FLEMISH	Girl	2620	37887	531.72	3.53	53.64	2.09
BELGIUM FLEMISH	Boy	2350	32751	542.49	3.75	46.36	2.09

In this example, the mean eighth grade mathematics achievement scores, based on all five plausible values, and their respective standard errors are calculated separately for boys and girls by country. In the results listing, we can see that there are entries for each country and gender combination. The first column has the country name and the second column indicates the gender of the students. The third column has the number of valid cases by country and gender and the fourth column has the total sum of weights by country and gender. The fifth and sixth columns report the mean eighth grade mathematics achievement score, based on all five plausible values, by country and gender and its standard error. The last two columns report the weighted percentage of girls and boys in each country and their respective standard errors.

From the first few lines of the results in Exhibit 5.5, we can say that in Australia there are 2,443 girls in the sample representing 131,600 students in the whole population. The mean mathematics score for the girls, based on the five plausible values, is 498.59 with a standard error of 5.79. Girls made up 51.13% of Australia's student population. Additionally, Australia sampled 2,348 boys representing 125,807 students in the whole population. The mean mathematics score for the boys, based on the five plausible values, is 511.10 with a standard error of 5.79. Boys made up 48.87% of Australia's student population.

Computing Means and Their JRR Standard Errors without Plausible Values (JACKGEN.SAS)

This section presents example SAS code that can be used to compute the JRR standard errors for means of variables other than plausible values and percentages. This code is provided in the form of an SAS macro, called JACKGEN.SAS, that computes the percentages of students within subgroups defined by a set of classification variables, the JRR standard errors of these percentages, the means on a variable of choice, and the JRR standard errors of these means. Although you can compute weighted percentages and means using other basic SAS commands, the macro JACKGEN.SAS computes the proper JRR standard errors for these means and percentages.

This macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of a specified analysis variable.

3. Computes the percentages of students within each group, their mean on the analysis variable, and their respective standard errors. The resulting working file FINAL contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, one analysis variable, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SAS macro language in order to use JACKGEN.SAS. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro needs to be included in every batch. If you are using SAS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the

session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKGEN" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SAS:

```
%include "<path>jackgen.sas";
```

where <path> points to the specific drive and directory where the macro JACKGEN.SAS can be found. The macro requires that several arguments be specified when it is invoked. These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file. This can be a single variable, or a list of variables. The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country. At least one variable has to be specified, usually IDCNTRY.
DVAR	This is the variable for which means are to be computed. Only one variable can be listed here. If you want to examine results for two different variables, then the macro needs to be invoked separately to generate each table.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.

JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75, the maximum possible value. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries are being used for an analysis, then the largest number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used in the analysis, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis in parentheses, each separated by a comma. For example, if the macro is invoked using

```
%JackGen (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, BSDAGE, BSGALLM3) ;
```

it will compute the eighth grade mean ages and their respective standard errors within each country, using the variable TOTWGT as the sampling weight. The data will be read from the SAS data file BSGALLM3 and the standard errors will be computed based on 75 replicate weights.

The file that contains the results is called FINAL and is saved to the default directory being used by SAS. The variables that are contained in this file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

Weight Variable

Contains the sum of weights within each group defined by the classification variables.

N

Contains the number of valid cases within each group defined by the classification variables.

MNX

Contains the weighted means of the variable DVAR for each group defined by the classification variables.

MNX_SE

Contains the JRR standard errors of the MNX values.

PCT

Contains the weighted percentages of students in the groups for the classification variable listed last, within the specific combination of the categories defined by the groups initially. In the example it is the weighted percentage of students by country.

PCT_SE

Contains the JRR standard errors of PCT values.

The contents of the FINAL file can be printed using a SAS procedure of choice. An example call to this macro, and an extract of the results file is presented in Exhibit 5.6. The code is included in the file called SampleJackGen.SAS.

Exhibit 5.6 Extract of SAS Control Code and Output File for Using the Macro JACKGEN.SAS

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackgen.sas" ;

data BSGALLM3 ;
 set bm3.BSGARMM3
     bm3.BSGAUSM3
     bm3.BSGBFLM3
     bm3.BSGBGRM3
     bm3.BSGBHRM3 ;

 where nmiss(BSDAGE) = 0 ;

proc format library=work ;
 value country
    < list all country codes and country names >

* Run the macro to get the results ;
%JackGen (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, BSDAGE, BSGALLM3) ;

* Print the results ;
proc print data=final noobs;
 var IDCNTRY n TOTWGT mnx mnx_se pct pct_se ;
 format IDCNTRY country. n 6.0 TOTWGT 10.0 mnx mnx_se pct pct_se 6.2 ;

run ;
```

IDCNTRY	N	TOTWGT	mnx	mnx_se	pct	pct_se
AUSTRALIA	4531	245526	13.88	0.01	52.43	0.86
BAHRAIN	4195	10533	14.07	0.01	2.25	0.05
ARMENIA	5693	54216	14.88	0.01	11.58	0.38
BULGARIA	4107	87402	14.89	0.01	18.66	0.58
BELGIUM FLEMISH	4970	70637	14.12	0.02	15.08	0.45

In this example, the variable BSDAGE is used to calculate the mean age of the eighth grade students in each country. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country name, the second column has the number of valid cases in each sample after selecting only those cases where BSDAGE is not missing, and the third column is the total sum of weights by country. This is followed by the mean age of the eighth grade students and its standard error.

From the first line of the results in Exhibit 5.6, we can say that in Australia there were 4,531 eighth grade students in the sample representing 245,526 students in the whole population, with a mean age of 13.88 and a standard error of 0.01. The sum of weights for Australia represents 52.43% of all sums of weights for the countries involved in the analysis. The standard error of this percentage is 0.86.

Computing Regression Coefficients and Their JRR Standard Errors without Plausible Values (JACKREG.SAS)

This section presents example SAS code that can be used to compute regression coefficients and their JRR standard errors. This code is provided in the form of a SAS macro, called JACKREG.SAS, which performs a multiple linear regression betweens the specified dependent and independent variables within subgroups defined by a set of classification variables, as well as the regression coefficients and their JRR standard errors.

If you wish to conduct regression analyses using plausible values as the dependent variables, refer to JACKREGP.SAS described in the next section.

The JACKREG.SAS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of all specified analysis variables.

3. Performs a multiple linear regression within each group, and computes the regression coefficients and their respective standard errors. The resulting working file REG contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the analysis variables, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SAS macro language in order to use the macro. The macro should be included in the program file where it is going to be used. If you are operating in batch mode, then the macro needs to be included in every batch. If you are using SAS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKREG" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SAS:

```
%include "<path>jackreg.sas";
```

where <path> points to the specific drive and directory where the macro JACKREG.SAS can be found.The macro requires that several parameters be specified when it is invoked.These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file.This can be a single variable, or a list of variables.The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country.At least one variable has to be specified, usually IDCNTRY.
XVAR	This is a list of independent variables that will be used as predictors of the dependent variable specified in DVAR.The independent variables can be continuous or categorical. For example, it could be the variable ITSEX as originally coded in the data files, or dummy coded as 1 or 0.
DVAR	This is the dependent variable that will be predicted by the variable or variables specified by the XVAR parameter. Only one variable can be listed here. If you want to use the same set of predictor variables to predict two different variables, then the macro needs to be invoked separately to generate each set of results.

JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR standard errors. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries are being used for an analysis, then the larger number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a comma. For example, if the macro is invoked using

```
%JackReg (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BOOK, BSGALLM3) ;
```

it will perform a multiple linear regression with the variable REGSEX as a predictor of the number of books at home, and the standard errors of the regression coefficients will be computed based on 75 replicate weights.

The file that contains these results is called REG and is saved to the default directory being used by SAS. The variables that are contained in this results file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

N

Contains the number of valid cases within each group defined by the classification variables.

Mult_RSQ

The squared multiple correlation coefficient for the model within each group.

SS_Res, SS_Reg, SS_Total

The residual, regression, and total sums of squares for the model within each group.

Regression Coefficients and Standard Errors (B## and B##.SE)

These are the regression coefficients for each of the predictor variables in the model and their respective JRR standard errors. The coefficient zero (B00) is the intercept for the model. The other coefficients receive a sequential number starting with 01. This sequential number corresponds to the order of the variables in the list of variables specified in the parameter XVAR.

The contents of the REG file can be printed using a SAS procedure of choice. An example call to this macro, and an extract of the results file is presented in Exhibit 5.7. The code is included in the file called SampleJackReg.SAS.

Exhibit 5.7 Extract of SAS Control Code and Output File for Using the Macro JACKREG.SAS

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackreg.sas" ;

data BSGALLM3 ;
 set bm3.BSGARMM3
     bm3.BSGAUSM3
     bm3.BSGBFLM3
     bm3.BSGBGRM3
     bm3.BSGBHRM3 ;

 where nmiss(ITSEX) = 0 ;

 REGSEX = ITSEX-1 ;

 select (BSBGBOOK) ;
     when(1)     BOOK =   5 ;    /*  5 Books at home*/
     when(2)     BOOK =  18 ;    /* 18 Books at home*/
     when(3)     BOOK =  63 ;    /* 63 Books at home*/
     when(4)     BOOK = 151 ;    /*151 Books at home*/
     when(5)     BOOK = 251 ;    /*251 Books at home*/
     otherwise ;
     end ;

proc format library=work ;
 value country
    < list all country codes and country names >

%JackReg (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BOOK, BSGALLM3) ;

* Print the results ;
proc print data=reg noobs ;
 var IDCNTRY n mult_rsq ss_total ss_reg b00 b00_se b01 b01_se ;
 format IDCNTRY country. n 6.0 mult_rsq 5.3 ss_total ss_reg 10.0
        b00 b00_se b01 b01_se 6.2 ;

run ;
```

IDCNTRY	N	Mult_RSQ	SS_Total	SS_Reg	b00	b00_se	b01	b01_se
AUSTRALIA	4663	0.002	2056635596	4451708	129.26	3.24	8.42	4.06
BAHRAIN	4162	0.001	76995110	60535	92.17	2.14	-4.81	2.88
ARMENIA	5558	0.000	430338454	17825	91.67	3.32	1.16	2.85
BULGARIA	3996	0.001	785508028	897904	120.51	4.66	-6.51	4.30
BELGIUM FLEMISH	4888	0.000	416292531	533	78.80	2.12	0.18	3.35

In this example, the variable REGSEX is created by subtracting one from the variable ITSEX. As a result, the girls receive a code of 0 and the boys receive a code of 1 on this variable. The variable BOOK is created to convert the responses to number of books. In this regression model, the variable REGSEX is used to predict the values of the variable BOOK by country. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country code and the second column has the number of valid cases in each country. The multiple R squared is listed for each country, followed by the sums of squares for the model, and the regression coefficients

and their standard errors. Because of the way in which the variable REGSEX is coded, the intercept B00 is the mean value for the variable BOOK for the girls and B00_SE is its standard error. The first regression coefficient (B01) is the difference in the mean value of the variable BOOK between girls and boys, and B01_SE is its JRR standard error.

From the first line of the results in Exhibit 5.7, we can say that in Australia valid data were available for 4,663 cases. The squared multile correlation between gender and books at home is 0.002, with girls having on average 129.26 books at home and boys having on average 8.42 books more than girls. This difference is statistically significant, which can be determined by dividing the value of B01 by its standard error and comparing the result to the appropriate critical value.

Computing Regression Coefficients and Their JRR Standard Errors with Plausible Values (JACKREGP.SAS)

In this section example SAS code that can be used to compute the JRR standard errors for regression coefficients using plausible values as the dependent variable is described. This code is provided in the form of an SAS macro called JACKREGP.SAS. This macro computes the multiple correlation coefficient between the specified plausible values and independent variables within subgroups defined by a set of classification variables, as well as the regression coefficients and the JRR standard errors.

The JACKREGP.SAS macro operates as follows:

1. Computes a set of replicate weights specified using the parameters NJKZ, JKZ, and JKR.

2. Aggregates or summarizes the data by computing the sum of the weights for each subgroup, the sum of the weights overall, and the weighted sum of all specified analysis variables.

3. Performs a multiple linear regression within each group, and computes the regression coefficients and their respective standard errors. The resulting working file REG contains all the computed statistics.

When using this macro, you need to specify a set of classification variables, the analysis variables including the set of plausible values, the number of replicate weights to be generated, the variables that contain the jackknife replication information (JKZONE and JKREP), and the sampling weight that is to be used for the analysis. You will also need to specify the data file that contains the data that is to be processed.

You need to know some basic SAS macro language in order to use the macro. The macro should be included in the program file where it is going to be used. If

you are operating in batch mode, then the macro needs to be included in every batch. If you are using SAS interactively then the macro needs to be included once at the beginning of the session and it will remain active throughout the session. If the session is terminated and restarted at a later time the macro needs to be included once again. Once the macro is included in a specific session, the word "JACKREGP" should not be used within that program because doing so will invoke the macro.

The macro is included in the program file by issuing the following command in SAS:

```
%include "<path>jackregp.sas";
```

where <path> points to the specific drive and directory where the macro JACKREGP.SAS can be found.The macro requires that several parameters be specified when it is invoked.These parameters are:

INFILE	The name of the data file that contains the variables necessary for the analysis. If the path location is included as part of the file name, the name of the file has to be enclosed in quotes. It is important to emphasize that this system file must include only those cases that are of interest in the analysis. If you want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.
CVAR	This lists the variables that are to be used to classify the students in the data file.This can be a single variable, or a list of variables.The maximum number of variables will depend mostly on the computer resources available to you at the time. It is recommended to always include the variable that identifies the country.At least one variable has to be specified, usually IDCNTRY.
XVAR	This is a list of independent variables which will be used as predictors of the dependent variable specified as a set of plausible values in ROOTPV. The independent variables can be continuous or categorical. For example, it could be the variable ITSEX as originally coded in the data files, or dummy coded as 1 or 0.

ROOTPV	This is the prefix used to identify the set of plausible values for the achievement scale of interest. This corresponds to the first 7 characters of the plausible values variable name. For example, the root of the overall science plausible values is "BSSSCI0," the root of the geometry plausible values is "BSMGEO0."
NPV	This is the number of plausible values that will be used in the analysis. Generally you will want to use all five plausible values for the analysis, although in some circumstances fewer can be used. You should always use at least two plausible values for any analysis.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS files is JKZONE.
JKR	The variable that captures whether the case is to be dropped or have its weight doubled for each set of replicate weights. The name of this variable in all TIMSS files is JKREP.
NJKZ	This indicates the number of replicate weights to be generated when computing the JRR error estimates. When conducting analyses using the data from all countries, the value of NJKZ should be set to 75, the maximum possible value. When you are working with the data for only one country, you should set the NJKZ argument to as many replicates as are needed for the country. If the data from two or more countries is being used for an analysis, then the larger number of jackknife zones should be used. When in doubt, NJKZ should be set to 75. The standard errors will always be estimated correctly if more replicate weights than necessary are computed, but will be underestimated if you specify fewer replicate weights than necessary.
WGT	The sampling weight to be used, generally TOTWGT when using the student files, or MATWGT, SCIWGT, or TCHWGT when using the teacher files.

The simplest and most straightforward way to invoke the macro is by using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of arguments for the analysis, each separated by a slash. For example, if the macro is invoked using

```
%JackRegP (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX , BSMMAT0, 5, BSGALLM3);
```

it will perform a multiple linear regression with the variable REGSEX as a predictor of the mathematics plausible values, and the standard errors of the regression coefficients will be computed based on 75 replicate weights.

The file that contains the results is called REG and is saved in the default directory being used by SAS. The variables that are contained in this file are:

Classification Variables

All classification variables are kept in the results file. In the example there is only one variable: IDCNTRY. There is one record for each category of this variable.

N

Contains the number of valid cases within each group defined by the classification variables.

Mult_RSQ

The squared multiple correlation coefficient for the model within each group.

SS_Res, SS_Reg, SS_Total

The residual, regression, and total sums of squares for the model within each group.

Regression Coefficients and Standard Errors (B## and B##.SE)

These are the regression coefficients for each of the predictor variables in the model and their respective JRR standard errors. The coefficient zero (B00) is the intercept for the model. The other coefficients receive a sequential number starting with 01. This sequential number corresponds to the order of the variables in the list of variables specified in the parameter XVAR.

The contents of the REG file can be printed using a SAS procedure of choice. An example call to this macro, and an extract of the results file, is presented in Exhibit 5.8. The code is included in the file called SampleJackRegP.SAS.

Exhibit 5.8 Extract of SAS Control Code and Output File for Using the Macro JACKREGP.SAS

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackregp.sas" ;

data BSGALLM3 ;
 set bm3.BSGARMM3
     bm3.BSGAUSM3
     bm3.BSGBFLM3
     bm3.BSGBGRM3
     bm3.BSGBHRM3 ;

 where ITSEX > .Z ;

 REGSEX = ITSEX-1 ;

proc format library=work ;
 value country
    < list all country codes and country names >

%JackRegP (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX , BSMMAT0, 5, BSGALLM3) ;

* Print the results ;
proc print data=reg noobs;
 var IDCNTRY n mult_rsq ss_total ss_reg b00 b00_se b01 b01_se ;
 format IDCNTRY country. n 6.0 mult_rsq 5.3 ss_total ss_reg 12.0
        b00 b00_se b01 b01_se 6.2 ;

run ;
```

IDCNTRY	n	Mult_RSQ	SS_Total	SS_Reg	b00	b00_se	b01	b01_se
AUSTRALIA	4791	0.006	1711442579	10114110	498.59	5.79	12.51	7.04
BAHRAIN	4199	0.045	61405486	2791933	417.32	2.37	-32.54	3.34
ARMENIA	5699	0.004	378269349	1380629	482.86	3.29	-10.08	2.97
BULGARIA	4117	0.000	619290982	44393	475.65	5.48	1.01	4.70
BELGIUM FLEMISH	4970	0.005	381570675	2053629	531.72	3.53	10.77	4.82

In this example, the variable REGSEX is once again created by subtracting one from the variable ITSEX. As a result, the girls receive a code of 0 and the boys receive a code of 1 on this variable. In this regression model, the variable REGSEX is used to predict the mathematics achievement by country using all five plausible values. In the results listing, we can see that there is one entry for each value of the variable IDCNTRY. The first column has the country code and the second column has the number of valid cases in each country. The multiple R squared is listed for each country, followed by the sums of squares for the model, and the regression coefficients and their standard errors. Because of the way in which the variable REGSEX is coded, the intercept B00 is the

mean mathematics achievement for the girls and B00_SE is its standard error. The first regression coefficient (B01) is the difference in the mean mathematics achievement between girls and boys, and B01_SE is its JRR standard error.

From the first line of the results in Exhibit 5.8, we can say that in Australia valid data was available for 4,791 cases. The squared multiple correlation between gender and mathematics achievement is 0.006 with girls achieving on average 498.59 in mathematics and boys scoring on average 12.51 points higher. This difference is not statistically significant.

5.8 Replicating Analyses from the TIMSS 2003 International Reports: Student-Level

Many analyses of the TIMSS data can be undertaken using student-level data. We have already presented some examples in the previous sections when explaining how to use the macros provided with the data files. We now proceed to work through additional examples of actual analyses from the TIMSS 2003 international reports, where all the required steps are undertaken, including the invocation of the appropriate SAS macros.

Example of Student-Level Analysis without Plausible Values

In our first example, we wish to replicate the analysis of eighth graders' reports on the average number of hours spent reading a book for enjoyment during their leisure time on a normal school day. The results, originally presented in Exhibit 5.9 of the TIMSS 2003 International Science Report, are reproduced in Exhibit 4.8. Since we only want to report the average number of hours, which does not require any plausible values, we need to use the macro JACKGEN.

Exhibit 5.9 Sample Exhibit for Student-Level Analysis without Plausible Values Taken From the TIMSS 2003 International Science Report (Exhibit 4.8)

Countries	Average Hours Spent Each Day*							
	Watch Television and Videos	Play Computer Games	Play or Talk with Friends	Do Jobs at Home	Play Sports	Read a Book for Enjoyment	Use the Internet	Work at a Paid Job
Armenia	1.8 (0.03)	r 0.9 (0.03)	r 1.6 (0.03)	r 0.4 (0.02)	r 1.2 (0.03)	r 1.6 (0.03)	r 0.7 (0.03)	r 1.0 (0.04)
Australia	2.0 (0.03)	0.9 (0.02)	1.7 (0.04)	1.0 (0.02)	1.6 (0.03)	0.7 (0.02)	1.3 (0.04)	0.4 (0.03)
Bahrain	2.0 (0.03)	1.2 (0.02)	1.6 (0.03)	1.2 (0.02)	1.5 (0.03)	0.9 (0.02)	1.4 (0.03)	0.6 (0.02)
Belgium (Flemish)	2.1 (0.03)	1.0 (0.03)	1.9 (0.03)	0.9 (0.02)	1.6 (0.03)	0.5 (0.01)	1.3 (0.03)	0.2 (0.02)
Botswana	1.4 (0.03)	0.5 (0.02)	2.1 (0.04)	2.3 (0.03)	1.5 (0.02)	1.8 (0.03)	0.7 (0.02)	0.6 (0.03)
Bulgaria	2.5 (0.04)	1.1 (0.04)	2.6 (0.05)	1.5 (0.03)	1.2 (0.04)	0.7 (0.03)	1.0 (0.04)	0.3 (0.02)
Chile	2.2 (0.02)	0.7 (0.02)	2.3 (0.02)	1.5 (0.02)	1.8 (0.03)	0.6 (0.01)	0.7 (0.02)	0.3 (0.02)
Chinese Taipei	1.7 (0.03)	1.4 (0.04)	1.4 (0.03)	0.7 (0.01)	1.0 (0.02)	1.0 (0.02)	1.4 (0.04)	0.2 (0.01)
Cyprus	2.1 (0.03)	1.3 (0.02)	2.1 (0.03)	1.0 (0.03)	1.7 (0.03)	0.9 (0.02)	1.2 (0.02)	0.6 (0.02)
Egypt	0.8 (0.02)	0.7 (0.02)	0.8 (0.02)	1.3 (0.03)	1.1 (0.02)	1.0 (0.02)	0.6 (0.02)	0.6 (0.02)
Estonia	2.3 (0.03)	1.1 (0.03)	2.8 (0.03)	1.1 (0.02)	1.4 (0.03)	0.7 (0.02)	1.5 (0.04)	0.4 (0.02)
Ghana	0.7 (0.02)	0.6 (0.02)	1.2 (0.03)	1.5 (0.03)	1.3 (0.02)	1.7 (0.03)	0.8 (0.03)	0.8 (0.03)
Hong Kong, SAR	2.3 (0.03)	2.0 (0.04)	1.6 (0.03)	0.7 (0.01)	1.0 (0.02)	1.1 (0.02)	2.0 (0.03)	0.1 (0.01)
Hungary	2.1 (0.03)	1.1 (0.03)	2.2 (0.03)	1.1 (0.02)	1.5 (0.03)	0.8 (0.02)	0.6 (0.03)	0.2 (0.02)
Indonesia	1.5 (0.03)	0.5 (0.02)	1.3 (0.03)	2.2 (0.03)	1.1 (0.02)	1.1 (0.02)	0.3 (0.02)	0.8 (0.03)
Iran, Islamic Rep. of	1.6 (0.03)	0.4 (0.02)	1.4 (0.03)	1.5 (0.03)	1.4 (0.04)	1.0 (0.02)	0.2 (0.02)	0.7 (0.05)
Israel	2.5 (0.04)	1.9 (0.03)	2.3 (0.03)	1.4 (0.03)	1.6 (0.03)	0.9 (0.02)	1.8 (0.04)	0.6 (0.02)
Italy	1.8 (0.03)	1.0 (0.02)	2.6 (0.03)	1.1 (0.03)	1.8 (0.03)	0.7 (0.02)	0.6 (0.02)	0.9 (0.02)
Japan	2.7 (0.03)	0.9 (0.02)	1.6 (0.04)	0.6 (0.01)	1.3 (0.03)	0.9 (0.02)	0.6 (0.02)	0.1 (0.01)
Jordan	1.5 (0.03)	0.9 (0.03)	1.2 (0.03)	1.3 (0.03)	1.2 (0.03)	0.9 (0.02)	0.6 (0.03)	0.6 (0.03)
Korea, Rep. of	1.7 (0.03)	1.5 (0.03)	1.8 (0.03)	0.7 (0.01)	0.7 (0.02)	0.6 (0.01)	1.7 (0.03)	0.1 (0.01)
Latvia	2.4 (0.03)	1.0 (0.02)	2.8 (0.03)	1.6 (0.03)	1.3 (0.03)	0.8 (0.03)	0.8 (0.03)	0.5 (0.02)
Lebanon	1.8 (0.04)	1.3 (0.03)	1.6 (0.04)	1.3 (0.03)	1.6 (0.03)	1.0 (0.02)	1.0 (0.03)	0.8 (0.03)
Lithuania	2.1 (0.03)	1.1 (0.03)	2.6 (0.04)	1.6 (0.04)	1.1 (0.03)	0.6 (0.02)	0.7 (0.03)	0.3 (0.02)
Macedonia, Rep. of	2.3 (0.04)	1.3 (0.03)	2.2 (0.03)	1.6 (0.03)	1.8 (0.03)	1.0 (0.02)	0.9 (0.03)	0.7 (0.03)
Malaysia	2.1 (0.04)	0.8 (0.03)	1.5 (0.03)	1.7 (0.02)	1.1 (0.02)	1.2 (0.02)	0.6 (0.02)	0.3 (0.02)
Moldova, Rep. of	1.9 (0.04)	0.7 (0.03)	2.0 (0.04)	2.2 (0.06)	1.3 (0.03)	1.1 (0.03)	0.7 (0.03)	0.5 (0.03)
Morocco	1.3 (0.04)	2.3 (0.06)	1.3 (0.03)	1.8 (0.03)	1.5 (0.03)	r 1.3 (0.03)	r 2.6 (0.06)	r 2.8 (0.06)
Netherlands	2.1 (0.05)	1.2 (0.04)	2.0 (0.05)	0.8 (0.02)	1.7 (0.04)	0.5 (0.02)	1.5 (0.04)	0.8 (0.05)
New Zealand	2.1 (0.04)	1.0 (0.04)	1.8 (0.05)	1.0 (0.02)	1.5 (0.03)	0.7 (0.03)	1.3 (0.04)	0.6 (0.03)
Norway	2.2 (0.03)	1.2 (0.03)	2.7 (0.03)	1.0 (0.03)	1.8 (0.03)	0.6 (0.02)	1.2 (0.03)	0.7 (0.02)
Palestinian Nat'l Auth.	1.2 (0.02)	0.7 (0.02)	1.3 (0.03)	1.5 (0.03)	1.1 (0.03)	1.0 (0.02)	0.5 (0.02)	0.6 (0.03)
Philippines	1.6 (0.04)	0.6 (0.02)	1.7 (0.03)	1.9 (0.03)	1.4 (0.02)	1.2 (0.02)	0.5 (0.03)	0.8 (0.04)
Romania	2.0 (0.04)	0.9 (0.03)	2.1 (0.03)	1.7 (0.05)	1.3 (0.03)	1.0 (0.03)	0.8 (0.04)	0.5 (0.04)
Russian Federation	2.0 (0.03)	1.0 (0.03)	2.5 (0.04)	1.6 (0.03)	1.3 (0.02)	1.1 (0.03)	0.4 (0.02)	0.2 (0.02)
Saudi Arabia	1.6 (0.05)	1.1 (0.03)	1.3 (0.03)	1.5 (0.04)	1.2 (0.04)	0.9 (0.02)	0.8 (0.05)	0.8 (0.03)
Scotland	2.2 (0.03)	1.4 (0.04)	2.7 (0.03)	0.8 (0.02)	1.7 (0.03)	0.6 (0.02)	1.4 (0.03)	0.5 (0.03)
Serbia	2.1 (0.03)	1.0 (0.03)	2.1 (0.03)	1.3 (0.03)	1.7 (0.03)	0.8 (0.02)	0.6 (0.03)	0.3 (0.02)
Singapore	2.3 (0.02)	1.4 (0.02)	1.7 (0.02)	0.7 (0.02)	1.4 (0.02)	0.9 (0.02)	1.6 (0.02)	0.2 (0.02)
Slovak Republic	2.5 (0.03)	1.1 (0.03)	2.8 (0.03)	1.5 (0.03)	1.9 (0.04)	0.9 (0.02)	0.6 (0.03)	0.4 (0.02)
Slovenia	2.2 (0.03)	1.3 (0.03)	2.0 (0.03)	1.2 (0.03)	1.7 (0.03)	0.8 (0.02)	1.1 (0.03)	0.4 (0.02)
South Africa	1.5 (0.03)	0.7 (0.02)	2.0 (0.03)	1.8 (0.03)	1.6 (0.02)	1.6 (0.03)	0.8 (0.02)	0.8 (0.02)
Sweden	2.1 (0.03)	1.1 (0.03)	2.8 (0.03)	1.0 (0.02)	1.6 (0.03)	0.6 (0.02)	1.7 (0.04)	0.4 (0.02)
Tunisia	1.4 (0.02)	0.8 (0.03)	1.5 (0.02)	1.9 (0.03)	1.5 (0.02)	1.3 (0.02)	0.7 (0.02)	0.6 (0.02)
United States	2.2 (0.03)	1.1 (0.02)	2.4 (0.03)	1.2 (0.02)	1.8 (0.02)	0.7 (0.01)	1.8 (0.03)	0.6 (0.02)
¶ England	2.0 (0.04)	1.1 (0.04)	2.4 (0.05)	0.8 (0.03)	1.4 (0.05)	0.5 (0.02)	1.4 (0.04)	0.5 (0.04)
International Avg.	1.9 (0.00)	1.1 (0.00)	1.9 (0.00)	1.3 (0.00)	1.4 (0.00)	0.9 (0.00)	1.0 (0.00)	0.6 (0.00)
Benchmarking Participants								
Basque Country, Spain	1.6 (0.04)	0.9 (0.03)	2.4 (0.04)	0.9 (0.03)	1.5 (0.03)	0.7 (0.02)	0.8 (0.03)	0.4 (0.03)
Indiana State, US	2.2 (0.06)	1.0 (0.04)	2.4 (0.06)	1.2 (0.04)	1.8 (0.04)	0.7 (0.03)	1.7 (0.04)	0.6 (0.05)
Ontario Province, Can.	2.1 (0.04)	1.2 (0.04)	2.0 (0.04)	0.9 (0.02)	1.7 (0.03)	0.8 (0.02)	1.9 (0.04)	0.6 (0.03)
Quebec Province, Can.	2.0 (0.03)	1.4 (0.03)	2.0 (0.04)	0.9 (0.02)	1.7 (0.04)	0.6 (0.02)	1.5 (0.04)	0.6 (0.02)

To replicate the results in this exhibit, we need to undertake several steps. After reviewing the codebooks and the questionnaire information, we observe that the variable BSBGREBO contains information on the number of hours spent reading for enjoyment before or after school (see Supplement 1 for a copy of the student background questionnaire), and this variable is found in the Student Background data file. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no national adaptations were made, we can continue with our analysis without any modifications.

We then proceed to read from the Student Background file our variable of interest (BSBGREBO), the student sampling weight (TOTWGT), the variables that contain the jackknife replication information (JKZONE and JKREP), and the variable containing the country identification code (IDCNTRY). In this analysis, we will use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used the JOIN program, described earlier in this chapter, to join the eighth grade Student Background files for all countries into a single file called BSGALLM3.

In general, analyses involving all available countries are quite feasible with a powerful desktop computer; however, you need to keep in mind that computing and storage requirements for these types of analyses can be quite demanding.

The SAS program code is presented in Exhibit 5.10 and is included on the DVD under the name EXAMPLE1.SAS. The results obtained from this program are displayed in Exhibit 5.11. We have included as part of the program the corresponding value labels and format statements so that the different categories or groups are labeled appropriately.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BSBGREBO.

In general, to perform student-level analyses of this type using the Student Background data files, you should do the following:

- Identify the variables of interest in the Student Background files and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Student Background files, including the sampling weights, the Jackknife replication information, and any other variables used in the selection of cases.
- Use the macro JACKGEN with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 5.10 SAS Control Statements for Performing Student-Level Analyses without Plausible Values (EXAMPLE1.SAS)

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackgen.sas" ;

data student1 ;
 set bm3.BSGALLM3;
 where nmiss(BSBGREBO) = 0;
 select (BSBGREBO);
     when (1) BSBGREBO = 0;   * No time      ;
     when (2) BSBGREBO = 0.5; * Less than 1 hour;
     when (3) BSBGREBO = 1.5; * 1 - 2 hours;
     when (4) BSBGREBO = 3;   * More than 2 but less than 4 hours;
     when (5) BSBGREBO = 4.5; * 4 or more hours;
     otherwise BSBGREBO = .;
     end;

proc format library=work ;
value country
   51 = 'ARMENIA'    36 = 'AUSTRALIA'            956 = 'BELGIUM FLEMISH'  100 = 'BULGARIA'
   48 = 'BAHRAIN'    72 = 'BOTSWANA'            9132 = 'CANADA ONTARIO'  9133 = 'CANADA QUEBEC'
  152 = 'CHILE'     196 = 'CYPRUS'               818 = 'EGYPT'            926 =  'ENGLAND'
 3724 = 'BASQUE'    233 = 'ESTONIA'              288 = 'GHANA'            344 = 'HONG KONG'
  348 = 'HUNGARY'   360 = 'INDONESIA'            364 = 'IRAN'             376 = 'ISRAEL'
  380 = 'ITALY'     400 = 'JORDAN'               392 = 'JAPAN'            410 = 'KOREA'
  422 = 'LEBANON'   440 = 'LITHUANIA'            428 = 'LATVIA'           504 = 'MOROCCO'
  498 = 'MOLDOVA'   807 = 'MACEDONIA'            458 = 'MALAYSIA'         528 = 'NETHERLANDS'
  578 = 'NORWAY'    554 = 'NEW ZEALAND'          275 = 'PALESTINE'        608 = 'PHILIPPINES'
  642 = 'ROMANIA'   643 = 'RUSSIAN FEDERATION'   682 = 'SAUDI ARABIA'     927 = 'SCOTLAND'
  702 = 'SINGAPORE' 703 = 'SLOVAK REPUBLIC'      705 = 'SLOVENIA'         752 = 'SWEDEN'
  760 = 'SYRIA'     788 = 'TUNISIA'              158 = 'CHINESE TAIPEI'   840 = 'UNITED STATES'
  887 = 'YEMEN'     891 = 'SERBIA AND MONTENEGRO' 710 = 'SOUTH AFRICA'  11800 = 'INDIANA US';

%JackGen (TOTWGT, jkzone, jkrep, 75, IDCNTRY, BSBGREBO, student1) ;

* Print the results ;
proc print data=final noobs ;
 var IDCNTRY n TOTWGT mnx mnx_se pct pct_se ;
 format IDCNTRY country. n 6.0 TOTWGT 10.0 mnx pct mnx_se pct_se 6.2 ;

run ;
```

Exhibit 5.11 Extract of SAS Computer Output for Performing Student-Level Analyses without Plausible Values (EXAMPLE 1)

IDCNTRY	N	TOTWGT	mnx	mnx_se	pct	pct_se
AUSTRALIA	4609	248940	0.69	0.02	1.29	0.04
BAHRAIN	4051	10177	0.89	0.02	0.05	0.00
ARMENIA	4697	45299	1.59	0.03	0.23	0.01
BOTSWANA	4665	32840	1.79	0.03	0.17	0.00
BULGARIA	3842	81651	0.74	0.03	0.42	0.01
CHILE	6291	261935	0.62	0.01	1.36	0.03
CHINESE TAIPEI	5363	296886	1.03	0.02	1.54	0.03
CYPRUS	3790	8720	0.93	0.02	0.05	0.00
ESTONIA	3903	20266	0.68	0.02	0.10	0.00
PALESTINE	5158	62339	0.98	0.02	0.32	0.01
GHANA	4524	243471	1.75	0.03	1.26	0.05
HONG KONG	4914	81716	1.06	0.02	0.42	0.01
HUNGARY	3200	97457	0.80	0.02	0.50	0.01
INDONESIA	5452	2186548	1.06	0.02	11.32	0.24
IRAN	4815	1332910	1.00	0.02	6.90	0.15
ISRAEL	4076	81016	0.90	0.02	0.42	0.01
ITALY	4229	562078	0.68	0.02	2.91	0.05
JAPAN	4801	1255020	0.86	0.02	6.50	0.06
JORDAN	4257	91377	0.85	0.02	0.47	0.01
KOREA	5266	566354	0.62	0.01	2.93	0.05
LEBANON	3467	52587	1.05	0.02	0.27	0.01
LATVIA	3524	32618	0.78	0.03	0.17	0.00
LITHUANIA	4383	41668	0.57	0.02	0.22	0.01
MALAYSIA	5278	411531	1.15	0.02	2.13	0.05
MOLDOVA	3875	59224	1.12	0.03	0.31	0.01
MOROCCO	2540	176187	1.32	0.03	0.91	0.03
NETHERLANDS	2861	176429	0.50	0.02	0.91	0.03
NEW ZEALAND	3595	54534	0.72	0.03	0.28	0.01
NORWAY	3977	59045	0.64	0.02	0.31	0.01
PHILIPPINES	6754	1362283	1.22	0.02	7.05	0.17
ROMANIA	3917	280384	0.96	0.03	1.45	0.03
RUSSIAN FEDERATION	4499	1853726	1.13	0.03	9.60	0.41
SAUDI ARABIA	4059	309671	0.91	0.02	1.60	0.07
SINGAPORE	5980	52964	0.89	0.02	0.27	0.00
SLOVAK REPUBLIC	4150	74563	0.86	0.02	0.39	0.01
SLOVENIA	3498	22485	0.82	0.02	0.12	0.00
SOUTH AFRICA	8133	708468	1.60	0.03	3.67	0.09
SWEDEN	4071	104366	0.63	0.02	0.54	0.01
TUNISIA	4680	174690	1.30	0.02	0.90	0.01
MACEDONIA	3523	23466	1.00	0.02	0.12	0.00
EGYPT	6479	1216237	1.00	0.02	6.30	0.13
UNITED STATES	8671	3359064	0.69	0.01	17.39	0.25
SERBIA AND MONTENEGRO	4024	82070	0.76	0.02	0.42	0.01
ENGLAND	2631	616594	0.53	0.02	3.19	0.10
SCOTLAND	3396	56784	0.59	0.02	0.29	0.01
BELGIUM FLEMISH	4849	68852	0.47	0.01	0.36	0.01
BASQUE	2470	18394	0.70	0.02	0.10	0.00
CANADA ONTARIO	4074	141318	0.80	0.02	0.73	0.03
CANADA QUEBEC	4253	78813	0.59	0.02	0.41	0.01
INDIANA US	2144	74604	0.69	0.03	0.39	0.01

In this example, each country's mean value for BSBGREBO is reported for the eighth grade. The results are presented by country. The countries are identified in the first column and the second column reports the number of valid cases. The third column reports the sum of weights of these students, followed by the mean for BSBGREBO and its respective standard error. The last two columns

report the weighted percentages of students in the population and their respective standard errors.

From the first line in Exhibit 5.11, we can say that in Australia valid data were available for 4,609 cases. These sampled students represent a population of 248,940 students. Australian students spend, on average, 0.69 hours reading for enjoyment before or after school. The standard error of this mean is 0.02.

Example of Student-Level Analysis with Plausible Values

In this second example, we wish to replicate another one of the results presented in the international reports. We are interested in looking at the eighth graders' reports on the number of books in their home and their science achievement. These results, originally presented in Exhibit 4.4 of the TIMSS 2003 International Science Report, are reproduced in Exhibit 5.12. Since the results in this Exhibit are based on plausible values, we need to use the macro JACKPV.

Exhibit 5.12 Sample Exhibit for Student-Level Analysis with Plausible Values Taken From the TIMSS 2003 International Science Report (Exhibit 4.4)

Countries	More than 200 Books		101-200 Books		26-100 Books		11-25 Books		0-10 Books	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	20 (1.0)	478 (5.1)	13 (0.6)	475 (4.2)	28 (0.7)	467 (3.6)	24 (0.9)	453 (4.8)	15 (0.9)	433 (5.2)
Australia	31 (1.4)	553 (4.1)	23 (0.8)	540 (3.4)	30 (1.0)	517 (4.8)	11 (0.8)	493 (5.8)	5 (0.5)	464 (8.7)
Bahrain	17 (0.5)	450 (2.7)	14 (0.6)	457 (3.4)	31 (0.8)	445 (2.1)	26 (0.8)	423 (3.0)	11 (0.5)	420 (5.0)
Belgium (Flemish)	12 (0.6)	539 (4.0)	15 (0.6)	538 (2.6)	34 (0.9)	524 (2.7)	25 (0.8)	503 (4.0)	14 (0.7)	477 (5.7)
Botswana	4 (0.5)	407 (14.6)	5 (0.3)	402 (7.4)	13 (0.6)	395 (6.2)	30 (0.9)	368 (3.4)	48 (1.3)	348 (3.0)
Bulgaria	28 (1.3)	494 (8.2)	18 (0.9)	484 (6.0)	25 (1.1)	481 (5.9)	15 (0.7)	470 (6.3)	14 (1.6)	449 (11.8)
Chile	5 (0.4)	484 (6.4)	7 (0.4)	458 (5.8)	27 (0.9)	437 (3.5)	37 (0.9)	402 (2.6)	23 (1.2)	374 (3.5)
Chinese Taipei	15 (1.0)	616 (3.5)	14 (0.6)	602 (3.8)	30 (0.7)	582 (3.2)	24 (0.9)	552 (3.8)	17 (0.9)	515 (4.2)
Cyprus	11 (0.5)	472 (5.0)	16 (0.7)	458 (3.5)	35 (0.8)	453 (3.0)	27 (0.7)	427 (3.3)	11 (0.5)	391 (4.6)
Egypt	6 (0.4)	447 (8.9)	6 (0.4)	438 (9.5)	18 (0.7)	440 (5.3)	38 (0.8)	424 (4.2)	33 (1.2)	415 (3.8)
Estonia	45 (1.2)	567 (2.9)	18 (0.6)	552 (3.6)	23 (0.7)	543 (3.1)	11 (0.6)	528 (3.8)	3 (0.3)	516 (7.4)
Ghana	10 (0.6)	259 (11.1)	6 (0.4)	276 (13.8)	16 (0.7)	277 (8.2)	34 (1.0)	264 (6.3)	34 (1.5)	246 (6.4)
Hong Kong, SAR	9 (0.6)	576 (5.6)	8 (0.4)	574 (4.2)	27 (0.6)	565 (3.0)	28 (0.7)	555 (3.6)	28 (0.7)	538 (4.2)
Hungary	31 (1.2)	578 (3.2)	22 (0.7)	551 (3.5)	29 (1.0)	531 (3.1)	13 (0.6)	499 (4.5)	5 (0.7)	466 (7.7)
Indonesia	1 (0.2)	~ ~	3 (0.3)	449 (9.6)	19 (0.7)	431 (5.1)	45 (0.9)	416 (4.4)	32 (1.0)	416 (4.3)
Iran, Islamic Rep. of	7 (0.5)	492 (6.1)	5 (0.3)	483 (5.2)	17 (0.8)	468 (3.5)	31 (0.8)	454 (2.6)	39 (1.3)	437 (2.6)
Israel	22 (0.9)	511 (4.1)	22 (0.7)	507 (3.9)	33 (0.8)	487 (3.6)	17 (0.8)	460 (4.2)	6 (0.4)	448 (7.5)
Italy	19 (0.9)	524 (4.2)	14 (0.6)	502 (4.7)	25 (0.7)	497 (3.8)	29 (0.7)	474 (4.0)	13 (0.7)	457 (5.5)
Japan	17 (0.7)	584 (3.2)	17 (0.5)	567 (2.9)	32 (0.8)	552 (2.3)	22 (0.6)	539 (2.4)	13 (0.7)	517 (3.3)
Jordan	9 (0.6)	499 (7.9)	8 (0.5)	509 (7.2)	28 (0.9)	496 (4.1)	33 (0.9)	470 (4.2)	23 (0.8)	449 (4.3)
Korea, Rep. of	19 (0.8)	596 (2.2)	22 (0.7)	572 (2.3)	33 (0.8)	556 (2.2)	10 (0.6)	533 (2.9)	15 (0.7)	514 (3.0)
Latvia	28 (1.3)	532 (3.6)	25 (0.8)	517 (3.1)	31 (1.1)	504 (3.2)	12 (0.7)	491 (4.1)	4 (0.4)	479 (7.0)
Lebanon	8 (0.6)	421 (8.9)	8 (0.8)	446 (8.6)	25 (1.0)	423 (5.0)	36 (1.1)	384 (5.2)	23 (1.4)	353 (5.2)
Lithuania	12 (0.8)	551 (4.5)	15 (0.7)	537 (4.2)	34 (0.9)	525 (2.3)	30 (1.1)	503 (2.7)	10 (0.7)	483 (6.4)
Macedonia, Rep. of	8 (0.7)	471 (7.8)	8 (0.6)	489 (6.6)	28 (0.9)	476 (3.9)	40 (1.2)	443 (3.9)	17 (0.8)	401 (5.9)
Malaysia	5 (0.5)	557 (6.4)	9 (0.6)	540 (5.2)	28 (0.8)	524 (3.6)	40 (1.0)	501 (3.4)	17 (0.9)	482 (4.7)
Moldova, Rep. of	8 (0.8)	507 (5.2)	9 (0.6)	494 (5.9)	23 (1.0)	483 (4.3)	37 (1.2)	467 (4.6)	23 (1.1)	452 (5.1)
Morocco	5 (0.6)	410 (10.3)	4 (0.3)	403 (8.8)	21 (0.9)	404 (3.6)	38 (1.0)	392 (3.4)	33 (1.4)	399 (3.6)
Netherlands	21 (1.4)	567 (4.4)	19 (0.9)	556 (3.8)	31 (1.3)	535 (3.2)	19 (1.2)	508 (5.3)	10 (0.8)	492 (5.7)
New Zealand	25 (1.5)	556 (7.4)	22 (1.1)	537 (4.4)	31 (1.0)	512 (4.5)	14 (0.8)	490 (4.4)	8 (0.7)	453 (7.8)
Norway	27 (1.2)	515 (2.6)	22 (0.7)	504 (2.8)	33 (0.9)	493 (3.1)	11 (0.6)	463 (4.6)	7 (0.4)	441 (7.0)
Palestinian Nat'l Auth.	7 (0.5)	446 (7.1)	6 (0.4)	457 (6.8)	24 (0.7)	456 (4.4)	36 (0.8)	432 (3.6)	27 (1.0)	421 (3.7)
Philippines	3 (0.3)	373 (13.1)	4 (0.3)	423 (12.3)	17 (0.8)	418 (7.8)	34 (0.8)	381 (5.7)	43 (1.0)	356 (5.6)
Romania	12 (1.2)	516 (7.2)	13 (1.1)	508 (5.3)	29 (1.2)	479 (4.3)	27 (1.4)	451 (5.9)	20 (1.7)	435 (9.0)
Russian Federation	21 (1.3)	538 (3.5)	26 (0.9)	526 (4.1)	32 (1.4)	512 (4.2)	17 (1.1)	481 (5.0)	4 (0.5)	458 (9.4)
Saudi Arabia	10 (0.7)	422 (7.4)	9 (0.9)	414 (6.0)	25 (1.0)	410 (4.9)	33 (1.1)	391 (4.5)	23 (1.4)	382 (4.3)
Scotland	17 (1.0)	564 (4.8)	16 (0.7)	541 (4.3)	29 (0.8)	516 (3.6)	21 (1.0)	480 (3.3)	16 (0.9)	460 (4.8)
Serbia	6 (0.5)	509 (4.7)	9 (0.5)	518 (5.3)	27 (1.0)	490 (3.8)	38 (1.0)	458 (2.5)	21 (1.1)	428 (4.0)
Singapore	14 (0.5)	631 (4.1)	16 (0.5)	607 (4.2)	33 (0.7)	589 (3.7)	24 (0.7)	546 (6.1)	12 (0.7)	508 (6.9)
Slovak Republic	12 (0.8)	564 (4.7)	18 (0.8)	547 (4.1)	41 (0.9)	520 (3.0)	24 (1.1)	481 (3.2)	5 (0.5)	440 (7.5)
Slovenia	13 (0.7)	545 (4.5)	15 (0.7)	542 (3.2)	38 (0.9)	527 (2.2)	27 (0.7)	502 (3.5)	8 (0.6)	474 (4.7)
South Africa	6 (0.5)	315 (20.7)	5 (0.4)	316 (22.1)	14 (0.7)	288 (13.6)	31 (0.9)	241 (6.0)	44 (1.3)	218 (4.5)
Sweden	32 (1.3)	558 (3.2)	21 (0.6)	537 (3.0)	27 (0.9)	511 (3.0)	14 (0.7)	481 (4.4)	6 (0.6)	472 (6.2)
Tunisia	4 (0.4)	433 (7.8)	6 (0.5)	426 (6.3)	22 (0.9)	415 (3.1)	44 (1.1)	400 (2.0)	23 (1.1)	392 (2.3)
United States	24 (0.9)	569 (3.6)	18 (0.5)	552 (3.4)	28 (0.6)	527 (2.9)	18 (0.6)	493 (3.3)	13 (0.6)	469 (4.6)
¶ England	24 (1.1)	588 (5.7)	18 (1.0)	564 (6.5)	27 (1.0)	541 (4.4)	17 (0.9)	520 (4.8)	13 (1.1)	487 (5.0)
International Avg.	15 (0.1)	506 (1.0)	13 (0.1)	498 (1.0)	27 (0.1)	483 (0.7)	26 (0.1)	458 (0.7)	18 (0.1)	438 (1.0)
Benchmarking Participants										
Basque Country, Spain	25 (1.4)	514 (4.6)	20 (0.9)	505 (4.6)	36 (1.3)	481 (3.2)	15 (0.8)	462 (4.3)	5 (0.5)	435 (9.3)
Indiana State, US	19 (1.6)	566 (6.4)	17 (0.9)	552 (5.7)	32 (1.0)	537 (4.4)	19 (1.0)	510 (5.8)	14 (1.2)	477 (6.3)
Ontario Province, Can.	28 (1.6)	560 (3.1)	21 (0.9)	539 (3.3)	31 (1.1)	523 (3.7)	14 (0.9)	507 (5.1)	7 (0.6)	497 (5.0)
Quebec Province, Can.	13 (0.8)	553 (4.6)	16 (0.9)	551 (4.9)	33 (0.9)	535 (3.2)	24 (1.1)	519 (3.3)	14 (0.7)	501 (4.3)

To replicate the results in this exhibit, we need to undertake several steps. After reviewing the codebooks and the questionnaire information, we observe that the variable BSBGBOOK contains information on the number of books in the home (see Supplement 1 for a copy of the student background questionnaire), and this variable is found in the Student Background data file. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no national adaptations were made, we can continue with our analysis without any modifications.

We then proceed to read from the Student Background file our variable of interest (BSBGBOOK), the science achievement plausible values (BSSSCI01-BSSSCI05), the student sampling weight (TOTWGT), the variables that contain the jackknife replication information (JKZONE and JKREP), and the variable containing the country identification code (IDCNTRY). In this analysis, we will again use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries.

The SAS program code is presented in Exhibit 5.13 and is included on the DVD under the name EXAMPLE2.SAS. Selected results obtained from this program are displayed in Exhibit 5.14. We have included as part of the program the corresponding value labels and format statements so that the different categories or groups are labeled appropriately.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BSBGBOOK.

In general, to perform student-level analyses involving plausible values and using the Student Background data files, you should do the following:

- Identify the variables of interest in the Student Background file and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Student Background files, including the achievement scores, sampling weights, the Jackknife replication information, and any other variables used in the selection of cases.
- Use the macro JACKPV with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 5.13 SAS Control Statements for Performing Student-Level Analyses with Plausible Values (EXAMPLE2.SAS)

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\JackPV.sas" ;

data student2 ;
 set bm3.BSGALLM3;
 where nmiss(BSBGBOOK) = 0 ;

proc format library=work ;
 value country
   51 = 'ARMENIA'    36 = 'AUSTRALIA'             956 = 'BELGIUM FLEMISH'  100 = 'BULGARIA'
   48 = 'BAHRAIN'    72 = 'BOTSWANA'             9132 = 'CANADA ONTARIO'  9133 = 'CANADA QUEBEC'
  152 = 'CHILE'     196 = 'CYPRUS'               818 = 'EGYPT'             926 =  'ENGLAND'
 3724 = 'BASQUE'    233 = 'ESTONIA'              288 = 'GHANA'             344 = 'HONG KONG'
  348 = 'HUNGARY'   360 = 'INDONESIA'            364 = 'IRAN'              376 = 'ISRAEL'
  380 = 'ITALY'     400 = 'JORDAN'               392 = 'JAPAN'             410 = 'KOREA'
  422 = 'LEBANON'   440 = 'LITHUANIA'            428 = 'LATVIA'            504 = 'MOROCCO'
  498 = 'MOLDOVA'   807 = 'MACEDONIA'            458 = 'MALAYSIA'          528 = 'NETHERLANDS'
  578 = 'NORWAY'    554 = 'NEW ZEALAND'          275 = 'PALESTINE'         608 = 'PHILIPPINES'
  642 = 'ROMANIA'   643 = 'RUSSIAN FEDERATION'   682 = 'SAUDI ARABIA'      927 = 'SCOTLAND'
  702 = 'SINGAPORE' 703 = 'SLOVAK REPUBLIC'      705 = 'SLOVENIA'          752 = 'SWEDEN'
  760 = 'SYRIA'     788 = 'TUNISIA'              158 = 'CHINESE TAIPEI'   840 = 'UNITED STATES'
  887 = 'YEMEN'     891 = 'SERBIA AND MONTENEGRO' 710 = 'SOUTH AFRICA'   11800 = 'INDIANA US';

 value books 1 = 'None or very few (0-10)'
             2 = 'For 1 shelf (11-25)'
             3 = 'For 1 bookcase (26-100)'
             4 = 'For 2 bookcases (101-200)'
             5 = 'For 3 or more bookcases (>200)' ;

%JackPV (TOTWGT, jkzone, jkrep, 75, IDCNTRY BSBGBOOK, BSSSCI0, 5, student2) ;

* Print the results ;
proc print data=final noobs ;
 var IDCNTRY BSBGBOOK n TOTWGT mnpv mnpv_se pct pct_se ;
 format IDCNTRY country. BSBGBOOK books. n 6.0 TOTWGT 10.0 mnpv mnpv_se pct pct_se 6.2 ;

run ;
```

Exhibit 5.14 Extract of SAS Computer Output for Performing Student-Level Analyses with Plausible Values (EXAMPLE 2)

IDCNTRY	BSBGBOOK	N	TOTWGT	mnpv	mnpv_se	pct	pct_se
ARMENIA	None or very few (0-10)	798	8025	433.20	5.17	15.14	0.94
	For 1 shelf (11-25)	1246	12595	453.07	4.75	23.77	0.87
	For 1 bookcase (26-100)	1621	14899	467.14	3.59	28.12	0.71
	For 2 bookcases (101-200)	781	7047	474.69	4.21	13.30	0.64
	For 3 or more bookcases (>200)	1112	10426	478.40	5.06	19.67	1.00
AUSTRALIA	None or very few (0-10)	248	13527	463.86	8.67	5.38	0.50
	For 1 shelf (11-25)	477	27603	493.11	5.77	10.98	0.77
	For 1 bookcase (26-100)	1369	74730	516.78	4.82	29.72	0.96
	For 2 bookcases (101-200)	1104	57620	540.00	3.38	22.92	0.82
	For 3 or more bookcases (>200)	1465	77934	553.16	4.09	31.00	1.38
.							
.							
.							
NORWAY	None or very few (0-10)	247	3959	441.31	7.04	6.59	0.41
	For 1 shelf (11-25)	453	6815	462.59	4.58	11.35	0.60
	For 1 bookcase (26-100)	1307	19661	492.55	3.05	32.74	0.86
	For 2 bookcases (101-200)	902	13223	504.34	2.80	22.02	0.69
	For 3 or more bookcases (>200)	1144	16393	514.52	2.63	27.30	1.15
UNITED STATES	None or very few (0-10)	1157	436292	468.96	4.62	12.82	0.58
	For 1 shelf (11-25)	1619	623310	493.21	3.28	18.32	0.59
	For 1 bookcase (26-100)	2441	936415	526.81	2.90	27.52	0.62
	For 2 bookcases (101-200)	1573	603150	552.40	3.41	17.73	0.50
	For 3 or more bookcases (>200)	2010	803597	568.95	3.65	23.62	0.90

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable BSBGBOOK. The results are presented by country and each value of the variable BSBGBOOK. The countries and the five response options are presented in the first and second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values and its respective standard error. The last two columns report the weighted percentages of students within each category and their respective standard errors.

From the first few lines in Exhibit 5.14, we can say that in Armenia the 1,112 students (19.67%) who reported having more than 200 books have a mean science achievement of 478.40 with a standard error of 5.06; while the 798 students (15.14%) who reported having none or very few books (0-10) have a mean science achievement of 433.20 with a standard error of 5.17.

5.9 Performing Analyses with Teacher-Level Variables

The TIMSS 2003 teachers do not constitute representative samples of teachers. Rather, they are the teachers for nationally representative samples of students. Therefore, it is appropriate that statements about the teachers be made only in terms of how many students are taught by teachers of one kind or another, and not in terms of how many teachers in a country have one attribute or another.

When analyzing teacher data, it is first necessary to link the students with their respective teachers. Each eighth grade student record in the Student Background file can link to as many as six different teachers in the Teacher Background file. There are usually fewer student-teacher links at the fourth grade. To facilitate the linking between students and their teachers, the Student-Teacher Linkage file was created and is part of the International Database. This file is called BST<COUNTRY>M3 for the eighth grade and AST<COUNTRY>M3 for the fourth grade. The Student-Teacher Linkage file contains one record for each student-teacher combination, with the appropriate identification variables.

Each record in the Student-Teacher Linkage file also contains the number of mathematics and science teachers for the student and a set of weights that can be used when conducting analyses with these data. Student achievement plausible values, sampling weights, and Jackknife replication information have been added to the Student-Teacher Linkage file in order to simplify the merging process for analyses that link teacher variables to student achievement. For such analyses, it is necessary to merge only the Teacher Background file with the Student-Teacher Linkage file. For analyses linking teacher variables to other student variables, it is also necessary to merge the Student Background file with the Teacher Background file after it has been combined with the Student-Teacher Linkage file.

Conducting analyses with teacher data requires some extra steps. As our third example, we will investigate the age of the science teachers who teach the eighth grade students in each of the TIMSS countries. In particular, we will investigate the percentage of eighth grade students who are taught by teachers from specified age groups (BTBGAGE), and the mean science achievement of these students taught by those teachers. The results are found in the Science Teacher Background Data Almanac (BSALM7_M3) for questionnaire item TQS2-1, as shown in Exhibits 5.15 and 5.16. The percentages also appear in Exhibit 6.3 of the TIMSS 2003 International Science Report.

Exhibit 5.15 Sample Data Almanac Sheet for Teacher-Level Analysis (Percentages)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
Science Teacher Background Data Almanac - 8th Grade

Question : How old are you?
Location : TQS2-1 (BTBGAGE)

Country	Sample	Valid N	1.UNDER 25 %	2.25-29 %	3.30-39 %	4.40-49 %	5.50-59 %	6.60 OR OLDER %	Not Administered %	Omitted %
Armenia	772	649	2.3	7.5	27.0	35.6	20.2	7.4	16.7	0.3
Australia	520	411	5.7	17.6	22.6	32.8	19.4	1.9	15.8	1.2
Bahrain	147	147	1.4	25.5	58.0	13.8	1.2	.	0.0	0.0
Belgium (Flemish)	641	609	14.8	16.4	23.1	27.7	17.5	0.5	4.1	0.9
Botswana	146	136	6.2	50.2	35.0	6.0	1.3	1.2	5.4	2.3
Bulgaria	770	594	1.4	6.6	24.8	34.2	29.6	3.4	17.8	0.5
Chile	214	211	.	5.0	19.8	38.8	31.6	4.7	0.8	0.0
Chinese Taipei	151	149	3.7	14.0	38.5	25.3	17.5	1.1	1.6	0.0
Cyprus	472	472	1.1	9.2	20.7	46.8	22.3	.	0.0	0.0
Egypt	217	217	2.7	13.3	59.1	23.5	1.4	.	0.0	0.0
England	503	271	5.1	17.4	26.9	28.1	22.0	0.6	42.6	0.3
Estonia	521	502	4.9	6.1	15.7	34.8	23.4	15.1	3.1	0.2
Ghana	152	142	8.8	41.3	30.3	13.1	5.8	0.8	7.1	0.0
Hong Kong, SAR	131	129	9.8	20.6	42.2	18.6	8.8	.	0.0	1.8
Hungary	627	605	1.8	7.2	19.6	39.9	27.4	4.1	3.7	0.0
Indonesia	278	276	1.2	14.8	50.3	26.2	7.0	0.5	0.3	0.3
Iran, Islamic Rep.	181	180	4.9	11.9	42.2	36.2	4.8	.	0.2	0.0
Israel	308	287	2.3	11.8	35.0	30.0	20.4	0.5	3.5	0.5
Italy	217	216	.	2.7	7.5	31.0	56.5	2.3	0.0	0.5
Japan	146	145	4.3	9.9	29.8	38.3	16.0	1.7	0.7	0.0
Jordan	140	140	7.5	25.5	45.0	15.4	6.5	.	0.0	0.0
Korea, Rep. of	357	256	2.4	12.8	40.7	39.8	4.4	.	28.3	0.0
Latvia	438	406	2.5	6.4	24.1	32.8	24.2	10.0	7.0	0.0
Lebanon	306	303	17.9	27.0	27.4	20.0	6.8	0.7	1.0	0.6
Lithuania	999	921	3.3	7.6	25.6	33.6	23.7	6.2	9.4	0.1
Macedonia, Rep. of	595	578	0.8	3.2	16.5	29.0	42.9	7.5	2.9	0.0
Malaysia	150	149	3.5	22.2	39.1	31.2	4.0	.	0.9	0.0
Moldova, Rep. of	505	428	8.8	9.3	14.9	24.5	30.9	11.6	11.5	0.3
Morocco	145	140	1.2	16.1	29.4	46.0	7.3	.	2.1	0.0
Netherlands	377	323	3.9	14.1	19.8	30.7	28.0	3.4	13.9	0.0
New Zealand	176	166	7.2	7.7	33.6	30.9	19.2	1.4	2.7	2.2
Norway	179	171	1.0	17.0	24.6	21.7	32.5	3.2	3.5	1.3
Palestinian Nat'l	145	144	10.1	25.2	35.8	21.2	7.2	0.6	0.7	0.0
Philippines	137	131	4.2	19.8	31.7	24.4	19.0	1.0	3.9	0.7
Romania	712	699	4.9	15.1	20.0	21.8	34.2	4.0	1.3	0.0
Russian Federation	855	843	6.2	10.2	22.6	29.0	24.8	7.2	1.9	0.2
Saudi Arabia	172	168	11.2	33.8	37.4	15.6	2.0	.	1.4	0.0
Scotland	677	387	4.2	8.5	13.3	34.3	37.2	2.5	38.3	0.0
Serbia and Montene	702	660	0.6	6.9	21.8	25.8	39.4	5.5	4.2	0.0
Singapore	336	333	5.3	28.3	26.6	19.3	19.5	1.0	0.6	0.4
Slovak Republic	599	585	3.5	12.6	20.1	24.9	31.5	7.4	1.9	0.0
Slovenia	528	492	1.4	6.9	30.8	41.9	17.3	1.7	6.0	0.0
South Africa	255	222	2.3	22.1	51.3	20.0	4.3	.	11.5	0.8
Sweden	647	581	2.5	13.0	29.4	21.6	24.1	9.5	7.2	0.3
Syrian Arab Republ	240	199	16.7	11.6	51.6	15.2	4.9	.	13.6	1.6
Tunisia	150	148	1.4	22.9	45.3	18.6	11.0	0.7	0.7	0.7
United States	1090	924	2.4	12.5	23.3	31.4	27.0	3.5	10.7	1.8
International Avg.	398	358	4.9	15.5	30.4	27.7	18.9	3.8	6.6	0.4
Basque Country, Sp	124	114	.	9.3	28.6	49.1	12.6	0.3	5.4	0.4
Indiana State, US	285	270	2.5	14.2	14.9	32.4	31.2	4.8	0.3	2.7
Ontario Province,	206	186	1.1	24.6	31.4	23.5	19.4	0.1	5.9	1.9
Quebec Province, C	442	330	6.3	21.6	32.8	23.4	15.3	0.8	11.1	1.5

Exhibit 5.16 Sample Data Almanac Sheet for Teacher-Level Analysis (Means)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
Science Teacher Background Data Almanac - 8th Grade

Question : How old are you?
Location : TQS2-1 (BTBGAGE)

Country	Sample	Valid N	1.UNDER 25 Mean	2.25-29 Mean	3.30-39 Mean	4.40-49 Mean	5.50-59 Mean	6.60 OR OLDER Mean	Not Administered Mean	Omitted Mean
Armenia	772	649	490.9	460.1	458.9	466.9	458.0	465.7	455.7	432.8
Australia	520	411	521.3	513.9	527.3	537.5	520.6	515.7	528.7	545.2
Bahrain	147	147	450.9	441.2	437.5	434.8	436.6	.	.	.
Belgium (Flemish)	641	609	515.4	506.6	521.6	525.4	502.9	541.8	495.3	546.7
Botswana	146	136	353.3	359.6	368.0	376.1	352.6	365.0	391.7	358.9
Bulgaria	770	594	488.5	479.8	470.7	479.6	482.2	475.5	482.5	461.1
Chile	214	211	.	427.7	434.6	411.5	400.7	402.4	391.1	.
Chinese Taipei	151	149	593.2	573.7	564.2	582.4	561.7	517.5	624.5	.
Cyprus	472	472	447.5	434.3	443.2	438.4	443.8	.	.	.
Egypt	217	217	436.9	410.0	419.7	429.8	412.2	.	.	.
England	503	271	516.1	553.8	541.6	548.1	575.3	537.2	533.7	524.9
Estonia	521	502	555.8	550.7	552.8	554.7	549.2	549.6	549.2	628.2
Ghana	152	142	275.6	254.6	243.5	243.1	272.1	371.0	279.3	.
Hong Kong, SAR	131	129	545.5	559.6	555.8	557.9	553.2	.	.	576.5
Hungary	627	605	535.4	540.6	546.6	542.9	537.6	557.4	550.8	.
Indonesia	278	276	436.3	419.3	420.7	423.0	442.0	442.0	483.3	350.9
Iran, Islamic Rep.	181	180	426.6	439.6	453.2	460.1	467.8	.	433.1	.
Israel	308	287	489.2	503.0	480.8	487.7	499.1	459.4	457.8	486.9
Italy	217	216	.	510.4	484.0	484.4	495.5	479.2	.	415.6
Japan	146	145	557.9	547.7	552.2	549.5	555.5	596.6	541.8	.
Jordan	140	140	455.7	469.1	481.8	471.7	478.9	.	.	.
Korea, Rep. of	357	256	542.5	558.4	557.7	562.5	558.9	.	555.9	.
Latvia	438	406	498.3	501.4	512.8	515.1	512.5	515.0	509.0	.
Lebanon	306	303	370.8	382.9	399.5	418.2	398.1	423.4	376.7	374.6
Lithuania	999	921	524.5	525.5	520.2	515.5	517.6	520.1	527.5	534.2
Macedonia, Rep. of	595	578	340.6	449.4	448.6	439.7	455.2	458.8	472.5	.
Malaysia	150	149	478.0	501.0	508.9	524.2	503.2	.	493.8	.
Moldova, Rep. of	505	428	458.8	480.6	477.4	472.9	465.8	474.7	482.2	499.5
Morocco	145	140	395.1	402.9	395.2	400.1	400.1	.	415.0	.
Netherlands	377	323	530.1	541.7	542.2	534.1	532.0	544.7	531.8	.
New Zealand	176	166	511.7	492.4	540.4	507.3	523.9	513.7	440.2	565.2
Norway	179	171	516.0	497.2	484.8	498.1	493.9	500.6	498.7	502.2
Palestinian Nat'l	145	144	435.9	443.1	429.7	431.0	449.9	414.3	442.1	.
Philippines	137	131	494.3	367.0	361.2	385.7	389.4	313.8	323.1	492.8
Romania	712	699	476.2	463.1	461.0	474.9	473.2	473.4	457.4	.
Russian Federation	855	843	510.0	513.2	512.3	509.5	520.7	510.0	532.8	447.8
Saudi Arabia	172	168	379.9	396.1	403.9	399.7	379.7	.	418.6	.
Scotland	677	387	501.8	514.2	520.5	515.8	517.1	500.0	504.7	.
Serbia and Montene	702	660	480.5	469.6	473.7	462.9	466.7	462.1	477.6	.
Singapore	336	333	587.0	573.3	568.6	590.0	578.6	615.9	599.4	643.7
Slovak Republic	599	585	517.2	512.5	519.4	519.2	514.0	523.4	491.8	.
Slovenia	528	492	524.4	514.8	518.7	523.0	524.4	519.8	507.3	.
South Africa	255	222	244.6	236.0	221.5	268.0	451.5	.	235.1	292.4
Sweden	647	581	492.1	529.0	528.4	520.4	524.5	528.4	516.0	521.0
Syrian Arab Republ	240	199	395.1	394.6	415.1	412.9	428.6	.	413.9	426.5
Tunisia	150	148	403.9	396.4	399.0	411.8	423.1	424.7	408.7	378.0
United States	1090	924	530.2	530.6	520.9	536.3	540.5	495.9	498.3	492.4
International Avg.	398	358	471.8	471.1	472.3	475.6	479.6	486.0	471.4	479.1
Basque Country, Sp	124	114	.	503.2	495.7	483.7	491.4	459.0	473.6	439.9
Indiana State, US	285	270	520.1	510.3	521.8	535.8	542.0	529.8	512.9	506.3
Ontario Province,	206	186	500.1	538.4	533.3	539.5	526.2	466.3	528.0	484.9
Quebec Province, C	442	330	523.0	541.4	524.3	535.2	542.7	493.0	519.8	496.6

As before, we first proceed to identify the variables relevant to the analysis in the appropriate files, and review the documentation on any specific national adaptations to the questions of interest (Supplements 1 and 2). Since we are using teacher-level variables, we need to look in the teacher file and the Student-Teacher Linkage file to find the variables. From the teacher file, we will need the variable that contains the information on the science teachers' age (BTBGAGE), the variable that identifies the country (IDCNTRY), and the two variables that will allow us to link the teacher information to the student data (IDTEACH and IDLINK).

For the eighth grade, there is one teacher file for the mathematics teachers and a second teacher file for the science teachers. If you want to look only at mathematics teachers, then you will need to use the mathematics teacher file (BTM<COUNTRY>M3); if your interest is in the science teachers then you will need to use the science teacher file (BTS<COUNTRY>M3); but if your interest is in the mathematics and science teachers combined, both these files need to be combined by adding one file to the other. In doing so, it is important to keep in mind that although there are variables in common between these two files, most of them are not.

In our example, our teacher variable of interest (BTBGAGE) is a categorical variable with six categories. However, we want to categorize the teachers into four groups: less than 30 years old, 30-39 years old, 40-49 years old, and 50 years or older. When reading the teacher file, we will use SAS commands to collapse the six values into four categories and label them accordingly. We then proceed to read the necessary information from the Student-Teacher Linkage file. From this file we need the country identification (IDCNTRY) and the two variables that will allow us to link the student information to the teacher data (IDTEACH and IDLINK). We also need the science achievement plausible values (BSSSCI01-BSSSCI05), and the jackknife replication information (JKZONE and JKREP). We need to use the weight variable appropriate for science teacher variables (SCIWGT). If you are investigating the mathematics teachers, then the weight variable MATWGT should be used; if you are interested in analyzing mathematics and science teachers combined, the weight variable TCHWGT should be used.

The two files are merged into one file that will then be used with the JACKPV macro. These two files are merged using the variables IDCNTRY, IDTEACH, and IDLINK. The combination of values for these three variables is unique within the teacher data, but is repeated in the Student-Teacher Linkage file as many times as the specific teacher teaches students in a class. After the files are merged, the macro JACKPV is used and the results can be printed.

In this analysis, we will again use the eighth grade data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used

the JOIN program, described earlier in this chapter, to join the Science Teacher Background files for all available countries into a single Science Teacher Background file called BTSALLM3. The JOIN program was used a second time to join all the Student-Teacher Linkage files into a single one called BSTALLM3.

The SAS program code for this example is presented in Exhibit 5.17 and is included on the DVD under the name EXAMPLE3.SAS. Selected results obtained from this program are displayed in Exhibit 5.18. In this program, the variable TCHAGE is created by collapsing the categorical variable BTBGAGE into only four categories.

Note that one of the steps in this program is to select only those science teachers who have non-missing data in the variable of interest TCHAGE.

In general, to perform teacher-level analyses using the Teacher Background data files, you should do the following:

- Identify the variables of interest in the appropriate Teacher Background files and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the Teacher Background files. If you are investigating mathematics and science teachers combined, then the files for these teachers need to be added to each other.
- Retrieve the relevant variables from the Student-Teacher Linkage files. This includes the country and teacher identification information (IDCNTRY, IDTEACH, and IDLINK), the achievement scores, the Jackknife replication information, and the appropriate sampling weights. If the analysis is to be based on mathematics teachers only, then the weight variable to use is MATWGT. If the analysis is to be based on the science teachers only, then the weight variable to be used is SCIWGT. If the analysis is to be based on the science and mathematics teachers combined, then the weight variable to be used is TCHWGT.
- Merge the Teacher Background files with the Student-Teacher Linkage files using the variables IDCNTRY, IDTEACH and IDLINK.
- Use the macro JACKGEN, or JACKPV if plausible values are involved, with the appropriate arguments and parameters.
- Print out the results file.

Exhibit 5.17 SAS Control Statements for Performing Teacher-Level Analysis (EXAMPLE3.SAS)

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\JackPV.sas" ;

data TEACHER ;
 set bm3.BTSALLM3;
 select (BTBGAGE) ;
     when(1,2)   TCHAGE = 1 ;    /*Less than 30 years old*/
     when(3)     TCHAGE = 2 ;    /*30-39 years old       */
     when(4)     TCHAGE = 3 ;    /*40-49 years old       */
     when(5,6)   TCHAGE = 4 ;    /*50 years or older     */
     otherwise ;
     end ;

proc sort data= TEACHER;
 by IDCNTRY IDTEACH IDLINK ;

data STDTCH ;
 set bm3.BSTALLM3;

proc sort data= STDTCH;
 by IDCNTRY IDTEACH IDLINK;

data MERGED3 ;
 merge STDTCH TEACHER;
 by IDCNTRY IDTEACH IDLINK;
 if SCIWGT > 0 and nmiss(TCHAGE) = 0 ;

proc format library=work ;
value country
   51 = 'ARMENIA'    36 = 'AUSTRALIA'             956 = 'BELGIUM FLEMISH'  100 = 'BULGARIA'
   48 = 'BAHRAIN'    72 = 'BOTSWANA'             9132 = 'CANADA ONTARIO'  9133 = 'CANADA QUEBEC'
  152 = 'CHILE'     196 = 'CYPRUS'               818 = 'EGYPT'            926 =  'ENGLAND'
 3724 = 'BASQUE'    233 = 'ESTONIA'              288 = 'GHANA'            344 = 'HONG KONG'
  348 = 'HUNGARY'   360 = 'INDONESIA'            364 = 'IRAN'             376 = 'ISRAEL'
  380 = 'ITALY'     400 = 'JORDAN'               392 = 'JAPAN'            410 = 'KOREA'
  422 = 'LEBANON'   440 = 'LITHUANIA'            428 = 'LATVIA'           504 = 'MOROCCO'
  498 = 'MOLDOVA'   807 = 'MACEDONIA'            458 = 'MALAYSIA'         528 = 'NETHERLANDS'
  578 = 'NORWAY'    554 = 'NEW ZEALAND'          275 = 'PALESTINE'        608 = 'PHILIPPINES'
  642 = 'ROMANIA'   643 = 'RUSSIAN FEDERATION'   682 = 'SAUDI ARABIA'     927 = 'SCOTLAND'
  702 = 'SINGAPORE' 703 = 'SLOVAK REPUBLIC'      705 = 'SLOVENIA'         752 = 'SWEDEN'
  760 = 'SYRIA'     788 = 'TUNISIA'              158 = 'CHINESE TAIPEI'   840 = 'UNITED STATES'
  887 = 'YEMEN'     891 = 'SERBIA AND MONTENEGRO' 710 = 'SOUTH AFRICA'  11800 = 'INDIANA US';

 value age  1 = 'Less than 30 years old'
            2 = '30-39 years old'
            3 = '40-49 years old'
            4 = '50 years or older' ;

%JackPV (SCIWGT, JKZONE, JKREP, 75, IDCNTRY TCHAGE, BSSSCI0, 5, MERGED3) ;

* Print the results ;
proc print data=final noobs ;
 var IDCNTRY TCHAGE n SCIWGT mnpv mnpv_se pct pct_se ;
 format IDCNTRY country. TCHAGE age. n 6.0 SCIWGT 10.0 mnpv mnpv_se pct pct_se 6.2 ;

run ;
```

Exhibit 5.18 Extract of SAS Computer Output Performing Teacher-Level Analysis (EXAMPLE 3)

IDCNTRY	TCHAGE	N	SCIWGT	mnpv	mnpv_se	pct	pct_se
ARMENIA	Less than 30 years old	1778	4392	467.22	7.48	9.78	1.45
	30-39 years old	5162	12146	458.93	5.20	27.04	2.02
	40-49 years old	6475	16006	466.90	4.12	35.64	2.26
	50 years or older	5174	12369	460.08	4.29	27.54	1.74
AUSTRALIA	Less than 30 years old	1035	49869	515.66	7.05	23.34	3.25
	30-39 years old	1110	48223	527.35	5.88	22.57	2.52
	40-49 years old	1309	70160	537.52	6.81	32.84	3.77
	50 years or older	866	45374	520.17	8.89	21.24	3.21
.							
.							
.							
NORWAY	Less than 30 years old	726	10478	498.21	5.74	17.96	3.26
	30-39 years old	1030	14363	484.85	5.26	24.62	3.35
	40-49 years old	856	12658	498.10	5.33	21.70	3.32
	50 years or older	1337	20832	494.52	3.21	35.71	4.36
UNITED STATES	Less than 30 years old	1090	448839	530.54	6.15	14.88	2.28
	30-39 years old	1932	702160	520.86	6.74	23.29	2.44
	40-49 years old	2375	945533	536.32	5.75	31.36	3.14
	50 years or older	2378	918958	535.40	6.17	30.47	2.92

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable TCHAGE. The results are presented by country and each value of the variable TCHAGE. The countries and the four age groups are presented in the first and the second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values and its respective standard error. The last two columns report the weighted percentages of students within each teacher age group and their respective standard errors.

From the first few lines of Exhibit 5.18, we can say that in Armenia the 1,778 students (9.78%) with teachers less than 30 years old have a mean science achievement of 467.22 with a standard error of 7.48; while the 5,174 students (27.54%) with teachers 50 years or older have a mean science achievement of 460.08 with a standard error of 4.29.

5.10 Performing Analyses with School-Level Variables

TIMSS 2003 has representative samples of schools and so it is possible to compute weighted numbers of schools with particular characteristics for providing reasonable estimates of percentages and averages across primary or middle schools in each country. However, the school samples were designed to optimize the student samples and the student-level estimates. For this reason, it is preferable to analyze school-level variables as attributes of students, rather than as elements in their own right. The following example describes school-level analyses based on student-weighted data.

For student-weighted analyses, the school-level data are analyzed to make statements about the number of students attending schools with one characteristic or another, rather than the number of schools with one characteristic or another. When school-level variables are analyzed, we recommend that you merge the selected school-level variables with the student-level file, and then use the sampling and weight information contained in the student-level file to make the desired statements. The example presented in this section describes how this can be accomplished using SAS.

As our fourth example, we wish to investigate the percentage of eighth grade students who attend schools in areas of different population sizes (BCBGCOMU), and their mean science achievement. The results are found in the School Background Data Almanac by Science Achievement (BSALM4_M3) for questionnaire item SCQ2-3, as shown in Exhibits 5.19 and 5.20.

Exhibit 5.19 Sample Data Almanac Sheet for School-Level Analysis (Percentages)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
School Background Data Almanac by SCIENCE Achievement - 8th Grade

Question : How many people live in the city, town, or area where your school is located?
Location : SCQ2-3 (BCBGCOMU)

Country	Sample	Valid N	1.MORE THAN 500000 PEOPLE %	2.10000 TO 500000 PEOPLE %	3.50001 TO 100000 PEOPLE %	4.15001 TO 50000 PEOPLE %	5.3001 TO 15000 PEOPLE %	6.FEWER THAN 3000 PEOPLE %	Not Administered %	Omitted %
Armenia	149	122	16.9	8.1	4.6	16.7	32.0	21.6	16.8	2.9
Australia	207	185	35.2	17.0	12.4	16.3	15.4	3.7	8.4	2.7
Bahrain	67	58	9.1	2.9	12.9	35.1	33.4	6.6	0.0	8.7
Belgium (Flemish)	144	136	2.9	8.6	14.9	54.3	19.3	.	2.6	3.4
Botswana	146	131	2.5	3.7	13.2	28.3	32.3	20.0	10.0	1.6
Bulgaria	164	160	12.5	18.4	14.9	13.4	17.8	22.9	1.1	0.9
Chile	195	193	21.3	29.1	14.1	15.6	9.5	10.4	0.7	0.5
Chinese Taipei	150	148	25.9	34.5	18.1	17.2	3.7	0.6	0.0	1.5
Cyprus	59	57	.	23.0	19.4	13.3	41.7	2.5	1.3	1.9
Egypt	217	210	17.2	12.3	10.0	21.3	29.9	9.3	0.0	2.4
England	87	58	19.3	21.3	27.9	15.0	14.6	1.9	32.6	1.4
Estonia	151	143	3.2	26.3	11.1	15.3	25.0	19.2	5.0	0.7
Ghana	150	140	19.5	10.8	6.7	8.4	35.1	19.6	6.2	1.7
Hong Kong, SAR	125	115	37.9	51.9	3.2	7.0	.	.	5.0	3.5
Hungary	155	147	13.0	14.5	7.4	22.5	23.0	19.6	5.7	0.0
Indonesia	150	148	22.5	5.5	11.2	16.8	36.1	7.9	0.0	1.1
Iran, Islamic Rep.	181	177	25.4	18.9	10.2	11.5	18.2	15.8	0.0	2.2
Israel	146	139	4.0	22.5	14.9	26.6	26.6	5.3	1.9	2.6
Italy	171	170	12.2	9.9	14.2	23.1	35.3	5.3	0.0	0.7
Japan	146	144	24.3	39.2	11.8	15.8	8.1	0.7	0.0	1.2
Jordan	140	140	23.1	5.9	12.8	14.8	30.0	13.4	0.0	0.0
Korea, Rep. of	149	146	48.4	26.1	9.0	10.8	4.7	1.0	0.0	2.3
Latvia	140	129	20.9	5.4	4.9	11.8	27.7	29.2	8.8	0.0
Lebanon	152	148	19.7	11.9	6.4	18.8	28.5	14.7	0.0	2.1
Lithuania	143	128	6.8	21.5	5.1	18.0	21.7	26.9	9.6	0.7
Macedonia, Rep. of	147	144	12.8	4.2	18.5	17.6	37.0	9.9	0.8	1.9
Malaysia	150	150	9.3	15.7	15.2	26.6	29.4	3.7	0.0	0.0
Moldova, Rep. of	149	112	15.1	3.0	.	17.0	37.6	27.3	18.3	3.0
Morocco	131	82	4.8	0.5	9.4	17.8	42.8	24.6	32.0	5.6
Netherlands	130	121	4.3	23.2	23.6	44.9	4.1	.	4.5	1.7
New Zealand	169	156	20.9	21.3	12.7	18.9	21.1	5.2	3.5	5.5
Norway	138	134	5.8	13.1	7.5	31.9	36.4	5.3	2.0	0.5
Palestinian Nat'l	145	142	5.3	14.4	20.3	19.1	30.8	10.2	0.0	2.1
Philippines	137	132	13.3	13.3	22.4	15.7	18.7	16.6	1.2	1.7
Romania	148	146	13.6	20.4	6.2	12.4	17.3	30.0	1.7	0.0
Russian Federation	214	211	20.6	20.0	10.1	10.6	15.9	22.8	0.0	1.4
Saudi Arabia	155	148	32.2	12.4	4.4	15.7	11.3	24.0	0.4	3.6
Scotland	128	86	8.3	14.6	14.6	23.7	34.9	4.0	30.2	3.0
Serbia and Montene	149	146	9.2	17.2	11.8	24.2	24.9	12.7	1.9	0.0
Singapore	164	161	100.0	.	.	.	.	.	1.7	0.0
Slovak Republic	179	176	1.7	9.7	15.0	27.0	22.1	24.5	0.8	0.9
Slovenia	174	155	2.3	12.2	1.3	15.8	38.6	29.9	9.2	0.0
South Africa	255	219	15.3	7.2	11.9	22.2	29.0	14.3	8.0	2.8
Sweden	159	149	7.7	18.9	12.9	27.2	26.2	7.1	5.5	0.5
Syrian Arab Republ	134	114	6.7	9.1	9.1	24.5	40.8	9.9	12.3	1.6
Tunisia	150	146	2.7	4.9	12.5	41.9	38.1	.	0.7	2.0
United States	232	200	11.4	13.2	12.3	31.3	20.9	10.9	12.1	1.0
International Avg.	154	143	16.7	15.6	12.1	20.7	25.5	13.6	5.6	1.8
Basque Country, Sp	115	114	5.4	35.7	11.9	24.5	21.7	0.7	0.4	0.0
Indiana State, US	54	50	13.3	13.1	12.0	17.9	30.7	13.1	0.0	6.1
Ontario Province,	186	181	37.7	26.3	8.4	7.2	11.1	9.3	2.1	0.0
Quebec Province, C	175	162	20.3	18.2	16.0	20.0	22.7	2.8	5.5	2.6

Exhibit 5.20 Sample Data Almanac Sheet for School-Level Analysis (Means)

Trends in International Mathematics and Science Study - TIMSS 2003 Main Survey
School Background Data Almanac by SCIENCE Achievement - 8th Grade

Question : How many people live in the city, town, or area where your school is located?
Location : SCQ2-3 (BCBGCOMU)

Country	Sample	Valid N	1.MORE THAN 500000 PEOPLE Mean	2.10000 1 TO 500000 PEOPLE Mean	3.50001 TO 100000 PEOPLE Mean	4.15001 TO 50000 PEOPLE Mean	5.3001 TO 15000 PEOPLE Mean	6.FEWER THAN 3000 PEOPLE Mean	Not Administered Mean	Omitted Mean
Armenia	149	122	474.6	473.3	484.5	468.3	455.4	435.6	462.5	508.9
Australia	207	185	532.3	529.4	525.7	526.7	527.1	511.9	512.5	521.8
Bahrain	67	58	428.2	450.1	429.0	435.5	440.7	449.9	.	450.4
Belgium (Flemish)	144	136	454.5	499.3	516.1	517.2	531.6	.	504.7	497.2
Botswana	146	131	378.7	458.1	380.3	361.8	355.4	343.4	379.7	382.4
Bulgaria	164	160	466.8	471.9	493.0	476.3	456.4	501.8	461.7	476.1
Chile	195	193	440.2	415.5	415.9	414.3	396.1	363.5	386.2	350.3
Chinese Taipei	150	148	582.6	574.5	563.8	561.0	534.7	533.9	.	601.2
Cyprus	59	57	.	442.2	447.2	449.5	435.6	429.8	463.5	445.4
Egypt	217	210	437.4	431.5	456.9	409.9	408.7	402.6	.	428.1
England	87	58	519.2	565.5	557.8	553.2	541.5	549.3	534.4	536.2
Estonia	151	143	546.0	561.0	541.6	551.9	549.3	552.4	551.3	539.7
Ghana	150	140	261.6	301.4	335.3	265.5	230.6	210.9	301.3	356.5
Hong Kong, SAR	125	115	566.3	546.3	545.7	546.3	.	.	587.9	570.2
Hungary	155	147	562.4	553.4	550.1	553.5	527.7	523.4	546.2	.
Indonesia	150	148	437.2	441.6	421.8	423.5	404.1	423.8	.	405.1
Iran, Islamic Rep.	181	177	471.7	472.8	452.9	447.9	433.8	428.7	.	446.9
Israel	146	139	501.2	502.0	489.1	482.8	480.0	487.7	496.2	478.3
Italy	171	170	483.9	504.2	498.1	475.7	493.3	523.6	.	410.7
Japan	146	144	559.8	555.8	540.1	544.4	545.5	556.4	.	544.5
Jordan	140	140	492.1	480.0	473.4	477.9	462.1	469.4	.	.
Korea, Rep. of	149	146	563.9	555.8	553.8	557.1	527.2	524.4	.	573.9
Latvia	140	129	519.4	530.8	502.7	527.6	509.3	504.4	506.0	.
Lebanon	152	148	401.3	399.7	397.0	415.5	374.4	386.0	.	385.1
Lithuania	143	128	544.0	528.4	514.7	525.4	517.6	506.3	514.8	511.4
Macedonia, Rep. of	147	144	494.0	477.1	449.8	456.8	433.5	432.6	388.6	438.0
Malaysia	150	150	528.5	520.7	513.4	507.6	503.4	486.3	.	.
Moldova, Rep. of	149	112	481.7	466.5	.	477.2	469.9	465.0	471.7	501.6
Morocco	131	82	405.9	422.7	378.2	393.5	396.4	398.4	396.3	411.2
Netherlands	130	121	493.9	537.5	524.9	543.1	544.1	.	537.1	549.8
New Zealand	169	156	516.2	524.9	540.6	516.9	517.3	503.9	480.0	526.0
Norway	138	134	503.6	494.9	505.4	491.0	492.7	502.5	470.0	457.1
Palestinian Nat'l	145	142	440.7	448.4	427.7	428.0	430.9	448.9	.	472.9
Philippines	137	132	392.8	405.1	381.4	389.9	351.2	357.4	293.5	414.3
Romania	148	146	486.0	493.8	478.4	488.3	453.2	449.3	405.0	.
Russian Federation	214	211	534.1	530.6	502.7	509.7	494.7	500.3	.	508.5
Saudi Arabia	155	148	407.3	397.5	385.2	396.5	396.0	386.9	339.0	416.9
Scotland	128	86	507.3	501.6	513.1	512.6	525.9	574.1	499.2	498.5
Serbia and Montene	149	146	508.1	478.7	473.3	468.2	452.5	445.7	475.5	.
Singapore	164	161	577.3	.	.	.	.	.	609.6	.
Slovak Republic	179	176	538.4	537.9	543.0	518.4	507.8	494.9	511.2	588.5
Slovenia	174	155	515.4	523.1	539.0	519.2	523.2	517.5	516.6	.
South Africa	255	219	282.6	318.9	320.4	226.4	197.6	183.8	294.0	265.3
Sweden	159	149	521.4	529.6	523.4	527.9	520.5	521.6	514.2	542.1
Syrian Arab Republ	134	114	435.6	420.1	421.9	410.4	396.1	409.8	429.7	394.4
Tunisia	150	146	392.6	406.7	420.3	403.9	396.9	.	408.7	424.1
United States	232	200	523.0	505.6	538.4	536.7	532.9	541.8	500.0	537.2
International Avg.	154	143	480.7	482.3	477.0	471.5	459.4	458.1	463.2	470.9
Basque Country, Sp	115	114	490.9	495.3	489.2	486.5	480.9	484.9	425.3	.
Indiana State, US	54	50	523.0	514.9	539.2	511.7	550.0	540.3	.	503.1
Ontario Province,	186	181	532.9	534.5	537.5	535.2	529.8	526.0	533.0	.
Quebec Province, C	175	162	534.0	532.2	525.5	543.5	526.1	544.8	512.9	508.6

The first step in our analysis is to identify the variables of interest in the appropriate files and review the documentation on specific national adaptations to the questions of interest (Supplements 1 and 2). We observe that the variable BCBGCOMU in the School Background file contains information on the size of the community where the schools are located. Our next step is to review the documentation of national adaptations to the questionnaires to ensure that there were no deviations listed for this variable (see Supplement 2). If no adaptations were made, we can continue with our analysis without any modifications.

We then read from the School Background file the variables relevant to our analysis. In this case, we will need our variable of interest (BCBGCOMU) and the country and school identification information (IDCNTRY and IDSCHOOL). These last two variables will allow us to merge the school data to the student data. We then read the variables of interest from the Student Background file. We will need the country and school identification information (IDCNTRY and IDSCHOOL), which will allow us to merge the student data to the school data. We will also need the international science achievement plausible values (BSSSCI01-BSSSCI05), the student sampling weight (TOTWGT), and the variables that contain the jackknife replication information (JKZONE and JKREP).

We then proceed to merge the school information with the student information using the variables IDCNTRY and IDSCHOOL, and then use the macro JACKPV to obtain the percentages of students and their mean science achievement scores within each category of the variable BCBGCOMU by country.

In this analysis, we will again use the data for all available countries, although the exact same steps need to be taken if you want to examine these variables within a single country, or for a select group of countries. We used the JOIN program, described earlier in this chapter, to join the School Background files for all available countries into a single School Background file called BCGALLM3. The JOIN program was used a second time to join all the Student Background files into a single one called BSGALLM3.

The SAS program code for this example is presented in Exhibit 5.21 and is included on the DVD under the name EXAMPLE4.SAS. Selected results obtained from this program are displayed in Exhibit 5.22.

Note that one of the steps in this program is to select only those eighth grade students who have non-missing data in the variable of interest BCBGCOMU.

In general, to perform student-weighted school-level analyses using the School Background files, you should do the following:

- Identify the variables of interest in the School Background file and note any specific national adaptations to the variables.
- Retrieve the relevant variables from the School Background file.
- Retrieve the relevant variables from the Student Background file, including the achievement scores, sampling weights, jackknife replication information, and any other variables used in the selection of cases.
- Merge the School Background files with the Student Background files using the variables IDCNTRY and IDSCHOOL.
- Use the macro JACKGEN, or JACKPV if plausible values are involved, with the appropriate arguments and parameters.

Exhibit 5.21 SAS Control Statements for Performing Student-Weighted Analyses with School-Level Variables (EXAMPLE4.SAS)

```
libname bm3 "D:\TIMSS2003\Data\SAS_Data" ;

%include "D:\TIMSS2003\Programs\SAS_Programs\jackpv.sas" ;

data SCHOOL ;
 set bm3.BCGALLM3;

proc sort data= SCHOOL;
 by IDCNTRY IDSCHOOL ;

data STUDENT ;
 set bm3.BSGALLM3;

proc sort data= STUDENT;
 by IDCNTRY IDSCHOOL;

data MERGED4 ;
 merge STUDENT SCHOOL;
 by IDCNTRY IDSCHOOL;
 if BCBGCOMU > .Z ;

proc format library=work;
value country
   51 = 'ARMENIA'     36 = 'AUSTRALIA'              956 = 'BELGIUM FLEMISH'  100 = 'BULGARIA'
   48 = 'BAHRAIN'     72 = 'BOTSWANA'              9132 = 'CANADA ONTARIO'  9133 = 'CANADA QUEBEC'
  152 = 'CHILE'      196 = 'CYPRUS'                818 = 'EGYPT'             926 =  'ENGLAND'
 3724 = 'BASQUE'     233 = 'ESTONIA'               288 = 'GHANA'             344 = 'HONG KONG'
  348 = 'HUNGARY'    360 = 'INDONESIA'             364 = 'IRAN'              376 = 'ISRAEL'
  380 = 'ITALY'      400 = 'JORDAN'                392 = 'JAPAN'             410 = 'KOREA'
  422 = 'LEBANON'    440 = 'LITHUANIA'             428 = 'LATVIA'            504 = 'MOROCCO'
  498 = 'MOLDOVA'    807 = 'MACEDONIA'             458 = 'MALAYSIA'          528 = 'NETHERLANDS'
  578 = 'NORWAY'     554 = 'NEW ZEALAND'           275 = 'PALESTINE'         608 = 'PHILIPPINES'
  642 = 'ROMANIA'    643 = 'RUSSIAN FEDERATION'    682 = 'SAUDI ARABIA'      927 = 'SCOTLAND'
  702 = 'SINGAPORE'  703 = 'SLOVAK REPUBLIC'       705 = 'SLOVENIA'          752 = 'SWEDEN'
  760 = 'SYRIA'      788 = 'TUNISIA'               158 = 'CHINESE TAIPEI'    840 = 'UNITED STATES'
  887 = 'YEMEN'      891 = 'SERBIA AND MONTENEGRO' 710 = 'SOUTH AFRICA'    11800 = 'INDIANA US';

 value comm    1 = 'More than 500000 people'
               2 = '100001 to 500000 people'
               3 = '50001 to 100000 people'

       4 = '15001 to 50000 people'

       5 = '3001 to 15000 people'

       6 = 'Fewer than 3000 people' ;

%JackPV (TOTWGT, JKZONE, JKREP, 75, IDCNTRY BCBGCOMU, BSSSCI0, 5, MERGED4) ;

* Print the results ;
proc print data=final noobs ;
 var IDCNTRY BCBGCOMU n TOTWGT mnpv mnpv_se pct pct_se ;
 format IDCNTRY country. BCBGCOMU comm. n 6.0 TOTWGT 10.0 mnpv mnpv_se pct pct_se 6.2 ;

run ;
```

Exhibit 5.22 Extract of SAS Computer Output for Performing Student-Weighted Analyses with School-Level Variables (EXAMPLE 4)

IDCNTRY	BCBGCOMU	N	TOTWGT	mnpv	mnpv_se	pct	pct_se
AUSTRALIA	More than 500000 people	1366	80685	532.32	7.22	35.24	4.09
	100001 to 500000 people	842	38918	529.37	10.95	17.00	3.70
	50001 to 100000 people	548	28317	525.72	14.80	12.37	2.86
	15001 to 50000 people	705	37412	526.70	12.25	16.34	2.77
	3001 to 15000 people	559	35212	527.09	7.61	15.38	3.23
	Fewer than 3000 people	270	8385	511.89	4.77	3.66	1.36
ARMENIA	More than 500000 people	844	7404	474.60	5.67	16.90	2.78
	100001 to 500000 people	489	3555	473.32	9.05	8.12	2.14
	50001 to 100000 people	292	2035	484.47	15.59	4.65	1.92
	15001 to 50000 people	754	7337	468.27	6.76	16.75	3.78
	3001 to 15000 people	1716	14000	455.38	6.85	31.96	4.32
	Fewer than 3000 people	713	9473	435.57	7.09	21.63	3.44
.							
.							
.							
NORWAY	More than 500000 people	281	3434	503.55	12.52	5.76	2.06
	100001 to 500000 people	725	7815	494.87	6.06	13.10	2.81
	50001 to 100000 people	402	4495	505.44	8.18	7.54	2.44
	15001 to 50000 people	1295	19015	491.00	3.20	31.88	4.06
	3001 to 15000 people	1206	21713	492.75	4.16	36.40	3.79
	Fewer than 3000 people	108	3175	502.48	7.10	5.32	2.27
UNITED STATES	More than 500000 people	951	340114	523.04	11.63	11.35	2.05
	100001 to 500000 people	1053	396476	505.56	8.98	13.24	2.33
	50001 to 100000 people	1041	369343	538.39	8.96	12.33	2.33
	15001 to 50000 people	2274	936639	536.72	6.05	31.27	3.71
	3001 to 15000 people	1659	626613	532.89	8.02	20.92	3.06
	Fewer than 3000 people	701	326297	541.76	7.43	10.89	2.09

In this example, each country's eighth grade mean science achievement is reported for each response category in the variable BCBGCOMU. The results are presented by country and each value of the variable BCBGCOMU. The countries and the six community types are presented in the first and the second columns. The third column reports the number of valid cases. The fourth column reports the sum of weights of these students, followed by the mean science achievement based on the five plausible values, and its respective standard error. The last two columns report the weighted percentages of students within each category and their respective standard errors.

From the first few lines of Exhibit 5.22, we can say that in Armenia 844 students (16.9%), who represent 7,404 students in the population, responded that they live in a city of more than 500,000 people. These students have a mean science achievement of 474.60 with a standard error of 5.67.

A Acknowledgements

Developing and implementing TIMSS 2003 was an extremely ambitious and truly collaborative effort involving hundreds of individuals around the world. Staff from the national research centers in each participating country, the International Association for the Evaluation for Educational Achievement (IEA), the TIMSS & PIRLS International Study Center (ISC) at Boston College, advisors, and funding agencies worked closely to develop and implement TIMSS 2003. The project would not have been possible without the tireless efforts of all involved. Below, the individuals and organizations are acknowledged for their contributions. Given that implementing TIMSS 2003 has spanned approximately four years and involved so many people and organizations, this list may not pay heed to all who contributed throughout the life of the project. Any omission is inadvertent. TIMSS 2003 also acknowledges the students, teachers, and school principals who contributed their time and effort to the study. This report would not be possible without them.

A.1 Funding Agencies

Funding for the international coordination of TIMSS 2003 was provided by the National Center for Education Statistics of the US Department of Education, the US National Science Foundation, the World Bank, the United Nations Development Programme (UNDP), Boston College, and participating countries. Valena Plisko, Patrick Gonzales, Elois Scott, and Eugene Owen of the National Center for Education Statistics; Janice Earle, Larry Suter, Finbarr Sloane, and Elizabeth VanderPutten of the National Science Foundation; Marlaine Lockheed of the World Bank; and Maen Nsour of the UNDP each played a crucial role in making TIMSS 2003 possible and for ensuring the quality of the study. Each participating country was responsible for funding national project costs and implementing TIMSS 2003 in accordance with the international procedures.

A.2 Management and Operations

TIMSS 2003 was conducted under the auspices of the IEA. The study was directed by Michael O. Martin and Ina V.S. Mullis, and managed centrally by the staff of the TIMSS & PIRLS International Study Center at Boston College, Lynch School of Education. Although the study was directed by the International

Study Center and its staff members implemented various parts of TIMSS 2003, important activities also were carried out in centers around the world. In the IEA Secretariat, Hans Wagemaker, Executive Director, was responsible for overseeing fundraising and country participation. The IEA Secretariat also managed the ambitious translation verification effort conducted for the field test and main assessment and recruited international quality control monitors in each country. The IEA Data Processing Center was responsible for processing and verifying the data from the participating countries and for constructing the international database. Statistics Canada was responsible for collecting and evaluating the sampling documentation from each country and for calculating the sampling weights. Educational Testing Service in Princeton, New Jersey provided consultation on psychometric issues as well as technical support and software for scaling the achievement data. The Project Management Team, comprising the study directors and representatives from the International Study Center, IEA, Statistics Canada, and Educational Testing Service, met regularly throughout the study to discuss the study's progress, procedures, and schedule.

IEA Secretariat

Alejandro Tiana, IEA Chair (until 2004)

Seamus F. Hegarty, IEA Chair (2004 to present)

Hans Wagemaker, Executive Director

Barbara Malak-Minkiewicz, Manager Membership Relations

Juriaan Hartenberg, Financial Manager

Isabelle Braun-Gemin, Financial Manager Assistant

Katazyna Krohn, Management Assistant

TIMSS & PIRLS International Study Center at Boston College

Michael O. Martin, Co-Director

Ina V.S. Mullis, Co-Director

Eugenio J. Gonzalez, Director of Operations and Data Analysis (until 2004)

Pierre Foy, Director of Sampling and Data Analysis (2005 to present)

Teresa Smith Neidorf, TIMSS Science Coordinator (until 2003)

Robert Garden, TIMSS Mathematics Coordinator

Steven Chrostowski, TIMSS Project Coordinator (until 2004)

Ann Kennedy, PIRLS Project Coordinator

Joseph Galia, Senior Statistician/Programmer

Isaac Li, Statistician/Programmer

Alka Arora, Research Associate

Dana Diaconu, Research Associate

Ebru Erberber, Research Associate

Cheryl Flaherty, Research Associate

Ieva Johansone, Research Associate (2005 to present)

María José Ramírez, Graduate Assistant (until 2004)

Keith Morgan, Publications Design & Production Manager (2003 to present)

José Nieto, Publications Production Manager (until 2003)

Mario Pita, Data Graphics Specialist

Betty Hugh, Data Graphics Specialist

Susan Messner, Graphics Specialist

Christine Hoage, Manager, Finance

Marcie Petras, Manager, Office Administration

Laura Brown, Administrative Coordinator

Rita Holmes, Administrative Coordinator

IEA Data Processing Center

Dirk Hastedt, Senior Researcher

Pierre Foy, Senior Researcher (until 2005)

Oliver Neuschmidt, Researcher

Juliane Barth, Researcher

Ieva Johansone, Junior Researcher (until 2005)

Milena Taneva, Junior Researcher

Christine Busch, Junior Researcher

Dirk Oehler, Programmer

Stefan Petzchen, Programmer

Harpreet Singh Choudry, Programmer

Statistics Canada

Marc Joncas, Senior Methodologist

Educational Testing Service

John Barone, Executive Director, Center for Data Analysis Research

Matthias Von Davier, Principal Research Scientist

Ed Kulick, Manager, Research Data Analysis

Project Management Team

Michael O. Martin, International Study Center

Ina V.S. Mullis, International Study Center

Eugenio J. Gonzalez, International Study Center (until 2004)

Hans Wagemaker, IEA Secretariat

Dirk Hastedt, IEA Data Processing Center

Pierre Foy, IEA Data Processing Center

Marc Joncas, Statistics Canada

Matthias Von Davier, Educational Testing Service

TIMSS 2003 Special Consultants

Sampling Referee

Keith Rust, Westat, Inc.

Psychometric Design

Eugene Johnson, American Institutes for Research

IEA Editorial Review

David Robitaille, University of British Columbia

IEA Technical Executive Group

A.3 TIMSS 2003 Advisory Committees and Task Forces

The TIMSS & PIRLS International Study Center at Boston College was supported in its work by a number of advisory committees. The International Expert Panel in Mathematics and Science played a crucial role in developing the TIMSS 2003 frameworks and specifications for the assessment. The Mathematics and Science Item Development Task Forces coordinated the work of the national research coordinators in developing and reviewing the mathematics and science achievement items. The Science and Mathematics Item Review Committee reviewed and revised successive drafts of the achievement items and was an integral part of the scale anchoring process. The Questionnaire Item Review Committee revised the TIMSS context questionnaires for the 2003 assessment.

International Expert Panel

Mathematics

Khattab Abu-Libdeh, Jordan

Anica Aleksova, Republic of Macedonia

Kiril Bankov, Bulgaria

Aarnout Brombacher, South Africa

Anna Maria Caputo, Italy

Joan Ferrini-Mundy, United States

Jim Fey, United States

Derek Holton, New Zealand

Jeremy Kilpatrick, United States

Pekka Kupari, Finland
Mary Lindquist, United States
David Robitaille, Canada
Graham Ruddock, England
Hanako Senuma, Japan

Science

K.Th. (Kerst) Boersma, the Netherlands
Rodger Bybee, United States
Audrey Champagne, United States
Reinders Duit, Germany
Martin Hollins, England
Eric Jakobsson, United States
Galina Kovalyova, Russian Federation
Svein Lie, Norway
Jan Lokan, Australia
Francisco Mazzitelli, Argentina
Gabriela Noveanu, Romania
Margery Osborne, United Status
Jana Paleckova, Czech Republic
Hong Kim Tan, Singapore
Khadija Zaim-Idrissi, Morocco

Mathematics Item Development Task Force

Robert Garden, New Zealand (Mathematics Coordinator)
Chancey Jones, United States
Graham Ruddock, England

Science Item Development Task Force

Teresa Smith Neidorf, United States (Science Coordinator)
Svein Lie, Norway
Christine O'Sullivan, United States

Science and Mathematics Item Review Committee

Mathematics

Anica Aleksova, Republic of Macedonia
Kiril Bankov, Bulgaria
Aarnout Brombacher, South Africa
Francine Jaques, Canada
Jeremy Kilpatrick, United States

Mary Lindquist, United States
Graham Ruddock, England
Hanako Senuma, Japan

Science

Audrey Champagne, United States
Chang Chu-Nan, Chinese Taipei
Galina Kovalyova, Russian Federation
Svein Lie, Norway
Jan Lokan, Australia
Francisco Mazzitelli, Argentina
Gabriela Noveanu, Romania
Ahmed Muhammed Rafea, Bahrain
Vivien Talisayon, Philippines
Sandy Tan, Singapore

Questionnaire Item Review Committee

Khattab Abu Lebdeh, Jordan
Klaas Bos, the Netherlands
Megan Chamberlain, New Zealand
Chiu Mei-Hung, Chinese Taipei
Rich Coley, United States
Patrick Gonzales, United States
Mike Marshall, Canada

National Research Coordinators

The TIMSS 2003 National Research Coordinators and their staff had the enormous task of implementing the TIMSS 2003 design. This involved obtaining funding for the project; participating in the development of the instruments and procedures; conducting field tests; participating in and conducting training sessions; translating the instruments and procedural manuals into the local language; selecting the sample of schools and students; working with the schools to arrange for the testing; arranging for data collection, coding, and data entry; preparing the data files for submission to the IEA Data Processing Center; contributing to the development of the international reports; and preparing national reports. The way in which the national centers operated and the resources that were available varied considerably across the TIMSS 2003 countries. In some countries, the tasks were conducted centrally, while in others, various components were subcontracted to other organizations. In some countries, resources were more than adequate, while in some cases, the national centers were operating with limited resources. All of the TIMSS 2003 National Research Coordinators and their staff members are to be commended for their professionalism and their dedication in conducting all aspects of TIMSS.

ARGENTINA

Margarita Poggi
Ministerio de Educación
Dirección Nacional de Información y Evaluación
Paraguay 1657, 2er Piso – Of 201
Buenos Aires C1062ACA

ARMENIA, REPUBLIC OF

Arsen Baghdasaryan
Yerevan State University
26 Halabyan Str Apt 31
Yerevan 375036

AUSTRALIA

Sue Thomson
Australian Council for Educational Research(ACER)
19 Prospect Hill Rd.
Camberwell, Victoria 3124

BAHRAIN

Ahmed Muhammad Rafea
Chief, Assessment and Curriculum Development Division
PO Box 43
Ministry Education
Manama

BELGIUM (Flemish)

Christiane Brusselmans-Dehairs
Vakgroep Onderwijskunde Universiteit Gent
Henri Dunantlaan 2
B 9000 Gent

Ann Van Den Broeck
LIVO
Dekenstraat 2
Leuven B-3000

BOTSWANA

Cyprian Ismael Cele
Examinations Research and Testing Division
Ministry of Education
Private Bag 0070
Gaborone

BULGARIA

Kiril Bankov
Faculty of Mathematics and Informatics
University of Sofia
5, bul James Boucher
Sofia 1164

CHILE

Leonor Cariola Huerta
Ministerio de Educación
Alameda 1146
Piso 8, Sector B
Santiago

CHINESE TAIPEI

Chu-Nan Chang
Dean of College of Science
National Taiwan Normal University
88 Sec 4, Ting-Chou Road
Taipei, 116

CYPRUS

Constantinos Christou
Research and Evaluation Department
Pedagogical Institue
University of Cyprus-Dept. of Education
Kallipoleous 75, P.O. Box 20537
Nicosia 1678

EGYPT

Solaiman El-Khodary El-Sheikh
National Center of Examinations and Educational Evaluation
Hadaba Olya
Al-Mokkatam
Cairo

ENGLAND

Graham Ruddock
National Foundation for Educational Research (NFER)
The Mere, Upton Park
Slough, Berkshire
SL1 2DQ

ESTONIA

Kristi Mere
Estonian Ministry of Education
Munga 18
Tartu EE 50088

GHANA

Aba Mansa Folson
Head of Inspectorate Division
Ministry of Education
Ghana Education Service
Arakan Printing Press Building
Kotobabi, Accra

HONG KONG, SAR

Frederick Leung
The University of Hong Kong – Hong Kong IEA Centre
Pokfulam Road
Hong Kong, SAR

HUNGARY

Peter Vari
National Institute of Public Education
Centre for Evaluation Studies
Dorottya u.8, PF 701/420
Budapest 1051

INDONESIA

Jahja Umar
Ministry of National Education
Examiniation Development Center
Jalan Gunung Sahari Raya – 4
Jakarta Pusat, 1000 Jakarta

IRAN, ISLAMIC REPUBLIC OF

Abbass Rahiminezhad
Institute for National Research
Hojjat Doost Alley Naderi St.
196 Keshavarz Blvd.
Tehran

ISRAEL

Ruth Zuzovsky
Tel Aviv University
School of Education
Center for Science and Technology Education
Ramat Aviv, Tel Aviv 69978

ITALY

Anna Maria Caputo
Istituto Nazionale per la
Valutazione del Sistema dell'Istruzione (CEDE)
Borromini 5 – Villa Falconieri
Frascati (Roma) 00044

JAPAN

Yuji Saruta
National Institute for Educational Research (NIER)
6-5-22 Shimomeguro
Meguro-ku, Tokyo
153-8681

Hanako Senuma
National Institute for Educational Research (NIER)
6-5-22 Shimomeguro
Meguro-ku, Tokyo
153-8681

JORDAN

Tayseer Al-Nhar
National Center for Human Resources Development
P. O. Box 560
Amman 11941

KOREA, REPUBLIC OF

Chung Park
Korea Institute of Curriculum & Evaluation(KICE)
25-1 Samchung-dong
GhongRo-Gu, Seoul
110-230

LATVIA
Andrejs Geske
University of Latvia
IEA National Research Center
Jurmalas Gatve 74/76, Rm 204A
Riga LV-1083

LEBANON

Leila Maliha Fayad
Ministry of Education
The Educational Center for Research and Development
Dekwanen, Beirut

LITHUANIA

Algirdas Zabulionis
Ministry of Education and Science
National Examination Center
M. Katkaus 44
Vilnius LT2051

MACEDONIA, REPUBLIC OF

Anica Aleksova
Ministry of Education and Science
Bureau for Development of Education
Ruder Boskovic St bb
1000 Skopje

MALAYSIA

Azmi Zakaria
Ministry of Education
Educational Planning and Research Division
Level 2, Block J South
Pusat Bandar Damansara, Kuala Lumpur
50604

MOLDOVA, REPUBLIC OF
Ilie Nasu
Ministry of Education and Science
University A Russo
Str. Puschin 38
Balti 3100

MOROCCO

Mohamed Sassi
Direction de l'Évaluation du Système Educatif
Ministère de l'Éducation Nationale
Innovations Pédagogiques
32 Boulevard Ibn Toumert
Place Bob Rouah, Rabat

THE NETHERLANDS

Martina Meelissen
University of Twente
Centre for Applied Research in Education(OCTO)
PO Box 217
7500 AE Enschede

NEW ZEALAND

Megan Chamberlain
Ministry of Education
CER Unit-Research Division
45-47 Pipitea Street
Thorndon, Wellington

Fiona Sturrock
Ministry of Education
CER Unit-Research Division
45-47 Pipitea Street
Thorndon, Wellington

NORWAY

Liv Sissel Grønmo
University of Oslo ILS
Postboks 1099 Blindern
0316 Oslo 3

PALESTINIAN NATIONAL AUTHORITY

Ola Khalili
Ministry of Education
Assessment Center
Box 719
Ramallah – West Bank

PHILIPPINES

Vivien Talisayon
University of the Philippines
TIMSS 2003 Coordination Office
Vidal Tan Hall
Diliman, Quezon City

ROMANIA

Gabriela Noveanu
Institute for Educational Sciences
Evaluation and Forecasting Division
Revoltiei B1. C7/7
Bucharest Ro-70732

RUSSIAN FEDERATION

Galina Kovalyova
Center for Evaluating the Quality of Education
Institute of General Secondary Education
Russian Academy of Education
Ul. Pogodinskaya, 8 - Moscow 119905

SAUDI ARABIA

Ali Alhakami
Ministry of Education
Center for Educational Development
PO Box 102298
Riyadh, 11675

SCOTLAND

Jo MacDonald
Scottish Executive Education Dept Research
Economic and Corporate Strategy Unit
1B (South) Victoria Quay
Edinburgh EH6 6QQ

SERBIA

Slobodanka Milanovic-Nahod
Institute for Educational Research
Dobrinjska 11/lll
PF 546
11001 Belgrade

SINGAPORE

Kok Leong Boey
Research and Evaluation Section
#15-31 MOE Building
1 North Buona Vista Drive
138675 Singapore

SLOVAK REPUBLIC

Jozef Kuraj
National Institute for Education
P O Box 26, Pluhova 8
Brastislava SK – 830 00

SLOVENIA

Barbara Japelj
Educational Research Institute
Gerbiceva 62
PO Box 76
Ljubljana 1000

SOUTH AFRICA

Vijay Reddy
Human Sciences Research Council (HSRC)
134 Pretorius Street
Private Bag X07
Pretoria 0001

SWEDEN

Jan-Olof Lindstrom
Department of Educational Measurement/ TIMSS
Umeå University
Enheten for pedagogiska matningar
Samhallsvetarhuset, 90187 Umeå

SYRIA

Aychoua Ishak
Ministry of Education
Damascus

TUNISIA

Mejib Ayed
CNIPRE
130 Boulevard du 9 Avril 1938
Tunis 1006

USA

Patrick Gonzales
National Center for Education Statistics
US Department of Education
1990 K St., NW Rm 9071
Washington, DC 20006

YEMEN, REPUBLIC OF

Omar Ba-Fadhel
Center for Educational Research and Development
Ministry of Education
General Market (Nokom),
Sana'a 23049

Benchmarking Participants

Basque Country, SPAIN

Josu Sierra
ISEI-IVEI
Asturias 9
Bilbao, Basque Country 48015

State of Indiana, USA

Carole Gallagher
Division of Assessment
Indiana Department of Education
Room 229, State House
Indianapolis, IN 46204

Ontario Province, CANADA

Francine Jaques
Education Quality and Accountability Office
2 Carlton Street
Suite 1200
Toronto, Ontario M5B 2M9

Québec Province, CANADA

Serge Baillargeon
MEQ Direction de la Sanction des Études
1035 rue de la Chevrotière
13e Étage
Québec, PQ G1R 5 A5