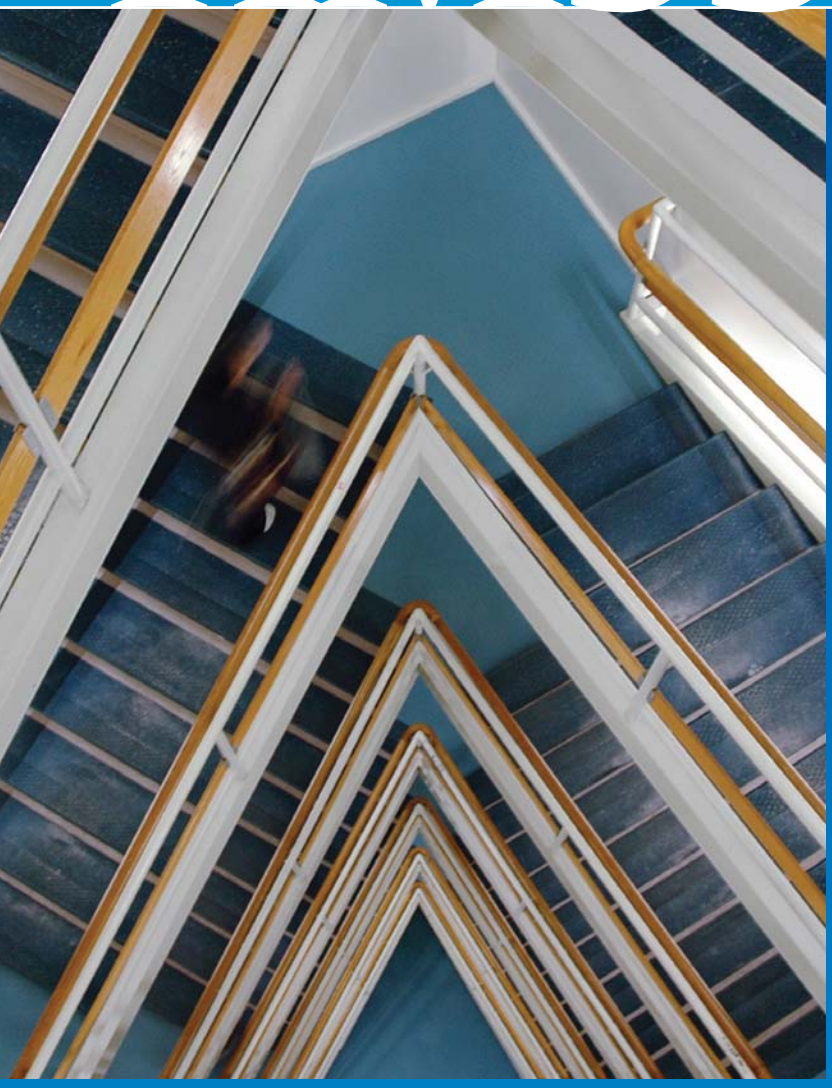
TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

TIMSS



TIMSS 2007 User Guide

for the International Database

Edited by

Pierre Foy

John F. Olson

TIMSS & PIRLS
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Lynch School of Education, Boston College

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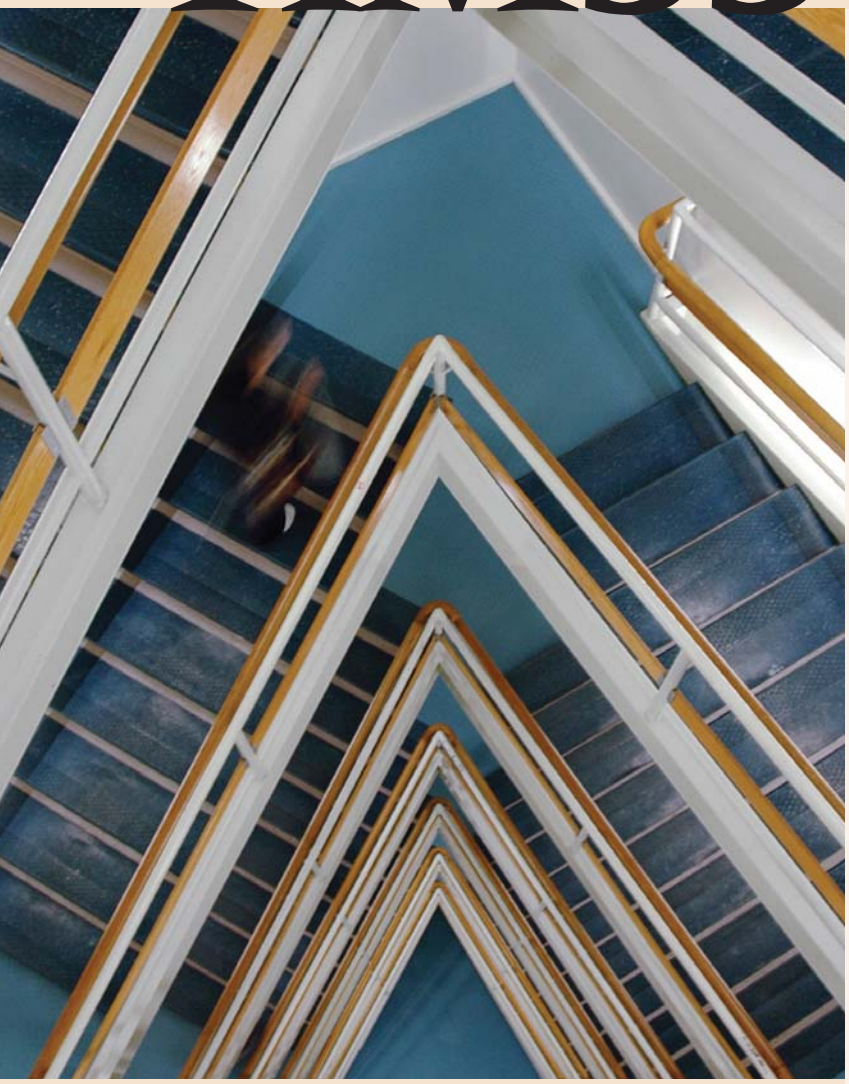

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Contents

Chapter 1

Introduction

1.1 Overview of the TIMSS 2007 International Database and User Guide

TIMSS[1] measures trends in mathematics and science achievement at the fourth and eighth grades in participating countries around the world, as well as monitoring curricular implementation and identifying promising instructional practices. Conducted on a regular 4-year cycle, TIMSS has assessed mathematics and science in 1995, 1999, 2003, and 2007, with planning underway for 2011. TIMSS collects a rich array of background information to provide comparative perspectives on trends in achievement in the context of different educational systems, school organizational approaches, and instructional practices.

To support and promote secondary analyses aimed at improving mathematics and science education at the fourth and eighth grades, the TIMSS 2007 international database makes available to researchers, analysts, and other users the data collected and processed by the TIMSS project. This database comprises student achievement data as well as student, teacher, school, and curricular background data for 59 countries and 8 benchmarking participants. Across both grades, the database includes data from 433,785 students, 46,770 teachers, 14,753 school principals, and the National Research Coordinators of each country. All participating countries gave the IEA permission to release their national data.

For countries that participated in previous assessments, TIMSS 2007, the fourth data collection in the TIMSS cycle of studies, provides trends for up to four cycles at the eighth grade (1995, 1999, 2003, and 2007) and data over three points in time at the fourth grade (1995, 2003, and 2007). In countries new to the study, the 2007 results can help policy makers and practitioners assess their comparative standing

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[1] The Trends in International Mathematics and Science Study is a project of the International Association for the Evaluation of Educational Achievement (IEA) and together with PIRLS, the Progress in International Reading Literacy Study, constitutes IEA's regular cycle of core studies.

and gauge the rigor and effectiveness of their mathematics and science programs. Details of the assessments conducted in 2007 can be found in the *TIMSS 2007 International Mathematics Report* (Mullis, Martin, & Foy, 2008) and the *TIMSS 2007 International Science Report* (Martin, Mullis, & Foy, 2008).

TIMSS 2007 was an ambitious and demanding study, involving complex procedures for assessing students' 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 the characteristics of the study, which are described fully in the *TIMSS 2007 Technical Report* (Olson, Martin, & Mullis, 2008). 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 Analyzing the TIMSS 2007 Data

The TIMSS 2007 International Database offers researchers and analysts a rich environment for examining student achievement in mathematics and science in an international context. This includes:

- Extensive data on mathematics and science achievement providing in-depth study of the quality of education in terms of learning outcomes
- Comparable data for 59 countries and 8 benchmarking participants from around the world providing an international perspective from which to examine educational practices and student outcomes in mathematics and science
- Student achievement in mathematics and science linked to questionnaire information from students, teachers, school principals, and curriculum experts, providing policy-relevant contextual information on the antecedents of achievement
- Achievement scales on a common metric that link four assessment cycles, providing for analysis of trends in mathematics and science achievement since 1995

The TIMSS database is quite complex, which can make analyzing the data challenging for users. In particular, two of the more complicated issues that need to be addressed are TIMSS' complex multi-stage sample design and its use of imputed scores (also known as plausible values).

The TIMSS target populations are all fourth and eighth graders in each participating country. To obtain accurate and representative samples, TIMSS used a two-stage sampling procedure whereby a random sample of schools is selected at the first stage and one or two intact fourth or eighth grade classes are sampled at the second stage. This is a very effective and efficient sampling approach, but the resulting student sample has a complex structure that must be taken into consideration when analyzing the data. In particular, sampling weights need to be applied and a re-sampling technique such as the jackknife employed to estimate sampling variances correctly.[2]

In addition, TIMSS 2007 uses Item Response Theory (IRT) scaling to summarize student achievement on the assessment and to provide accurate measures of trends from previous assessments. The TIMSS IRT scaling approach used multiple imputation—or "plausible values"—methodology to obtain proficiency scores in mathematics and science for all students. Each student record in the TIMSS 2007 international database contains imputed scores in mathematics and science overall, as well as for each of the content domain subscales and cognitive domain subscales. Because each imputed score is a prediction based on limited information, it almost certainly includes some small amount of error. To allow analysts to incorporate this error into analyses of the TIMSS achievement data, the TIMSS database provides five separate imputed scores for each scale. Each analysis should be replicated five times, using a different plausible value each time, and the results combined into a single result that includes information on standard errors that incorporate both sampling and imputation error.[3]

IEA has developed the International Database (IDB) Analyzer software (IEA, 2009) specifically for analyzing TIMSS international data files. Used in conjunction with SPSS, this software helps users analyze the TIMSS achievement data by conducting each analysis separately on each plausible value, averaging the resulting statistics, and applying the jackknife algorithm to provide appropriate standard errors for each statistic. It also simplifies management of the TIMSS database by providing a module for selecting subsets of countries and variables, and merging files for analysis.

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[2] More details on the sampling design and its implementation are provided in Chapters 5 and 9 (Joncas, 2008) of the *TIMSS 2007 Technical Report*.

[3] More details on plausible values can be found in Chapter 11 (Foy, Galia, & Li, 2008) of the *TIMSS 2007 Technical Report*.

1.3 Contents of the TIMSS 2007 User Guide

This User Guide describes the content and format of the data in the TIMSS 2007 international database. In addition to this introduction, the User Guide includes the following three chapters.

- Chapter 2 introduces the IEA International Database (IDB) Analyzer software (IEA, 2008) and presents examples of analyses of the TIMSS 2007 data using this software in conjunction with SPSS.
- Chapter 3 explains how to implement the analyses described in Chapter 2 using the SAS (2002) statistical software system and the SAS programs and macros included with the database.
- Chapter 4 describes the structure and content of the database.

The User Guide is accompanied by four supplements.

- Supplement 1 comprises the international version of all TIMSS 2007 background questionnaires.
- Supplement 2 describes any adaptations to the questions in the background questionnaires made by the TIMSS participants.
- Supplement 3 describes how indices and other derived variables were constructed for reporting the TIMSS data.
- Supplement 4 describes the sampling stratification variables for each country.

1.4 Contents of the TIMSS 2007 International Database DVD

This User Guide is included as a PDF document on the DVD that contains the TIMSS 2007 international database, along with all student mathematics and science achievement and student, teacher, and school background questionnaire data files. The DVD also includes support materials. The following is a list of the DVD folders and a description of their contents:

User Guide:	This User Guide with its Supplements
Data:	Student, teacher, and school data files in SAS and SPSS formats
Programs:	SAS and SPSS programs and macros

Codebooks:	Codebook files describing all variables in the international database
Almanacs:	Data almanacs with summary statistics for all items and background variables
Items:	Item information files, IRT item parameters, and released items
Curriculum:	Curriculum questionnaires data files
Reports:	PDF versions of all TIMSS 2007 publications, including the *TIMSS 2007 Assessment Frameworks*, *TIMSS 2007 International Mathematics Report*, *TIMSS 2007 International Science Report*, *TIMSS* 2007 *Technical Report*, and *TIMSS 2007 Encyclopedia*
IDB Analyzer:	Executable file for installing the IEA IDB Analyzer
TCMA:	National item selection data for the Text-Curriculum Matching Analysis (see Appendix C in international reports for more details on the TCMA).

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Chapter 2

Using the IEA IDB Analyzer to Analyze the TIMSS 2007 International Database

2.1 Overview

This chapter describes the use of the IEA International Database Analyzer software (IEA, 2009) for analyzing the TIMSS 2007 data. Used in conjunction with SPSS (SPSS, 2008), the IEA IDB Analyzer provides a user-friendly interface to easily merge the various data file types of the TIMSS 2007 database and seamlessly takes into account the sampling information and the multiple imputed achievement scores to produce accurate statistical results.

Example analyses will illustrate the capabilities of the IEA IDB Analyzer to compute a variety of statistics, including percentages of students in specified subgroups, mean student achievement in those subgroups, correlations, regression coefficients, and percentages of students reaching benchmark levels. The examples use student, teacher, and school background data to replicate some of the TIMSS 2007 results included in the *TIMSS 2007 International Mathematics Report* (Mullis, Martin, & Foy, 2008), as well as other useful analyses for investigating policy-relevant research questions.

With a basic knowledge of the TIMSS 2007 international database, users should be able to perform statistical analyses with the IEA IDB Analyzer. A more detailed description of the data files contained in the international database—their structure and contents—is given in Chapter 4, along with descriptions of all the supporting documentation provided on the DVD.

2.2 The IEA IDB Analyzer

Developed by the IEA Data Processing and Research Center (IEA DPC), the IEA International Database Analyzer (IEA IDB Analyzer) is a plug-in for SPSS, a well-known statistical analysis system. The IEA IDB Analyzer enables users to combine SPSS data files from IEA's large-scale assessments and conduct analyses using SPSS without actually writing programming code. The IEA IDB Analyzer generates SPSS syntax that takes into account information from the sampling design in the computation of statistics and their standard errors. In addition, the generated SPSS syntax makes appropriate use of plausible values for calculating estimates of achievement scores and their standard errors, combining both sampling variance and imputation variance.

The IEA IDB Analyzer consists of two modules—a merge module and an analysis module, which are executed as independent applications. The merge module is used to create analysis datasets by combining data files of different types and from different countries, and selecting subsets of variables for analysis. The analysis module provides procedures for computing various statistics and their standard errors. Both modules can be accessed by the using the START menu in Windows:

Start ⇨ All Programs ⇨ IEA ⇨ IDB Analyzer ⇨ Merge Module
⇨ Analysis Module

2.3 Merging Files with the IEA IDB Analyzer

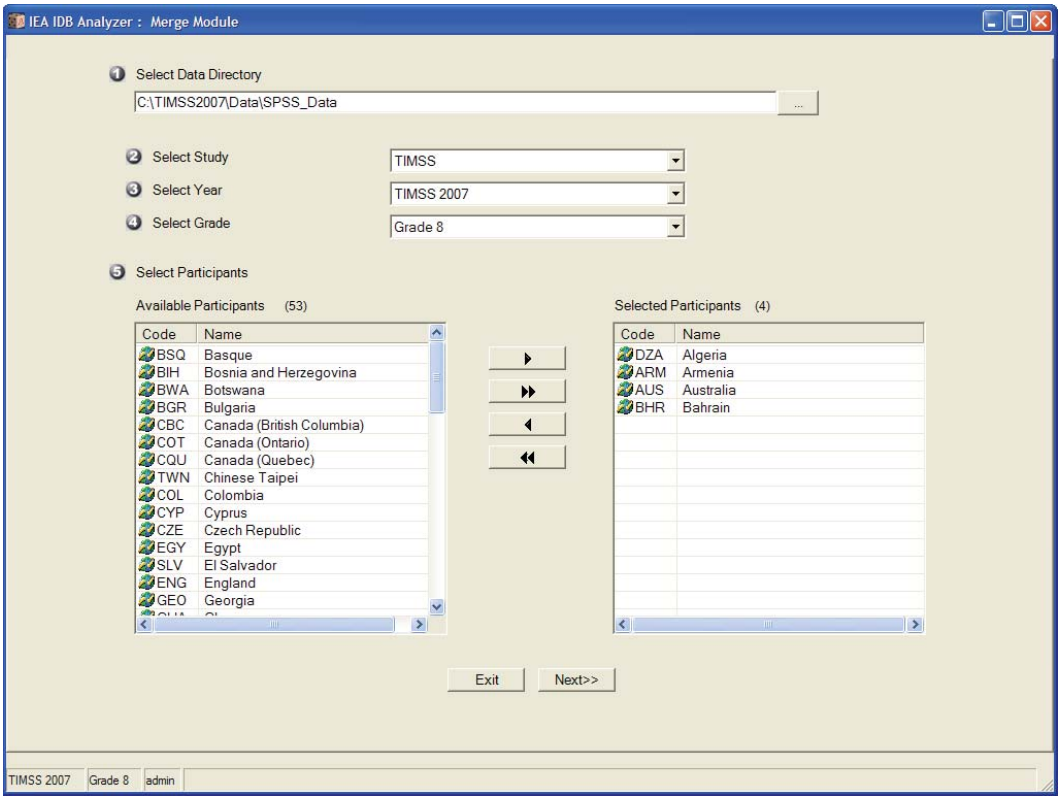
The IEA IDB Analyzer uses the SPSS data files located in the "Data" folder of the database DVD. The TIMSS 2007 data files are disseminated separately for each country and by file type. In addition to allowing users to combine like datasets from more than one country for cross-country analyses, the merge module allows for the combination of data from different sources (e.g., student, teacher, and school) into one SPSS dataset for subsequent analyses. Before doing any statistical analyses with the TIMSS international database, users should copy the contents of the DVD to an alternate location, either on their computer or on a server. For the purposes of this chapter, we will assume all files on the DVD have been copied to the "C:\TIMSS2007\" folder.

The following steps will create an SPSS data file with data from multiple countries and/or multiple file types:

1) Open the merge module of the IEA IDB Analyzer.

2) In the **Select Data Source Directory** field, browse to the folder where all SPSS data files are located. For example, in Exhibit 2.1, all SPSS data files are located in the "C:\TIMSS2007\Data\SPSS_Data" folder. The program will automatically recognize and complete the **Select Study**, **Select Year**, and **Select Grade** fields and list all countries available in this folder as possible candidates for merging. If the folder contains data from more than one IEA study, or from more than one grade, the IEA IDB Analyzer will prompt users to select files from the desired study and grade for analyses. In Exhibit 2.1, the TIMSS 2007 eighth grade is selected.

Exhibit 2.1 IEA IDB Analyzer Merge Module: Selecting Countries

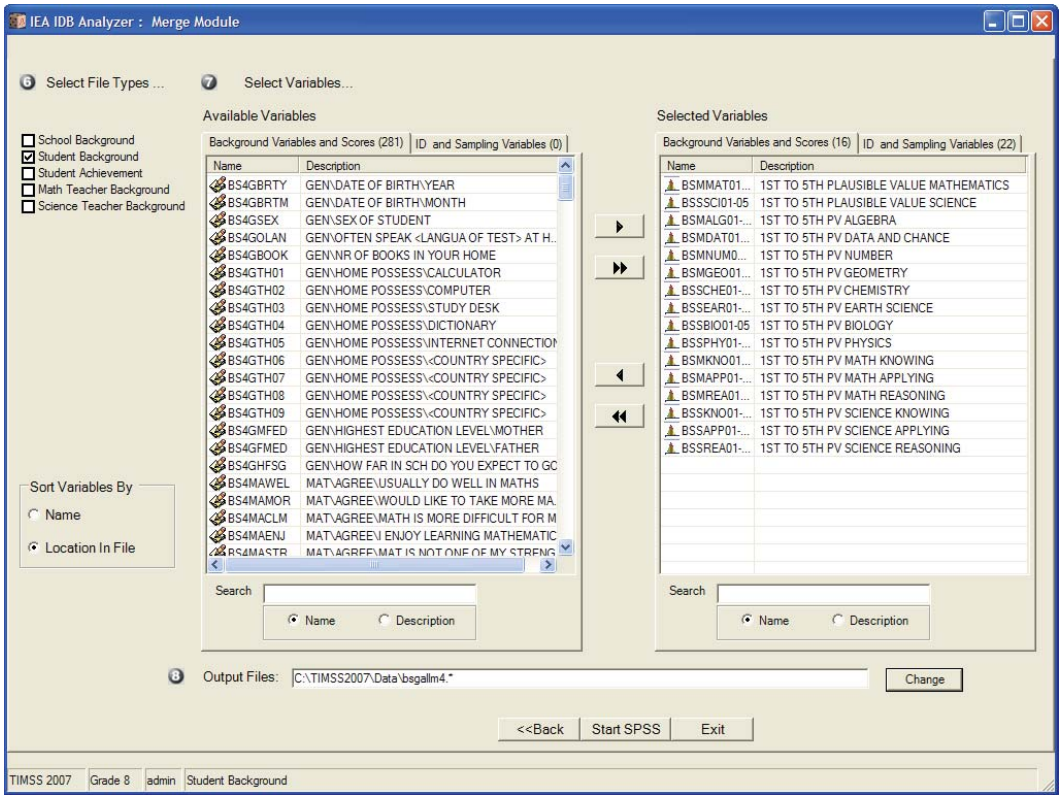


3) Select the countries of interest from the **Available Participants** list. To select multiple countries, hold the CTRL key of the keyboard when selecting the countries. Click the **right arrow** button (▶) to move the

selected countries to the **Selected Participants** panel. Click the **double right arrow** button (⏩) to select all countries. In Exhibit 2.1, Algeria, Armenia, Australia, and Bahrain are selected.

4) Click the **Next>>** button to proceed to the next step: selecting files and variables. The software will open the second window of the merge module, as shown in Exhibit 2.2, to select the files and the variables to be included in the merged data file.

Exhibit 2.2 IEA IDB Analyzer Merge Module: Selecting File Types and Variables



5) Select the files for merging by checking the appropriate boxes to the left of the window. For example, in Exhibit 2.2, the student background data files are selected.

6) Select the variables required from the list of background variables available in the left panel. Note that Supplement 1 provides the variable names for all questions in the background questionnaires. Variables are selected by clicking on them and then clicking the **right arrow** button. Clicking the **double right arrow** button selects all variables. The search tool at the

bottom of the left panel also can be used to locate variables. All achievement scores and all identification and sampling variables are selected automatically by the IEA IDB Analyzer.

7) Specify the desired name of the merged data file and the folder where it will be stored in the **Output Files** field by clicking the **Change** button. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) of the same name and in the same folder with the code necessary to perform the merge. In the example shown in Exhibit 2.2, the merged file BSGALLM4.SAV and the syntax file BSGALLM4.SPS will both be created and stored in the "C:\TIMSS2007\Data" folder.

8) Click on the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window ready for execution. The syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Once SPSS has completed its execution, it is important to check the SPSS output window for possible warnings. If warnings appear, they should be examined carefully as they might indicate that the merge process was not performed properly and the resulting merged data file might not be as expected.

Merging Teacher and Student Data Files

The teachers in the TIMSS 2007 international database do not constitute representative samples of teachers in the participating countries. Rather, they are the teachers of nationally representative samples of students. Therefore, analyses with teacher data should be made with students as the units of analysis and reported in terms of students who are taught by teachers with a particular attribute.

Teacher data are analyzed by linking the students to their teachers. The student-teacher linkage data files are used for this purpose and the IEA IDB Analyzer will make use of them automatically. To merge the teacher and student background data files, select both file types in the second window of the IEA IDB Analyzer merge module. The variables of interest need to be selected separately for both file types, as follows:

1) Click on the **Student Background** file type so that it appears checked and highlighted. The **Background Variables and Scores** listed in the left panel will include all available variables from the student background data files.

2) Select the variables of interest from the left panel and click the **right arrow** button to move these variables into the **Selected Variables** panel to the right. Click the **double right arrow** button to select all available variables.

3) Next, click on the **Teacher Background** file type (Math or Science at the eighth grade), selecting the variables of interest from the **Background Variables and Scores** panel to the left in the same manner.

4) Specify the folder and merged data file name in the **Output Files** field, as described earlier.

5) Click on the **Start SPSS** button to create the SPSS syntax file that will produce the required merged data file, which can then be run by opening the **Run** menu of SPSS and selecting the **All** menu option.

Merging School and Student Data Files

Because TIMSS 2007 has representative samples of schools, it is possible to compute reasonable statistics with schools as units of analysis. 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. Therefore, analyzing school data should be done by linking the students to their schools.

To merge the school and student background data files, select both the **School Background** and **Student Background** file types in the second window of the IEA IDB Analyzer merge module. The variables of interest to be included in the merged data file are selected separately by file type, as was described earlier and using the same set of instructions.

Merged Data Files for the Examples

To carry out the analysis examples presented in this chapter, the following merged data files should be created with all available background variables and scores selected:

BSGALLM4.SAV	Merge the eighth-grade student background data files for all countries
BTMALLM4.SAV	Merge the eighth-grade mathematics teacher and student background data files for all countries

BCGALLM4.SAV Merge the eighth-grade school and student background data files for all countries

2.4 Performing Analyses with the IEA IDB Analyzer

The analysis module of the IEA IDB Analyzer can perform statistical analyses on any files created using the merge module. The following statistical procedures are available in the analysis module of the IEA IDB Analyzer:

Percentages only

Compute percentages by subgroups defined by grouping variable(s)

Percentages and Means

Compute percentages, means, and standard deviations for selected variables by subgroups defined by grouping variable(s)

Regression

Compute regression coefficients for selected independent variables to predict a dependent variable by subgroups defined by grouping variable(s)

Benchmarks

Compute percentages of students meeting a set of user-specified achievement benchmarks, in particular the TIMSS international achievement benchmarks, by subgroups defined by grouping variable(s)

Correlations

Compute means, standard deviations, and correlation coefficients for selected variables by subgroups defined by grouping variable(s)

All statistical procedures offered within the analysis module of the IEA IDB Analyzer make appropriate use of sampling weights and standard errors are computed using the jackknife repeated replication (JRR) method (see Joncas, 2008). Percentages, means, regressions, and correlations may be specified with or without achievement scores. When achievement scores are used, the analyses are

performed five times—once for each plausible value—and the results are aggregated to produce accurate estimates of achievement and standard errors that incorporate both sampling and imputation errors. To conduct analyses using achievement scores, check the **With Achievement Scores** option from the **Select Analysis Type** panel.

The IEA IDB Analyzer requires the selection of variables for a number of purposes:

Grouping Variables

This is a list of variables to define subgroups. The list must consist of at least one grouping variable. By default, the IEA IDB Analyzer includes the variable IDCNTRY used to distinguish the participating countries. Additional variables may be selected from the available list. If the **Exclude Missing from Analysis** option from the **Select Analysis Type** panel is checked, which is done by default, only cases that have non-missing values in the grouping variables will be used in the analysis. If it is not checked, missing values become reporting categories

Analysis Variables

This is a list of variables for which means are to be computed, or of independent variables for a regression analysis. More than one analysis variable can be selected. To compute means for achievement scores, it is necessary to check the **With Achievement Scores** option in the **Select Analysis Type** panel and select the achievement scores of interest in the **Achievement Scores** section.

Achievement Scores

This section is used to identify the set of plausible values to be used when achievement scores are the analysis variable for computing percentages and means, or the dependent variable in a regression analysis. The **With Achievement Scores** option in the **Select Analysis Type** panel should be checked before specifying achievement scores in the **Achievement Scores** section.

Dependent Variable

This is the variable to be used as the dependent variable when a regression analysis is specified. Only one dependent variable can be listed. To use achievement scores as the dependent variable, it is necessary to check the **With Achievement Scores** option in the **Select Analysis Type** panel and select the achievement scores of interest in the **Achievement Scores** section.

Benchmarks

They are the values that will be used as cut points on an achievement scale for computing the percentages of students meeting the specified benchmarks. Multiple cut points can be specified, each separated by a blank space.

Weight Variable

This is the sampling weight that will be used in the analysis. The IEA IDB Analyzer automatically selects the appropriate weight variable for analysis based on the file types included in the merged data file. Generally, this will be TOTWGT. MATWGT will be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data and TCHWGT will be used when analyzing all teacher data. Chapter 4 provides more information on the TIMSS sampling weights.

Jackknifing Variables

They are the variables that capture the assignment of cases to sampling zones (JKZONE) and whether a case is to be dropped or have its weight doubled (JKREP) when computing the sets of replicate weights needed by the jackknife repeated replication method. The IEA IDB Analyzer automatically selects these variables and cannot be changed.

2.5 TIMSS Analyses with Student-Level Variables

Many analyses of the TIMSS 2007 international database can be undertaken using only student-level data. This section presents examples of actual analyses used to produce exhibits from the *TIMSS 2007 International Mathematics Report*. Examples of regression analyses and computing percentages of students reaching the TIMSS international benchmarks also are included in this section.

The first example computes means for a straightforward continuous variable, whereas the second example computes means of achievement scores. In both cases, the IEA IDB Analyzer uses the sampling weights and implements the jackknife repeated replication method to compute appropriate sampling errors. In the second example, where achievement plausible values are used, the IEA IDB Analyzer effectively performs the computations five times—once for each plausible value—and aggregates the results to produce accurate estimates of mean achievement and standard errors that incorporate both sampling and imputation errors.

Student-Level Analysis

In our first example, we will replicate an analysis of eighth-grade students' reported age at the time of testing. The results, presented in Exhibit 1.1 of the *TIMSS 2007 International Mathematics Report*, are reproduced here in Exhibit 2.3. This example will focus on the results presented in the fifth data column—the average age at the time of testing.

We need to undertake a number of steps to replicate the results in this exhibit. After reviewing the eighth-grade student background data codebook (the codebooks are described in Section 4.4 of Chapter 4), we identify the student background variable BSDAGE as the variable that reports the age of students at the time of testing.

After creating the merged data file BSGALLM4, the analysis module of the IEA IDB Analyzer is used to perform the analysis in the following steps:

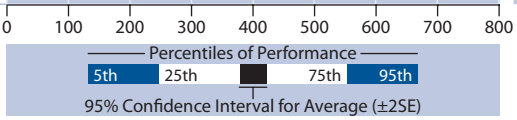
1) Open the analysis module of the IEA IDB Analyzer.
2) Select the merged data file BSGALLM4 as the **Analysis File** by clicking the **Change** button.
3) Select **Percentages and Means** as the **Analysis Type**. There are two options available to check: **With Achievement Scores** and **Exclude Missing from Analysis**. Since no achievement scores are used in this analysis, only **Exclude Missing from Analysis** should be checked, which is done by default, to exclude cases that have missing values in the grouping variables.
4) The variable IDCNTRY is selected automatically as **Grouping Variables**. No additional grouping variables are needed for this analysis.
5) Specify the analysis variables. To activate this section, click the **Analysis Variables** radio button. For our example, the variable BSDAGE is selected from the list of available variables and moved to the **Analysis Variables** field by clicking the **right arrow** button in this section.

Exhibit 2.3 Exhibit of Example Student-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 1.1)

Exhibit 1.1 **TIMSS 2007 Distribution of Mathematics Achievement (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	Mathematics Achievement Distribution	Average Scale Score	Years of Formal Schooling*	Average Age at Time of Testing	Human Development Index**
Chinese Taipei		▲ 598 (4.5)	8	14.2	0.932
Korea, Rep. of		▲ 597 (2.7)	8	14.3	0.921
Singapore		▲ 593 (3.8)	8	14.4	0.922
† Hong Kong SAR		▲ 572 (5.8)	8	14.4	0.937
Japan		▲ 570 (2.4)	8	14.5	0.953
Hungary		▲ 517 (3.5)	8	14.6	0.874
† England		▲ 513 (4.8)	9	14.2	0.946
Russian Federation		▲ 512 (4.1)	7 or 8	14.6	0.802
2 † United States		▲ 508 (2.8)	8	14.3	0.951
1 Lithuania		▲ 506 (2.3)	8	14.9	0.862
Czech Republic		504 (2.4)	8	14.4	0.891
Slovenia		501 (2.1)	7 or 8	13.8	0.917
TIMSS Scale Avg.		500			
Armenia		499 (3.5)	8	14.9	0.775
Australia		496 (3.9)	8	13.9	0.962
Sweden		▼ 491 (2.3)	8	14.8	0.956
Malta		▼ 488 (1.2)	9	14.0	0.878
† Scotland		▼ 487 (3.7)	9	13.7	0.946
1 2 Serbia		▼ 486 (3.3)	8	14.9	0.810
Italy		▼ 480 (3.0)	8	13.9	0.941
Malaysia		▼ 474 (5.0)	8	14.3	0.811
Norway		▼ 469 (2.0)	8	13.8	0.968
Cyprus		▼ 465 (1.6)	8	13.8	0.903
Bulgaria		▼ 464 (5.0)	8	14.9	0.824
3 Israel		▼ 463 (3.9)	8	14.0	0.932
Ukraine		▼ 462 (3.6)	8	14.2	0.788
Romania		▼ 461 (4.1)	8	15.0	0.813
Bosnia and Herzegovina		▼ 456 (2.7)	8 or 9	14.7	0.803
Lebanon		▼ 449 (4.0)	8	14.4	0.772
Thailand		▼ 441 (5.0)	8	14.3	0.781
Turkey		▼ 432 (4.8)	8	14.0	0.775
Jordan		▼ 427 (4.1)	8	14.0	0.773
Tunisia		▼ 420 (2.4)	8	14.5	0.766
1 Georgia		▼ 410 (5.9)	8	14.2	0.754
Iran, Islamic Rep. of		▼ 403 (4.1)	8	14.2	0.759
Bahrain		▼ 398 (1.6)	8	14.1	0.866
Indonesia		▼ 397 (3.8)	8	14.3	0.728
Syrian Arab Republic		▼ 395 (3.8)	8	13.9	0.724
Egypt		▼ 391 (3.6)	8	14.1	0.708
Algeria		▼ 387 (2.1)	8	14.5	0.733
Colombia		▼ 380 (3.6)	8	14.5	0.791
Oman		▼ 372 (3.4)	8	14.3	0.814
Palestinian Nat'l Auth.		▼ 367 (3.5)	8	14.0	0.731
Botswana		▼ 364 (2.3)	8	14.9	0.654
◆◆ Kuwait		▼ 354 (2.3)	8	14.4	0.891
El Salvador		▼ 340 (2.8)	8	15.0	0.735
Saudi Arabia		▼ 329 (2.9)	8	14.4	0.812
Ghana		▼ 309 (4.4)	8	15.8	0.553
Qatar		▼ 307 (1.4)	8	13.9	0.875
‡ Morocco		▼ 381 (3.0)	8	14.8	0.646
Benchmarking Participants					
2 Massachusetts, US		▲ 547 (4.6)	8	14.2	–
2 † Minnesota, US		▲ 532 (4.4)	8	14.3	–
3 Quebec, Canada		▲ 528 (3.5)	8	14.2	–
2 Ontario, Canada		▲ 517 (3.5)	8	13.8	–
3 British Columbia, Canada		▲ 509 (3.0)	8	13.9	–
Basque Country, Spain		499 (3.0)	8	14.1	–
◆◆ ‡ Dubai, UAE		▼ 461 (2.4)	8	14.2	–



▲ Country average significantly higher than TIMSS scale average
▼ Country average significantly lower than TIMSS scale average

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

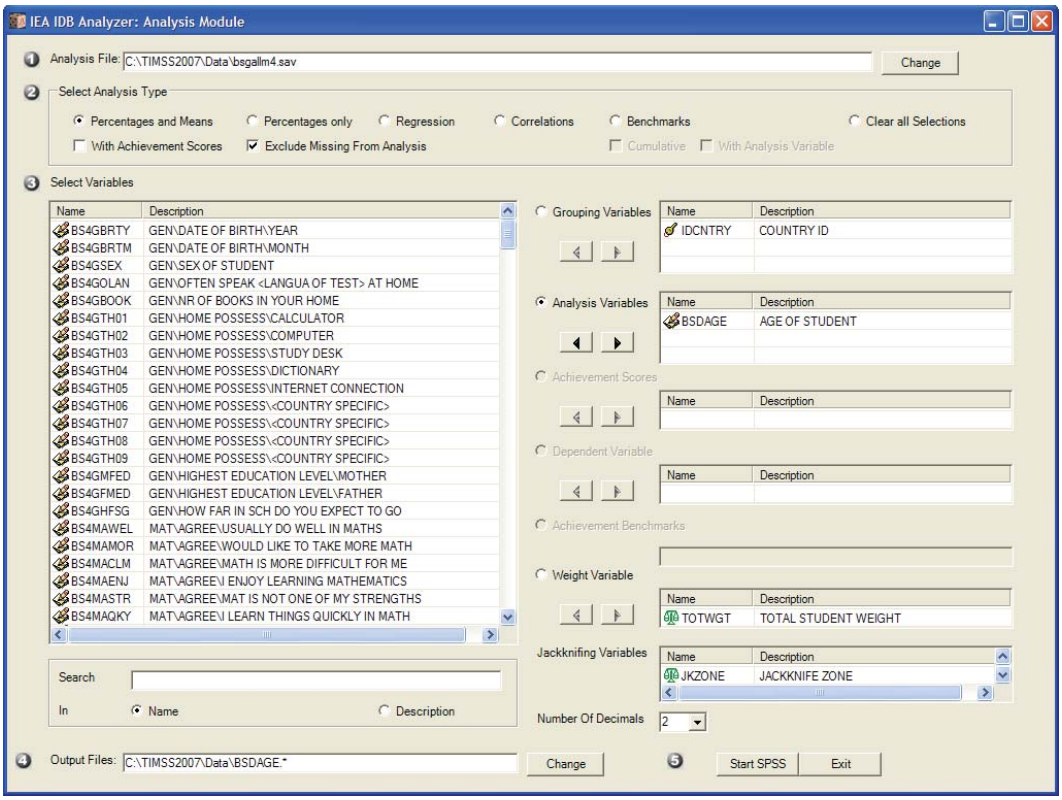
6) The **Weight Variable** is automatically selected by the software. As this example analysis uses student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.

7) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button. The IEA IDB Analyzer will use this name and folder to create three output files: an SPSS syntax file that contains the code for performing the analysis, an SPSS data file with the results, and an Excel file with these same results.

8) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.4 shows the completed analysis module for this example. The results are displayed in Exhibit 2.5, though only the first four countries are displayed to conserve space (this will be done for all analysis examples in this chapter).

Exhibit 2.4 IEA IDB Analyzer Setup for Example Student-Level Analysis



In Exhibit 2.5, each country's average for the BSDAGE variable is reported for all sampled students. The countries are identified in the first column. The second column reports the number of valid cases. The third column reports the sum of weights of the sampled students, followed by the percent, mean, and standard deviation, each accompanied by its jackknife standard error. The last column reports the percent of missing values. From the first line of results, Algeria has valid data for 5,445 students and these sampled students represent a population of 656,247 students. Students in Algeria were, on average, 14.46 years old at the time the TIMSS 2007 assessment took place, with a standard error of 0.03. Only 0.02% of sampled students in Algeria did not report their age at the time of testing.

Exhibit 2.5 Output for Example Student-Level Analysis

Average for BSDAGE by (IDCNTRY) PAGE 1

COUNTRY ID	N of Cases	Sum of TOTWGT	Percent	Percent (s.e.)	BSDAGE (Mean)	BSDAGE (s.e.)	Std.Dev.	Std.Dev. (s.e.)	Percent Missing
Algeria	5445	656247	3.07	.06	14.46	.03	1.16	.01	.02
Armenia	4689	50218	.23	.01	14.89	.01	.45	.01	.00
Australia	4066	255583	1.19	.02	13.90	.01	.48	.01	.05
Bahrain	4227	11361	.05	.00	14.07	.01	.79	.02	.08

Student-Level Analysis with Achievement Scores

In our second example, we want to replicate another set of results presented in the *TIMSS 2007 International Mathematics Report*. We are interested in investigating the relationship between eighth-grade students' gender and mathematics achievement. These results, presented in Exhibit 1.5 of the *TIMSS 2007 International Mathematics Report*, are repeated here in Exhibit 2.6. Since the results in this exhibit are based on plausible values, we need to make sure they are included when creating the input file, and also to indicate that this analysis will make use of achievement scores.

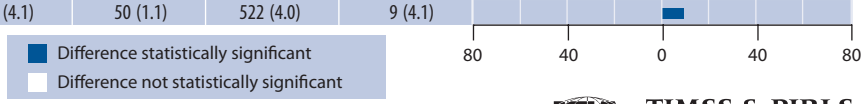
After reviewing the appropriate codebook, we observe that the variable ITSEX contains categorical information on the gender of students, and this variable is found in the student background data files. The **Percentages and Means** analysis type with activation of the **With Achievement Scores** checkbox will compute the percentages and mean achievement scores based on plausible values and their respective standard errors.

Exhibit 2.6 Exhibit of Example Student-Level Analysis with Achievement Scores Taken from the TIMSS 2007 International Mathematics Report (Exhibit 1.5)

Exhibit 1.5 **TIMSS 2007 Average Mathematics Achievement by Gender (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
Malta	51 (0.3)	488 (1.5)	49 (0.3)	488 (1.7)	0 (2.2)		
Turkey	47 (0.8)	432 (5.3)	53 (0.8)	432 (5.0)	1 (3.9)		
Hungary	50 (1.1)	517 (4.1)	50 (1.1)	517 (3.7)	1 (3.6)		
Chinese Taipei	48 (1.3)	599 (4.6)	52 (1.3)	598 (5.3)	1 (4.2)		
Bosnia and Herzegovina	49 (0.8)	456 (3.1)	51 (0.8)	455 (2.8)	1 (2.5)		
Slovenia	50 (0.8)	500 (2.7)	50 (0.8)	503 (2.6)	2 (3.2)		
Czech Republic	48 (0.8)	505 (2.5)	52 (0.8)	503 (2.8)	2 (2.4)		
3 Israel	53 (1.6)	465 (4.6)	47 (1.6)	462 (4.9)	3 (5.4)		
† Scotland	51 (1.0)	486 (3.8)	49 (1.0)	489 (4.4)	3 (3.5)		
2 † United States	51 (0.7)	507 (3.0)	49 (0.7)	510 (3.1)	4 (2.2)		
Sweden	48 (0.9)	493 (2.6)	52 (0.9)	490 (2.5)	4 (2.5)		
Norway	49 (0.7)	471 (2.1)	51 (0.7)	467 (2.6)	4 (2.5)		
Indonesia	51 (1.0)	399 (4.1)	49 (1.0)	395 (4.4)	4 (4.0)		
Korea, Rep. of	48 (2.7)	595 (3.3)	52 (2.7)	599 (3.1)	4 (3.4)		
Armenia	50 (0.9)	501 (4.4)	50 (0.9)	497 (3.5)	4 (3.7)		
Japan	50 (1.0)	568 (3.2)	50 (1.0)	572 (3.2)	4 (4.3)		
1 Georgia	50 (1.0)	412 (5.9)	50 (1.0)	408 (6.7)	4 (4.3)		
Russian Federation	52 (0.9)	514 (4.3)	48 (0.9)	509 (4.7)	5 (3.7)		
Ukraine	52 (0.8)	465 (3.9)	48 (0.8)	459 (3.9)	5 (2.9)		
Algeria	49 (0.6)	384 (2.4)	51 (0.6)	389 (2.2)	5 (1.8)		
† England	51 (1.9)	511 (5.0)	49 (1.9)	516 (6.1)	6 (5.7)		
Italy	48 (0.7)	477 (3.3)	52 (0.7)	483 (3.5)	6 (3.2)		
1 2 Serbia	49 (0.7)	489 (3.6)	51 (0.7)	483 (4.0)	6 (3.9)		
1 Lithuania	50 (1.1)	509 (3.0)	50 (1.1)	502 (2.3)	7 (2.6)		
Iran, Islamic Rep. of	46 (1.5)	407 (5.3)	54 (1.5)	400 (6.1)	7 (8.1)		
Malaysia	53 (1.5)	479 (5.6)	47 (1.5)	468 (5.3)	11 (4.4)		
† Hong Kong SAR	50 (1.3)	578 (5.0)	50 (1.3)	567 (8.0)	11 (6.7)		
Egypt	49 (2.7)	397 (5.0)	51 (2.7)	384 (4.6)	13 (6.4)		
Lebanon	54 (1.8)	443 (4.1)	46 (1.8)	456 (4.7)	13 (3.6)		
Bulgaria	50 (1.2)	471 (4.6)	50 (1.2)	456 (6.3)	15 (5.0)		
Singapore	49 (0.9)	600 (4.1)	51 (0.9)	586 (4.6)	15 (4.4)		
Australia	48 (1.9)	488 (5.5)	52 (1.9)	504 (5.4)	15 (7.7)		
Botswana	53 (0.8)	371 (2.4)	47 (0.8)	355 (3.2)	15 (3.3)		
Syrian Arab Republic	52 (1.9)	387 (4.3)	48 (1.9)	403 (5.1)	16 (5.6)		
Romania	49 (0.9)	470 (4.2)	51 (0.9)	452 (4.6)	18 (3.3)		
Cyprus	50 (0.6)	476 (2.2)	50 (0.6)	455 (2.4)	20 (3.2)		
Jordan	48 (2.0)	438 (6.4)	52 (2.0)	417 (5.6)	20 (8.8)		
El Salvador	52 (1.4)	331 (3.8)	48 (1.4)	351 (3.6)	21 (4.9)		
Tunisia	52 (0.8)	410 (2.8)	48 (0.8)	431 (2.7)	21 (2.4)		
Ghana	45 (0.8)	297 (5.0)	55 (0.8)	319 (4.4)	22 (3.6)		
◆◆ Kuwait	54 (2.1)	364 (2.7)	46 (2.1)	342 (4.0)	22 (4.8)		
Saudi Arabia	48 (1.6)	341 (3.6)	52 (1.6)	319 (4.0)	23 (5.0)		
Thailand	50 (1.3)	453 (5.3)	50 (1.3)	430 (5.5)	23 (4.7)		
Colombia	51 (1.6)	364 (4.2)	49 (1.6)	396 (4.1)	32 (4.3)		
Bahrain	49 (0.4)	414 (2.2)	51 (0.4)	382 (2.6)	32 (3.6)		
Palestinian Nat'l Auth.	51 (1.4)	385 (4.2)	49 (1.4)	349 (5.4)	36 (6.5)		
Qatar	50 (0.2)	325 (2.1)	50 (0.2)	288 (2.0)	38 (2.9)		
Oman	52 (2.0)	399 (3.6)	48 (2.0)	344 (5.0)	54 (5.6)		
‡ Morocco	53 (1.3)	377 (3.7)	47 (1.3)	385 (3.9)	9 (4.8)		
International Avg.	50 (0.2)	453 (0.7)	50 (0.2)	448 (0.7)	5 (0.6)		
Benchmarking Participants							
◆◆ ‡ Dubai, UAE	49 (4.8)	461 (5.2)	51 (4.8)	461 (5.9)	0 (10.1)		
3 Quebec, Canada	49 (1.5)	527 (3.5)	51 (1.5)	529 (4.6)	2 (4.2)		
2 † Minnesota, US	52 (1.3)	531 (4.4)	48 (1.3)	535 (5.1)	4 (3.7)		
Basque Country, Spain	48 (1.7)	496 (3.9)	52 (1.7)	501 (3.9)	4 (5.0)		
2 Massachusetts, US	50 (1.0)	544 (4.8)	50 (1.0)	550 (5.1)	5 (3.8)		
3 British Columbia, Canada	51 (1.1)	507 (3.3)	49 (1.1)	512 (3.4)	6 (2.9)		
2 Ontario, Canada	50 (1.1)	513 (4.1)	50 (1.1)	522 (4.0)	9 (4.1)		



SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

The analysis module of the IEA IDB Analyzer is used to perform the analysis in the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Select the merged data file BSGALLM4 as the **Analysis File** by clicking the **Change** button.
3) Select **Percentages and Means** as the **Analysis Type**.
4) Check the **With Achievement Scores** box.
5) Add the variable ITSEX as a second **Grouping Variable**.
6) Specify the achievement scores to be used for the analysis. To activate this section, click the **Achievement Scores** radio button. Select the variable BSMMAT01-05 from the list of available variables and move it to the **Achievement Scores** field by clicking the **right arrow** button in this section.
7) The **Weight Variable** is automatically selected by the software. As this example analysis uses student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.
8) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.
9) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.7 displays the analysis module with the proper settings for this example analysis. The output for this example is shown in Exhibit 2.8.

In Exhibit 2.8, each country's results are displayed on two lines, one for each value of the ITSEX variable. The countries are identified in the first column and the second column describes the category of ITSEX being reported. The third column reports the number of valid cases and the fourth the sum of weights of the sampled students. The next two columns report the percentage of students in each category and its standard error, followed by the estimated mean mathematics achievement and its standard error. The standard deviation of the achievement scores and its standard error are reported in the last two columns. From the first two lines of results, 49.17% of students in Algeria are girls, and 50.83% are boys.

The mean mathematics achievement for girls is 384.06 (standard error of 2.42) and is 389.36 (standard error of 2.23) for boys.

Exhibit 2.7 IEA IDB Analyzer Setup for Example Student-Level Analysis with Achievement Scores

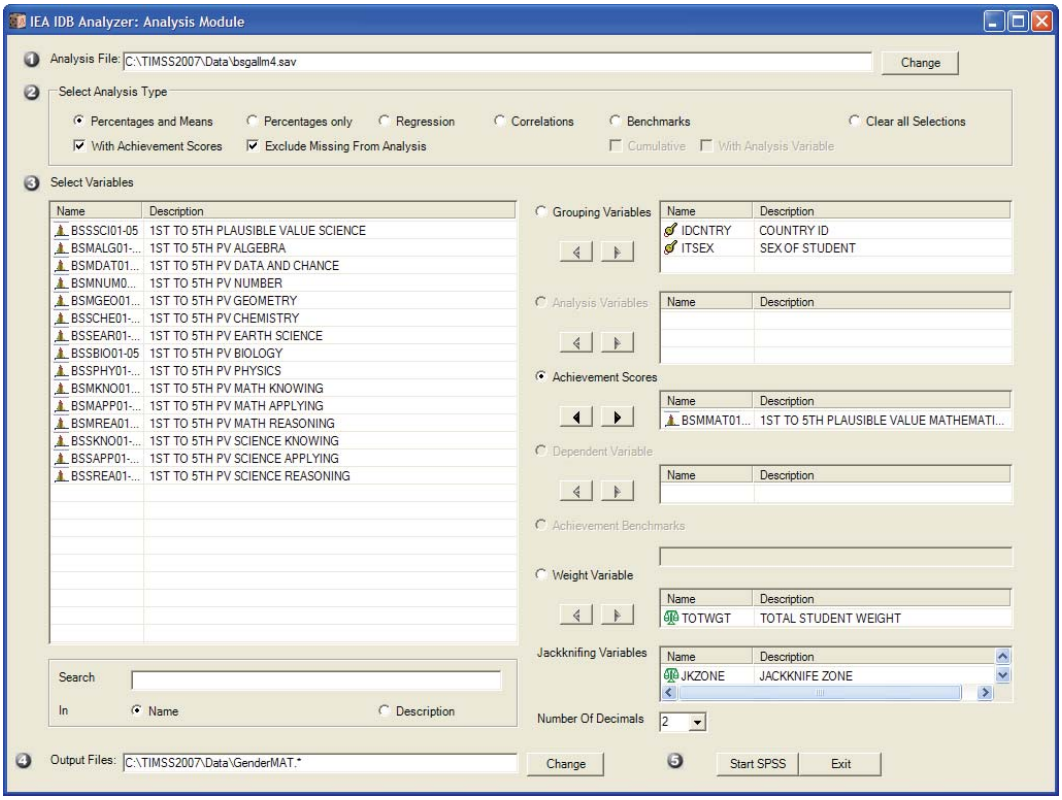


Exhibit 2.8 Output for Example Student-Level Analysis with Achievement Scores

Average for BSMMAT0 by IDCNTRY ITSEX

COUNTRY ID	SEX OF STUDENT	N of Cases	Sum of TOTWGT	Percent	Percent (s.e.)	BSMMAT0 (Mean)	BSMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)
Algeria	GIRL	2680	322725	49.17	.59	384.06	2.42	59.57	1.14
	BOY	2767	333679	50.83	.59	389.36	2.23	58.82	1.20
Armenia	GIRL	2305	25089	49.96	.90	500.69	4.41	84.63	3.51
	BOY	2384	25128	50.04	.90	496.67	3.46	84.78	2.60
Australia	GIRL	1843	123207	48.18	1.93	488.26	5.53	75.25	2.77
	BOY	2226	132492	51.82	1.93	503.64	5.42	82.43	3.05
Bahrain	GIRL	1974	5561	48.91	.40	414.35	2.16	73.45	1.59
	BOY	2256	5809	51.09	.40	382.49	2.62	89.54	1.90

Student-Level Regression Analysis

This section demonstrates a regression analysis using variables from the merged data file BSGALLM4. In this example, we will examine gender as a predictor of the eighth-grade students' age at the time of testing (BSDAGE). This will allow us to determine if the age difference between girls and boys is statistically significant.

For this example, the values of the variable ITSEX are recoded into variable REGSEX by running the special SPSS syntax file SYNTAX_BSGALLM4.SPS shown in Exhibit 2.9 and provided on the DVD. REGSEX has a value of zero for girls and one for boys. By using REGSEX, the regression intercept—or constant—will be the estimated mean age of girls, whereas the regression slope column in the SPSS output) will be the estimated increase in mean age for boys.[1]

Exhibit 2.9 Example SPSS Program to Recode Variables for Student-Level Regression Analysis

```
* Compute new variable REGSEX from ITSEX .

get file = "<datpath>bsgallm4.sav" .

compute REGSEX = ITSEX - 1 .

value labels
    REGSEX 0 'Girl'
           1 'Boy' .

variable labels
    REGSEX "Recoded ITSEX (Girls = 0; Boys = 1)" .

save outfile = "<datpath>bsgallm4.sav" .
```

The parameter <datpath> in the SPSS syntax shown in Exhibit 2.9 needs to be edited to specify the location of the input and output data files.

The example regression analysis is performed by the analysis module of the IEA IDB Analyzer using the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Specify the data file BSGALLM4 as the **Analysis File** by clicking the **Change** button, after having run the SPSS syntax file SYNTAX_BSGALLM4.SPS to create the variable REGSEX.
3) Select Regression as the **Analysis Type**. Make sure that the **With Achievement Scores** option is not checked.

[1] This form of variable recoding—known as "dummy coding"—makes the interpretation of regression coefficients easier. It essentially transforms a regression analysis into an analysis of variance to test for differences among groups.

4) The variable IDCNTRY is selected automatically as **Grouping Variables**. No additional grouping variables are needed for this analysis.

5) Click the **Analysis Variables** radio button to activate the section and select REGSEX as the analysis variable. This is done by selecting REGSEX from the list of available variables and moving it to the **Analysis Variables** field by clicking the **right arrow** button in this section.

6) Click the **Dependent Variable** radio button. Select the variable BSDAGE from the list of available variables and move it to the **Dependent Variable** field by clicking the **right arrow** button in this section.

7) The **Weight Variable** is automatically selected by the software. As this example analysis uses student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.

8) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.

9) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file will be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.10 demonstrates the completed analysis module for this example regression analysis. The output for this example is shown in Exhibit 2.11.

From the first line of results in Exhibit 2.11, the estimated mean age of eighth-grade girls in Algeria, labeled "Constant (estimate)", is 14.31 years, with a standard error of 0.03. The eighth-grade boys are an estimated 0.30 years older than the girls, as shown in the column labeled "REGSEX (estimate)". With an estimated standard error of 0.03, this difference is statistically significant at a 95% confidence level.

Exhibit 2.10 IDB-Analyzer Set-Up for Example Student-Level Regression Analysis

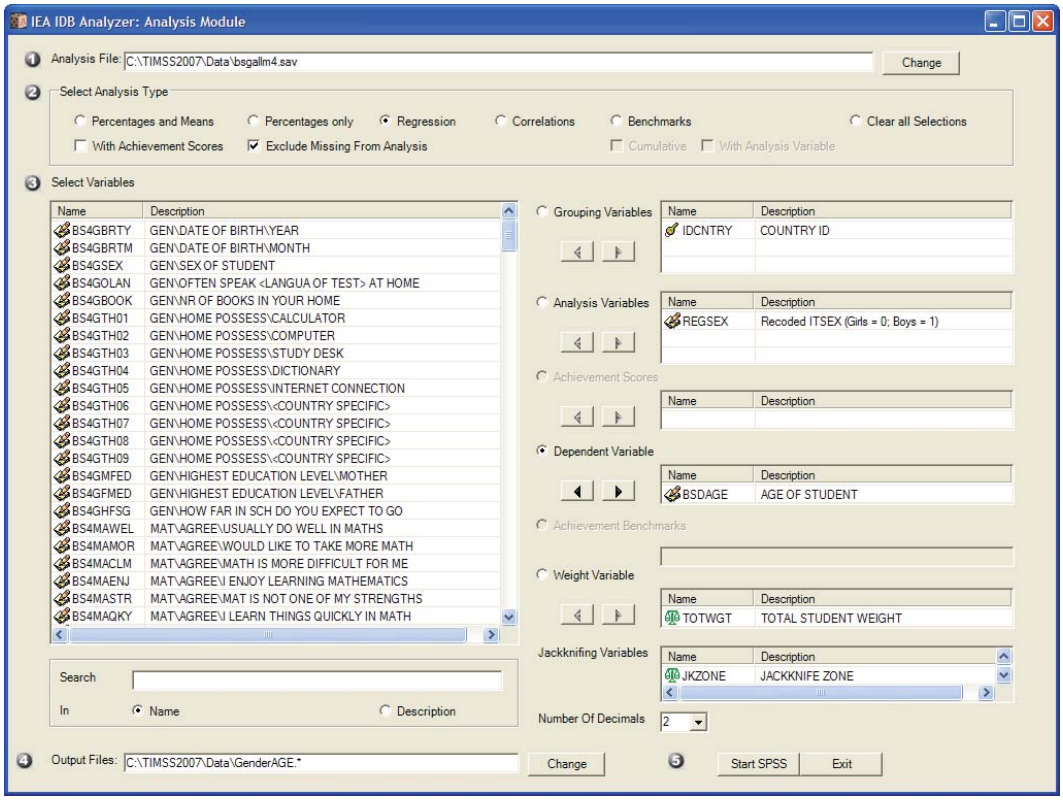


Exhibit 2.11 Output for Example Student-Level Regression Analysis

```
Predictors: REGSEX / Predicted: BSDAGE                                          PAGE    1

                          N of                  Constant    Constant    REGSEX     REGSEX     REGSEX
COUNTRY ID                Cases    Mult_RSQ     (estimate)  (s.e.)      (estimate) (s.e.)     (t-test)
_________________________ _______  ________     _________   ________    __________ ________   ________

Algeria                    5445        .02         14.31        .03         .30        .03        9.19
Armenia                    4689        .00         14.91        .02        -.03        .02       -1.77
Australia                  4066        .00         13.86        .01         .07        .02        2.94
Bahrain                    4227        .00         14.04        .02         .06        .03        2.11
```

Student-Level Regression Analysis with Achievement Scores

The next example of student-level regression analysis will examine gender as a predictor of mathematics achievement using five plausible values (BSMMAT01 through BSMMAT05). This example also will use the recoded variable REGSEX, this time to determine if the difference in mean achievement between girls and boys is statistically significant. The regression analysis is performed by the analysis module of the IEA IDB Analyzer using the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Specify the data file BSGALLM4 as the **Analysis File** by clicking the **Change** button, after having run the SPSS syntax file SYNTAX_BSGALLM4.SPS to create the variable REGSEX.
3) Select **Regression** as the **Analysis Type**.
4) Check the **With Achievement Scores** box.
5) The variable IDCNTRY is selected automatically as **Grouping Variables**. No additional grouping variables are needed for this analysis.
6) Click the **Analysis Variables** radio button to activate the section. Select the variable REGSEX from the list of available variables and move it to the **Analysis Variables** field by clicking the **right arrow** button in this section.
7) Click the **Achievement Scores** radio button. Select the variable BSMMAT01-05 from the list of available variables and move it to the **Achievement Scores** field by clicking the **right arrow** button in this section.
8) The **Weight Variable** is automatically selected by the software. As this example analysis uses student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.
9) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.
10) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file will be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.12 shows the analysis module with the proper settings for this example regression analysis. The output is displayed in Exhibit 2.13.

From the first line of results in Exhibit 2.13, the estimated mean mathematics achievement of eighth-grade girls in Algeria is 384.06, with a standard error of 2.42. The estimated mean mathematics achievement for eighth-grade boys in Algeria is 5.30 points higher than for girls. With an estimated standard error of 1.80, this difference is statistically significant at a 95% confidence level.

Exhibit 2.12 IDB-Analyzer Set-Up for Example Student-Level Regression Analysis with Achievement Scores

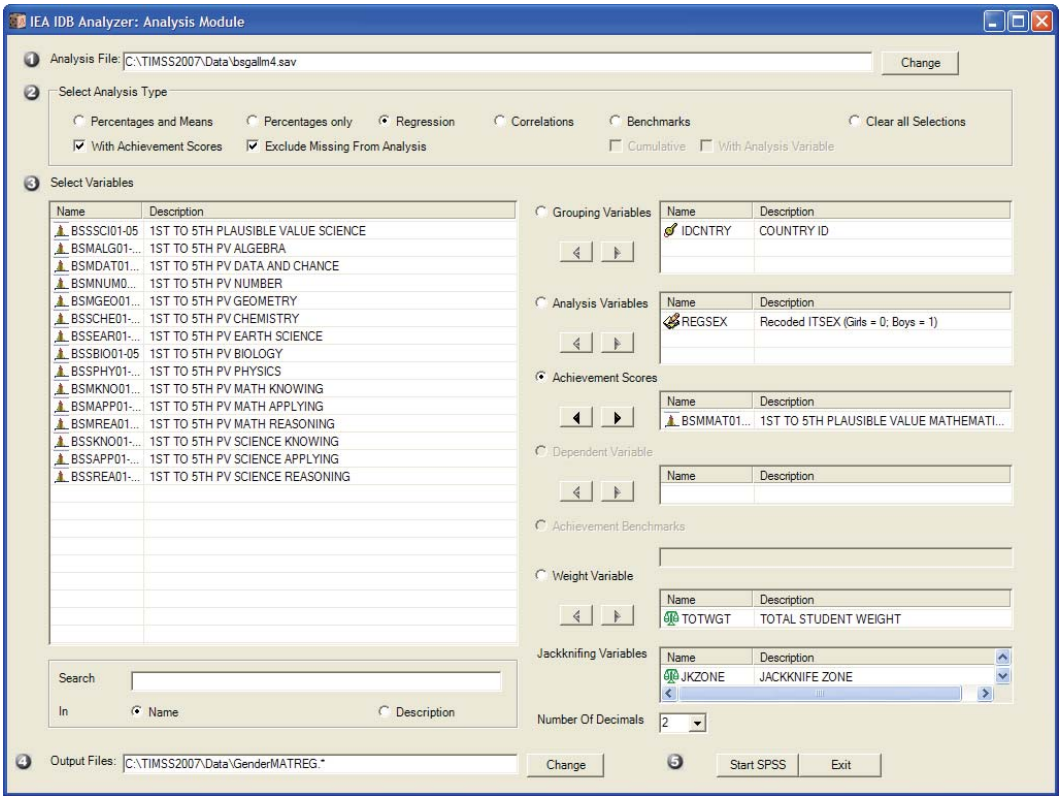


Exhibit 2.13 Output for Example Student-Level Regression Analysis with Achievement Scores

```
Predictors: REGSEX / Predicted: BSMMAT0                                  PAGE    1

                 N of              Constant   Constant    REGSEX    REGSEX   REGSEX
COUNTRY ID      Cases  Mult_RSQ  (estimate)   (s.e.)   (estimate)  (s.e.)  (t-test)
_____________  _____  ________  __________  ________  __________  ______  ________

Algeria         5447       .00      384.06      2.42        5.30    1.80      2.94
Armenia         4689       .00      500.69      4.41       -4.03    3.73     -1.08
Australia       4069       .01      488.26      5.53       15.38    7.71      2.00
Bahrain         4230       .04      414.35      2.16      -31.86    3.63     -8.78
```

Calculating Percentages of Students Reaching Benchmarks

This section describes how to use the IEA IDB Analyzer to perform analyses of student achievement in relation to the TIMSS achievement benchmarks. As an example, we will compute the percentages of students reaching the four TIMSS 2007 international benchmarks of eighth-grade mathematics achievement (advanced, high, intermediate, and low) using the merged BSGALLM4 data file.

These results, presented in Exhibit 2.2 of the *TIMSS 2007 International Mathematics Report*, are repeated here in Exhibit 2.14.

This example is performed by the analysis module of the IEA IDB Analyzer using the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Specify the data file BSGALLM4 as the **Analysis File** by clicking the **Change** button.
3) Select **Benchmarks** as the **Analysis Type**.
4) Check the **Cumulative** box in the **Select Analysis Type** panel to get cumulated percentages of students reaching the international benchmarks.
5) The variable IDCNTRY is selected automatically as **Grouping Variables**. No additional grouping variables are needed for this analysis.
6) Click the **Achievement Scores** radio button. Select the variable BSMMAT01-05 from the list of available variables and move it to the **Achievement Scores** field by clicking the **right arrow** button in this section.
7) Click the **Achievement Benchmarks** radio button to activate this section and specify the TIMSS 2007 international benchmarks, which are 400, 475, 550, and 625, respectively as low, intermediate, high, and advanced. Enter these four values in the input field, each separated by a blank space.
8) The **Weight Variable** is automatically selected by the software. As this example analysis uses student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.
9) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.
10) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file will be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

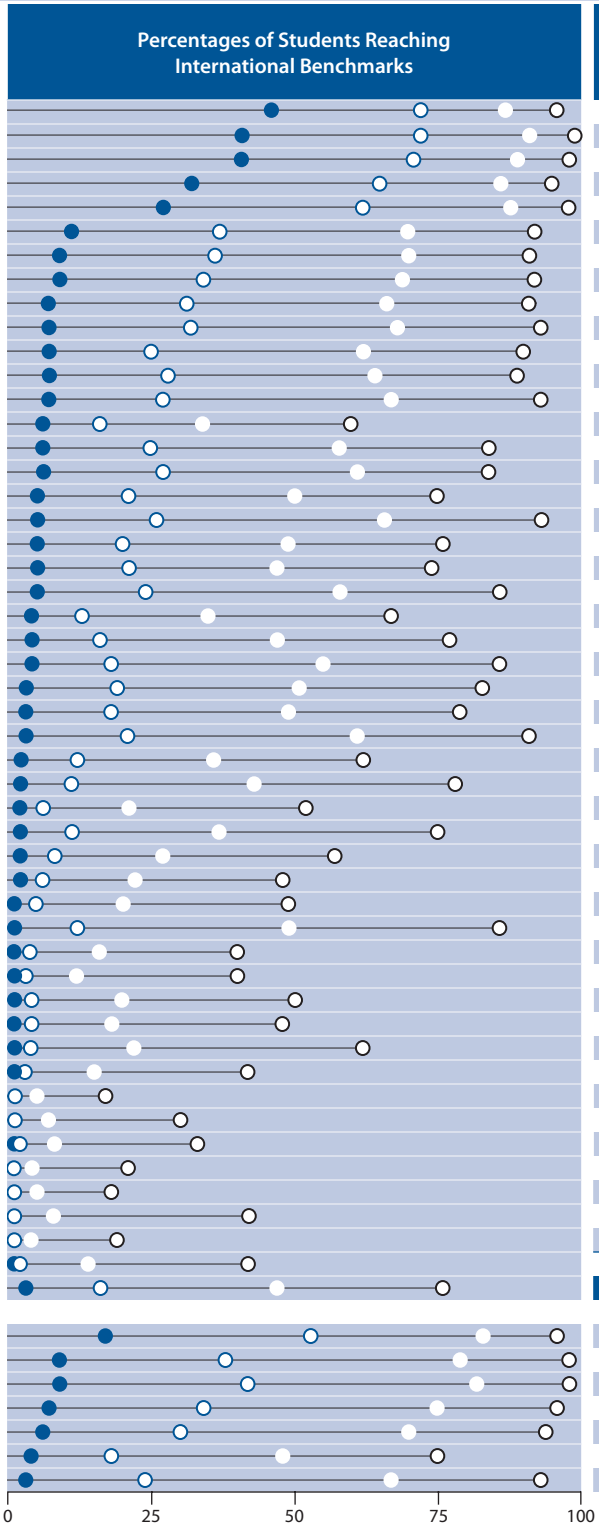
Exhibit 2.15 shows the completed analysis module for this example. The output is displayed in Exhibit 2.16.

Exhibit 2.14 Example Exhibit of Benchmark Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 2.2)

Exhibit 2.2 **Percentages of Students Reaching the TIMSS 2007 International Benchmarks of Mathematics Achievement (Continued)**

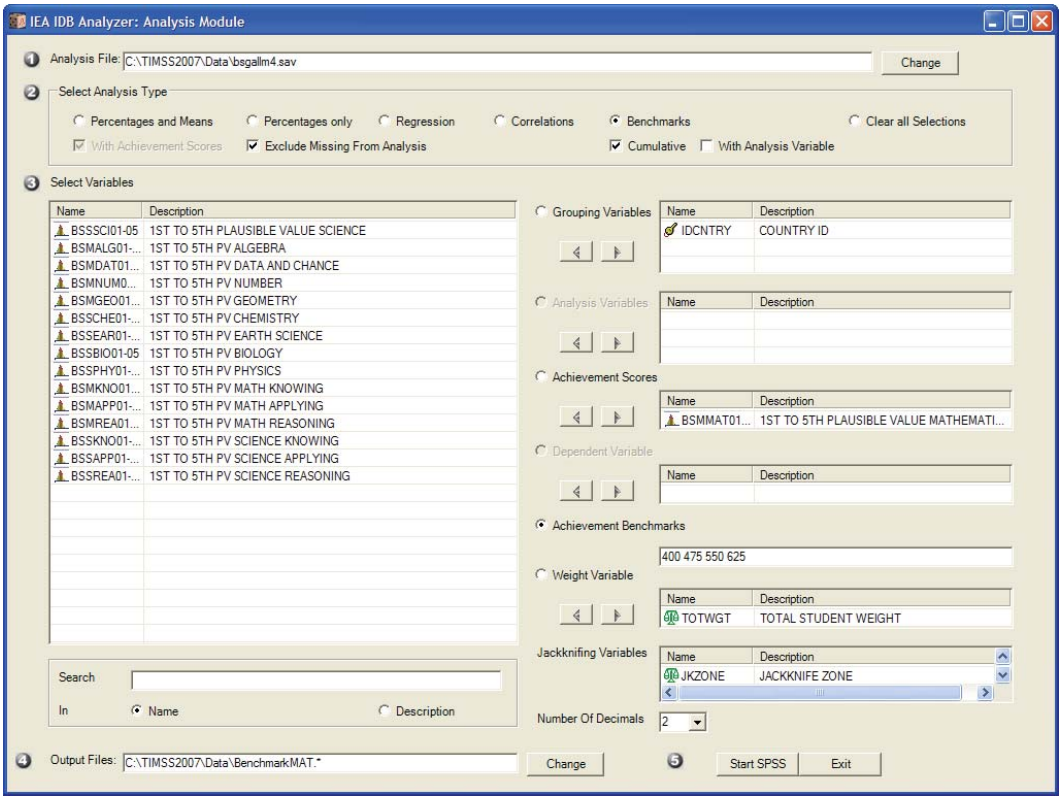
TIMSS2007 Mathematics 8th Grade

Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
Chinese Taipei	45 (1.9)	71 (1.5)	86 (1.2)	95 (0.6)
Korea, Rep. of	40 (1.2)	71 (1.1)	90 (0.7)	98 (0.3)
Singapore	40 (1.9)	70 (2.0)	88 (1.4)	97 (0.6)
† Hong Kong SAR	31 (2.1)	64 (2.6)	85 (2.1)	94 (1.1)
Japan	26 (1.3)	61 (1.2)	87 (0.9)	97 (0.3)
Hungary	10 (1.0)	36 (1.6)	69 (1.6)	91 (1.0)
† England	8 (1.5)	35 (2.5)	69 (2.3)	90 (1.4)
Russian Federation	8 (0.9)	33 (1.8)	68 (2.1)	91 (1.2)
1 Lithuania	6 (0.7)	30 (1.1)	65 (1.3)	90 (0.8)
2 † United States	6 (0.6)	31 (1.5)	67 (1.4)	92 (0.8)
Australia	6 (1.3)	24 (1.8)	61 (1.9)	89 (1.0)
Armenia	6 (0.9)	27 (1.9)	63 (1.4)	88 (0.8)
Czech Republic	6 (0.7)	26 (1.2)	66 (1.4)	92 (0.8)
Turkey	5 (0.6)	15 (1.3)	33 (1.8)	59 (1.8)
1 2 Serbia	5 (0.8)	24 (1.3)	57 (1.8)	83 (1.2)
Malta	5 (0.4)	26 (0.8)	60 (0.6)	83 (0.5)
Bulgaria	4 (0.8)	20 (1.5)	49 (1.9)	74 (1.7)
Slovenia	4 (0.6)	25 (1.0)	65 (1.4)	92 (0.8)
3 Israel	4 (0.5)	19 (1.3)	48 (1.7)	75 (1.4)
Romania	4 (0.6)	20 (1.3)	46 (1.8)	73 (1.7)
† Scotland	4 (0.6)	23 (1.8)	57 (2.2)	85 (1.3)
Thailand	3 (0.8)	12 (1.7)	34 (2.2)	66 (2.0)
Ukraine	3 (0.5)	15 (1.1)	46 (1.7)	76 (1.5)
Italy	3 (0.6)	17 (1.2)	54 (1.5)	85 (1.1)
Malaysia	2 (0.5)	18 (2.1)	50 (2.7)	82 (1.9)
Cyprus	2 (0.3)	17 (0.8)	48 (0.9)	78 (0.7)
Sweden	2 (0.3)	20 (1.0)	60 (1.3)	90 (0.9)
Jordan	1 (0.2)	11 (0.8)	35 (1.7)	61 (1.8)
Bosnia and Herzegovina	1 (0.2)	10 (0.7)	42 (1.4)	77 (1.3)
Iran, Islamic Rep. of	1 (0.2)	5 (0.9)	20 (1.7)	51 (1.9)
Lebanon	1 (0.2)	10 (1.2)	36 (2.4)	74 (2.3)
1 Georgia	1 (0.3)	7 (0.8)	26 (1.7)	56 (2.8)
Egypt	1 (0.1)	5 (0.4)	21 (1.0)	47 (1.5)
Indonesia	0 (0.2)	4 (0.6)	19 (1.4)	48 (1.9)
Norway	0 (0.1)	11 (0.7)	48 (1.5)	85 (0.8)
Palestinian Nat'l Auth.	0 (0.1)	3 (0.4)	15 (0.9)	39 (1.4)
Colombia	0 (0.0)	2 (0.3)	11 (1.1)	39 (2.1)
Bahrain	0 (0.1)	3 (0.3)	19 (0.7)	49 (0.9)
Syrian Arab Republic	0 (0.1)	3 (0.5)	17 (1.3)	47 (1.9)
Tunisia	0 (0.1)	3 (0.3)	21 (1.2)	61 (1.5)
Oman	0 (0.0)	2 (0.3)	14 (1.1)	41 (1.5)
Qatar	0 (0.0)	0 (0.1)	4 (0.2)	16 (0.5)
◆◆ Kuwait	0 (0.0)	0 (0.2)	6 (0.5)	29 (1.3)
Botswana	0 (0.0)	1 (0.1)	7 (0.7)	32 (1.3)
El Salvador	0 (0.0)	0 (0.1)	3 (0.5)	20 (1.2)
Ghana	0 (0.0)	0 (0.1)	4 (0.7)	17 (1.4)
Algeria	0 (0.0)	0 (0.1)	7 (0.5)	41 (1.4)
Saudi Arabia	0 (0.0)	0 (0.1)	3 (0.4)	18 (1.1)
‡ Morocco	0 (0.1)	1 (0.5)	13 (1.1)	41 (2.0)
International Median	2	15	46	75
Benchmarking Participants				
2 Massachusetts, US	16 (1.7)	52 (2.5)	82 (2.2)	95 (1.1)
3 Quebec, Canada	8 (1.2)	37 (2.0)	78 (1.8)	97 (0.8)
2 † Minnesota, US	8 (1.4)	41 (2.8)	81 (2.0)	97 (1.0)
2 Ontario, Canada	6 (0.8)	33 (2.0)	74 (1.8)	95 (1.1)
3 British Columbia, Canada	5 (1.0)	29 (1.7)	69 (1.5)	93 (0.9)
◆◆ ‡ Dubai, UAE	3 (0.5)	17 (1.1)	47 (1.5)	74 (1.2)
Basque Country, Spain	2 (0.4)	23 (1.5)	66 (1.9)	92 (1.0)



SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Exhibit 2.15 IDB-Analyzer Set-Up for Example Benchmark Analysis



From the first few lines of results in Exhibit 2.16, 40.97% of the eighth-grade students in Algeria are at or above the low international benchmark of 400, with a standard error of 1.43; 7.10% of students reached the intermediate international benchmark, with a standard error of 0.51; 0.20% of the students reached the high international benchmark, with a standard error of 0.08. In the output for Algeria there is no line for students "Above 625" since no sampled eighth-grade students in Algeria reached the TIMSS 2007 advanced international benchmark in mathematics.

Exhibit 2.16 Output for Example Benchmark Analysis

Percent reaching benchmarks (400 475 550 625) of BSMMAT0 PAGE 1

COUNTRY ID	Performance Group	N of Cases	Sum of TOTWGT	Percent	Percent (s.e.)
Algeria	Above 400	2237	268924	40.97	1.43
	Above 475	387	46588	7.10	.51
	Above 550	12	1308	.20	.08
Armenia	Above 400	4185	44324	88.26	.83
	Above 475	3024	31882	63.49	1.41
	Above 550	1239	13314	26.51	1.91
	Above 625	259	2794	5.56	.92
Australia	Above 400	3601	226426	88.55	.98
	Above 475	2483	155426	60.79	1.88
	Above 550	961	61515	24.06	1.84
	Above 625	199	14713	5.75	1.26
Bahrain	Above 400	2156	5628	49.50	.95
	Above 475	851	2134	18.77	.70
	Above 550	153	347	3.05	.33
	Above 625	14	25	.22	.07

Computing Correlations with Background Variables and Achievement Scores

In addition to the analyses described above, the IEA IDB Analyzer can compute correlations among background variables, and between background variables and achievement scores. While no example is presented here, the steps for conducting these analyses are the same as those described previously: select the grouping variables, the analysis variables, the achievement scores (if necessary), and confirm the weight and sampling variables. The output will display, for each group defined by the grouping variables, the correlation coefficients for each possible pair of variables. When using only background variables, the diagonal and the elements above the diagonal of the correlation matrix are displayed with their corresponding standard errors. When using achievement scores, a single column is displayed containing the correlations between each of the background variables specified in the model and the achievement scores selected.

2.6 TIMSS Analyses with Teacher-Level Variables

Analyses with teacher background data seek to make statements about students whose teachers have a given characteristic, rather than about teachers with a given characteristic. As our example of an analysis using teacher background data, we will investigate the percentage of eighth-grade students according to the age of their mathematics teachers. The results of such an analysis are presented in Exhibit 6.1 of the *TIMSS 2007 International Mathematics Report* and are reproduced here in Exhibit 2.17.

Exhibit 2.17 Exhibit of Example Teacher-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 6.1)

Exhibit 6.1 **Mathematics Teachers' Gender, Age, and Number of Years Teaching with Trends (Continued)**

TIMSS2007 Mathematic

Country	Percentage of Students by Teacher Characteristics						Trends in Average Number of Years Teaching		
	Gender		Age						
	Female	Male	29 Years or Under	30–39 Years	40–49 Years	50 Years or Older		2007	Difference from 2003
Algeria	40 (4.2)	60 (4.2)	6 (1.9)	25 (3.8)	63 (4.0)	7 (2.0)		19 (0.8)	◊ ◊
Armenia	82 (2.7)	18 (2.7)	9 (2.6)	26 (3.3)	29 (3.4)	36 (3.6)	r	20 (0.7)	1 (1.0)
Australia	49 (4.3)	51 (4.3)	20 (3.2)	29 (3.7)	22 (3.2)	30 (3.2)		15 (0.8)	0 (1.2)
Bahrain	48 (1.1)	52 (1.1)	18 (1.9)	51 (2.7)	27 (2.6)	4 (1.4)		12 (0.5)	1 (0.9)
Bosnia and Herzegovina	57 (4.1)	43 (4.1)	6 (2.1)	22 (3.3)	22 (3.7)	50 (3.5)		23 (0.8)	◊ ◊
Botswana	43 (4.5)	57 (4.5)	32 (4.4)	60 (4.5)	8 (2.3)	0 (0.1)	r	8 (0.4)	1 (0.7)
Bulgaria	86 (2.7)	14 (2.7)	1 (0.7)	12 (2.6)	37 (4.1)	50 (4.2)		23 (0.9)	3 (1.1) ▲
Chinese Taipei	57 (4.4)	43 (4.4)	16 (3.2)	45 (4.1)	29 (3.7)	10 (2.4)		12 (0.7)	−2 (1.1)
Colombia	41 (5.8)	59 (5.8)	23 (4.0)	25 (3.8)	22 (4.1)	31 (5.3)		18 (1.4)	◊ ◊
Cyprus	69 (2.4)	31 (2.4)	6 (1.5)	32 (2.4)	36 (2.6)	26 (2.5)		13 (0.5)	1 (0.8)
Czech Republic	79 (3.3)	21 (3.3)	13 (2.4)	19 (3.0)	34 (3.6)	35 (3.9)		20 (0.9)	◊ ◊
Egypt	22 (3.5)	78 (3.5)	10 (2.5)	52 (3.8)	34 (3.6)	4 (1.4)		14 (0.6)	1 (0.7)
El Salvador	55 (4.6)	45 (4.6)	21 (3.7)	45 (4.9)	27 (3.3)	7 (2.3)		12 (0.6)	◊ ◊
England	52 (4.2)	48 (4.2)	18 (3.4)	25 (3.3)	26 (3.3)	31 (2.8)	r	14 (0.9)	−2 (1.7)
Georgia	89 (3.2)	11 (3.2)	3 (1.3)	21 (3.7)	30 (4.1)	46 (4.2)		23 (1.0)	◊ ◊
Ghana	8 (2.2)	92 (2.2)	52 (3.9)	28 (4.2)	16 (3.1)	4 (1.1)		7 (0.4)	0 (0.7)
Hong Kong SAR	40 (3.8)	60 (3.8)	26 (4.0)	35 (4.4)	27 (4.3)	12 (2.7)		13 (0.9)	1 (1.2)
Hungary	80 (3.3)	20 (3.3)	9 (2.7)	19 (3.3)	35 (2.9)	37 (3.2)		21 (0.8)	−1 (1.1)
Indonesia	44 (4.3)	56 (4.3)	15 (3.2)	41 (3.9)	37 (4.3)	7 (2.3)		14 (0.7)	0 (0.9)
Iran, Islamic Rep. of	42 (2.0)	58 (2.0)	26 (3.2)	49 (3.5)	20 (3.1)	5 (1.3)		14 (0.5)	0 (0.7)
Israel	76 (3.3)	24 (3.3)	15 (2.7)	33 (3.2)	32 (3.0)	20 (2.4)	r	17 (0.7)	1 (1.0)
Italy	81 (2.8)	19 (2.8)	2 (1.1)	10 (1.9)	22 (2.3)	67 (2.9)		23 (0.7)	0 (0.9)
Japan	43 (3.7)	57 (3.7)	20 (3.1)	28 (3.3)	39 (3.7)	13 (2.7)		16 (0.8)	−1 (1.0)
Jordan	52 (2.6)	48 (2.6)	36 (3.9)	39 (3.8)	18 (3.0)	7 (2.0)		10 (0.6)	−1 (0.9)
Korea, Rep. of	64 (3.2)	36 (3.2)	25 (2.8)	29 (2.9)	34 (3.2)	12 (2.5)	s	14 (0.6)	1 (0.8)
Kuwait	r 51 (2.5)	49 (2.5)	r 19 (3.7)	49 (4.9)	22 (3.6)	10 (2.9)	r	12 (0.7)	◊ ◊
Lebanon	42 (4.4)	58 (4.4)	33 (4.0)	27 (3.6)	22 (3.7)	19 (3.8)	r	14 (0.9)	−1 (1.2)
Lithuania	93 (1.7)	7 (1.7)	7 (1.8)	12 (2.7)	47 (4.0)	34 (3.4)		22 (0.7)	2 (1.1) ▲
Malaysia	71 (3.7)	29 (3.7)	22 (3.7)	39 (4.1)	28 (3.8)	10 (2.5)		12 (0.7)	2 (0.9)
Malta	59 (0.2)	41 (0.2)	47 (0.2)	30 (0.2)	13 (0.2)	10 (0.1)		11 (0.0)	◊ ◊
Norway	41 (3.6)	59 (3.6)	10 (2.2)	34 (3.0)	17 (2.3)	39 (2.5)		17 (0.7)	−1 (1.2)
Oman	52 (2.4)	48 (2.4)	83 (3.0)	14 (2.9)	3 (1.0)	0 (0.4)		5 (0.4)	◊ ◊
Palestinian Nat'l Auth.	49 (3.1)	51 (3.1)	37 (4.4)	29 (3.7)	24 (3.4)	11 (2.4)		12 (0.9)	1 (1.1)
Qatar	51 (0.2)	49 (0.2)	25 (0.1)	40 (0.1)	22 (0.1)	13 (0.1)		14 (0.0)	◊ ◊
Romania	60 (3.4)	40 (3.4)	6 (1.8)	21 (3.0)	23 (3.1)	50 (3.2)		23 (1.0)	0 (1.5)
Russian Federation	94 (1.8)	6 (1.8)	5 (1.0)	21 (2.8)	33 (2.9)	41 (3.4)		24 (0.7)	0 (1.1)
Saudi Arabia	47 (1.7)	53 (1.7)	35 (4.3)	46 (4.2)	13 (2.6)	7 (2.6)		11 (0.8)	– –
Scotland	58 (3.1)	42 (3.1)	16 (2.1)	25 (3.0)	25 (2.9)	33 (3.6)	r	15 (0.8)	−1 (1.3)
Serbia	61 (4.4)	39 (4.4)	9 (2.4)	20 (3.0)	20 (3.5)	51 (4.0)		20 (1.0)	−2 (1.4)
Singapore	64 (2.7)	36 (2.7)	45 (2.5)	31 (2.3)	12 (1.8)	12 (1.3)		8 (0.4)	−4 (0.8) ▼
Slovenia	82 (2.0)	18 (2.0)	17 (2.1)	23 (2.4)	39 (3.0)	21 (2.5)		18 (0.6)	−2 (1.0)
Sweden	55 (2.9)	45 (2.9)	11 (2.0)	30 (2.7)	22 (2.7)	37 (3.2)		15 (0.8)	1 (1.1)
Syrian Arab Republic	55 (3.8)	45 (3.8)	34 (3.8)	39 (4.0)	17 (3.0)	10 (2.8)		11 (0.7)	◊ ◊
Thailand	64 (4.1)	36 (4.1)	19 (3.5)	29 (3.9)	26 (3.9)	25 (3.8)		15 (0.9)	◊ ◊
Tunisia	33 (3.8)	67 (3.8)	15 (2.9)	47 (4.1)	25 (3.6)	13 (2.7)	s	13 (0.6)	0 (1.1)
Turkey	45 (4.2)	55 (4.2)	49 (4.0)	16 (2.8)	19 (3.3)	16 (3.4)		11 (0.8)	◊ ◊
Ukraine	91 (2.4)	9 (2.4)	8 (2.3)	21 (3.1)	31 (4.1)	40 (4.2)		23 (0.9)	◊ ◊
United States	69 (2.6)	31 (2.6)	20 (2.3)	29 (2.8)	26 (2.8)	25 (2.2)		14 (0.6)	−1 (0.9)
‡ Morocco	25 (3.5)	75 (3.5)	9 (2.9)	13 (3.0)	47 (5.4)	31 (5.2)	r	20 (1.3)	– –
International Avg.	57 (0.5)	43 (0.5)	21 (0.4)	30 (0.5)	26 (0.5)	23 (0.4)		15 (0.1)	
Benchmarking Participants									
Basque Country, Spain	51 (5.2)	49 (5.2)	2 (1.4)	23 (4.0)	34 (4.3)	41 (4.8)		22 (1.1)	1 (1.4)
British Columbia, Canada	45 (4.3)	55 (4.3)	16 (3.4)	39 (4.7)	24 (3.9)	21 (3.8)		13 (0.8)	◊ ◊
Dubai, UAE	s 57 (6.2)	43 (6.2)	s 13 (1.5)	46 (5.6)	24 (4.3)	17 (4.3)	s	15 (0.6)	◊ ◊
Massachusetts, US	56 (6.1)	44 (6.1)	23 (5.6)	29 (6.5)	23 (5.3)	25 (5.3)		12 (1.2)	◊ ◊
Minnesota, US	50 (8.2)	50 (8.2)	33 (8.6)	32 (7.7)	19 (7.0)	16 (4.6)		12 (1.5)	◊ ◊
Ontario, Canada	49 (3.6)	51 (3.6)	20 (3.8)	50 (5.0)	16 (3.6)	14 (3.5)		10 (0.9)	−1 (1.2)
Quebec, Canada	53 (4.3)	47 (4.3)	22 (3.7)	46 (4.6)	19 (3.6)	13 (2.7)		11 (0.8)	−5 (1.3) ▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

2007 significantly higher ▲
2007 significantly lower ▼

We will use the **Percentages only** analysis type to estimate the percentages of students in the reporting categories of teachers' age since we are not concerned with student achievement in this analysis.

As in previous examples, we first identify the variables relevant to the analysis in the appropriate files and review the documentation for any specific national adaptations to the questions of interest (Supplements 1 and 2). In the eighth-grade mathematics teacher background data files, we find the variable that contains the information on the age of eighth-grade mathematics teachers (BT4GAGE).

The merged data file BTMALLM4 will be used for this example. Note that one of the steps in reproducing this analysis is to combine response categories 1 and 2 and response categories 5 and 6 of the variable BT4GAGE in order to match the results presented in the international report, where teachers are categorized into four groups: 29 years or under, 30-39 years old, 40-49 years old, and 50 years or older. The SPSS syntax shown in Exhibit 2.18 is used to recode BT4GAGE into a new variable NEWAGE and is available in the SPSS syntax file SYNTAX_BTMALLM4.SPS on the DVD. The parameter <datpath> needs to be edited to specify the location of the input and output data files

Exhibit 2.18 Example SPSS Program to Recode Variables for Teacher-Level Analysis

```
* Compute new variable NEWAGE from BT4GAGE .

get file = "<datpath>btmallm4.sav" .

recode BT4GAGE (1,2=1) (3=2) (4=3) (5,6=4) (else=sysmis) into NEWAGE .

value labels
    NEWAGE 1 '29 yrs or under'
           2 '30-39 years'
           3 '40-49 years'
           4 '50 years or older' .

variable labels
    NEWAGE "Recoded BT4GAGE Teacher Age" .

save outfile = "<datpath>btmallm4.sav" .
```

The example teacher-level analysis is performed by the analysis module of the IEA IDB Analyzer using the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Specify the data file BTMALLM4 as the **Analysis File** by clicking the **Change** button.
3) Select **Percentages only** as the **Analysis Type**.
4) Add the variable NEWAGE as a second **Grouping Variable**.

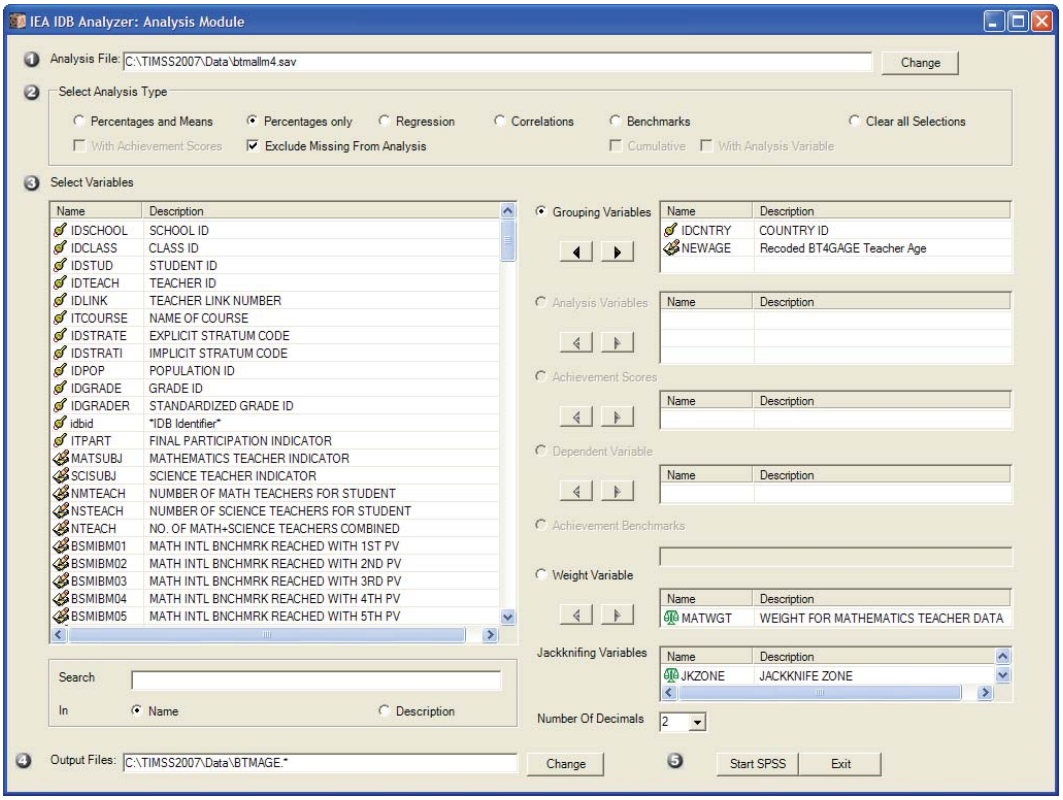
5) The **Weight Variable** is automatically selected by the software. As this example analysis uses eight-grade mathematics teacher background data, MATWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.

6) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.

7) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file will be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.19 displays the analysis module with the proper settings for this example analysis. The output is shown in Exhibit 2.20.

Exhibit 2.19 IDB-Analyzer Set-Up for Example Teacher-Level Analysis



Each country's results in Exhibit 2.20 are presented on four lines, one for each value of the NEWAGE variable. The results are presented in the same manner as in previous examples, with countries identified in the first column and the second

column describing the categories of NEWAGE. From the first four lines of results, 5.84% of students in Algeria were taught by teachers 29 years or younger, 24.94% by teachers 30 to 39 years old, 62.51% by teachers 40 to 49 years old, and 6.71% by teachers 50 years or older. The appropriate standard errors also are presented in Exhibit 2.20.

Exhibit 2.20 Output for Example Teacher-Level Analysis

Percentages by (IDCNTRY NEWAGE) PAGE 1

COUNTRY ID	Recoded BT4GAGE Teacher Age	N of Cases	Sum of MATWGT	Percent	Percent (s.e.)
Algeria	29 yrs or under	301	36432	5.84	1.89
	30-39 years	1295	155668	24.94	3.81
	40-49 years	3203	390172	62.51	4.04
	50 years or older	371	41871	6.71	2.04
Armenia	29 yrs or under	260	4419	8.85	2.55
	30-39 years	1351	13003	26.04	3.29
	40-49 years	1406	14383	28.80	3.39
	50 years or older	1645	18129	36.31	3.63
Australia	29 yrs or under	718	48130	19.63	3.22
	30-39 years	1063	70105	28.59	3.74
	40-49 years	966	54043	22.04	3.24
	50 years or older	1203	72894	29.73	3.17
Bahrain	29 yrs or under	665	1905	17.65	1.90
	30-39 years	2170	5462	50.60	2.66
	40-49 years	1041	2950	27.32	2.65
	50 years or older	192	479	4.43	1.42

2.7 TIMSS Analyses with School-Level Variables

When performing analyses with school background data, the data are analyzed to make statements about students attending schools with a given characteristic, rather than about schools with a given characteristic. Our example of an analysis using school background data will compute the percentages of eighth-grade students who attend schools with a high, medium, and low index of good attendance at school. We can use the variable BCDGAS for this purpose. We also will calculate the mean mathematics achievement at each level of good attendance at school. The results of this analysis are presented in Exhibit 8.3 of the *TIMSS 2007 International Mathematics Report* and are displayed here in Exhibit 2.21.

Exhibit 2.21 Exhibit of Example School-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 8.3)

Exhibit 8.3 **Index of Good Attendance at School (GAS) (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	High GAS		Medium GAS		Low GAS	
	2007 Percent of Students	Average Achievement	2007 Percent of Students	Average Achievement	2007 Percent of Students	Average Achievement
Lebanon	52 (5.1)	454 (6.4)	42 (5.2)	447 (8.5)	5 (1.6)	434 (15.4)
Chinese Taipei	52 (4.0)	603 (6.5)	42 (4.0)	596 (6.1)	5 (1.9)	577 (9.6)
Oman	50 (4.3)	374 (5.1)	42 (4.8)	379 (6.2)	9 (2.6)	350 (17.8)
Korea, Rep. of	49 (4.3)	599 (3.7)	42 (4.4)	594 (3.9)	9 (1.8)	598 (8.4)
Malta	43 (0.2)	528 (1.6)	47 (0.2)	458 (1.5)	10 (0.2)	440 (3.8)
Czech Republic	36 (4.2)	520 (5.9)	53 (4.4)	497 (3.4)	11 (2.9)	483 (5.4)
Egypt	34 (4.0)	402 (6.0)	53 (4.1)	386 (6.1)	13 (2.7)	372 (8.9)
Armenia	30 (3.7)	495 (5.0)	56 (4.1)	501 (5.8)	14 (2.6)	498 (5.5)
Hong Kong SAR	30 (4.1)	611 (8.2)	60 (4.7)	560 (7.5)	10 (3.0)	500 (24.2)
Jordan	30 (3.8)	433 (9.3)	52 (4.3)	429 (6.3)	18 (3.3)	408 (11.8)
Singapore	30 (0.0)	629 (6.4)	66 (0.0)	580 (5.0)	4 (0.0)	535 (28.4)
Italy	28 (3.5)	483 (4.9)	56 (4.0)	479 (4.1)	15 (2.7)	474 (8.4)
Slovenia	28 (3.7)	498 (4.9)	54 (4.1)	506 (2.9)	19 (3.2)	497 (4.5)
Bosnia and Herzegovina	28 (3.6)	455 (4.2)	61 (4.2)	457 (3.8)	11 (2.7)	449 (11.0)
Hungary	26 (3.6)	527 (9.2)	55 (4.6)	520 (5.3)	19 (3.7)	493 (8.1)
Iran, Islamic Rep. of	25 (3.3)	410 (7.1)	72 (3.4)	401 (5.4)	3 (1.3)	403 (8.3)
Turkey	25 (3.8)	447 (11.3)	53 (5.1)	435 (7.8)	22 (3.5)	408 (11.6)
Algeria	23 (3.4)	389 (4.4)	56 (4.5)	385 (2.8)	21 (3.9)	391 (3.7)
England	23 (3.1)	555 (10.2)	65 (4.0)	507 (6.1)	12 (2.8)	481 (13.0)
Ukraine	23 (3.5)	470 (7.3)	65 (4.1)	464 (4.5)	12 (3.0)	437 (8.9)
Israel	21 (3.2)	467 (9.7)	55 (4.8)	469 (6.2)	24 (4.0)	458 (10.4)
Palestinian Nat'l Auth.	21 (3.3)	380 (7.9)	65 (4.0)	372 (4.9)	14 (2.5)	331 (11.0)
Romania	18 (2.7)	476 (11.3)	52 (3.8)	471 (5.8)	30 (4.1)	440 (8.9)
Australia	18 (2.8)	547 (10.1)	65 (3.7)	495 (5.2)	16 (2.7)	448 (7.5)
Syrian Arab Republic	17 (3.6)	384 (10.4)	64 (4.9)	396 (5.4)	19 (3.3)	399 (7.6)
Russian Federation	17 (2.8)	530 (8.9)	63 (3.1)	512 (4.9)	20 (3.0)	495 (6.7)
Bulgaria	17 (3.0)	492 (10.3)	44 (3.9)	470 (7.7)	39 (4.0)	445 (9.3)
Malaysia	17 (2.8)	503 (12.2)	68 (3.2)	471 (5.7)	15 (2.8)	455 (12.8)
Bahrain	17 (0.2)	412 (3.8)	64 (0.3)	398 (2.1)	20 (0.2)	384 (2.6)
Serbia	16 (3.6)	496 (6.4)	55 (4.4)	483 (4.4)	29 (3.6)	485 (7.4)
Colombia	15 (3.2)	400 (10.3)	38 (4.8)	384 (5.8)	47 (4.2)	369 (6.2)
United States r	15 (2.5)	519 (5.9)	66 (3.6)	514 (4.2)	19 (2.8)	481 (6.4)
Scotland	15 (2.9)	514 (15.9)	78 (3.3)	485 (4.9)	7 (1.8)	461 (20.0)
Saudi Arabia	14 (3.1)	315 (8.2)	65 (3.8)	330 (3.8)	21 (3.1)	336 (6.5)
Thailand	14 (2.7)	459 (14.9)	68 (3.7)	438 (6.5)	18 (3.5)	441 (12.9)
Tunisia	14 (2.9)	421 (6.1)	63 (4.0)	422 (3.1)	23 (3.7)	415 (4.6)
Qatar r	13 (0.1)	326 (3.9)	64 (0.2)	290 (1.7)	23 (0.2)	323 (2.5)
Botswana	13 (2.7)	381 (7.6)	61 (3.9)	367 (3.2)	27 (3.5)	346 (4.4)
Japan	11 (2.5)	572 (8.2)	49 (4.5)	581 (4.1)	40 (3.9)	556 (4.4)
El Salvador	11 (2.3)	357 (9.0)	67 (4.1)	341 (3.7)	22 (3.8)	331 (7.0)
Cyprus	11 (0.1)	462 (3.8)	73 (0.2)	466 (1.9)	16 (0.2)	462 (5.2)
Georgia	10 (3.1)	391 (24.4)	69 (4.9)	408 (7.0)	21 (4.2)	417 (8.9)
Norway	8 (2.1)	478 (6.5)	73 (4.0)	470 (2.3)	19 (3.6)	465 (4.6)
Indonesia	7 (2.2)	432 (17.2)	57 (4.8)	405 (6.2)	36 (4.3)	376 (8.8)
Kuwait	7 (2.7)	366 (9.4)	57 (4.8)	351 (3.9)	36 (4.3)	355 (5.1)
Lithuania	6 (2.0)	493 (10.1)	44 (4.3)	507 (4.2)	50 (4.4)	506 (4.0)
Ghana	5 (2.0)	354 (45.8)	71 (4.2)	313 (5.2)	24 (4.0)	290 (11.1)
Sweden	4 (1.6)	519 (13.9)	58 (4.0)	492 (2.8)	38 (3.9)	487 (3.6)
‡ Morocco	7 (2.5)	432 (20.3)	50 (6.5)	373 (5.4)	43 (6.3)	377 (5.6)
International Avg.	21 (0.4)	464 (1.7)	58 (0.6)	450 (0.8)	20 (0.5)	436 (1.6)
Benchmarking Participants						
Basque Country, Spain	28 (4.7)	505 (7.0)	63 (5.3)	499 (3.8)	9 (2.6)	482 (10.1)
Minnesota, US	27 (7.7)	526 (5.9)	71 (7.7)	537 (5.1)	2 (1.2)	~ ~
Dubai, UAE s	24 (0.6)	480 (3.7)	65 (0.7)	452 (4.2)	11 (0.3)	502 (5.2)
Ontario, Canada	18 (3.7)	526 (8.0)	72 (4.3)	521 (3.4)	10 (2.9)	500 (12.4)
Quebec, Canada	17 (3.3)	567 (10.8)	59 (4.5)	527 (5.2)	25 (3.8)	506 (7.2)
Massachusetts, US	16 (5.5)	557 (18.6)	75 (6.6)	549 (6.4)	9 (4.5)	502 (16.3)
British Columbia, Canada	13 (3.6)	525 (10.8)	68 (4.4)	517 (4.0)	19 (3.4)	482 (8.3)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

For this analysis, we will use the **Percentages and Means** analysis type of the IEA IDB Analyzer with the **With Achievement Scores** option checked. The variable BCDGAS in the school background data files contains information on the index of good attendance at school. As BCDGAS is a derived variable, we can refer to Supplement 3 to see how it was created. We also should review the documentation on national adaptations to its component variables in Supplement 2.

The merged data file BCGALLM4 will be used for this example. This school-level analysis is performed by the analysis module of the IEA IDB Analyzer using the following steps:

1) Open the analysis module of the IEA IDB Analyzer.
2) Specify the data file BCGALLM4 as the **Analysis File** by clicking the **Change** button.
3) Select **Percentages and Means** as the **Analysis Type**.
4) Check the **With Achievement Scores** box.
5) Add the variable BCDGAS as a second **Grouping Variable**.
6) Click the **Achievement Scores** radio button. Select the variable BSMMAT01-05 from the list of available variables and move it to the **Achievement Scores** field by clicking the **right arrow** button in this section.
7) The **Weight Variable** is automatically selected by the software. As this example analysis uses school background data linked to student background data, TOTWGT is selected by default. The **Jackknifing Variables** JKZONE and JKREP also are selected by default.
8) Specify the name and folder of the output files in the **Output Files** field by clicking the **Change** button.
9) Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax window. The syntax file will be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. If necessary, the IEA IDB Analyzer will display a prompt to confirm the overwriting of existing files.

Exhibit 2.22 shows the analysis module with the proper settings for this example analysis. The output is shown in Exhibit 2.23, with each country's results displayed on three lines, one for each value of the BCDGAS variable. The results are presented in the same manner as in previous examples, with countries identified in the first column and the second column describing the categories of

BCDGAS. From the first three lines of results, 23.30% of eighth-grade students in Algeria attend schools with a high level of good attendance at school, 55.99% attend schools with a medium level, and 20.71% attend schools with a low level of good attendance at school. Also, the estimated mean mathematics achievement of eighth-grade students in schools with a high level of good attendance at school is 389.02 (standard error of 4.38), whereas the estimated mean mathematics achievement of eighth-grade students in schools with a medium and low levels of good attendance at school are 385.33 (standard error of 2.78) and 391.13 (standard error of 3.68), respectively.

Exhibit 2.22 IDB-Analyzer Set-Up for Example School-Level Analysis

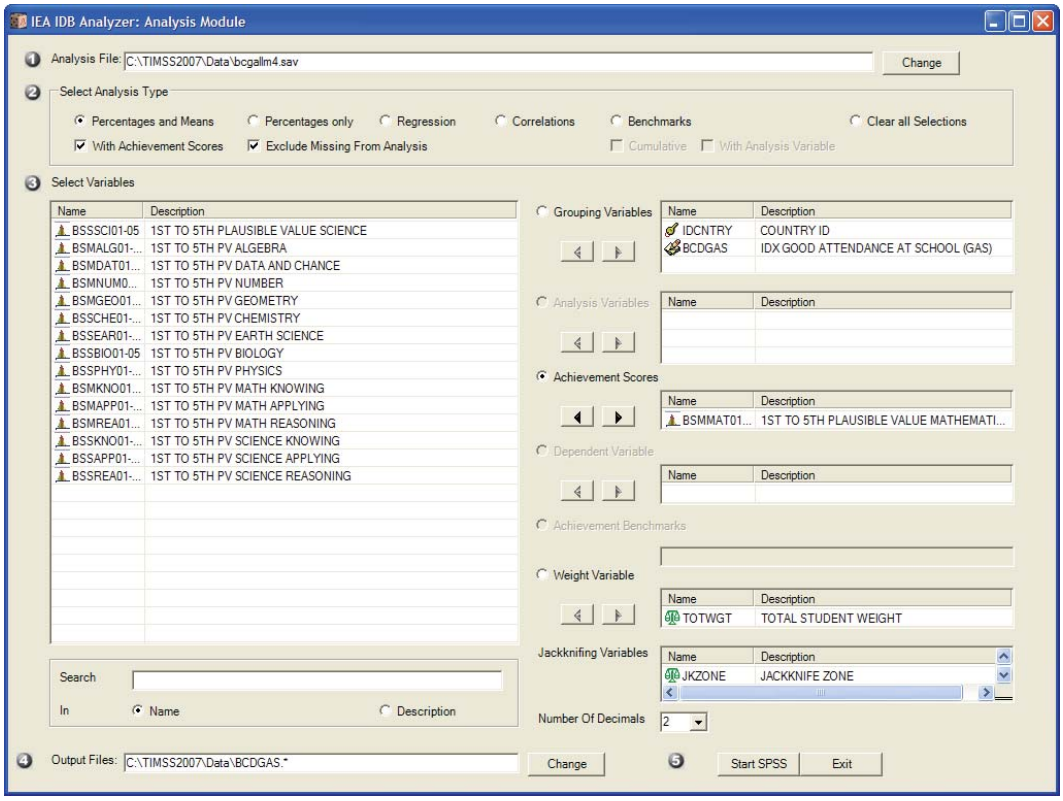


Exhibit 2.23 Output for Example School-Level Analysis

Average for BSMMAT0 by IDCNTRY BCDGAS PAGE 1

COUNTRY ID	IDX GOOD ATTENDANCE AT SCHOOL (GAS)	N of Cases	Sum of TOTWGT	Percent	Percent (s.e.)	BSMMAT0 (Mean)	BSMMAT0 (s.e.)	Std.Dev	Std.Dev (s.e.)
Algeria	HIGH	1212	134737	23.30	3.40	389.02	4.38	62.62	1.91
	MEDIUM	2585	323692	55.99	4.51	385.33	2.78	58.75	1.22
	LOW	992	119735	20.71	3.88	391.13	3.68	56.89	1.46
Armenia	HIGH	1417	15258	30.38	3.75	494.84	5.01	78.93	2.49
	MEDIUM	2457	28131	56.02	4.10	501.03	5.82	89.25	4.40
	LOW	815	6829	13.60	2.56	497.56	5.49	77.46	3.33
Australia	HIGH	703	45649	18.36	2.75	547.50	10.12	75.45	4.30
	MEDIUM	2641	162444	65.32	3.70	495.27	5.20	74.04	3.06
	LOW	577	40606	16.33	2.69	447.81	7.48	71.20	2.73
Bahrain	HIGH	751	1824	16.57	.23	411.68	3.76	75.25	2.70
	MEDIUM	2619	7012	63.69	.26	398.37	2.14	85.48	1.83
	LOW	790	2173	19.74	.21	383.84	2.60	83.17	1.71

References

IEA (2009). *IEA international database analyzer* (version 2.0). Hamburg, Germany: IEA Data Processing and Research Center.

Joncas, M. (2008). TIMSS 2007 sampling weights and participation rates. Chapter 9 in J.F. Olson, M.O. Martin, and I.V.S. Mullis (Eds.), *TIMSS 2007 technical report* (pp. 153-192). Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Mullis, I.V.S., Martin, M.O., & Foy, P. (with Olson, J.F., Preuschoff, C., Erberber, E., Arora, A., & Galia, J.). (2008). *TIMSS 2007 international mathematics report: Findings from IEA's Trends in International Mathematics and Science Study at the fourth and eighth grades*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

SPSS Inc. (2008). *SPSS for Windows* (version 16.0). Chicago, IL: SPSS Inc.

Chapter 3

Analyzing the TIMSS 2007 International Database Using SAS

3.1 Overview

Although users of the TIMSS 2007 international database are encouraged to use the IEA IDB Analyzer in conjunction with SPSS because it is easy to use and deals effectively with the complexity of the TIMSS 2007 data, this chapter also presents some basic examples of analyses that can be performed with the TIMSS 2007 international database using the SAS statistical analysis system (SAS, 2002) and the SAS programs and macros provided. The SAS macros use sampling weights and a jackknifing algorithm to deal with the TIMSS complex sample design and take into account plausible values when analyzing student achievement.

Although some familiarity with the structure of the TIMSS 2007 database will be helpful, the analyses presented in this chapter are simple in nature, and are designed primarily to familiarize users with the various data files and their structure, as well as the variables to be used in most analyses. Chapter 4 provides a more detailed description of the data files contained in the international database—their structure and contents, along with detailed information on all the supporting documentation provided on the DVD.

In general, the examples in this chapter compute percentages of students in specified subgroups, average mathematics achievement in those subgroups, and appropriate standard errors for these statistics. Additional examples compute regression coefficients and their standard errors. The example analyses, using student, teacher and school data, replicate some of the analyses that are included in the *TIMSS 2007 International Mathematics Report* (Mullis, Martin, & Foy, 2008). Users are encouraged to practice analyzing the TIMSS data by replicating some of the exhibits presented in the international reports.

Before doing any statistical analyses with the TIMSS international database, users should copy the contents of the TIMSS 2007 database DVD to an alternate location, either on their computer or on a server. For the purposes of this chapter, we will assume all files on the DVD have been copied to the "C:\TIMSS2007\" folder. All SAS programs presented in this chapter are available on the DVD. They can be adapted to perform a variety of analyses with some basic knowledge of the SAS language. With a little experience and some practice with these programs, users should be able to make the necessary modifications to obtain the desired results. The example SAS programs invoke SAS macros that will be described in this chapter. Although users will be expected to modify the example programs, there is no need to make any changes within the SAS macros.

3.2 SAS Programs and Macros

The "Programs" folder on the DVD that accompanies this User Guide includes a number of SAS programs needed to process the SAS data files, compute survey results, and carry out example analyses. This chapter gives detailed instructions on how to adapt and make use of them. The following programs are available:

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.

ASASCRM4.SAS, BSASCRM4.SAS

These two SAS programs can be used to convert the response codes to the achievement items to their corresponding score levels.

JOIN.SAS

This SAS program combines files of the same type from more than one country.

JACKGEN.SAS (and SAMPLEJACKGEN.SAS)

This SAS macro program is used to compute weighted percentages of students within defined subgroups, along with their means on a specified continuous variable. This macro generates replicate weights and computes standard errors using the jackknife repeated replication (JRR) methodology. The analysis

variable can be any continuous variable. When computing mean achievement scores with plausible values, the macro JACKPV.SAS should be used.

JACKPV.SAS (and SAMPLEJACKGPV.SAS)

This SAS macro program is used to compute weighted percentages of students within defined subgroups, along with their mean achievement on a scale using the available plausible values. This macro generates replicate weights and computes standard errors using the jackknife repeated replication (JRR) and multiple imputation methodologies. This macro should be used when achievement plausible values are used in an analysis.

JACKREG.SAS (and SAMPLEJACKREG.SAS)

This SAS macro program is used to compute weighted regression coefficients and their standard errors within defined subgroups. This macro can be used with any analysis variable, but is not appropriate for analyzing achievement with plausible values.

JACKREGP.SAS (and SAMPLEJACKREGP.SAS)

This SAS macro program is used to compute weighted regression coefficients and their standard errors within defined subgroups when using achievement plausible values as the dependent variable.

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

EXAMPLE1.SAS, EXAMPLE2.SAS, EXAMPLE3.SAS, EXAMPLE4.SAS

They are the programs used in the example analyses presented in this chapter.

3.3 Converting the SAS Export Files

The DVD provides a program called CONVERT.SAS that converts the SAS Export files provided on the DVD into SAS data files. This conversion is necessary since all the SAS macros and SAS programs presented in this chapter require the use of SAS data files.

To convert SAS Export files into SAS data files, users should apply the following steps:

1) Open the SAS program file CONVERT.SAS
2) At the beginning of the program, specify the data file type in the parameter "TYPE"
3) Specify the path where the SAS Export files are located in the parameter "EXPPATH"
4) Specify the folder where the converted SAS data files will be located in the parameter "DATPATH"
5) List all the countries of interest in the parameter "COUNTRY"
   By default, all TIMSS 2007 countries are listed and the program will automatically select the appropriate list by grade based on the file type specified
6) Submit the edited code for processing

An example of the CONVERT program is presented in Exhibit 3.1. This example converts the SAS Export files of type BSG for all countries. For this example, all SAS Export files are located in the "C:\TIMSS2007\Data\SAS_Data" folder and the converted SAS data files also will be located in this folder.

Exhibit 3.1 Example of CONVERT Program Used to Convert SAS Export Files into SAS Data Files

```
%LET TYPE = BSG ;

%LET EXPPATH = C:\TIMSS2007\Data\SAS_Data\ ;

%LET DATPATH = C:\TIMSS2007\Data\SAS_Data\ ;

%MACRO DOIT ;

  %LET COUNTRY = < List of TIMSS 2007 countries > ;

  %LET I = 1 ;
  %DO %WHILE(%LENGTH(%SCAN(&COUNTRY,&I))) ;
    %LET CTRY = %SCAN(&COUNTRY,&i) ;

    PROC CIMPORT FILE = "&EXPPATH&TYPE&CTRY.M4.EXP"
                 DATA = "&DATPATH&TYPE&CTRY.M4" ;

    %LET I = %EVAL(&I + 1) ;
  %END ;

%MEND DOIT ;

%DOIT ;
```

Users are advised to run the CONVERT program for all countries and all file types. The file types at the fourth grade are ACG, ASA, ASG, ASR, AST, and ATG. At the eighth-grade, the file types are BCG, BSA, BSG, BSR, BST, BTM, and BTS. File types are described in Chapter 4. In principle, this program needs to be run only once for each file type and should be one of the first thing users do with the TIMSS 2007 international database before moving on to any data analyses, more specifically the data analysis examples in this User Guide.

3.4 Scoring Individual TIMSS 2007 Items

Student achievement in TIMSS is represented by a set of five plausible values for each achievement domain and these are the preferred scores for any analysis of student achievement. However, analyzing performance on individual items may be of interest to some users. Carrying out such analyses requires that the individual items in the TIMSS 2007 database be assigned their correctness score levels, rather than the actual response options selected by students for multiple-choice items, or the two-digit codes given to students' responses to constructed-response items. The DVD provides SAS programs to perform this task.

For multiple-choice items, numbers 1 through 5 are used to represent response options A through E, respectively, in the TIMSS 2007 achievement data files. These responses need to be converted to their appropriate score level ("1" for correct and "0" for incorrect) based on each multiple-choice item's correct response key. For constructed-response items, worth a total of one or two points, two-digit codes are used to represent the students' written responses in the TIMSS database. These codes also need to be recoded to represent the correct point values of the responses—either zero, one, or two points.

For both types of items, special codes are set aside to represent missing data as either "Not Administered", "Omitted", or "Not Reached". These special missing codes also must be recoded in order to carry out specific item-level analyses. By default, the not administered response code is left as missing and the omitted and not reached response codes as incorrect. These default settings can be modified within the programs, depending on the requirements of the item-level analyses. For example, not reached responses were treated as missing for the purpose of calibrating the TIMSS 2007 items, whereas they were treated as incorrect when deriving achievement scores for students.

The DVD includes two SAS programs—ASASCRM4.SAS for the fourth-grade items and BSASCRM4.SAS for the eighth-grade items—which will recode the responses to individual items from the achievement data files to their appropriate

score levels. To score each individual TIMSS 2007 item, the program code in the ASASCRM4 and BSASCRM4 programs needs to be adapted. Users should do the following steps:

1) Open the SAS program file ASASCRM4.SAS or BSASCRM4.SAS
2) Specify the folder where the SAS data files are located in the "LIBNAME" statement
3) List all the countries of interest in the parameter "COUNTRY"
   By default, all TIMSS 2007 countries are listed
4) Submit the edited code for processing

Each program uses the student achievement data files as input (ASA/BSA), recodes the individual items and saves the results in SAS data files that have "ASC/BSC" instead of "ASA/BSA" as the first three characters in their file names. Exhibit 3.2 shows a condensed version of the ASASCRM4 and BSASCRM4 programs to score the individual TIMSS 2007 items.

Exhibit 3.2 Example of ASASCRM4/BSASCRM4 Programs for Converting Individual Item Response Codes to their Score Level

```
LIBNAME LIBDAT "C:\TIMSS2007\Data\SAS_Data\" ;

%LET COUNTRY = < List of TIMSS 2007 countries > ;

%LET ARIGHT = < List of multiple-choice items where A is correct > ;
%LET BRIGHT = < List of multiple-choice items where B is correct > ;
%LET CRIGHT = < List of multiple-choice items where C is correct > ;
%LET DRIGHT = < List of multiple-choice items where D is correct > ;
%LET ERIGHT = < List of multiple-choice items where E is correct > ;
%LET CONSTR = < List of constructed-response items > ;

%MACRO SCOREIT (ITEM, TYPE, RIGHT, NR, NA, OM, OTHER) ;

   .  .  .

%MEND SCOREIT ;

%MACRO DOIT ;

   .  .  .

  DO OVER ARIGHT ; %SCOREIT (ARIGHT, "MC", 1, .R, .A, ., .I) ; END ;
  DO OVER BRIGHT ; %SCOREIT (BRIGHT, "MC", 2, .R, .A, ., .I) ; END ;
  DO OVER CRIGHT ; %SCOREIT (CRIGHT, "MC", 3, .R, .A, ., .I) ; END ;
  DO OVER DRIGHT ; %SCOREIT (DRIGHT, "MC", 4, .R, .A, ., .I) ; END ;
  DO OVER ERIGHT ; %SCOREIT (ERIGHT, "MC", 5, .R, .A, ., .I) ; END ;
  DO OVER CONSTR ; %SCOREIT (CONSTR, "CR",  , .R, .A, ., .I) ; END ;

   .  .  .

%MEND DOIT ;

%DOIT ;
```

If not reached responses are to be treated as missing rather than incorrect, users should replace the following statement (which appears twice in the programs):

```
IF &ITEM = &NR THEN SCORE = 0 ;
```

with this statement:

```
IF &ITEM = &NR THEN SCORE = . ;
```

3.5 Joining the TIMSS 2007 Data Files

The TIMSS 2007 international database contains separate data files for each country. The DVD provides a SAS program called JOIN.SAS that joins individual country data files of a particular type into a single aggregated data file, facilitating joint analyses involving more than one country. This program, however, can only join SAS data files of the same type. The JOIN program can be used for the following data file types: ACG/BCG, ASA/BSA, ASC/BSC, ASG/BSG, ASR/BSR, AST/BST, and ATG/BTM/BTS. To create a SAS data file with more than one country's data, users should do the following:

1) Open the SAS program file JOIN.SAS
2) At the beginning of the program, specify the data file type in the parameter "TYPE"
3) Specify the folder where the SAS data files are located in the LIBDAT statement
4) List all the countries of interest in the parameter "COUNTRY"
5) Submit the edited code for processing

An example of the JOIN program is displayed in Exhibit 3.3. It joins the eighth-grade student background data files (BSG) of all countries. All country data files are located in the "C:\TIMSS2007\Data\SAS_Data" folder for the sake of this example. The resulting data file, BSGALLM4, will be saved in this folder as well.

Exhibit 3.3 Example of JOIN Program Used to Join SAS Data Files for More Than One Country

```
%LET TYPE = BSG ;

LIBNAME LIBDAT "C:\TIMSS2007\Data\SAS_Data\" ;

%MACRO DOIT ;

  %LET COUNTRY = < List of TIMSS 2007 countries > ;

  DATA &TYPE.ALLM4 ;
       SET  %LET I = 1 ;
            %DO %WHILE(%LENGTH(%SCAN(&COUNTRY,&I))) ;
              %LET CTRY = %SCAN(&COUNTRY,&I) ;
              LIBDAT.&TYPE&CTRY.M4
              %LET I = %EVAL(&I + 1) ;
            %END ; ;

  PROC SORT DATA = &TYPE.ALLM4 OUT = LIBDAT.&TYPE.ALLM4 ;
       BY &SORTVARS ;

%MEND DOIT ;

%DOIT ;
```

3.6 SAS Macros to Compute Statistics and their Standard Errors

This section describes the four SAS macros needed to compute specific statistics with their correct standard errors, along with sample SAS programs to demonstrate their use. Users are encouraged to modify the sample SAS programs and familiarize themselves with their functioning. However, the four SAS macros do not require any modifications.

Each SAS macro serves a specific analytical purpose. These macros ensure that analyses of the TIMSS 2007 data are done properly. Sampling weights are used and standard errors are computed using the jackknife repeated replication (JRR) method. Furthermore, achievement scores are based on sets of five plausible values that take into account the measurement error arising from the test design and the IRT scaling methodology. The macros that make use of plausible values effectively perform five analyses—one for each plausible value—and aggregate the results to produce accurate estimates of achievement and standard errors that incorporate both sampling and imputation errors.

The sample SAS programs presented in this section all use as input the SAS data file BSGALLM4, which contains the eighth-grade student background data files of all participating countries. In all sample programs, <datpath> must be edited to specify the folder where the BSGALLM4 file is located.

Computing Means and Their Standard Errors (JACKGEN)

The JACKGEN macro is used to compute percentages and means of continuous variables with their JRR standard errors. We will demonstrate its use with a sample SAS program that calls the macro JACKGEN to compute the percentages of students within specified subgroups and their mean on a variable of choice. The macro also computes the appropriate standard errors for the percentages and means. However, this macro is not appropriate for analyzing achievement means based on plausible values; the JACKPV macro should be used for this purpose.

The JACKGEN macro is a self-contained program, located in the program file JACKGEN.SAS, and should not be modified. It essentially computes sets of replicate weights using the sampling and weighting variables, aggregates the data by subgroups using the replicate weights, and then computes and stores the desired statistics in a SAS working file called FINAL.

The macro JACKGEN is included in a SAS program by issuing the following command:

```
%INCLUDE "<macpath>JACKGEN.SAS" ;
```

where <macpath> points to the folder where the SAS macro JACKGEN.SAS is located. The macro requires that several parameters be specified as input when it is invoked. These parameters are:

WGT	The sampling weight to be used in the analysis. Generally, TOTWGT should be used. MATWGT should be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data and TCHWGT should be used when analyzing all teacher data.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS data 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 data files is JKREP.
NJKZ	The number of replicate weights to be generated when computing the JRR standard errors. The value of NJKZ should be set to 75, the maximum possible value across all participating countries.

CVAR — The list of variables that are to be used to define the subgroups. The list can consist of one or more variables. We recommend that users always include IDCNTRY as the first classification variable.

DVAR — The variable for which means are to be computed. Only one variable can be listed and it should be a continuous variable. Plausible values of achievement scores should not be specified here.

INFILE — The name of the data file that contains the data being analyzed. If the folder is included as part of the file name, the name of the file must be enclosed in quotes. It is important to emphasize that this data file must include only those cases that are of interest in the analysis. If users want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.

The JACKGEN macro is invoked by a SAS program using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of parameters in parenthesis, each separated by a comma. For example, the JACKGEN macro invoked using the following statement:

```
%JACKGEN (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSDAGE, BSGALLM4) ;
```

will compute the mean age (BSDAGE) of eighth-grade students by gender (ITSEX) and their standard errors within each country (IDCNTRY), using the weighting variable TOTWGT. It will also compute the percentages of boys and girls and their standard errors within each country. The data will be read from the data file BSGALLM4 and the standard errors will be computed based on 75 sets of replicate weights.

The results of the JACKGEN macro are stored in a SAS working file called FINAL, which is stored in the default folder used by SAS. The following variables are contained in this results file:

Classification Variables

All classification variables are kept in the results file. In the example invocation above, there are two classification variables: IDCNTRY and ITSEX. There is one record in the results file for each subgroup defined by the categories of the classification variables.

N

This variable contains the number of valid cases for each subgroup defined by the classification variables. In the example, it is the number of boys and girls with valid data in each country's sample.

Weight Variable

The weight variable contains the sum of weights within each subgroup defined by the classification variables. In the example, this variable is called TOTWGT since TOTWGT was specified as the weighting variable. This variable will be an estimate of the total population within each subgroup.

MNX

This variable contains the estimated means of the specified analysis variable by subgroup.

MNX_SE

This variable contains the JRR standard errors of the estimated means by subgroup.

PCT

This variable contains the estimated percentages of students in each subgroup for the last classification variable listed. In the example it is the percentage of boys and girls within each country.

PCT_SE

This variable contains the JRR standard errors of the estimated percentages.

The contents of the FINAL file can be printed using the SAS PRINT procedure. The sample SAS program that invokes the JACKGEN macro and a printout of the results are presented in Exhibit 3.4. This program is available on the database DVD in the file called SAMPLEJACKGEN.SAS. It produces the mean ages for eighth-grade boys and girls in all countries, although the exhibit shows the results only for the first four countries.

Exhibit 3.4 Sample SAS Program Invoking the SAS Macro JACKGEN and Results

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKGEN.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4 ;

     WHERE NMISS (ITSEX, BSDAGE) = 0 ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

 VALUE SEX
     1 = 'GIRL'
     2 = 'BOY' ;

%JACKGEN (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSDAGE, BSGALLM4) ;

PROC PRINT DATA = FINAL NOOBS ;
     VAR IDCNTRY ITSEX N TOTWGT MNX MNX_SE PCT PCT_SE ;
     FORMAT IDCNTRY COUNTRY. ITSEX SEX. N 6.0 TOTWGT 10.0
            MNX MNX_SE PCT PCT_SE 6.2 ;
```

IDCNTRY	ITSEX	N	TOTWGT	MNX	MNX_SE	PCT	PCT_SE
ALGERIA	GIRL	2680	322725	14.31	0.03	49.18	0.59
ALGERIA	BOY	2765	333521	14.61	0.03	50.82	0.59
ARMENIA	GIRL	2305	25089	14.91	0.02	49.96	0.90
ARMENIA	BOY	2384	25128	14.87	0.01	50.04	0.90
AUSTRALIA	GIRL	1843	123207	13.86	0.01	48.21	1.93
AUSTRALIA	BOY	2223	132376	13.93	0.01	51.79	1.93
BAHRAIN	GIRL	1972	5554	14.04	0.02	48.88	0.40
BAHRAIN	BOY	2255	5807	14.10	0.02	51.12	0.40

From the first two lines of the results shown in Exhibit 3.4, there are 2,680 girls in the Algeria eighth-grade sample representing 322,725 girls in the whole population. The mean age for eighth-grade girls in Algeria is estimated to be 14.31 with a standard error of 0.03. Girls made up 49.18% of Algeria's eighth-grade student population. Conversely, Algeria sampled 2,765 boys representing 333,521 boys in the whole population. The estimated mean age for eighth-grade boys in Algeria is 14.61 with a standard error of 0.03. Boys made up 50.82 percent of Algeria's eighth-grade student population.

Computing Achievement Means and Their Standard Errors (JACKPV)

The JACKPV macro computes percentages and mean achievement scores using plausible values. It makes use of the sampling weights, the jackknifing algorithm to compute sampling variances, and the five plausible values to compute imputation variances. It effectively performs five analyses—one for each plausible value—and aggregates the results to produce accurate estimates of mean

achievement and standard errors that incorporate both sampling and imputation errors.

A second sample program demonstrates the use of the JACKPV macro, which computes the percentages of students within specified subgroups and their mean achievement scores. The SAS macro also computes the appropriate standard errors for those percentages and achievement means.

The JACKPV macro is a self-contained program, located in the program file JACKPV.SAS, and should not be modified. It essentially computes sets of replicate weights using the sampling and weighting variables, aggregates the data by subgroups using the replicate weights, and then computes and stores the desired statistics in a SAS working file called FINAL. The macro aggregates data across all plausible values to obtain the correct results.

The SAS macro JACKPV is included in a SAS program by issuing the following command:

```
%INCLUDE "<macpath>JACKPV.SAS" ;
```

where <macpath> points to the folder where the SAS macro program JACKPV.SAS is located. The macro requires that several parameters be specified as input when it is invoked. These parameters are:

WGT — The sampling weight to be used in the analysis. Generally, TOTWGT should be used. MATWGT should be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data and TCHWGT should be used when analyzing all teacher data.

JKZ — The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS data 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 data files is JKREP.

NJKZ — The number of replicate weights to be generated when computing the JRR standard errors. The value of NJKZ should be set to 75, the maximum possible value across all participating countries.

CVAR — The list of variables that are to be used to define the subgroups. The list can consist of one or more variables. We recommend that users always include IDCNTRY as the first classification variable.

ROOTPV — The variable root used to identify the set of plausible values for the achievement score of interest. It corresponds to the first 7 characters of the plausible values variable name. For example, the root of the eighth-grade overall mathematics plausible values is BSMMAT0, the root of the eighth-grade overall science plausible values is BSSSCI0.

NPV — The number of plausible values that will be used for the analysis. Generally, it is set to five to use all five plausible values for analysis.

INFILE — The name of the data file that contains the data being analyzed. If the folder is included as part of the file name, the name of the file must be enclosed in quotes. It is important to emphasize that this data file must include only those cases that are of interest in the analysis. If users want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.

The JACKPV macro is invoked by a SAS program using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of parameters in parenthesis, each separated by a comma. For example, the JACKPV macro invoked using the following statement:

```
%JACKPV (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSMMAT0, 5, BSGALLM4) ;
```

will compute the mean eighth-grade mathematics achievement (BSMMAT01 through BSMMAT05) by gender (ITSEX) within each country (IDCNTRY) and their standard errors, using the weighting variable TOTWGT. The macro uses all five plausible values to compute these statistics. It will also compute the percentages of boys and girls within each country, and their standard errors. The data will be read from the data file BSGALLM4 and the standard errors will be computed based on 75 sets of replicate weights.

The results of the JACKPV macro are stored in a SAS working file called FINAL, which is stored in the default folder used by SAS. The following variables are contained in this results file:

Classification Variables

All classification variables are kept in the results file. In this example, there are two classification variables: IDCNTRY and ITSEX. There is one record in the

results file for each subgroup defined by the categories of the classification variables.

N

This variable contains the number of valid cases for each subgroup defined by the classification variables. In the example, it is the number of boys and girls with valid data in each country's sample.

Weight Variable

The weight variable contains the sum of weights within each subgroup defined by the classification variables. In the example, this variable is called TOTWGT since TOTWGT was specified as the weighting variable. This variable will be an estimate of the total population within each subgroup.

MNPV

This variable contains the estimated mean achievement by subgroup, based on the plausible values.

MNPV_SE

This variable contains the JRR standard errors of the estimated mean achievement by subgroup, based on the plausible values.

PCT

This variable contains the estimated percentages of students in each subgroup for the last classification variable listed. In the example it is the percentage of boys and girls within each country.

PCT_SE

This variable contains the JRR standard errors of the estimated percentages.

The contents of the FINAL file can be printed using the SAS PRINT procedure. The sample SAS program that invokes the JACKPV macro and a printout of the results are shown in Exhibit 3.5. This program is available on the DVD in the file called SAMPLEJACKPV.SAS. It produces the mean eighth-grade mathematics

achievement for boys and girls in all countries, although Exhibit 3.5 gives the results only for the first four countries.

Exhibit 3.5 Sample SAS Program Invoking the SAS Macro JACKPV and Results

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKPV.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4 ;

     WHERE NMISS (ITSEX) = 0 ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

 VALUE SEX
     1 = 'GIRL'
     2 = 'BOY' ;

%JACKPV (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSMMAT0, 5, BSGALLM4) ;

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 ;
```

IDCNTRY	ITSEX	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ALGERIA	GIRL	2680	322725	384.06	2.42	49.17	0.59
ALGERIA	BOY	2767	333679	389.36	2.23	50.83	0.59
ARMENIA	GIRL	2305	25089	500.69	4.41	49.96	0.90
ARMENIA	BOY	2384	25128	496.67	3.46	50.04	0.90
AUSTRALIA	GIRL	1843	123207	488.26	5.53	48.18	1.93
AUSTRALIA	BOY	2226	132492	503.64	5.42	51.82	1.93
BAHRAIN	GIRL	1974	5561	414.35	2.16	48.91	0.40
BAHRAIN	BOY	2256	5809	382.49	2.62	51.09	0.40

From the first two lines of the results presented in Exhibit 3.5, the mean mathematics achievement of eighth-grade girls in Algeria is estimated to be 384.06 with a standard error of 2.42. The mean mathematics achievement of eighth-grade boys in Algeria is estimated to be 389.36 with a standard error of 2.23.

Computing Regression Coefficients and Their Standard Errors (JACKREG)

The JACKREG macro performs a multiple linear regression between a dependent variable and a set of independent variables. A third sample program demonstrates the use of the JACKREG macro, which computes the regression coefficients and their JRR standard errors. This macro is not appropriate for regression analyses using achievement scores as the dependent variable. The JACKREGP macro should be used for this purpose.

The JACKREG macro is a self-contained program, located in the program file JACKREG.SAS, and should not be modified. It computes sets of replicate weights using the sampling and weighting variables, performs a linear regression by subgroup and replicate weights, and then computes and stores the desired statistics in a SAS working file called REG.

The SAS macro JACKREG is included in a SAS program by issuing the following command:

```
%INCLUDE "<macpath>JACKREG.SAS" ;
```

where <macpath> points to the specific folder where the SAS macro program JACKREG.SAS is located. The macro requires that several parameters be specified as input when it is invoked. These parameters are:

WGT	The sampling weight to be used in the analysis. Generally, TOTWGT should be used. MATWGT should be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data and TCHWGT should be used when analyzing all teacher data.
JKZ	The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS data 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 data files is JKREP.
NJKZ	The number of replicate weights to be generated when computing the JRR standard errors. The value of NJKZ should be set to 75, the maximum possible value across all participating countries.
CVAR	The list of variables that are to be used to define the subgroups. The list can consist of one or more variables. We recommend that users always include IDCNTRY as the first classification variable.
XVAR	The list of independent variables used as predictors in the regression model. The independent variables can be either continuous or categorical, such as ITSEX for example.
DVAR	The dependent variable to be predicted by the list of independent variables specified in XVAR. Only one variable can be listed and plausible values of achievement scores should not be specified here.

INFILE — The name of the data file that contains the data being analyzed. If the folder is included as part of the file name, the name of the file must be enclosed in quotes. It is important to emphasize that this data file must include only those cases that are of interest in the analysis. If users want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.

The JACKREG macro is invoked by a SAS program using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of parameters in parenthesis, each separated by a comma. For example, the JACKREG macro invoked using the following statement:

```
%JACKREG (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BSDAGE, BSGALLM4) ;
```

will perform a linear regression with gender (REGSEX) as a predictor of the eighth-grade students' age at the time of testing (BSDAGE), using the weighting variable TOTWGT. It will compute the regression coefficients and their standard errors. The data will be read from the data file BSGALLM4 and the standard errors will be computed based on 75 replicate weights.

The results of the JACKREG macro are stored in a SAS working file called REG, which is stored in the default folder used by SAS. The following variables are contained in this results file:

Classification Variables

All classification variables are kept in the results file. In this example, there is a single classification variable IDCNTRY. There is one record in the results file for each subgroup defined by the categories of the classification variables.

N

This variable contains the number of valid cases for each subgroup defined by the classification variables. In the example, it is the number of students with valid data in each country's sample.

MULT_RSQ

The squared multiple correlation coefficient (R^2) for the regression model applied in each subgroup.

SS_RES, SS_REG, SS_TOTAL

The residual, regression, and total weighted sums of squares for the regression model applied in each subgroup.

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

The regression coefficients for the intercept and the predictor variables with their respective standard errors. The regression coefficients are numbered sequentially, starting with zero (B00) for the intercept, and based on the order of the predictor variables are specified in the parameter XVAR.

The contents of the REG file can be printed using the SAS PRINT procedure. The sample SAS program that invokes the JACKREG macro and a printout of the results are displayed in Exhibit 3.6. This program is available on the DVD in the file called SAMPLEJACKREG.SAS. It performs a linear regression in each country, with the variable REGSEX as a predictor of the eighth-grade students' age at the time of testing (BSDAGE). The exhibit displays the results for the first four countries.

The regression performed by the sample program uses the independent variable REGSEX, which is a "dummy-coded" version of ITSEX, such that the value zero represents the girls and the value one represents the boys. By performing this recoding, the intercept B00 will be the estimated mean age of eighth-grade girls, whereas the regression coefficient B01 will be the estimated increase in mean age for boys. This will allow us to determine if the difference in mean ages between girls and boys is statistically significant.

From the first line of the results displayed in Exhibit 3.6, the estimated mean age of eighth-grade girls in Algeria (B00) is 14.31 years, with a standard error of 0.03. The eighth-grade boys in Algeria are an estimated 0.30 years older (B01) than the girls. With an estimated standard error of 0.03, this difference is statistically significant at a 95% confidence level.

Exhibit 3.6 Sample SAS Program Invoking the SAS Macro JACKREG and Results

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKREG.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4;

     WHERE NMISS (ITSEX, BSDAGE) = 0 ;

     SELECT (ITSEX) ;
       WHEN (1)  REGSEX = 0 ;  * GIRLS ;
       WHEN (2)  REGSEX = 1 ;  * BOYS ;
       OTHERWISE REGSEX = . ;
     END ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

%JACKREG (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BSDAGE, BSGALLM4) ;

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 ;
```

IDCNTRY	N	MULT_RSQ	SS_TOTAL	SS_REG	B00	B00_SE	B01	B01_SE
ALGERIA	5445	0.017	887742	14819	14.31	0.03	0.30	0.03
ARMENIA	4689	0.001	10092	13	14.91	0.02	-0.03	0.02
AUSTRALIA	4066	0.005	59585	295	13.86	0.01	0.07	0.02
BAHRAIN	4227	0.001	7020	9	14.04	0.02	0.06	0.03

Computing Regression Coefficients and Their Standard Errors with Achievement Scores (JACKREGP)

The JACKREGP macro is used to perform a multiple linear regression between a set of plausible values as the dependent variable and a set of independent variables. It computes the regression coefficients and their JRR standard errors, making use of the sampling weights, the jackknifing algorithm to compute sampling variances, and the five plausible values to compute imputation variances. It effectively performs five regression analyses—one for each plausible value—and aggregates the results to produce accurate estimates of the regression coefficients and standard errors that incorporate both sampling and imputation errors. We present a fourth sample program to demonstrate the use of the JACKREGP macro.

The JACKREGP macro is a self-contained program, located in the program file JACKREGP.SAS, and should not be modified. It computes sets of replicate weights using the sampling and weighting variables, performs a multiple linear

regression by subgroups and replicate weights, and then computes and stores the desired statistics in a SAS working file called REG.

The SAS macro JACKREGP is included in a SAS program by issuing the following command:

```
%INCLUDE "<macpath>JACKREGP.SAS" ;
```

where <macpath> points to the specific folder where the SAS macro program JACKREGP.SAS is located. The macro requires that several parameters be specified as input when it is invoked. These parameters are:

WGT — The sampling weight to be used in the analysis. Generally, TOTWGT should be used. MATWGT should be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data and TCHWGT should be used when analyzing all teacher data.

JKZ — The variable that captures the assignment of cases to sampling zones. The name of this variable in all TIMSS data 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 data files is JKREP.

NJKZ — The number of replicate weights to be generated when computing the JRR standard errors. The value of NJKZ should be set to 75, the maximum possible value across all participating countries.

CVAR — The list of variables that are to be used to define the subgroups. The list can consist of one or more variables. We recommend that users always include IDCNTRY as the first classification variable.

XVAR — The list of independent variables used as predictors in the regression model. The independent variables can be either continuous or categorical, such as ITSEX for example.

ROOTPV — The variable root used to identify the set of plausible values for the achievement score of interest. It corresponds to the first 7 characters of the plausible values variable name. For example, the root of the eighth-grade overall mathematics plausible values is BSMMAT0, the root of the eighth-grade overall science plausible values is BSSSCI0.

INFILE — The name of the data file that contains the data being analyzed. If the folder is included as part of the file name, the name of the file must be enclosed in quotes. It is important to emphasize that this data file must include only those cases that are of interest in the analysis. If users want to have specific cases excluded from the analysis, for example students with missing data, this should be done prior to invoking the macro.

The JACKREGP macro is invoked by a SAS program using the conventional SAS notation for invoking macros. This involves listing the macro name followed by the list of parameters in parenthesis, each separated by a comma. For example, the JACKREGP macro invoked using the following statement:

```
%JACKREGP (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BSMMAT0, 5, BSGALLM4) ;
```

will perform a linear regression with gender (REGSEX) as a predictor of eighth-grade mathematics achievement based on its five plausible values (BSMMAT01 through BSMMAT05), using the weighting variable TOTWGT. It will compute the regression coefficients and their standard errors. The data will be read from the data file BSGALLM4 and the standard errors will be computed based on 75 replicate weights.

The results of the JACKREGP macro are stored in a SAS working file called REG, which is stored in the default folder used by SAS. The following variables are contained in this results file:

Classification Variables

All classification variables are kept in the results file. In this example, there is a single classification variable IDCNTRY. There is one record in the results file for each subgroup defined by the categories of the classification variables.

N

This variable contains the number of valid cases for each subgroup defined by the classification variables. In the example, it is the number of students with valid data in each country's sample.

MULT_RSQ

The squared multiple correlation coefficient (R^2) for the regression model applied in each subgroup.

SS_RES, SS_REG, SS_TOTAL

The residual, regression, and total weighted sums of squares for the regression model applied in each subgroup.

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

The regression coefficients for the predictor variables and the intercept with their respective standard errors. The regression coefficients are numbered sequentially, starting with zero (B00) for the intercept, and based on the order of the predictor variables are specified in the parameter XVAR.

The contents of the REG file can be printed using the SAS PRINT procedure. The sample SAS program invoking the JACKREGP macro and a printout of the results are presented in Exhibit 3.7. This program is available on the DVD in the file called SAMPLEJACKREGP.SAS. It performs a linear regression in each country, with the variable REGSEX as a predictor of eighth-grade mathematics achievement. The exhibit displays the results for the first four countries.

The regression performed by our sample program uses the variable REGSEX that was defined in our previous example. By using REGSEX, the intercept B00 will be the estimated mean mathematics achievement of eighth-grade girls, whereas the regression coefficient B01 will be the estimated difference in the mean mathematics achievement of boys. This will allow us to determine if eighth-grade mathematics achievement is significantly different between girls and boys.

From the first line of the results shown in Exhibit 3.7, the estimated mean mathematics achievement of eighth-grade girls in Algeria (B00) is 384.06, with a standard error of 2.42. Note that these are the same results obtained from the JACKPV sample program (Exhibit 3.5). The eighth-grade boys have an estimated mean mathematics achievement 5.30 points (B01) lower than girls. With an estimated standard error of 1.80, this difference is statistically significant at a 95% confidence level.

Exhibit 3.7 Sample SAS Program Invoking the SAS Macro JACKREGP and Results

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKREGP.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4;

     WHERE NMISS (ITSEX) = 0 ;

     SELECT (ITSEX) ;
       WHEN (1)  REGSEX = 0 ;  * GIRLS ;
       WHEN (2)  REGSEX = 1 ;  * BOYS ;
       OTHERWISE REGSEX = . ;
     END ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

%JACKREGP (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, REGSEX, BSMMAT0, 5, BSGALLM4) ;

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 ;
```

IDCNTRY	N	MULT_RSQ	SS_TOTAL	SS_REG	B00	B00_SE	B01	B01_SE
ALGERIA	5447	0.002	2304617343	4633896	384.06	2.42	5.30	1.80
ARMENIA	4689	0.001	360580911	227354	500.69	4.41	-4.03	3.73
AUSTRALIA	4069	0.009	1613093019	15145784	488.26	5.53	15.38	7.71
BAHRAIN	4230	0.036	79476867	2892103	414.35	2.16	-31.86	3.63

3.7 TIMSS Analyses with Student-Level Variables

Many analyses of the TIMSS 2007 data can be undertaken using only student-level data. Examples in the previous sections illustrated the functioning of the SAS macros. This section presents examples of actual analyses used to produce the exhibits in the *TIMSS 2007 International Mathematics Report* (Mullis, Martin & Foy, 2008), using SAS programs provided on the DVD.

The first example computes means for a straightforward continuous variable, whereas the second example computes means of achievement scores. Both examples use the sampling weights and implement the jackknife repeated replication method to compute appropriate sampling errors. The second example, which uses achievement plausible values, effectively performs the computations five times—once for each plausible value—and aggregates the results to produce accurate estimates of mean achievement and standard errors that incorporate both sampling and imputation errors.

Student-Level Analysis

In this first example, we wish to replicate the analysis of eighth-grade students' reported age at the time of testing. The results, presented in Exhibit 1.1 of the *TIMSS 2007 International Mathematics Report*, are reproduced here in Exhibit 3.8. This example will focus on the results presented in the fifth data column—the average age at the time of testing.

We need to undertake a number of steps to replicate the results in this exhibit. After reviewing the eighth-grade student background data codebook (the codebooks are described in Section 4.4 of Chapter 4), we identify the student background variable BSDAGE as the variable that reports the age of students at the time of testing.

We then proceed to read from the student background data files our variable of interest (BSDAGE), 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. We used the JOIN program, described earlier in this chapter, to join the student background data files for all countries into a single file called BSGALLM4.

The SAS program used to perform this first example is presented in Exhibit 3.9 and is included on the DVD under the name EXAMPLE1.SAS. The results obtained from this program are displayed in Exhibit 3.10, although only the results of first four countries, sorted alphabetically, are shown for the sake of conciseness. Note that one of the steps in this program is to select only those students who have non-missing data in our variables of interest BSDAGE.

In general, to perform student-level analyses using the student background data files, users should do the following:

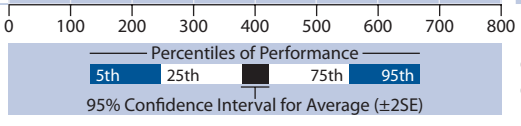
1) Identify the variables of interest in the student background data files and note any specific national adaptations to the variables
2) Retrieve the relevant variables from the student background data files, including classification variables, analysis variables, identification variables, sampling and weighting variables, and any other variables used in the selection of cases
3) Perform any necessary variable transformations or recodes
4) Use the macros JACKGEN and JACKREG with the appropriate parameters

Exhibit 3.8 Exhibit of Example Student-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 1.1)

Exhibit 1.1 **TIMSS 2007 Distribution of Mathematics Achievement (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	Mathematics Achievement Distribution	Average Scale Score	Years of Formal Schooling*	Average Age at Time of Testing	Human Development Index**
Chinese Taipei		▲ 598 (4.5)	8	14.2	0.932
Korea, Rep. of		▲ 597 (2.7)	8	14.3	0.921
Singapore		▲ 593 (3.8)	8	14.4	0.922
† Hong Kong SAR		▲ 572 (5.8)	8	14.4	0.937
Japan		▲ 570 (2.4)	8	14.5	0.953
Hungary		▲ 517 (3.5)	8	14.6	0.874
† England		▲ 513 (4.8)	9	14.2	0.946
Russian Federation		▲ 512 (4.1)	7 or 8	14.6	0.802
2 † United States		▲ 508 (2.8)	8	14.3	0.951
1 Lithuania		▲ 506 (2.3)	8	14.9	0.862
Czech Republic		504 (2.4)	8	14.4	0.891
Slovenia		501 (2.1)	7 or 8	13.8	0.917
TIMSS Scale Avg.		500			
Armenia		499 (3.5)	8	14.9	0.775
Australia		496 (3.9)	8	13.9	0.962
Sweden		▼ 491 (2.3)	8	14.8	0.956
Malta		▼ 488 (1.2)	9	14.0	0.878
† Scotland		▼ 487 (3.7)	9	13.7	0.946
1 2 Serbia		▼ 486 (3.3)	8	14.9	0.810
Italy		▼ 480 (3.0)	8	13.9	0.941
Malaysia		▼ 474 (5.0)	8	14.3	0.811
Norway		▼ 469 (2.0)	8	13.8	0.968
Cyprus		▼ 465 (1.6)	8	13.8	0.903
Bulgaria		▼ 464 (5.0)	8	14.9	0.824
3 Israel		▼ 463 (3.9)	8	14.0	0.932
Ukraine		▼ 462 (3.6)	8	14.2	0.788
Romania		▼ 461 (4.1)	8	15.0	0.813
Bosnia and Herzegovina		▼ 456 (2.7)	8 or 9	14.7	0.803
Lebanon		▼ 449 (4.0)	8	14.4	0.772
Thailand		▼ 441 (5.0)	8	14.3	0.781
Turkey		▼ 432 (4.8)	8	14.0	0.775
Jordan		▼ 427 (4.1)	8	14.0	0.773
Tunisia		▼ 420 (2.4)	8	14.5	0.766
1 Georgia		▼ 410 (5.9)	8	14.2	0.754
Iran, Islamic Rep. of		▼ 403 (4.1)	8	14.2	0.759
Bahrain		▼ 398 (1.6)	8	14.1	0.866
Indonesia		▼ 397 (3.8)	8	14.3	0.728
Syrian Arab Republic		▼ 395 (3.8)	8	13.9	0.724
Egypt		▼ 391 (3.6)	8	14.1	0.708
Algeria		▼ 387 (2.1)	8	14.5	0.733
Colombia		▼ 380 (3.6)	8	14.5	0.791
Oman		▼ 372 (3.4)	8	14.3	0.814
Palestinian Nat'l Auth.		▼ 367 (3.5)	8	14.0	0.731
Botswana		▼ 364 (2.3)	8	14.9	0.654
◆◆ Kuwait		▼ 354 (2.3)	8	14.4	0.891
El Salvador		▼ 340 (2.8)	8	15.0	0.735
Saudi Arabia		▼ 329 (2.9)	8	14.4	0.812
Ghana		▼ 309 (4.4)	8	15.8	0.553
Qatar		▼ 307 (1.4)	8	13.9	0.875
‡ Morocco		▼ 381 (3.0)	8	14.8	0.646
Benchmarking Participants					
2 Massachusetts, US		▲ 547 (4.6)	8	14.2	–
2 † Minnesota, US		▲ 532 (4.4)	8	14.3	–
3 Quebec, Canada		▲ 528 (3.5)	8	14.2	–
2 Ontario, Canada		▲ 517 (3.5)	8	13.8	–
3 British Columbia, Canada		▲ 509 (3.0)	8	13.9	–
Basque Country, Spain		499 (3.0)	8	14.1	–
◆◆ ‡ Dubai, UAE		▼ 461 (2.4)	8	14.2	–



▲ Country average significantly higher than TIMSS scale average
▼ Country average significantly lower than TIMSS scale average

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

5) Specify the location of the data files (<datpath>) and the macros (<macpath>)

6) Print the results file

Exhibit 3.9 Example SAS Program to Perform Student-Level Analysis (EXAMPLE1.SAS)

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKGEN.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4;

     WHERE NMISS (BSDAGE) = 0 ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

%JACKGEN (TOTWGT, JKZONE, JKREP, 75, IDCNTRY, BSDAGE, BSGALLM4) ;

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 ;
```

In Exhibit 3.10, each country's mean value for the BSDAGE variable is reported for all sampled students. 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 the sampled students, followed by the mean for BSDAGE and its standard error. The last two columns report the weighted percentage of students in the population and its standard error. For this example, the weighted percentages are of little use as they are the proportion each country represents among all participating countries. From the first line, Algeria has valid data for 5,445 students and these sampled students represent a population of 656,247 students. Students in Algeria were, on average, 14.46 years old at the time the TIMSS 2007 assessment took place, with a standard error of 0.03.

Exhibit 3.10 Output for Example Student-Level Analysis (EXAMPLE 1)

IDCNTRY	N	TOTWGT	MNX	MNX_SE	PCT	PCT_SE
ALGERIA	5445	656247	14.46	0.03	3.07	0.06
ARMENIA	4689	50218	14.89	0.01	0.23	0.01
AUSTRALIA	4066	255583	13.90	0.01	1.19	0.02
BAHRAIN	4227	11361	14.07	0.01	0.05	0.00

Student-Level Analysis with Achievement Scores

Our second example replicates another set of results presented in the *TIMSS 2007 International Mathematics Report*. We will investigate the relationship between eighth-grade students' gender and mathematics achievement. These results, presented in Exhibit 1.5 of the *TIMSS 2007 International Mathematics Report*, are repeated here in Exhibit 3.11. Since the results in this exhibit are based on plausible values, we will use the macro JACKPV.

After reviewing the appropriate codebook, we observe that the variable ITSEX in the student background data files contains information on the gender of students. We then proceed to read from the student background data files our variable of interest (ITSEX), the five plausible values of eighth-grade mathematics achievement (BSMMAT01 through BSMMAT05), the student sampling weight (TOTWGT), the variables that contain the jackknifing information (JKZONE and JKREP), and the country identification variable (IDCNTRY). Again, we will use the data of all available countries contained in the file BSGALLM4.

The SAS program that implements this second example is presented in Exhibit 3.12 and is included on the DVD under the name EXAMPLE2.SAS. Note that one of the steps in this program is to select only those students who have non-missing data in our variable of interest ITSEX. The results obtained from this program are shown in Exhibit 3.13. For the sake of conciseness, only the results of the first four countries, sorted alphabetically, are shown.

In general, to perform student-level analyses using the student background data files and achievement scores, users should do the following:

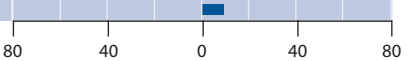
1) Identify the variables of interest in the student background data files and note any specific national adaptations to the variables
2) Retrieve the relevant variables from the student background data files, including the plausible values of achievement, classification variables, identification variables, sampling and weighting variables, and any other variables used in the selection of cases
3) Perform any necessary variable transformations or recodes
4) Use the macros JACKPV and JACKREGP with the appropriate parameters
5) Specify the location of the data files (<datpath>) and the macros (<macpath>)
6) Print the results file

Exhibit 3.11 Exhibit of Example Student-Level Analysis with Achievement Scores Taken from the TIMSS 2007 International Mathematics Report (Exhibit 1.5)

Exhibit 1.5 **TIMSS 2007 Average Mathematics Achievement by Gender (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	Girls		Boys		Difference (Absolute Value)	Gender Difference	
	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score		Girls Scored Higher	Boys Scored Higher
Malta	51 (0.3)	488 (1.5)	49 (0.3)	488 (1.7)	0 (2.2)		
Turkey	47 (0.8)	432 (5.3)	53 (0.8)	432 (5.0)	1 (3.9)		
Hungary	50 (1.1)	517 (4.1)	50 (1.1)	517 (3.7)	1 (3.6)		
Chinese Taipei	48 (1.3)	599 (4.6)	52 (1.3)	598 (5.3)	1 (4.2)		
Bosnia and Herzegovina	49 (0.8)	456 (3.1)	51 (0.8)	455 (2.8)	1 (2.5)		
Slovenia	50 (0.8)	500 (2.7)	50 (0.8)	503 (2.6)	2 (3.2)		
Czech Republic	48 (0.8)	505 (2.5)	52 (0.8)	503 (2.8)	2 (2.4)		
[3] Israel	53 (1.6)	465 (4.6)	47 (1.6)	462 (4.9)	3 (5.4)		
† Scotland	51 (1.0)	486 (3.8)	49 (1.0)	489 (4.4)	3 (3.5)		
[2] † United States	51 (0.7)	507 (3.0)	49 (0.7)	510 (3.1)	4 (2.2)		
Sweden	48 (0.9)	493 (2.6)	52 (0.9)	490 (2.5)	4 (2.5)		
Norway	49 (0.7)	471 (2.1)	51 (0.7)	467 (2.6)	4 (2.5)		
Indonesia	51 (1.0)	399 (4.1)	49 (1.0)	395 (4.4)	4 (4.0)		
Korea, Rep. of	48 (2.7)	595 (3.3)	52 (2.7)	599 (3.1)	4 (3.4)		
Armenia	50 (0.9)	501 (4.4)	50 (0.9)	497 (3.5)	4 (3.7)		
Japan	50 (1.0)	568 (3.2)	50 (1.0)	572 (3.2)	4 (4.3)		
[1] Georgia	50 (1.0)	412 (5.9)	50 (1.0)	408 (6.7)	4 (4.3)		
Russian Federation	52 (0.9)	514 (4.3)	48 (0.9)	509 (4.7)	5 (3.7)		
Ukraine	52 (0.8)	465 (3.9)	48 (0.8)	459 (3.9)	5 (2.9)		
Algeria	49 (0.6)	384 (2.4)	51 (0.6)	389 (2.2)	5 (1.8)		
† England	51 (1.9)	511 (5.0)	49 (1.9)	516 (6.1)	6 (5.7)		
Italy	48 (0.7)	477 (3.3)	52 (0.7)	483 (3.5)	6 (3.2)		
[1] [2] Serbia	49 (0.7)	489 (3.6)	51 (0.7)	483 (4.0)	6 (3.9)		
[1] Lithuania	50 (1.1)	509 (3.0)	50 (1.1)	502 (2.3)	7 (2.6)		
Iran, Islamic Rep. of	46 (1.5)	407 (5.3)	54 (1.5)	400 (6.1)	7 (8.1)		
Malaysia	53 (1.5)	479 (5.6)	47 (1.5)	468 (5.3)	11 (4.4)		
† Hong Kong SAR	50 (1.3)	578 (5.0)	50 (1.3)	567 (8.0)	11 (6.7)		
Egypt	49 (2.7)	397 (5.0)	51 (2.7)	384 (4.6)	13 (6.4)		
Lebanon	54 (1.8)	443 (4.1)	46 (1.8)	456 (4.7)	13 (3.6)		
Bulgaria	50 (1.2)	471 (4.6)	50 (1.2)	456 (6.3)	15 (5.0)		
Singapore	49 (0.9)	600 (4.1)	51 (0.9)	586 (4.6)	15 (4.4)		
Australia	48 (1.9)	488 (5.5)	52 (1.9)	504 (5.4)	15 (7.7)		
Botswana	53 (0.8)	371 (2.4)	47 (0.8)	355 (3.2)	15 (3.3)		
Syrian Arab Republic	52 (1.9)	387 (4.3)	48 (1.9)	403 (5.1)	16 (5.6)		
Romania	49 (0.9)	470 (4.2)	51 (0.9)	452 (4.6)	18 (3.3)		
Cyprus	50 (0.6)	476 (2.2)	50 (0.6)	455 (2.4)	20 (3.2)		
Jordan	48 (2.0)	438 (6.4)	52 (2.0)	417 (5.6)	20 (8.8)		
El Salvador	52 (1.4)	331 (3.8)	48 (1.4)	351 (3.6)	21 (4.9)		
Tunisia	52 (0.8)	410 (2.8)	48 (0.8)	431 (2.7)	21 (2.4)		
Ghana	45 (0.8)	297 (5.0)	55 (0.8)	319 (4.4)	22 (3.6)		
◆◆ Kuwait	54 (2.1)	364 (2.7)	46 (2.1)	342 (4.0)	22 (4.8)		
Saudi Arabia	48 (1.6)	341 (3.6)	52 (1.6)	319 (4.0)	23 (5.0)		
Thailand	50 (1.3)	453 (5.3)	50 (1.3)	430 (5.5)	23 (4.7)		
Colombia	51 (1.6)	364 (4.2)	49 (1.6)	396 (4.1)	32 (4.3)		
Bahrain	49 (0.4)	414 (2.2)	51 (0.4)	382 (2.6)	32 (3.6)		
Palestinian Nat'l Auth.	51 (1.4)	385 (4.2)	49 (1.4)	349 (5.4)	36 (6.5)		
Qatar	50 (0.2)	325 (2.1)	50 (0.2)	288 (2.0)	38 (2.9)		
Oman	52 (2.0)	399 (3.6)	48 (2.0)	344 (5.0)	54 (5.6)		
‡ Morocco	53 (1.3)	377 (3.7)	47 (1.3)	385 (3.9)	9 (4.8)		
International Avg.	50 (0.2)	453 (0.7)	50 (0.2)	448 (0.7)	5 (0.6)		
Benchmarking Participants							
◆◆ ‡ Dubai, UAE	49 (4.8)	461 (5.2)	51 (4.8)	461 (5.9)	0 (10.1)		
[3] Quebec, Canada	49 (1.5)	527 (3.5)	51 (1.5)	529 (4.6)	2 (4.2)		
[2] † Minnesota, US	52 (1.3)	531 (4.4)	48 (1.3)	535 (5.1)	4 (3.7)		
Basque Country, Spain	48 (1.7)	496 (3.9)	52 (1.7)	501 (3.9)	4 (5.0)		
[2] Massachusetts, US	50 (1.0)	544 (4.8)	50 (1.0)	550 (5.1)	5 (3.8)		
[3] British Columbia, Canada	51 (1.1)	507 (3.3)	49 (1.1)	512 (3.4)	6 (2.9)		
[2] Ontario, Canada	50 (1.1)	513 (4.1)	50 (1.1)	522 (4.0)	9 (4.1)		



Difference statistically significant
Difference not statistically significant

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

Exhibit 3.12 Example SAS Program to Perform Student-Level Analysis with Achievement Scores (EXAMPLE2.SAS)

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKPV.SAS" ;

DATA BSGALLM4 ;
     SET T07.BSGALLM4;

     WHERE NMISS (ITSEX) = 0 ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007 country formats > ;

 VALUE SEX
     1 = 'GIRL'
     2 = 'BOY' ;

%JACKPV (TOTWGT, JKZONE, JKREP, 75, IDCNTRY ITSEX, BSMMAT0, 5, BSGALLM4) ;

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 ;
```

In Exhibit 3.13, each country's results are displayed on two lines, one for each value of the variable ITSEX. The countries are identified in the first column and the second column describes the category of ITSEX being reported. The third column reports the number of valid cases and the fourth the sum of weights of the sampled students. The next two columns report the estimated mean mathematics achievement and its standard error, followed by the percentage of students in each category and its standard error. From the first two lines, the mean mathematics achievement for girls is 384.06 (standard error of 2.42) and is 389.36 (standard error of 2.23) for boys. An estimated 49.17% of students in Algeria are girls, and 50.83% are boys.

Exhibit 3.13 Output for Example Student-Level Analysis with Achievement Scores (EXAMPLE 2)

IDCNTRY	ITSEX	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ALGERIA	GIRL	2680	322725	384.06	2.42	49.17	0.59
ALGERIA	BOY	2767	333679	389.36	2.23	50.83	0.59
ARMENIA	GIRL	2305	25089	500.69	4.41	49.96	0.90
ARMENIA	BOY	2384	25128	496.67	3.46	50.04	0.90
AUSTRALIA	GIRL	1843	123207	488.26	5.53	48.18	1.93
AUSTRALIA	BOY	2226	132492	503.64	5.42	51.82	1.93
BAHRAIN	GIRL	1974	5561	414.35	2.16	48.91	0.40
BAHRAIN	BOY	2256	5809	382.49	2.62	51.09	0.40

3.8 TIMSS Analyses with Teacher-Level Variables

The teachers in the TIMSS 2007 international database do not constitute representative samples of teachers in the participating countries. Rather, they are the teachers of nationally representative samples of students. Therefore, analyses with teacher data should be made with students as the units of analysis and reported in terms of students who are taught by teachers with a particular attribute.

When analyzing teacher data, it is first necessary to link the students to their respective teachers. The student-teacher linkage data files (AST/BST) were created for this purpose. Student achievement scores (plausible values), jackknife replication information, and teacher weighting variables—MATWGT for mathematics teachers, SCIWGT for science teachers or TCHWGT for all teachers—appropriate for conducting analyses with teacher variables, are found in the student-teacher linkage data files in order to simplify the merging process for analyses that link teacher background variables to student achievement. For such analyses, it is only necessary to merge the teacher background data files (ATG/BTM/BTS) with the student-teacher linkage data files. For analyses linking teacher variables to student background variables, it is also necessary to merge the student background data files (ASG/BSG) with the teacher background data files after having been combined with the student-teacher linkage data files.

As our example of an analysis using teacher background data, we will investigate the age of the TIMSS 2007 eighth-grade mathematics teachers. The results of such an analysis are presented in Exhibit 6.1 of the *TIMSS 2007 International Mathematics Report* and are reproduced here in Exhibit 3.14. Although the results in this exhibit do not include any achievement, we will use the macro JACKPV to estimate the percentages we want.

Conducting analyses with teacher data requires a few extra steps. As before, we first proceed to identify the variables relevant to the analysis in the appropriate files, and review the documentation for any specific national adaptations to the questions of interest (Supplements 1 and 2). Since we are using a teacher-level variable, we need to use the teacher background data files and the student-teacher linkage data files to find the variables. From the teacher background data files, we need the variable that contains the information on the eighth-grade mathematics teachers' age (BT4GAGE), the variable that identifies the country (IDCNTRY), and the two teacher identification variables (IDTEACH and IDLINK) that will allow us to link the teacher data to the student data.

Exhibit 3.14 Exhibit of Example Teacher-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 6.1)

Exhibit 6.1 **Mathematics Teachers' Gender, Age, and Number of Years Teaching with Trends (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	Percentage of Students by Teacher Characteristics						Trends in Average Number of Years Teaching		
	Gender		Age						
	Female	Male	29 Years or Under	30–39 Years	40–49 Years	50 Years or Older		2007	Difference from 2003
Algeria	40 (4.2)	60 (4.2)	6 (1.9)	25 (3.8)	63 (4.0)	7 (2.0)		19 (0.8)	◊ ◊
Armenia	82 (2.7)	18 (2.7)	9 (2.6)	26 (3.3)	29 (3.4)	36 (3.6)	r	20 (0.7)	1 (1.0)
Australia	49 (4.3)	51 (4.3)	20 (3.2)	29 (3.7)	22 (3.2)	30 (3.2)		15 (0.8)	0 (1.2)
Bahrain	48 (1.1)	52 (1.1)	18 (1.9)	51 (2.7)	27 (2.6)	4 (1.4)		12 (0.5)	1 (0.9)
Bosnia and Herzegovina	57 (4.1)	43 (4.1)	6 (2.1)	22 (3.3)	22 (3.7)	50 (3.5)		23 (0.8)	◊ ◊
Botswana	43 (4.5)	57 (4.5)	32 (4.4)	60 (4.5)	8 (2.3)	0 (0.1)	r	8 (0.4)	1 (0.7)
Bulgaria	86 (2.7)	14 (2.7)	1 (0.7)	12 (2.6)	37 (4.1)	50 (4.2)		23 (0.9)	3 (1.1) ▲
Chinese Taipei	57 (4.4)	43 (4.4)	16 (3.2)	45 (4.1)	29 (3.7)	10 (2.4)		12 (0.7)	–2 (1.1)
Colombia	41 (5.8)	59 (5.8)	23 (4.0)	25 (3.8)	22 (4.1)	31 (5.3)		18 (1.4)	◊ ◊
Cyprus	69 (2.4)	31 (2.4)	6 (1.5)	32 (2.4)	36 (2.6)	26 (2.5)		13 (0.5)	1 (0.8)
Czech Republic	79 (3.3)	21 (3.3)	13 (2.4)	19 (3.0)	34 (3.6)	35 (3.9)		20 (0.9)	◊ ◊
Egypt	22 (3.5)	78 (3.5)	10 (2.5)	52 (3.8)	34 (3.6)	4 (1.4)		14 (0.6)	1 (0.7)
El Salvador	55 (4.6)	45 (4.6)	21 (3.7)	45 (4.9)	27 (3.3)	7 (2.3)		12 (0.6)	◊ ◊
England	52 (4.2)	48 (4.2)	18 (3.4)	25 (3.3)	26 (3.3)	31 (2.8)	r	14 (0.9)	–2 (1.7)
Georgia	89 (3.2)	11 (3.2)	3 (1.3)	21 (3.7)	30 (4.1)	46 (4.2)		23 (1.0)	◊ ◊
Ghana	8 (2.2)	92 (2.2)	52 (3.9)	28 (4.2)	16 (3.1)	4 (1.1)		7 (0.4)	0 (0.7)
Hong Kong SAR	40 (3.8)	60 (3.8)	26 (4.0)	35 (4.4)	27 (4.3)	12 (2.7)		13 (0.9)	1 (1.2)
Hungary	80 (3.3)	20 (3.3)	9 (2.7)	19 (3.3)	35 (2.9)	37 (3.2)		21 (0.8)	–1 (1.1)
Indonesia	44 (4.3)	56 (4.3)	15 (3.2)	41 (3.9)	37 (4.3)	7 (2.3)		14 (0.7)	0 (0.9)
Iran, Islamic Rep. of	42 (2.0)	58 (2.0)	26 (3.2)	49 (3.5)	20 (3.1)	5 (1.3)		14 (0.5)	0 (0.7)
Israel	76 (3.3)	24 (3.3)	15 (2.7)	33 (3.2)	32 (3.0)	20 (2.4)	r	17 (0.7)	1 (1.0)
Italy	81 (2.8)	19 (2.8)	2 (1.1)	10 (1.9)	22 (2.3)	67 (2.9)		23 (0.7)	0 (0.9)
Japan	43 (3.7)	57 (3.7)	20 (3.1)	28 (3.3)	39 (3.7)	13 (2.7)		16 (0.8)	–1 (1.0)
Jordan	52 (2.6)	48 (2.6)	36 (3.9)	39 (3.8)	18 (3.0)	7 (2.0)		10 (0.6)	–1 (0.9)
Korea, Rep. of	64 (3.2)	36 (3.2)	25 (2.8)	29 (2.9)	34 (3.2)	12 (2.5)	s	14 (0.6)	1 (0.8)
Kuwait	r 51 (2.5)	49 (2.5)	r 19 (3.7)	49 (4.9)	22 (3.6)	10 (2.9)	r	12 (0.7)	◊ ◊
Lebanon	42 (4.4)	58 (4.4)	33 (4.0)	27 (3.6)	22 (3.7)	19 (3.8)	r	14 (0.9)	–1 (1.2)
Lithuania	93 (1.7)	7 (1.7)	7 (1.8)	12 (2.7)	47 (4.0)	34 (3.4)		22 (0.7)	2 (1.1) ▲
Malaysia	71 (3.7)	29 (3.7)	22 (3.7)	39 (4.1)	28 (3.8)	10 (2.5)		12 (0.7)	2 (0.9)
Malta	59 (0.2)	41 (0.2)	47 (0.2)	30 (0.2)	13 (0.2)	10 (0.1)		11 (0.0)	◊ ◊
Norway	41 (3.6)	59 (3.6)	10 (2.2)	34 (3.0)	17 (2.3)	39 (2.5)		17 (0.7)	–1 (1.2)
Oman	52 (2.4)	48 (2.4)	83 (3.0)	14 (2.9)	3 (1.0)	0 (0.4)		5 (0.4)	◊ ◊
Palestinian Nat'l Auth.	49 (3.1)	51 (3.1)	37 (4.4)	29 (3.7)	24 (3.4)	11 (2.4)		12 (0.9)	1 (1.1)
Qatar	51 (0.2)	49 (0.2)	25 (0.1)	40 (0.1)	22 (0.1)	13 (0.1)		14 (0.0)	◊ ◊
Romania	60 (3.4)	40 (3.4)	6 (1.8)	21 (3.0)	23 (3.1)	50 (3.2)		23 (1.0)	0 (1.5)
Russian Federation	94 (1.8)	6 (1.8)	5 (1.0)	21 (2.8)	33 (2.9)	41 (3.4)		24 (0.7)	0 (1.1)
Saudi Arabia	47 (1.7)	53 (1.7)	35 (4.3)	46 (4.2)	13 (2.6)	7 (2.6)		11 (0.8)	– –
Scotland	58 (3.1)	42 (3.1)	16 (2.1)	25 (3.0)	25 (2.9)	33 (3.6)	r	15 (0.8)	–1 (1.3)
Serbia	61 (4.4)	39 (4.4)	9 (2.4)	20 (3.0)	20 (3.5)	51 (4.0)		20 (1.0)	–2 (1.4)
Singapore	64 (2.7)	36 (2.7)	45 (2.5)	31 (2.3)	12 (1.8)	12 (1.3)		8 (0.4)	–4 (0.8) ▼
Slovenia	82 (2.0)	18 (2.0)	17 (2.1)	23 (2.4)	39 (3.0)	21 (2.5)		18 (0.6)	–2 (1.0)
Sweden	55 (2.9)	45 (2.9)	11 (2.0)	30 (2.7)	22 (2.7)	37 (3.2)		15 (0.8)	1 (1.1)
Syrian Arab Republic	55 (3.8)	45 (3.8)	34 (3.8)	39 (4.0)	17 (3.0)	10 (2.8)		11 (0.7)	◊ ◊
Thailand	64 (4.1)	36 (4.1)	19 (3.5)	29 (3.9)	26 (3.9)	25 (3.8)		15 (0.9)	◊ ◊
Tunisia	33 (3.8)	67 (3.8)	15 (2.9)	47 (4.1)	25 (3.6)	13 (2.7)	s	13 (0.6)	0 (1.1)
Turkey	45 (4.2)	55 (4.2)	49 (4.0)	16 (2.8)	19 (3.3)	16 (3.4)		11 (0.8)	◊ ◊
Ukraine	91 (2.4)	9 (2.4)	8 (2.3)	21 (3.1)	31 (4.1)	40 (4.2)		23 (0.9)	◊ ◊
United States	69 (2.6)	31 (2.6)	20 (2.3)	29 (2.8)	26 (2.8)	25 (2.2)		14 (0.6)	–1 (0.9)
‡ Morocco	25 (3.5)	75 (3.5)	9 (2.9)	13 (3.0)	47 (5.4)	31 (5.2)	r	20 (1.3)	– –
International Avg.	57 (0.5)	43 (0.5)	21 (0.4)	30 (0.5)	26 (0.5)	23 (0.4)		15 (0.1)	
Benchmarking Participants									
Basque Country, Spain	51 (5.2)	49 (5.2)	2 (1.4)	23 (4.0)	34 (4.3)	41 (4.8)		22 (1.1)	1 (1.4)
British Columbia, Canada	45 (4.3)	55 (4.3)	16 (3.4)	39 (4.7)	24 (3.9)	21 (3.8)		13 (0.8)	◊ ◊
Dubai, UAE	s 57 (6.2)	43 (6.2)	s 13 (1.5)	46 (5.6)	24 (4.3)	17 (4.3)	s	15 (0.6)	◊ ◊
Massachusetts, US	56 (6.1)	44 (6.1)	23 (5.6)	29 (6.5)	23 (5.3)	25 (5.3)		12 (1.2)	◊ ◊
Minnesota, US	50 (8.2)	50 (8.2)	33 (8.6)	32 (7.7)	19 (7.0)	16 (4.6)		12 (1.5)	◊ ◊
Ontario, Canada	49 (3.6)	51 (3.6)	20 (3.8)	50 (5.0)	16 (3.6)	14 (3.5)		10 (0.9)	–1 (1.2)
Quebec, Canada	53 (4.3)	47 (4.3)	22 (3.7)	46 (4.6)	19 (3.6)	13 (2.7)		11 (0.8)	–5 (1.3) ▼

2007 significantly higher ▲
2007 significantly lower ▼

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

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

We then proceed to retrieve the necessary information from the eighth-grade student-teacher linkage data files. From these files, we need the country identification (IDCNTRY) and the two teacher identification variables (IDTEACH and IDLINK) needed to link the teacher data to the student data. We also need the jackknife replication variables (JKZONE and JKREP), the mathematics teacher weighting variable (MATWGT), and the eight-grade mathematics achievement plausible values (BSMMAT01 through BSMMAT05). Although we are only interested in estimating percentages, the mathematics achievement plausible values are required input for the JACKPV macro. This could be of analytical interest, providing some insight into the relationship between eighth-grade students' mathematics achievement and the age of their teachers.

The two file types are merged and the resulting merged file is then input to the JACKPV macro. The merging is done using the combination of identification variables IDCNTRY, IDTEACH, and IDLINK. The combination of values for these three variables is unique within the teacher background data files, but is repeated in the student-teacher linkage data files as many times as needed to link a teacher to all students in a classroom. After the files are merged, the JACKPV macro is invoked and the results can be printed.

For this analysis, we will again use the data for all available countries, making use of an aggregated teacher background data file, BTMALLM4, and an aggregated student-teacher linkage data file, BSTALLM4. These aggregated files can be created with the JOIN macro.

The SAS program that executes this third example is presented in Exhibit 3.15 and is included on the DVD under the name EXAMPLE3.SAS. The results obtained from this program are displayed in Exhibit 3.16, edited to show only the first four countries, alphabetically, for the sake of conciseness. Note that one of the steps in this program is to select only those students who have non-missing data in our variable of interest BT4GAGE. A second step consists of combining response categories 1 and 2 and response categories 5 and 6 of the variable BT4GAGE in order to match the results presented in Exhibit 3.14, where teachers are categorized into four groups: 29 years or under, 30-39 years old, 40-49 years old, and 50 years or older.

In general, to perform analyses using the teacher background data files, you should do the following:

1) Identify the variables of interest in the teacher background data files and note any specific national adaptations to the variables
2) Retrieve the relevant variables from the teacher background data files, including analysis variables, classification variables, identification variables (IDCNTRY, IDTEACH, and IDLINK), and any other variables used in the selection of cases
3) Retrieve the relevant variables from the student-teacher linkage data files, including plausible values of achievement, classification variables, identification variables (IDCNTRY, IDSTUD, IDTEACH, and IDLINK), sampling (JKZONE and JKREP) and weighting (MATWGT, SCIWGT, or TCHWGT) variables, and any other variables used in the selection of cases
4) Merge the teacher background data files with the student-teacher linkage data files using the variables IDCNTRY, IDTEACH and IDLINK
5) If student background variables also are needed, merge the student background data files with the merged student-teacher data files from the previous step using the variables IDCNTRY and IDSTUD
6) Perform any necessary variable transformations or recodes
7) Use the macros JACKGEN and JACKREG, or JACKPV and JACKREGP if plausible values are involved, with the appropriate arguments and parameters
8) Specify the location of the data files (<datpath>) and the macros (<macpath>)
9) Print the results file

Because our example uses data from mathematics teachers, the weighting variable MATWGT is specified. Analyses with science teachers require that SCIWGT be specified. For analyses with all teachers, TCHWGT should be specified. Chapter 4 provides more information on the sampling weights.

Exhibit 3.15 Example SAS Program to Analyze Teacher Variables (EXAMPLE3.SAS)

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKPV.SAS" ;

PROC SORT DATA = T07.BTMALLM4 OUT = BTMALLM4;
     BY IDCNTRY IDTEACH IDLINK ;

PROC SORT DATA = T07.BSTALLM4 OUT = BSTALLM4;
     BY IDCNTRY IDTEACH IDLINK ;

DATA MERGED ;
     MERGE BTMALLM4 (IN = INBTM)
           BSTALLM4 (IN = INBST) ;
     BY IDCNTRY IDTEACH IDLINK ;
     IF INBTM AND INBST ;

DATA MERGED ;
     SET MERGED ;

     IF NMISS (BT4GAGE) = 0 ;

     SELECT (BT4GAGE) ;
       WHEN (1,2) NEWAGE = 1 ;  * 29 YEARS OR UNDER ;
       WHEN (3)   NEWAGE = 2 ;  * 30-39 YEARS OLD ;
       WHEN (4)   NEWAGE = 3 ;  * 40-49 YEARS OLD ;
       WHEN (5,6) NEWAGE = 4 ;  * 50 YEARS OR OLDER ;
       OTHERWISE  NEWAGE = . ;
     END ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list TIMSS 2007country formats > ;

VALUE AGE
     1 = '29 YEARS OR UNDER'
     2 = '30-39 YEARS OLD'
     3 = '40-49 YEARS OLD'
     4 = '50 YEARS OR OLDER' ;

%JACKPV (MATWGT, JKZONE, JKREP, 75, IDCNTRY NEWAGE, BSMMAT0, 5, MERGED) ;

PROC PRINT DATA = FINAL NOOBS ;
     VAR IDCNTRY NEWAGE N MATWGT MNPV MNPV_SE PCT PCT_SE ;
     FORMAT IDCNTRY COUNTRY. NEWAGE AGE. N 6.0 MATWGT 10.0
            MNPV MNPV_SE PCT PCT_SE 6.2 ;
```

In Exhibit 3.16, each country's results are shown on four lines, one for each value of the recoded BT4GAGE variable. The results are presented much in the same manner as in previous examples, where the countries are identified in the first column and the second column describes the category of BT4GAGE being reported. From the first four lines, 5.84% of students in Algeria were taught by teachers 29 years or younger, 24.94% by teachers 30 to 39 years old, 62.51% by teachers 40 to 49 years old, and 6.71% by teachers 50 years or older. The appropriate standard errors also are presented in Exhibit 3.16.

Exhibit 3.16 Output for Example Teacher Variable Analysis (EXAMPLE 3)

IDCNTRY	NEWAGE	N	MATWGT	MNPV	MNPV_SE	PCT	PCT_SE
ALGERIA	29 YEARS OR UNDER	301	36432	379.11	6.11	5.84	1.89
ALGERIA	30-39 YEARS OLD	1295	155668	387.36	3.72	24.94	3.81
ALGERIA	40-49 YEARS OLD	3203	390172	387.71	2.69	62.51	4.04
ALGERIA	50 YEARS OR OLDER	371	41871	389.23	6.73	6.71	2.04
ARMENIA	29 YEARS OR UNDER	237	4246	507.86	19.00	8.69	2.54
ARMENIA	30-39 YEARS OLD	1289	12593	504.22	6.27	25.76	3.33
ARMENIA	40-49 YEARS OLD	1355	14050	498.54	5.83	28.74	3.38
ARMENIA	50 YEARS OR OLDER	1632	17996	493.18	5.39	36.81	3.65
AUSTRALIA	29 YEARS OR UNDER	706	47531	490.36	10.07	19.47	3.25
AUSTRALIA	30-39 YEARS OLD	1040	69686	492.92	9.13	28.54	3.75
AUSTRALIA	40-49 YEARS OLD	966	54043	512.45	12.41	22.13	3.26
AUSTRALIA	50 YEARS OR OLDER	1203	72894	496.79	9.31	29.86	3.19
BAHRAIN	29 YEARS OR UNDER	642	1832	389.84	4.62	17.90	2.09
BAHRAIN	30-39 YEARS OLD	1974	5150	398.54	3.12	50.35	2.80
BAHRAIN	40-49 YEARS OLD	976	2802	391.99	3.86	27.39	2.78
BAHRAIN	50 YEARS OR OLDER	168	446	397.02	11.58	4.36	1.50

3.9 TIMSS Analyses with School-Level Variables

Because TIMSS 2007 has representative samples of schools, it is possible to compute reasonable statistics with schools as units of analysis. 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. Therefore, analyzing school data should be done by linking the students to their schools.

Our example of an analysis using school background data will compute the percentages of eighth-grade students who attend schools with a high, medium, and low index of good attendance at school. We can use BCDGAS for this purpose. We also will calculate the mean mathematics achievement at each level of good attendance at school. The results of this analysis are presented in Exhibit 8.3 of the *TIMSS 2007 International Mathematics Report* and are displayed here in Exhibit 3.17.

The variable BCDGAS in the school background data files contains information on the index of good attendance at school. As BCDGAS is a derived variable, we can refer to Supplement 3 to see how it was created. We also should review the documentation on national adaptations to its component variables in Supplement 2.

Exhibit 3.17 Exhibit of Example School-Level Analysis Taken from the TIMSS 2007 International Mathematics Report (Exhibit 8.3)

Exhibit 8.3 **Index of Good Attendance at School (GAS) (Continued)**

TIMSS2007 Mathematics 8th Grade

Country	High GAS		Medium GAS		Low GAS	
	2007 Percent of Students	Average Achievement	2007 Percent of Students	Average Achievement	2007 Percent of Students	Average Achievement
Lebanon	52 (5.1)	454 (6.4)	42 (5.2)	447 (8.5)	5 (1.6)	434 (15.4)
Chinese Taipei	52 (4.0)	603 (6.5)	42 (4.0)	596 (6.1)	5 (1.9)	577 (9.6)
Oman	50 (4.3)	374 (5.1)	42 (4.8)	379 (6.2)	9 (2.6)	350 (17.8)
Korea, Rep. of	49 (4.3)	599 (3.7)	42 (4.4)	594 (3.9)	9 (1.8)	598 (8.4)
Malta	43 (0.2)	528 (1.6)	47 (0.2)	458 (1.5)	10 (0.2)	440 (3.8)
Czech Republic	36 (4.2)	520 (5.9)	53 (4.4)	497 (3.4)	11 (2.9)	483 (5.4)
Egypt	34 (4.0)	402 (6.0)	53 (4.1)	386 (6.1)	13 (2.7)	372 (8.9)
Armenia	30 (3.7)	495 (5.0)	56 (4.1)	501 (5.8)	14 (2.6)	498 (5.5)
Hong Kong SAR	30 (4.1)	611 (8.2)	60 (4.7)	560 (7.5)	10 (3.0)	500 (24.2)
Jordan	30 (3.8)	433 (9.3)	52 (4.3)	429 (6.3)	18 (3.3)	408 (11.8)
Singapore	30 (0.0)	629 (6.4)	66 (0.0)	580 (5.0)	4 (0.0)	535 (28.4)
Italy	28 (3.5)	483 (4.9)	56 (4.0)	479 (4.1)	15 (2.7)	474 (8.4)
Slovenia	28 (3.7)	498 (4.9)	54 (4.1)	506 (2.9)	19 (3.2)	497 (4.5)
Bosnia and Herzegovina	28 (3.6)	455 (4.2)	61 (4.2)	457 (3.8)	11 (2.7)	449 (11.0)
Hungary	26 (3.6)	527 (9.2)	55 (4.6)	520 (5.3)	19 (3.7)	493 (8.1)
Iran, Islamic Rep. of	25 (3.3)	410 (7.1)	72 (3.4)	401 (5.4)	3 (1.3)	403 (8.3)
Turkey	25 (3.8)	447 (11.3)	53 (5.1)	435 (7.8)	22 (3.5)	408 (11.6)
Algeria	23 (3.4)	389 (4.4)	56 (4.5)	385 (2.8)	21 (3.9)	391 (3.7)
England	23 (3.1)	555 (10.2)	65 (4.0)	507 (6.1)	12 (2.8)	481 (13.0)
Ukraine	23 (3.5)	470 (7.3)	65 (4.1)	464 (4.5)	12 (3.0)	437 (8.9)
Israel	21 (3.2)	467 (9.7)	55 (4.8)	469 (6.2)	24 (4.0)	458 (10.4)
Palestinian Nat'l Auth.	21 (3.3)	380 (7.9)	65 (4.0)	372 (4.9)	14 (2.5)	331 (11.0)
Romania	18 (2.7)	476 (11.3)	52 (3.8)	471 (5.8)	30 (4.1)	440 (8.9)
Australia	18 (2.8)	547 (10.1)	65 (3.7)	495 (5.2)	16 (2.7)	448 (7.5)
Syrian Arab Republic	17 (3.6)	384 (10.4)	64 (4.9)	396 (5.4)	19 (3.3)	399 (7.6)
Russian Federation	17 (2.8)	530 (8.9)	63 (3.1)	512 (4.9)	20 (3.0)	495 (6.7)
Bulgaria	17 (3.0)	492 (10.3)	44 (3.9)	470 (7.7)	39 (4.0)	445 (9.3)
Malaysia	17 (2.8)	503 (12.2)	68 (3.2)	471 (5.7)	15 (2.8)	455 (12.8)
Bahrain	17 (0.2)	412 (3.8)	64 (0.3)	398 (2.1)	20 (0.2)	384 (2.6)
Serbia	16 (3.6)	496 (6.4)	55 (4.4)	483 (4.4)	29 (3.6)	485 (7.4)
Colombia	15 (3.2)	400 (10.3)	38 (4.8)	384 (5.8)	47 (4.2)	369 (6.2)
United States r	15 (2.5)	519 (5.9)	66 (3.6)	514 (4.2)	19 (2.8)	481 (6.4)
Scotland	15 (2.9)	514 (15.9)	78 (3.3)	485 (4.9)	7 (1.8)	461 (20.0)
Saudi Arabia	14 (3.1)	315 (8.2)	65 (3.8)	330 (3.8)	21 (3.1)	336 (6.5)
Thailand	14 (2.7)	459 (14.9)	68 (3.7)	438 (6.5)	18 (3.5)	441 (12.9)
Tunisia	14 (2.9)	421 (6.1)	63 (4.0)	422 (3.1)	23 (3.7)	415 (4.6)
Qatar r	13 (0.1)	326 (3.9)	64 (0.2)	290 (1.7)	23 (0.2)	323 (2.5)
Botswana	13 (2.7)	381 (7.6)	61 (3.9)	367 (3.2)	27 (3.5)	346 (4.4)
Japan	11 (2.5)	572 (8.2)	49 (4.5)	581 (4.1)	40 (3.9)	556 (4.4)
El Salvador	11 (2.3)	357 (9.0)	67 (4.1)	341 (3.7)	22 (3.8)	331 (7.0)
Cyprus	11 (0.1)	462 (3.8)	73 (0.2)	466 (1.9)	16 (0.2)	462 (5.2)
Georgia	10 (3.1)	391 (24.4)	69 (4.9)	408 (7.0)	21 (4.2)	417 (8.9)
Norway	8 (2.1)	478 (6.5)	73 (4.0)	470 (2.3)	19 (3.6)	465 (4.6)
Indonesia	7 (2.2)	432 (17.2)	57 (4.8)	405 (6.2)	36 (4.3)	376 (8.8)
Kuwait	7 (2.7)	366 (9.4)	57 (4.8)	351 (3.9)	36 (4.3)	355 (5.1)
Lithuania	6 (2.0)	493 (10.1)	44 (4.3)	507 (4.2)	50 (4.4)	506 (4.0)
Ghana	5 (2.0)	354 (45.8)	71 (4.2)	313 (5.2)	24 (4.0)	290 (11.1)
Sweden	4 (1.6)	519 (13.9)	58 (4.0)	492 (2.8)	38 (3.9)	487 (3.6)
‡ Morocco	7 (2.5)	432 (20.3)	50 (6.5)	373 (5.4)	43 (6.3)	377 (5.6)
International Avg.	21 (0.4)	464 (1.7)	58 (0.6)	450 (0.8)	20 (0.5)	436 (1.6)
Benchmarking Participants						
Basque Country, Spain	28 (4.7)	505 (7.0)	63 (5.3)	499 (3.8)	9 (2.6)	482 (10.1)
Minnesota, US	27 (7.7)	526 (5.9)	71 (7.7)	537 (5.1)	2 (1.2)	~ ~
Dubai, UAE s	24 (0.6)	480 (3.7)	65 (0.7)	452 (4.2)	11 (0.3)	502 (5.2)
Ontario, Canada	18 (3.7)	526 (8.0)	72 (4.3)	521 (3.4)	10 (2.9)	500 (12.4)
Quebec, Canada	17 (3.3)	567 (10.8)	59 (4.5)	527 (5.2)	25 (3.8)	506 (7.2)
Massachusetts, US	16 (5.5)	557 (18.6)	75 (6.6)	549 (6.4)	9 (4.5)	502 (16.3)
British Columbia, Canada	13 (3.6)	525 (10.8)	68 (4.4)	517 (4.0)	19 (3.4)	482 (8.3)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

Since we are using a school-level variable, we need to use the school background data files and the student background data files to find the variables. From the school background data files, we need the variable that contains the information on the index of good attendance at school (BCDGAS) and the identification variables IDCNTRY and IDSCHOOL that will allow us to link the school data to the student data.

Next, we retrieve the variables of interest from the student background data files. We need the country and school identification variables (IDCNTRY and IDSCHOOL) necessary to merge the school data to the student data. We also need the jackknife replication variables (JKZONE and JKREP), the student weighting variable (TOTWGT), and the eighth-grade mathematics achievement plausible values (BSMMAT01 through BSMMAT05).

We then proceed to merge the school data with the student data using the variables IDCNTRY and IDSCHOOL and use the macro JACKPV to obtain the percentages of students and their mean achievement scores within each category of the variable BCDGAS for each country. For this analysis, we will use the data for all available countries, making use of an aggregated school file BCGALLM4 and an aggregated student file BSGALLM4. These aggregated files can be created with the JOIN macro.

The SAS program that implements this fourth example is presented in Exhibit 3.18 and is included on the DVD under the name EXAMPLE4.SAS. The results of this program are displayed in Exhibit 3.19, edited to show only the first four countries, alphabetically, for the sake of brevity. Note that one of the steps in this program is to select only those students who have non-missing data in our variable of interest BCDGAS.

In general, to perform analyses using the school background data files, you should do the following:

1) Identify the variables of interest in the school and student background data files and note any specific national adaptations to the variables
2) Retrieve the relevant variables from the school background data files, including analysis variables, classification variables, identification variables (IDCNTRY and IDSCHOOL), and any other variables used in the selection of cases
3) Retrieve the relevant variables from the student background data files, including plausible values of achievement, classification variables, identification variables (IDCNTRY and IDSCHOOL), sampling (JKZONE

and JKREP) and weighting (TOTWGT) variables, and any other variables used in the selection of cases

4) Merge the school background data files with the student background data files using the variables IDCNTRY and IDSCHOOL
5) Perform any necessary variable transformations or recodes
6) Use the macros JACKGEN and JACKREG, or JACKPV and JACKREGP if plausible values are involved, with the appropriate arguments and parameters
7) Specify the location of the data files (<datpath>) and the macros (<macpath>)
8) Print the results file

Exhibit 3.18 Example SAS Program for School Variable Analysis (EXAMPLE4.SAS)

```
LIBNAME T07 "<datpath>" ;

%INCLUDE "<macpath>JACKPV.SAS" ;

PROC SORT DATA = T07.BCGALLM4 OUT = BCGALLM4;
     BY IDCNTRY IDSCHOOL ;

PROC SORT DATA = T07.BSGALLM4 OUT = BSGALLM4;
     BY IDCNTRY IDSCHOOL ;

DATA MERGED ;
     MERGE BCGALLM4 (IN = INBCG)
           BSGALLM4 (IN = INBSG) ;
     BY IDCNTRY IDSCHOOL ;
     IF INBCG AND INBSG ;

DATA MERGED ;
     SET MERGED ;

     IF NMISS (BCDGAS) = 0 ;

PROC FORMAT LIBRARY = WORK ;

 VALUE COUNTRY
   < list country formats >

VALUE GAS
     1 = 'HIGH'
     2 = 'MEDIUM'
     3 = 'LOW' ;

%JACKPV (TOTWGT, JKZONE, JKREP, 75, IDCNTRY BCDGAS, BSMMAT0, 5, MERGED) ;

PROC PRINT DATA = FINAL NOOBS ;
     VAR IDCNTRY BCDGAS N TOTWGT MNPV MNPV_SE PCT PCT_SE ;
     FORMAT IDCNTRY COUNTRY. BCDGAS GAS. N 6.0 TOTWGT 10.0
            MNPV MNPV_SE PCT PCT_SE 6.2 ;
```

In Exhibit 3.19, each country's results are presented on three lines, one for each value of the BCDAGE variable. The results are presented much in the same

manner as in previous examples, where the countries are identified in the first column and the second column describes the category of BCDAGE being reported. From the first three lines, the estimated mean mathematics achievement of eighth-grade students in schools with a high level of good attendance at school is 389.02 (standard error of 4.38), whereas the estimated mean mathematics achievement of eighth-grade students in schools with a medium and low level of good attendance at school is 385.33 (standard error of 2.78) and 391.13 (standard error of 3.68), respectively. Also, 23.30% of eighth-grade students in Algeria attend schools with a high level of good attendance at school, 55.99% attend schools with a medium level, and 20.71% attend schools with a low level of good attendance at school.

Exhibit 3.19 Output for Example School Variable Analysis (EXAMPLE 4)

IDCNTRY	BCDGAS	N	TOTWGT	MNPV	MNPV_SE	PCT	PCT_SE
ALGERIA	HIGH	1212	134737	389.02	4.38	23.30	3.40
ALGERIA	MEDIUM	2585	323692	385.33	2.78	55.99	4.51
ALGERIA	LOW	992	119735	391.13	3.68	20.71	3.88
ARMENIA	HIGH	1417	15258	494.84	5.01	30.38	3.75
ARMENIA	MEDIUM	2457	28131	501.03	5.82	56.02	4.10
ARMENIA	LOW	815	6829	497.56	5.49	13.60	2.56
AUSTRALIA	HIGH	703	45649	547.50	10.12	18.36	2.75
AUSTRALIA	MEDIUM	2641	162444	495.27	5.20	65.32	3.70
AUSTRALIA	LOW	577	40606	447.81	7.48	16.33	2.69
BAHRAIN	HIGH	751	1824	411.68	3.76	16.57	0.23
BAHRAIN	MEDIUM	2619	7012	398.37	2.14	63.69	0.26
BAHRAIN	LOW	790	2173	383.84	2.60	19.74	0.21

References

Mullis, I.V.S., Martin, M.O., & Foy, P. (with Olson, J.F., Preuschoff, C., Erberber, E., Arora, A., & Galia, J.). (2008). *TIMSS 2007 international mathematics report: Findings from IEA's Trends in International Mathematics and Science Study at the fourth and eighth grades*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

SAS Institute (2002). *SAS system for Windows* (version 9.1). Cary, NC: SAS Institute.

Chapter 4

The TIMSS 2007 International Database Files

4.1 Overview

The TIMSS 2007 international database contains achievement data and student, teacher and school background data collected in the 59 countries and eight benchmarking participants that took part in TIMSS 2007. Exhibit 4.1 lists all TIMSS 2007 countries and benchmarking participants, along with identifying codes used in the international database. The database also contains materials that provide additional information on its structure and contents. This chapter describes the contents of the database and is divided into seven major sections corresponding to the different file types and materials included in the database. The database also includes data and relevant materials from the TIMSS 2007 Bridging Study, which are described in the final section of this chapter.

4.2 TIMSS 2007 User Guide

The TIMSS 2007 database includes a copy of this *TIMSS 2007 User Guide* in printable PDF format. It also includes a series of four supplements to the User Guide, also in PDF format. The User Guide and its supplements are located in the "User Guide" folder of the DVD.

Supplement 1 – International Version of the TIMSS 2007 Background and Curriculum Questionnaires

Supplement 1 includes the international version of all background and curriculum questionnaires administered in TIMSS 2007. It is a good reference guide to understand what questions were asked and the variable names under which the responses are recorded in the international database.

Exhibit 4.1 Countries Participating in TIMSS 1995 through 2007

Countries	ISO Codes		Fourth Grade			Eighth Grade			
	Alpha	Numeric	2007	2003	1995	2007	2003	1999	1995
Algeria	DZA	012	●			●			
Armenia	ARM	051	●	●		●	●		
Australia	AUS	036	●	●	●	●	●	●	●
Austria	AUT	040	●		●				●
Bahrain	BHR	048				●	●		
Bosnia and Herzegovina	BIH	070				●			
Botswana	BWA	072				●	●		
Bulgaria	BGR	100				●	●	●	●
Chinese Taipei	TWN	158	●	●		●	●	●	
Colombia	COL	170	●			●			●
Cyprus	CYP	196		●	●	●	●	●	●
Czech Republic	CZE	203	●		●	●		●	●
Denmark	DNK	208	●						●
Egypt	EGY	818				●	●		
El Salvador	SLV	222	●			●			
England	ENG	926	●	●	●	●	●	●	●
Georgia	GEO	268	●			●			
Germany	DEU	276	●						●
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				●	●	●	
Kazakhstan	KAZ	398	●						
Korea, Rep. of	KOR	410			●	●	●	●	●
Kuwait	KWT	414	●		●	●			●
Latvia	LVA	428	●	●	●		●	●	●
Lebanon	LBN	422				●	●		
Lithuania	LTU	440	●	●		●	●	●	●
Malaysia	MYS	458				●	●	●	

Exhibit 4.1 Countries Participating in TIMSS 1995 through 2007 *(Continued)*

Countries	ISO Codes		Fourth Grade			Eighth Grade			
	Alpha	Numeric	2007	2003	1995	2007	2003	1999	1995
Malta	MLT	470				●			
Mongolia	MNG	496	●			●			
Morocco	MAR	504	●	●		●	●	●	
Netherlands	NLD	528	●	●	●		●	●	●
New Zealand	NZL	554	●	●	●		●	●	●
Norway	NOR	578	●	●	●	●	●		●
Oman	OMN	512				●			
Palestinian Nat'l Auth.	PSE	275				●	●		
Qatar	QAT	634	●			●			
Romania	ROM	642				●	●	●	●
Russian Federation	RUS	643	●	●		●	●	●	●
Saudi Arabia	SAU	682				●	●		
Scotland	SCO	927	●	●	●	●	●		●
Serbia	SCG	891				●	●		
Singapore	SGP	702	●	●	●	●	●	●	●
Slovak Republic	SVK	703	●				●	●	●
Slovenia	SVN	705	●	●	●	●	●	●	●
Sweden	SWE	752	●			●	●		●
Syrian Arab Republic	SYR	760				●	●		
Thailand	THA	764			●	●		●	●
Tunisia	TUN	788	●	●		●	●	●	
Turkey	TUR	792				●		●	
Ukraine	UKR	804	●			●			
United States	USA	840	●	●	●	●	●	●	●
Yemen	YEM	887	●	●					
Benchmark Participants									
Alberta, Canada	CAB	9134	●		●			●	●
Basque Country, Spain	BSQ	3724				●	●		
British Columbia, Canada	CBC	9135	●			●		●	
Dubai, UAE	ADU	7841	●			●			
Massachusetts, US	UMA	12500	●			●		●	
Minnesota, US	UMN	12700	●		●	●			●
Ontario, Canada	COT	9132	●	●	●	●	●	●	●
Quebec, Canada	CQU	9133	●	●	●	●	●	●	●

Supplement 2 – National Adaptations of International Background Questionnaires

Supplement 2 provides details on all national adaptations that were applied to the national version of all TIMSS 2007 background questionnaires. Users should refer to this supplement for any special adaptations to background variables that could potentially affect the results of analyses.

Supplement 3 – Variables Derived from the Student, Teacher, and School Questionnaire Data

Supplement 3 describes how the derived background variables used for producing exhibits in the *TIMSS 2007 international reports* (Martin et al., 2008: Mullis et al., 2008) were computed.

Supplement 4 – TIMSS 2007 Sampling Stratification Information

Supplement 4 provides the labels assigned to the national explicit and implicit strata defined during the sampling process.

4.3 TIMSS 2007 Data Files

The TIMSS 2007 database includes the actual data from all instruments administered to the students, their teachers, and their school principals. This includes the student responses to the achievement items and the responses to the student, teacher, and school background questionnaires. These data files also include the achievement scores estimated for participating students, as well as background variables derived for reporting in the *TIMSS 2007 international reports*. National Research Coordinators' responses to the curriculum questionnaires are also part of the international database and are described later in this chapter.

This section describes the contents and format of the TIMSS data files. With the exception of the curriculum data files, they are provided in SAS export format (.EXP) and SPSS format (.SAV) in the "Data" folder of the DVD; there are separate subfolders for the two file formats. Data files are provided for each country that participated in TIMSS 2007 and for which internationally comparable data are available. The file names given to the various data file types are shown in Exhibit 4.2. For example, ASGNORM4.SAV is an SPSS file that contains Norway's TIMSS 2007 fourth-grade student background data. For each

file type, a separate data file is provided for each participating country. All data files and the variables they contain are described in the following sections.

Exhibit 4.2 TIMSS 2007 Data File Names

File Names	Descriptions
ACG●●●M4	Fourth-grade school background data files
ASA●●●M4	Fourth-grade student achievement data files
ASG●●●M4	Fourth-grade student background data files
ASR●●●M4	Fourth-grade within-country reliability scoring data files
AST●●●M4	Fourth-grade student-teacher linkage files
ATG●●●M4	Fourth-grade teacher background data files
BCG●●●M4	Eighth-grade school background data files
BSA●●●M4	Eighth-grade student achievement data files
BSG●●●M4	Eighth-grade student background data files
BSR●●●M4	Eighth-grade within-country reliability scoring data files
BST●●●M4	Eighth-grade student-teacher linkage files
BTM●●●M4	Eighth-grade mathematics teacher background data files
BTS●●●M4	Eighth-grade science teacher background data files

●●● = 3-character country abbreviation based on the ISO 3166 coding scheme (see Exhibit 4.1).

4.3.1 TIMSS Student Achievement Data Files (ASA/BSA)

The TIMSS 2007 student achievement data files contain the student responses to the individual achievement items in the TIMSS 2007 assessments. The student achievement data files are best suited for performing item-level analyses. Achievement scores (plausible values) for all of the TIMSS 2007 achievement scales are available in the student achievement data files, as well as in the student background data files and student-teacher linkage data files.

Students who participated in TIMSS 2007 were administered one of 14 assessment booklets, each with a series of items.[1] Some of these items were multiple-choice items and some were constructed-response items. The student achievement data files contain the actual responses to the multiple-choice questions and the scores assigned to the constructed-response items.

Item Variable Naming Conventions

The achievement item variable names are based on an 8-character alphanumeric code (e.g., M041300A), which adheres to the following rules:

- The first character is either "M" for mathematics items, or "S" for science items.
- The second and third characters indicate the assessment cycle when the item was first used in TIMSS. The code "01" was used for items introduced in TIMSS 1995. The items in the TIMSS 2007 assessment have either "02" for items produced in 1999, "03" for items produced in 2003, or "04" for new items in 2007.
- The fourth character is either "1" for fourth-grade items, or "2" for eighth-grade items.
- The fifth through seventh characters are a three-digit number used to uniquely identify the items.
- The eighth character indicates the item part, and only appears when required. It is generally a letter from "A" to "E", depending how many parts there are to a particular item. The letter "D" is sometimes used to represent a derived item where the scores of its item parts are combined into a single derived item.

For example, M041300A is the first part of a fourth-grade mathematics item produced in 2007 and whose unique sequence number is 300.

Item Response Code Values

A series of conventions also were adopted to code the data included in the TIMSS data files. This section describes these conventions for the achievement items.

---

[1] The TIMSS 2007 booklet design is described in Chapter 2 (Ruddock, O'Sullivan, Arora, & Erberber, 2008) of the *TIMSS 2007 Technical Report*.

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

Each constructed-response item had its own scoring guide[2] that relied on 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 one-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 in responding to the item. A second digit of 0 through 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.

For some constructed-response items, students were asked to provide an answer with supporting work, or to provide two reasons, or examples, or consequences, etc. The two parts of the item (parts A and B) were scored separately, but a single score was derived for the item as a whole. The total score for the item is contained in a derived variable, indicated by a final character of D in its item variable name. For example, derived variable S032310D contains the combined score for item parts S032310A and S032310B. For the majority of these items, each item part was worth one point, and the derived variables were given the code values shown in Exhibit 4.3.

Exhibit 4.3 TIMSS 2007 Derived Item Variable Codes

Codes	Descriptions
20	Full credit (1 point on both part A and part B)
10	Partial credit (1 point on either part A or part B)
70	No credit (no points on both part A and part B)

[2] Scoring guides for the released items are provided in the "Items" folder of the DVD.

Codes for Missing Values

A subset of the values for each variable type was reserved for specific codes related to different categories of missing data. We recommend that the user read the following section with particular care since the way in which these missing codes are used may have major consequences for analyses.

Omitted Response Codes (SAS: . ; SPSS: 9, 99)

"Omitted" response codes are used for items that a student should have answered but did not. An omitted response code also is given when an item is left blank or when two or more response options are checked for a multiple-choice item.

Not Administered Response Codes (SAS: .A ; SPSS: sysmis)

Special codes were given to items that were "Not Administered" to distinguish these cases from data that were missing due to non-response. In general, the not administered code was used when an item was not administered, either by design arising from the rotation of items across the assessment booklets, or unintentionally when an item was misprinted or otherwise unavailable for a student to respond. The not administered code was used in the following cases:

- Achievement item not assigned to the student: all students participating in TIMSS received only one of the 14 test booklets. All variables corresponding to items that were not present in a student's assigned booklet were coded as "Not Administered."
- Student absent from session: When a student was not present for a particular testing session, all variables relevant to that session were coded as "Not Administered."
- Item left out or misprinted: When a particular item (or a whole page) was misprinted or otherwise not available to the respondent, the corresponding variable was coded as "Not Administered."
- Item deleted or mistranslated: An item identified during translation verification or item review as having a translation error, such that the nature of the question was altered, or as having poor psychometric properties, was coded as "Not Administered."

Not Reached Response Codes (SAS: .R ; SPSS: 6, 96)

An item was considered not reached when—within part 1 or part 2 of a booklet—the item itself and the item immediately preceding it were not answered, and there were not other items completed in the remainder of that part of the booklet. For most purposes, TIMSS 2007 treated the not-reached items as incorrect responses, except during the item calibration step of the IRT scaling, when not-reached items were considered to have not been administered (see Foy, Galia, & Li, 2008).

TIMSS Achievement Scores

Achievement scales were produced for mathematics and science and their content and cognitive domains at both grades, as shown in Exhibit 4.4. A total of 14 achievement scales were produced at the fourth grade and 16 at the eighth grade. A detailed description of the TIMSS 2007 scaling and how these achievement scales were created is available in Chapter 11 (Foy, Galia, & Li, 2008) of the *TIMSS 2007 Technical Report*. For each achievement scale, the TIMSS 2007 database provides five separate estimates of each student's score on that scale. The five estimated scores are known as "plausible values," and the variability between them encapsulates the uncertainty inherent in the scale estimation process.

The plausible values for any given scale are the best available measures of student achievement on that scale in the TIMSS 2007 international database, and should be used as the outcome measure in any study of student achievement. Plausible values can be readily analyzed using the IEA IDB Analyzer and the SAS programs described in this User Guide.

The achievement score variable names are based on an 8-character alphanumeric code (e.g., ASMREA01), which adheres to the following rules:

- The first character of is either "A" for a fourth-grade score, or "B" for an eighth-grade score.
- The second character is always "S" to indicate it is a score variable.
- The third character is either "M" for a mathematics score, or "S" for a science score, whether an overall score, or a content or cognitive domain score.
- The fourth through sixth characters are a three-character code describing the achievement scale, as shown in Exhibit 4.4.

- The seventh and eighth characters are a two-digit number indicating the plausible value: "01", "02", "03", "04", or "05".

For example, ASMREA01 is the first plausible value on the fourth-grade mathematics reasoning cognitive domain achievement scale.

Exhibit 4.4 TIMSS 2007 Achievement Scales at Fourth and Eighth Grades

TIMSS 2007 Achievement Scales					
Fourth Grade	Overall	MAT	Mathematics	SCI	Science
	Content Domains	NUM	Number	LIF	Life Science
		GEO	Geometric Shapes and Measurement	PHY	Physical Science
		DAT	Data Display	EAR	Earth Science
	Cognitive Domains	KNO	Knowing	KNO	Knowing
		APP	Applying	APP	Applying
		REA	Reasoning	REA	Reasoning
Eighth Grade	Overall	MAT	Mathematics	SCI	Science
	Content Domains	NUM	Number	BIO	Biology
		ALG	Algebra	CHE	Chemistry
		GEO	Geometry	PHY	Physics
		DAT	Data and Chance	EAR	Earth Science
	Cognitive Domains	KNO	Knowing	KNO	Knowing
		APP	Applying	APP	Applying
		REA	Reasoning	REA	Reasoning

In addition to the plausible values for the achievement scales, the TIMSS 2007 database includes three interim achievement scores that were computed as part of the data processing effort.

Raw Scores

ASMSCPT, BSMSCPT

Number of score points obtained by a student on the mathematics items in her/his assigned booklet, for fourth and eighth grades.

ASSSCPT, BSSSCPT

Number of score points obtained by a student on the science items in her/his assigned booklet, 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 for 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 assessment booklet. Because the raw score is dependent on the number of items and score points in a student's assessment booklet, and since this number varies from booklet to booklet, the raw scores are not comparable across booklets, and so may be 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 are available only for overall mathematics and overall science at both grade levels.

Standardized Raw Scores

ASMSTDR, BSMSTDR

Standardized mathematics raw scores, for fourth and eighth grades.

ASSSTDR, BSSSTDR

Standardized science raw scores, 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 the TIMSS 2007 booklets for preliminary analyses. Each 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. Despite this standardization, comparisons across booklets have limited validity because of differences in difficulty across the assessment booklets, although every effort was made to ensure all booklets were similar in difficulty.

Standardized raw scores are available only for overall mathematics and science at both grades.

National Rasch Scores

ASMNRSC, BSMNRSC

National Rasch mathematics scores, for fourth and eighth grades.

ASSNRSC, BSSNRSC

National Rasch science scores, for fourth and eighth grades.

The national Rasch scores were computed to facilitate preliminary item analyses that were conducted prior to the TIMSS 2007 IRT scaling. Their main purpose was to provide preliminary measures of overall mathematics and science achievement that could be used as criterion variables in evaluations of item discrimination. The national Rasch scores were standardized to have a mean score of 150 points and a standard deviation of 10 points within each country. Because each country has the same mean score and dispersion, these scores are not useful for international comparisons. National Rasch scores are available only for overall mathematics and overall science at both grades.

TIMSS International Benchmarks of Achievement

To help users of the TIMSS achievement results understand what performance on the overall mathematics and science achievement scales signifies in terms of the mathematics and science students know and can do, TIMSS identified four points on the overall mathematics and science scales to serve as international benchmarks. As shown in Exhibit 4.5, the TIMSS international 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[3] to summarize and describe student achievement at these four points on the scale. The *TIMSS 2007 international reports* present the results of this scale anchoring, and report the percentage of students in each country reaching each of the international benchmarks.

[3] The scale anchoring procedure is described in Chapter 13 (Mullis, Erberber, & Preuschoff, 2008) of the *TIMSS 2007 Technical Report*.

Exhibit 4.5 TIMSS 2007 International Benchmarks for Mathematics and Science Achievement at Fourth and Eighth Grades

Scale Scores	International Benchmarks
625	Advanced International Benchmark
550	High International Benchmark
475	Intermediate International Benchmark
400	Low International Benchmark

To assist analysts in using the international benchmarks in secondary analyses, the TIMSS 2007 international database contains a set of variables indicating which international benchmark the students reached. There is a benchmark variable for each plausible value of the overall mathematics and science scales at both grades. The international benchmark variables follow the achievement score variable naming convention where the fourth through sixth positions have the letters "IBM". Thus, ASMIBM01-05 are the five benchmark variables for fourth-grade overall mathematics, ASSIBM01-05 the five benchmark variables for fourth-grade overall science, BSMIBM01-05 for eighth-grade overall mathematics, and BSSIBM01-05 for eighth-grade overall science. The codes used for all the benchmark variables are described in Exhibit 4.6.

Exhibit 4.6 TIMSS 2007 International Benchmark Variable Codes

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

4.3.2 TIMSS Within-Country Scoring Reliability Data Files (ASR/BSR)

The TIMSS 2007 within-country scoring reliability data files contain data that can be used to investigate the reliability of the TIMSS constructed-response item

scoring. The scoring reliability data files contain one record for each booklet that was double scored during the within-country scoring reliability exercise (see Johansone & Neuschmidt, 2008). For each constructed-response item in the achievement test, the following three variables are included in the scoring reliability data files:

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

It should be noted that the second score data were used only to evaluate within-country scoring reliability and were not used in computing the achievement scores included in the database and presented in the international reports.

Scoring Reliability Variable Naming Convention

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

- The Original Score variable has the number "0" as the second character, in accordance with the achievement item naming convention (e.g., M041300A)
- The Second Score variable has the letter "R" as the second character (e.g., MR41300A)
- The Score Agreement variable has the letter "I" as the second character (e.g., MI41300A).

Reliability Variable Score Values

The values contained in both the Original Score and Second Score variables are the two-digit diagnostic codes assigned using the TIMSS scoring guides. The Score Agreement variable may have one of three values, depending on the degree of agreement between the two scorers, as described in Exhibit 4.7.

Exhibit 4.7 TIMSS 2007 Score Agreement Variable Codes

Codes	Descriptions
0	Identical codes (both digits in the original and second scores)
1	Identical score levels, but different diagnostic codes (first digit of both scores are the same; second digits are different)
2	Different score levels (first digit of both scores are different)

In general, the data in the Original Score variables are identical to those contained in the Student Achievement data files. In some cases, however, the response scores for specific items were recoded after a review of the international item statistics revealed inconsistencies in the original scoring guides or showed that the original scores were not functioning as desired. The recoded score values were used in computing the achievement scores reflected in the international reports and are present in the student achievement data files. In contrast, the Original Score variables in the scoring reliability data files contain the original unrecoded response scores. This was done so that the scoring reliability measures indicated in the Score Agreement variables were based on the original scoring guides used during the constructed-response scoring sessions conducted in each country.

4.3.3 TIMSS Background Questionnaire Data Files

There are five types of TIMSS 2007 background questionnaire data files: four of them—student, teacher, school, and curriculum—corresponding to the four types of background questionnaires administered in TIMSS 2007 and the fifth one used to link the student and teacher background data. The first four types of data files contain the responses to the questions asked in their respective background questionnaires.

TIMSS Student Background Data Files (ASG/BSG)

Students who participated in TIMSS 2007 were administered a background questionnaire with questions related to their home background, school experiences, and attitudes to mathematics and science. The student background data files contain students' responses to these questions. They also contain students' mathematics and science achievement scores (plausible values) to facilitate analyses of relationships between student background characteristics and achievement. Two versions of the student questionnaire were administered at 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 data files also contain a number of identification variables, tracking variables, sampling and weighting variables, and derived variables that were used for producing exhibits in the international reports. These variables are described later in this chapter.

TIMSS Teacher Background Data Files (ATG/BTM/BTS)

The mathematics and science teachers of the students that were sampled for TIMSS 2007 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 data 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 background data file as classes were taught by the teacher, and the background information in part A from the completed questionnaire was entered into these teacher records.

There were two types of teacher questionnaires administered at the eighth grade—one for the mathematics teachers and one for the science teachers. The responses of teachers to the mathematics questionnaire are found in the BTM files and the responses of teachers to the science questionnaire are in the BTS 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 and all teachers' responses are found in the ATG files.

In the teacher background data files at both grades, each teacher has a unique identification number (IDTEACH) and a 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, within a country, 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 data files cannot be merged directly with the student data files and they do not contain sampling and weighting 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, therefore, should be thought of as attributes of the students to which they are linked, and should be analyzed only in conjunction with the student-teacher linkage data files. Chapters 2 and 3 of this User Guide describe student-level analyses with teacher data using the student-teacher linkage data files using the IEA IDB Analyzer software, as well as using SAS programs.

TIMSS School Background Data Files (ACG/BCG)

The school background data files contain school principals' responses to the questions in the TIMSS 2007 school background questionnaires. Although school-level analyses where the schools are the units of analysis can be performed, it is preferable to analyze school-level variables as attributes of students. To perform student-level analyses with school data, the school background data files must be merged with the student background data files using the country and school identification variables. Details of the merging procedure using the IEA IDB Analyzer, or SAS programs, are described in Chapters 2 and 3 of this User Guide, respectively.

TIMSS Student-Teacher Linkage Data Files (AST/BST)

The TIMSS 2007 student-teacher linkage data files contain information required to link the student and teacher data files. The student-teacher linkage data files contain one entry per student-teacher linkage combination in the data. For instance, if three teachers are linked to a student, there are three entries in the file

corresponding to that student. The sole purpose of the student-teacher linkage data files is to link teacher-level data with student-level data to perform appropriate student-level analyses where teacher characteristics become attributes of the students.

TIMSS Curriculum Data Files

The TIMSS 2007 curriculum questionnaire data files contain the responses provided by the National Research Coordinators of the participating countries to the TIMSS 2007 curriculum questionnaires. There are four separate curriculum questionnaire data files for the two grades, fourth and eighth, and the two subjects, mathematics and science. These files are available as Excel files in the "Curriculum" folder of the DVD.

Background Variable Naming Convention

The background variable naming convention is based on a 7- or 8-character string. The following rules are applied in naming the background variables:

- The first character is either "A" for fourth-grade data, or "B" for eighth-grade data.
- The second character indicates the type of respondent. The letter "C" is used identify data from the school principals, the letter "T" is used for teacher data, the letter "S" for student data, and the letter "U" for curriculum data.
- The third character is used to indicate the type of question or, in the case of questions in the background questionnaires, the cycle in which a background question was first used. The letter "B" is used for all background variables in the curriculum questionnaire data files, the letter "D" is used for all derived variables, and the number "4" is used for all other background variables.[4]

[4] The background variable naming convention was modified for TIMSS 2007 where the third character now is used to indicate the survey cycle when a background question is first introduced. As a result, all background variables use the number "4" to represent TIMSS 2007.

- The fourth character is used to indicate the subject or topic to which a background question refers. The following letters are used:[5]

  G General question (not subject specific)

  M Question related to mathematics

  S Question related to science

  B Questions related to biology or life science

  C Questions related to chemistry

  E Questions related to earth science

  P Questions related to physics of physical science

- The fifth through eighth characters of all background questionnaire variables are used to assign a unique and concise label to each question.

Background Questionnaire Variable Location Convention

To identify the location of a background variable in its corresponding background questionnaire, each question was assigned a unique identification code as shown in Exhibit 4.8. This unique code is followed by the sequence number of the question within the questionnaire. For example, if the location of a variable is given as SQ1-06, it refers to question 6 in the student background questionnaire. This convention is followed in the data almanacs and in the description of the variables included in Supplement 1 and Supplement 2 to this User Guide.

[5] The letters "B", "C", "E", and "P" are used only in the eighth-grade student background data files for variables corresponding to questions about separate sciences asked in the separate science version of the student questionnaires.

Exhibit 4.8 Background Questionnaire Variable Location Convention

Questionnaire	Location Code
Student Questionnaire	SQ1-●●● for fourth-grade SQ2-●●● for eighth-grade general science questionnaire SQ2S-●●● for eighth-grade separate science questionnaire
Teacher Questionnaire	TQ1-●●● for fourth-grade TQM2-●●● for eighth-grade mathematics questionnaire TQS2-●●● for eighth-grade science questionnaire
School Questionnaire	SCQ1-●●● for fourth-grade SCQ2-●●● for eighth-grade
Curriculum Questionnaire	CQM1-●●● for fourth-grade mathematics questionnaire CQS1-●●● for fourth-grade science questionnaire CQM2-●●● for eighth-grade mathematics questionnaire CQS2-●●● for eighth-grade science questionnaire

●●● = sequential numbering of the question location in the questionnaire

Data Coding Conventions

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

Background Question Response Code Values

The values assigned to each of the background variables depend on the item format and the number of options available. For categorical questions, sequential numerical values are used to correspond to the response options available. The numbers correspond to the sequence of appearance of the response options. For example, the first response option is represented with a 1, the response option with a 2, etc. Open-ended questions, such as "the number of students in a class", are coded with the actual number given as a response.

Codes for Missing Values

A subset of values for each variable type is reserved for specific codes related to various categories of missing data.

Omitted Response Codes (SAS: . ; SPSS: 9, 99, 999, ...)

"Omitted" response codes were used for questions that a student, teacher, or school principal should have answered but did not. The length of the omitted response code given to a variable in the SPSS data files depends on the number of characters needed to represent the variable. In all cases, the space necessary to represent the variable is filled with 9's. For questionnaire data, no distinction was 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 to open-ended questions. In a few cases, data received from a country in an invalid or inconsistent manner also were coded as "omitted."

Not Administered Response Codes (SAS: .A ; SPSS: sysmis)

Special codes were given to items that were "Not Administered" to distinguish these cases from data that were missing due to non-response. In general, the not administered code was used when a questionnaire was not completed or a question was not administered, such as when a question was left out of the instrument or misprinted. The not administered code was used in the following cases:

- Question left out or misprinted: When a particular question (or a whole page) was misprinted, or otherwise not available to the respondent, the corresponding variables were coded as "Not Administered."
- Background questions removed: Variables corresponding to questions in the student, teacher, or school background questionnaires that were considered not applicable in some countries were not included in the national versions of the questionnaires. These questions were coded as "Not Administered."
- Background questions mistranslated or not internationally comparable: In some cases, questions in the international version of the questionnaires were mistranslated or modified to fit the national context. Whenever possible, modified questions were recoded to match as closely as possible the international version. When this was not possible, modified questions were recoded as "Not Administered."

Not Applicable Response Codes (SAS: .B ; SPSS: 6, 96, 996, ...)

"Not Applicable" response codes were used for the background questionnaire items for which responses were dependent on a filter question. Generally, a "No" response to a filter question lead to any follow-up questions being coded as "Not Applicable" since there were no appropriate responses to these follow-up questions.

Summary Indices and Derived Variables

In the TIMSS questionnaires, there were often several questions asked about various aspects of a single construct. In these cases, responses to the individual items were combined to create a derived variable which provided a more comprehensive picture of the construct of interest than the individual variables could on their own.

In the TIMSS reports, an index is a special type of derived variable that assigns students to one of three levels—high, medium, or low—on the basis of their responses to the component variables. The high category of an index represents the responses that are expected to characterize aspects of a positive learning environment, and the low category those responses that are least supportive of learning.

Records—whether students, teachers or schools—were included in the derived variable calculation only if there were data available for at least two thirds of the variables involved. For example, if a derived variable was based on six component variables, records that were missing responses to more than two of these were counted as missing on the derived variable.

Supplement 3 to the User Guide provides a description of all derived variables included in the international database.

Using Sampling Weights in Analyzing the TIMSS 2007 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 at the fourth and eighth grades. For analyses based on these sample data to accurately reflect population 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 respondents by their sampling weight in all analyses. The sampling weights properly account for the sample design, take into account any stratification or disproportional sampling of subgroups, and include adjustments for non-response (see Joncas, 2008).

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-grade, 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.

Because statistics generated from the international database are estimates of national performance based on samples of students, rather than the value 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 sampling error of each statistic presented in the international reports. When used with achievement scores, or plausible values, the jackknife standard errors include both the error component due to sampling variation and the error component due to variation among the five plausible values generated for each student. These standard errors may be used to create confidence intervals for statistics computed from the TIMSS data.

The TIMSS 2007 international database includes the IEA IDB Analyzer software (see Chapter 2) that enables analysts to apply the jackknife algorithm and plausible values to a range of analyses of school, teacher, and student variables. It also provides a set of SAS programs and macros (see Chapter 3), which will perform analyses using the jackknife algorithm and plausible values.

Sampling Weights Included in the TIMSS 2007 Data Files

Several sampling and weighting variables are included in the TIMSS data files. They are listed and described in Exhibit 4.9, whereas Exhibit 4.10 illustrates the location of the various sampling and weighting variables among the different

types of data files. It is important to note that the teacher background data files do not have any sampling and weighting variables.

Exhibit 4.9 TIMSS 2007 Sampling and Weighting Variables

Variable Names	Descriptions
TOTWGT	Total student weight – sums to the national population
SENWGT	Student senate weight – sums to 500 in each country
HOUWGT	Student house weight – sums to the student sample size in each country
TCHWGT	Overall teacher weight
MATWGT	Mathematics teacher weight
SCIWGT	Science teacher weight
JKZONE	The sampling zone, or stratum, to which the student's school is assigned
JKREP	The sampling replicate, or primary sampling unit, to which the student's school is assigned
JKCZONE	The sampling zone, or stratum, to which the school is assigned
JKCREP	The sampling replicate, or primary sampling unit, to which the school is assigned
WGTFAC1	School weighting factor
WGTADJ1	School weighting adjustment
WGTFAC2	Class weighting factor
WGTADJ2	Class weighting adjustment
WGTFAC3	Student weighting factor
WGTADJ3	Student weighting adjustment

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 proportionately 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 weighted sample size of 500 in each country.

Additionally, since TOTWGT inflates sample sizes to approximate the population size, software systems that use the actual sample size to compute significance tests will give misleading results for analyses weighted by TOTWGT. HOUWGT, another transformation of TOTWGT, ensures that the weighted sample corresponds to the actual sample size in each country.

The weight variables TOTWGT, SENWGT and HOUWGT are designed for use in student-level analyses from all student-level files. The weight variable SCHWGT is designed for use in school-level analyses where the schools are the units of analysis.

The weight variables TCHWGT, MATWGT, and SCIWGT are specifically designed for using teacher background data in student-level analyses and are based on TOTWGT. Whereas TCHWGT is used for analyses using all teachers, MATWGT and SCIWGT are used for analyses of mathematics and science teachers, respectively. These teacher weights are located in the student-teacher linkage files (AST and BST), not in the actual teacher background data files (ATG, BTM and BTS). Analyses with teacher data will be properly weighted by merging the teacher files with the student-teacher linkage files.

The sampling variables beginning with the letters "JK" are used to compute standard errors based on the jackknife repeated replication methodology. All weighting variables beginning with the letters "WGT" are included to provide insight into the multi-stage sampling and weighting methodology applied to the TIMSS data. All weighting variables are described in Chapter 9 (Joncas, 2008) of the *TIMSS 2007 Technical Report*.

Exhibit 4.10 Location of Sampling and Weighting Variables in the TIMSS 2007 Database

Sampling and Weighting Variables	Data File Types			
	ASG BSG	ASA BSA	AST BST	ACG BCG
JKREP	●	●	●	
JKZONE	●	●	●	
JKCREP				●
JKCZONE				●
TOTWGT	●	●		
SENWGT	●	●		
HOUWGT	●	●		
TCHWGT			●	
MATWGT			●	
SCIWGT			●	
SCHWGT				●
WGTFAC1	●			●
WGTADJ1	●			●
WGTFAC2	●			
WGTADJ2	●			
WGTFAC3	●			
WGTADJ3	●			

Structure and Design Variables in TIMSS 2007 Data Files

Besides the variables used to store responses to the background questionnaires and achievement booklets, the TIMSS 2007 data files also contain variables meant to store information that identify and describe the respondents and design information required to properly analyze the data.

Identification Variables

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

IDCNTRY

IDCNTRY is a five-digit country identification code based on the ISO 3166 classification as shown in Exhibit 4.1. This variable should always be used as the first linking variable whenever files are linked within and across countries.

IDPOP

IDPOP identifies the target grade and is set to "1" for the fourth grade and "2" for the eighth grade.

IDGRADE

IDGRADE identifies the target grade of the participating students. In TIMSS 2007, the usual values are "4" and "8" for most countries.

IDSCHOOL

IDSCHOOL is a four-digit identification code that uniquely identifies the participating schools within each country. The school codes are not unique across countries. Schools across countries can be uniquely identified only with the IDCNTRY and IDSCHOOL combination of linking variables.

IDCLASS

IDCLASS is a six-digit identification code that uniquely identifies the sampled classrooms within a country. The variable IDCLASS has a hierarchical structure and is formed by concatenating the IDSCHOOL variable and a two-digit sequential number identifying the sampled classrooms within a school. Classrooms can be uniquely identified in the database by the combination of IDCNTRY and IDCLASS as linking variables.

IDSTUD

IDSTUD is an eight-digit identification code that uniquely identifies each sampled student in a country. The variable IDSTUD also has a hierarchical structure and is formed by concatenating the IDCLASS variable and a two-digit sequential number identifying all students within each classroom. Students can be uniquely identified in the database by the combination of IDCNTRY and IDSTUD as linking variables.

IDBOOK

IDBOOK identifies the specific assessment booklet that was administered to each student. The booklets are given a numerical value from 1 through 14.

IDSTRATE & IDSTRATI

IDSTRATE and IDSTRATI are identification variables generated by the school sampling process. IDSTRATE identifies the explicit strata and IDSTRATI the implicit strata from which the participating schools were sampled. The codes assigned to these two variables vary from country to country and are documented in Supplement 4 to the User Guide.

IDTEACH

IDTEACH is a six-digit identification code that uniquely identifies a teacher within a school. It has a hierarchical structure and is formed by the concatenation of IDSCHOOL and a two-digit sequential number within each school.

IDLINK

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

Exhibit 4.11 shows in which data files the various identification variables are located. It also highlights the combinations of variables used to uniquely identify the records contained in the different data file types. In the student background and achievement data files, the variables IDCNTRY and IDSTUD provide a

unique identification number to identify all students in the database. Since teachers may teach more than one class, the combination of the IDCNTRY, IDTEACH and IDLINK variables in the teacher background data files is needed to uniquely identify all teachers and the classes they teach. Teacher background variables are linked to the appropriate students using the student-teacher linkage data files. The variable IDSCHOOL, contained in all files, is a unique identification number for each school within a country. Combined with IDCNTRY, it can be used to link school background data to corresponding students or teachers.

Exhibit 4.11 Location of Identification Variables in the TIMSS 2007 Database

Identification Variables	Data File Types				
	ASA BSA	ASG BSG	AST BST	ATG BTM/BTS	ACG BCG
IDCNTRY	●	●	●	●	●
IDGRADE	●	●	●	●	●
IDPOP	●	●	●	●	●
IDSCHOOL	●	●	●	●	●
IDCLASS	●	●	●	●	
IDSTUD	●	●	●		
IDBOOK	●	●			
IDSTRATE	●	●			
IDSTRATI	●	●			
IDTEACH			●	●	
IDLINK			●	●	

Tracking Variables

Information about students, teachers, and schools provided by the survey tracking forms[6] is stored in the tracking variables. These variables have the prefix "IT." All

[6] Survey tracking forms are lists of students, teachers, or schools used for sampling and administrative purposes.

tracking variables are included in the student background data files. ITLANG is included in the student achievement and student background data files.

ITSEX

Gender of each student as stated in the Student Tracking Forms

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

Language of testing for each student. It is set to "1" for all countries that tested in a single language. For countries that administered the test in more than one language, additional numerical codes are used that correspond to the order of the testing languages as shown in Supplement 2 to the User Guide.

4.4 TIMSS 2007 Codebook Files

All information related to the structure of the TIMSS 2007 data files, as well as the source, format, descriptive labels, and response option codes for all variables, is contained in codebook files. Each data file type in the database is accompanied by a codebook file, with the exception of the curriculum data files.

The naming convention for codebook files is as follows:

- The first three characters of the filename are in every respect identical to those in the file names shown in Exhibit 4.2.
- The next three characters identify the files as TIMSS codebooks and are always "TMS".
- The seventh and eighth characters are always "M4" to indicate the TIMSS 2007 study cycle.
- The three-character file extension is always .SDB, which stands for standard dBase format.

Codebook files are located in the "Codebooks" folder of the DVD and can be read using Excel, or any standard database or spreadsheet program. Codebook files also are provided in printable PDF format. They describe the contents and structure of the TIMSS data files. Important codebook fields include FIELD_LABL, which contains extended textual information for all variables, QUEST_LOC, which provides the location of questions and achievement items within their respective survey instruments, and FIELD_CODE, which lists all acceptable responses allowed in the database.

4.5 TIMSS 2007Achievement Item Information Files

Achievement item information files are provided to enable users of the TIMSS 2007 database to readily produce summaries of item characteristics. There are separate achievement item information files for the fourth and eighth grades in the database. They are in Excel format in the "Items" folder of the DVD and they include the following information for each item in the TIMSS 2007 assessments:

- The item's permanent and unique identifier
- The item's block and its sequential location within the block
- The item's label
- The item's content domain and cognitive domain
- The item's type, either multiple-choice or constructed-response
- The number of options for a multiple-choice item
- The correct response key for a multiple-choice item
- The item's point value
- An indicator showing if the item was included in the IRT scaling
- An indicator showing if the item was released after the 2007 assessment

Item-Related Documents

The "Items" Folder also includes various documents related to the TIMSS 2007 achievement items. It contains PDF versions of the released TIMSS 2007 mathematics and science achievement items at the fourth and eighth grades. The documents include the items themselves with descriptive information and the scoring guides for the constructed-response items. The folder also includes Excel

files with the IRT item parameters estimated for all TIMSS 2007 items across all achievement scales. There is one Excel file for the scaling of overall mathematics and science and a second Excel file for the scaling of the mathematics and science content and cognitive domains. These same item parameters are presented in Appendix D of the *TIMSS 2007 Technical Report* (Olson, Martin, & Mullis, 2008).

4.6 TIMSS 2007 Data Almanac Files

Data almanacs provide weighted summary statistics for all variables in the TIMSS 2007 data files. There are two basic types of data almanacs: achievement data almanacs for the achievement items and background data almanacs for the background variables. All data almanac files are located in the "Almanacs" folder of the DVD in printable PDF format.

Achievement Data Almanacs

The achievement data almanacs provide weighted summary statistics for each participating country on each individual achievement item included in the TIMSS 2007 assessments. There are separate achievement almanacs for fourth and eighth grades and for the two subjects—mathematics and science. The achievement data almanacs display for each item its classification in the content and cognitive domains, the item block it belongs to, a brief description of the item, its variable name, whether it is a multiple-choice or constructed-response item, and the correct response key if it is a multiple-choice item. The trend item almanacs provide summary statistics for achievement items used in both the 2003 and 2007 assessments.[7] The achievement data almanac files available in the database are listed in Exhibit 4.12.

The data almanacs also display the international averages for each item, with each country weighted equally. The benchmark participants, listed below the international averages, are not included in the calculation of international averages.

There are two types of displays in the achievement data almanacs, depending on whether an item is a multiple-choice item or a constructed-response item. The statistics displayed in these almanacs are as follows:

[7] Although statistics on trend items from the 2003 and 2007 assessments are included in the database, the trend scaling for TIMSS 2007 relied on trend items between the 2003 assessment and the 2007 Bridging Study. Almanacs for these trend items are also available in the database and are mentioned in section 4.9 of this chapter.

- N: The number of students to whom the item was administered.
- DIFF: Percent of students that responded correctly to a multiple-choice item.
- A, B, C, D and E: The percent of students choosing each one of the response options for a multiple-choice item.
- Scoring Guide Codes (10, 11, 70, 71, etc.): The percent of student responses assigned each of the codes in the scoring guide for a constructed-response item.
- OMITTED: The percent of students that omitted to respond to the item.
- NOT REACHED: The percent of students that did not reach the item.
- V1, V2: The percent of students that scored 1 point or better on the item (V1) or 2 points or better (V2).
- 1.GIRL %RIGHT, 2.BOY %RIGHT: The percent of girls and boys that either got a multiple-choice item right, or obtained the maximum score on a constructed-response item.

Exhibit 4.12 TIMSS 2007 Achievement Data Almanacs

Achievement Data Almanacs	Contents
T07_G4_ItemAlmanac_MAT	Almanac for fourth-grade mathematics items
T07_G4_ItemAlmanac_SCI	Almanac for fourth-grade science items
T07_G4_TrendItemAlmanac_MAT	Trend almanac for fourth-grade mathematics items
T07_G4_TrendItemAlmanac_SCI	Trend almanac for fourth-grade science items
T07_G8_ItemAlmanac_MAT	Almanac for eighth-grade mathematics items
T07_G8_ItemAlmanac_SCI	Almanac for eighth-grade science items
T07_G8_TrendItemAlmanac_MAT	Trend almanac for eighth-grade mathematics items
T07_G8_TrendItemAlmanac_SCI	Trend almanac for eighth-grade science items

Background Data Almanacs

Background data almanac files contain weighted summary statistics for each participating country on each variable in the student, teacher, and school background questionnaires, including derived variables based on these background variables. Among the statistics reported are mean mathematics and science achievement by response category. 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 files. The background data almanac files available in the database are listed in Exhibit 4.13.

The background data almanacs also display the international averages for each variable, with each country weighted equally. The benchmark participants, listed below the international averages, are not included in the calculation of international averages.

There are two types of displays in the background data almanacs, depending on whether the data are categorical (i.e., have a small number of discrete values) or continuous. The almanac display for categorical variables includes:

- The sample size (number of students, teachers or schools included in the sample)
- The number of valid cases (number of students, parents, teachers or schools for whom valid data were obtained)
- The weighted percentages of students corresponding to each valid response option (percentages based only on the students with valid data)
- The weighted percentages of students for whom none of the valid response options were selected, coded as "Not Administered" or "Omitted" (percentages based on the sample size)
- The weighted mean achievement values of students corresponding to each valid response option, as well as the "Not Administered" and "Omitted" codes
- In cases where a variable can be coded as "Not Applicable" because of an earlier filter question, the weighted percentage of students for whom the variable is coded as "Not Applicable" is also displayed, based only on the students with valid data, along with the corresponding weighted mean achievement

Exhibit 4.13 TIMSS 2007 Background Data Almanacs

Background Data Almanacs	Contents
T07_G4_StudentAlmanac_MAT	Fourth-grade student background almanac with mathematics achievement
T07_G4_StudentAlmanac_SCI	Fourth-grade student background almanac with science achievement
T07_G4_TeacherAlmanac_MAT	Fourth-grade teacher background almanac with mathematics achievement
T07_G4_TeacherAlmanac_SCI	Fourth-grade teacher background almanac with science achievement
T07_G4_TeacherAlmanac_CMB	Fourth-grade teacher background almanac with combined mathematics and science achievement
T07_G4_SchoolAlmanac_MAT	Fourth-grade school background almanac with mathematics achievement
T07_G4_SchoolAlmanac_SCI	Fourth-grade school background almanac with science achievement
T07_G8_StudentAlmanac_MAT	Eighth-grade student background almanac with mathematics achievement
T07_G8_StudentAlmanac_SCI	Eighth-grade student background almanac with science achievement
T07_G8_TeacherAlmanac_MAT	Eighth-grade teacher background almanac with mathematics achievement
T07_G8_TeacherAlmanac_SCI	Eighth-grade teacher background almanac with science achievement
T07_G8_SchoolAlmanac_MAT	Eighth-grade school background almanac with mathematics achievement
T07_G8_SchoolAlmanac_SCI	Eighth-grade school background almanac with science achievement

The almanac display for continuous variables includes:

- The sample size (number of students, teachers or schools included in the sample)
- The number of valid cases (number of students, parents, teachers or schools for whom valid data were obtained)

- The weighted percentages of students for whom the variable is coded as "Not Administered" or "Omitted" (percentages based on the sample size)
- The weighted mean, mode, minimum, maximum, and the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles across students (based only on the students with valid data)
- In cases where a variable can be coded as "Not Applicable" because of an earlier filter question, the weighted percentage of students for whom the variable is coded as "Not Applicable" is also displayed, based only on the students with valid data

4.7 TIMSS 2007 Test-Curriculum Matching Analysis Data Files

The Test-Curriculum Matching Analysis (TCMA) was conducted to investigate the appropriateness of the TIMSS 2007 mathematics and science tests for the fourth- and eighth-grade students in the participating countries. To that end, participating countries were asked to indicate which items on the TIMSS 2007 tests were included in their national curricula. Thus, based on the computed average percent correct, each country was able to see the performance of all countries on the items appropriate for its curriculum, and also the performance of its students on the items judged appropriate for the curriculum in other countries. The analytical method used and the results of the TCMA are presented in Appendix C of the *TIMSS 2007 international reports*.

The "TCMA" folder of the DVD contains four TCMA data files—one for each combination of grade and subject—in Excel format and printable PDF format, showing which items were selected by each participating country. Only those countries that submitted TCMA item selection information are included in the files and were presented in the reported results.

4.8 TIMSS 2007 Program Files

The TIMSS 2007 international database includes a number of SAS programs and macros designed to facilitate the manipulation of the TIMSS 2007 data files and conduct proper statistical analyses taking into account the jackknife algorithm and the presence of plausible values. These programs are located in the "SAS_Programs" subfolder of the "Programs" folder on the DVD and are described in Chapter 3.

The "IDB_Recode_Programs" subfolder contains SPSS syntax files to perform variable recodes required for the proper execution of example analyses using the IEA IDB Analyzer. They are described in Chapter 2.

4.9 TIMSS 2007 Bridge Data

The TIMSS 2007 international database includes data and materials from the TIMSS 2007 Bridging Study (see section 11.3.1 of the *TIMSS 2007 Technical Report*). A total of 28,098 students at the fourth grade and 44,350 at the eighth grade took part in the Bridging Study. Data from the assessment booklets and the student background questionnaires given to the students sampled for the Bridging Study are included, along with their reliability scoring data. Countries that participated in the Bridging Study can be identified in Exhibit 11.5 of the *TIMSS 2007 Technical Report*. Twenty-one countries and two benchmark participants (Ontario and Quebec) administered the bridge booklets at the fourth grade. Thirty-three countries and three benchmark participants (Basque Country, Ontario, and Quebec) administered the bridge booklets at the eighth grade.

The bridge data files and their contents follow the same file and variable naming conventions presented earlier in this chapter. They are distinguished from the regular TIMSS 2007 data files with the letters "B4" in the seventh and eighth position of their file name, or with the word "Bridge" appended to their file name in the case of files with supporting documentation. All files for the Bridging Study are found in "Bridge" subfolders within the appropriate folders of the DVD.

The international database includes achievement data files (ASA/BSA), student background data files (ASG/BSG), and cross-country reliability data files (ASR/BSR) from the Bridging Study, as well as their corresponding codebook files. The database also includes item information files and achievement data almanacs for the items included in the bridge assessment, and background data almanacs for the background variables from the student background data files. The bridge trend achievement data almanacs are of particular interest since these trend items played an important role in establishing trend measures for the TIMSS 2007 scaling.

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Appendix

Organizations and Individuals Responsible for TIMSS 2007

Introduction

TIMSS 2007 was a collaborative effort involving hundreds of individuals around the world. This appendix recognizes the individuals and organizations for their contributions. Given the work on TIMSS 2007 has spanned approximately five years and has involved so many people and organizations, this list may not include all who contributed. Any omission is inadvertent.

Of the first importance, TIMSS 2007 is deeply indebted to the students, teachers, and school principals who contributed their time and effort to the study.

Management and Coordination

TIMSS is a major undertaking of IEA, and together with PIRLS, comprises the core of IEA's regular cycle of studies. PIRLS, which regularly assesses reading at the fourth grade, complements the TIMSS assessments.

The TIMSS & PIRLS International Study Center at Boston College has responsibility for the overall direction and management of the TIMSS and PIRLS projects. Headed by Drs. Michael O. Martin and Ina V.S. Mullis, the study center is located in the Lynch School of Education. In carrying out the project, the TIMSS & PIRLS International Study Center worked closely with

the IEA Secretariat in Amsterdam, which provided guidance overall and was responsible for verification of all translations produced by the participating countries. The IEA Data Processing and Research Center in Hamburg was responsible for processing and verifying the internal consistency and accuracy of the data submitted by the participants. Statistics Canada in Ottawa was responsible for school and student sampling activities. Educational Testing Service (ETS) in Princeton, New Jersey provided psychometric methodology recommendations addressing calibration, scaling, and survey design changes implemented in TIMSS 2007, and assisted in executing the item calibration analyses and made available software for scaling the achievement data.

The Project Management Team, comprised of the Directors and Senior Management from the TIMSS & PIRLS International Study Center, the IEA Secretariat, the IEA Data Processing and Research Center, Statistics Canada, and ETS met twice a year throughout the study to discuss the study's progress, procedures, and schedule. In addition, the Directors of the TIMSS & PIRLS International Study Center met with members of IEA's Technical Executive Group twice yearly to review technical issues.

Dr. Graham Ruddock from the National Foundation for Educational Research in England (NFER) was the TIMSS 2007 Mathematics Coordinator and Dr. Christine O'Sullivan from K–12 Consulting was the TIMSS 2007 Science Coordinator. Together with the Science and Mathematics Item Review Committee, a panel of internationally recognized experts in mathematics and science research, curriculum, instructions, and assessments, they provided excellent guidance throughout TIMSS 2007.

To work with the international team and coordinate within-country activities, each participating country designated one or two individuals to be the TIMSS National Research Coordinator or Co-Coordinators, known as the NRCs. The NRCs had the complicated and challenging task of implementing the TIMSS 2007 study in their countries in accordance with TIMSS guidelines and procedures. The quality of the TIMSS 2007 assessment and data depends on the work of the NRCs and their colleagues in carrying out the very complex sampling, data collection, and scoring tasks involved. In addition, the Questionnaire Development Group, comprised of NRCs, provided advice on questionnaire development.

Continuing the tradition of truly exemplary work established in previous TIMSS assessments, the TIMSS 2007 NRCs (often the same NRCs as in previous assessments), performed their many tasks with dedication, competence, energy, and goodwill, and have been commended by the IEA Secretariat, the TIMSS & PIRLS International Study Center, the IEA Data Processing and Research Center, and Statistics Canada for their commitment to the project and the high quality of their work.

Funding

A project of this magnitude requires considerable financial support. IEA's major funding partners for TIMSS 2007 included the World Bank, the U.S. Department of Education through the National Center for Education Statistics, the United Nations Development Programme (UNDP) and those countries that contributed by way of fees. The financial support provided by Boston College and NFER also is gratefully acknowledged.

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