TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

TIMSS

TIMSS 2019 USER GUIDE FOR THE INTERNATIONAL DATABASE

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TIMSS 2019 User Guide for the International Database
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INTRODUCTION

Overview

TIMSS (the Trends in International Mathematics and Science Study) is an international comparative study of student achievement in mathematics and science around the world. Conducted on a four-year assessment cycle since 1995, TIMSS has assessed student achievement at the fourth and eighth grades seven times—in 1995, 1999, 2003, 2007, 2011, 2015, and 2019—and has accumulated 24 years of trend measurements. TIMSS collects a rich array of information about the national, home, school, and classroom contexts in which students learn mathematics and science. These context data provide international comparative perspectives about the educational factors related to mathematics and science achievement.

In 2019, TIMSS began transitioning to computer-based assessment by introducing a digital version of the paper-and-pencil assessment called "eTIMSS." Over half the TIMSS 2019 participants opted to administer the digital version. eTIMSS 2019 included extended Problem Solving and Inquiry Tasks (PSIs) and a variety of digitally enhanced item types, including drag and drop, sorting, and drop-down menu input types. The eTIMSS 2019 achievement data were scaled to allow for relative comparisons of performance between both eTIMSS and paperTIMSS assessments, while also maintaining comparability of trend measurements overtime (Foy, Fishbein, von Davier, & Yin, 2020; von Davier, 2020). To provide a bridge between eTIMSS and paperTIMSS, eTIMSS countries also administered the paperTIMSS trend items to a separate sample of students, typically in the same schools. The TIMSS 2019 Bridge data form an intermediate link (or bridge) between eTIMSS countries' computer-based data in 2019 and their paper-based data in 2015, as well as the data from paperTIMSS 2019 countries.

TIMSS 2019 included a less difficult version of the fourth grade mathematics assessment, which enabled TIMSS 2019 to provide improved measurement for participating countries where fourth grade students were still developing fundamental mathematics skills. The less difficult fourth grade mathematics assessment had some blocks in common with the regular fourth grade mathematics assessment. Results for the two versions of the assessment were

linked and reported on the same TIMSS mathematics achievement scale. Countries administering the less difficult mathematics assessment also administered the regular fourth grade science assessment. Eleven countries participated in the less difficult fourth grade mathematics assessment, three of which also participated in TIMSS Numeracy 2015, and three of which also participated in TIMSS 2015.

To support and promote secondary analysis aimed at improving mathematics and science education at the fourth and eighth grades, the TIMSS 2019 International Database makes available to the researchers, analysts, and other users the data collected and analyzed by the TIMSS 2019 project. The database includes student achievement data as well as student, home, teacher, school, and national context data for 64 countries and 8 benchmarking participants. Across both grades and including the Bridge data, the database includes records for 682,680 students, 387,227 parents, 65,306 teachers, 24,316 school principals, and the National Research Coordinators of each participating country. All participating countries gave IEA Hamburg permission to release their national data.

For trend countries that participated in previous assessments, TIMSS 2019 provides trends for up to seven cycles—1995, 1999, 2003, 2007, 2011, 2015, and 2019 (no fourth grade assessment in 1999). Trend countries participating in eTIMSS 2019 also have data points collected in two modes of administration (von Davier, Foy, Martin, & Mullis, 2020). In countries new to TIMSS, the 2019 results can help policy makers and practitioners assess their comparative standing and gauge the rigor and effectiveness of their mathematics and science programs. Results of the assessments conducted in 2019 are reported in *TIMSS 2019 International Results in Mathematics and Science* (Mullis, Martin, Foy, Kelly, & Fishbein, 2020).

TIMSS 2019 was an ambitious and demanding study, involving complex procedures for drawing student samples, assessing students' achievement, analyzing the data, and reporting the results. To work effectively with TIMSS data, it is necessary to have an understanding of the characteristics of the study, which are described fully in *Methods and Procedures: TIMSS 2019 Technical Report* (Martin, von Davier, & Mullis, 2020). It is intended that this User Guide be used in conjunction with the technical documentation. While the User Guide describes the organization and content of the database, the chapters of the technical report provide the rationale for the techniques used and for the measures created in the process of data collection and compilation.

The TIMSS 2019 User Guide

This User Guide describes the content and format of the data in the TIMSS 2019 International Database and presents example analyses with the data. Following this introduction, the User Guide includes the following chapters:

- **Chapter 1** introduces the IEA International Database (IDB) Analyzer Software (IEA, 2021) and presents examples of analyses with the TIMSS 2019 data using this software in conjunction with SPSS (IBM Corporation, 2016) and SAS (SAS Institute, 2016).
- **Chapter 2** serves as a reference for details about the structure and contents of the TIMSS 2019 International Database, including detailed descriptions of the various data files, conventions for naming data files and variables, and descriptions of all the supporting documentation provided with the International Database.
- **Chapter 3** describes special SPSS and SAS programs needed to make full use of the TIMSS 2019 International Database, including programs to score the achievement items according to the assigned item response codes.

The User Guide is accompanied by the following supplements:

- **Supplement 1**: International Versions of the TIMSS 2019 Context Questionnaires
- **Supplement 2**: National Adaptations to the TIMSS 2019 Context Questionnaires
- **Supplement 3**: Variables Derived from the TIMSS 2019 Student, Home, Teacher, and School Context Data

The User Guide and its supplements are available on the TIMSS 2019 International Database and User Guide webpage: *http://timssandpirls.bc.edu/timss2019/international-database*. The primary purpose of this User Guide is to introduce users to the TIMSS 2019 International Database and demonstrate the basic functionality of the IEA IDB Analyzer through simple examples of results published in *TIMSS 2019 International Results in Mathematics and Science*. The IEA IDB Analyzer comes with its own manual, available through the Help Module, which describes the full functionality and features of the IEA IDB Analyzer.

The TIMSS 2019 International Database

The TIMSS 2019 International Database is available on the TIMSS 2019 International Database webpage: *http://timssandpirls.bc.edu/timss2019/international-database*. The TIMSS

2019 International Database is also available for download at the IEA Study Data Repository website: *https://www.iea.nl/data*. The repository allows users to download the data files and accompanying support materials from all recent IEA studies, including TIMSS 2019 and the TIMSS 2019 Bridge.

The International Database contains the TIMSS 2019 student achievement data files, student, home, teacher, and school context data files, curriculum data files, along with support materials. Exhibit 1 describes the general structure of the International Database, with a brief description of the support materials available for download.

Exhibit 1: Contents of the TIMSS 2019 International Database

User Guide	User Guide and supplements
Achievement Items	TIMSS 2019 Item information, IRT item parameters, and percent correct statistics
International Database	
SPSS Data	TIMSS 2019 student, home, teacher, and school data files in SPSS data format
SAS Data	TIMSS 2019 student, home, teacher, and school data files in SAS data or export format
Curriculum Data	TIMSS 2019 curriculum questionnaire data Excel files
Codebooks	Codebook files describing all variables in the TIMSS 2019 International Database
Data Almanacs	Summary statistics for all TIMSS 2019 achievement items and context variables
TCMA	National item selection for the Test-Curriculum Matching Analysis
Special Programs	SPSS and SAS programs to score achievement data and process SAS export files

Public Use and Restricted Use Versions of the TIMSS 2019 International Database

The TIMSS 2019 International Database is available in two versions: a public use version and a restricted use version. In the public use version, some variables are removed to minimize the risk of disclosing confidential information. The list of variables removed from the public use version is given in Chapter 2 of this User Guide. The public use version is available for immediate access from the TIMSS 2019 International Database webpage, as well as from the IEA Study Data Repository, and users should be able to replicate all published TIMSS 2019 results with this version of the TIMSS 2019 International Database. Users who require any of the removed variables to conduct their analyses should contact the IEA through the IEA Study Data Repository to obtain permission and access to the restricted use version of the TIMSS 2019 International Database.

References

Foy, P., Fishbein, B., von Davier, M., & Yin, L. (2020). Implementing the TIMSS 2019 scaling methodology. In M. O. Martin, M. von Davier, & I. V. S. Mullis (Eds.), M*ethods and Procedures: TIMSS 2019 Technical Report* (pp. 12.1-12.146). Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2019/methods/chapter-12.html

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CHAPTER 1

Analyzing TIMSS 2019 Data with the IEA IDB Analyzer

Overview

This chapter describes the general use of the IEA's IDB Analyzer software (IEA, 2021) for analyzing the TIMSS 2019 data. Used in conjunction with either SPSS (IBM Corporation, 2016) or SAS (SAS Institute, 2016), the IEA IDB Analyzer provides a user-friendly interface to easily merge and analyze the various data file types of the TIMSS 2019 International Database. The software seamlessly accounts for the sampling information and the multiple imputed achievement scores to produce accurate statistical results.

Seven example analyses presented in this chapter illustrate some of the capabilities of the IEA IDB Analyzer (version 4.0) to compute a variety of statistics, including means and percentages of students in specified subgroups, mean student achievement in specified subgroups, regression coefficients, and percentages of students reaching the TIMSS 2019 International Benchmarks of Achievement. The examples use student, home, teacher, and school context data files to replicate some of the TIMSS 2019 results included in *TIMSS 2019 International Results in Mathematics and Science* (Mullis, Martin, Foy, Kelly, & Fishbein, 2020).

Users should be able to perform statistical analyses with the IEA IDB Analyzer with a basic knowledge of the TIMSS 2019 International Database. Chapter 2 gives a detailed description of the data files contained in the International Database, including their structure and contents, conventions for naming data files and variables, and descriptions of all the supporting documentation provided with the International Database.

About the IEA IDB Analyzer

Developed by IEA Hamburg, the IEA IDB Analyzer is an API (application programming interface) for SPSS and SAS, both well-known statistical analysis software. The IEA IDB Analyzer enables users to combine data files from IEA's large-scale assessments and

conduct analyses using either SPSS or SAS, without actually writing programming code. The IEA IDB Analyzer generates SPSS and SAS syntax that takes into account information from the sampling design in the computation of statistics and their standard errors. In addition, the generated syntax makes appropriate use of plausible values for calculating estimates of achievement scores and their standard errors, combining both sampling variance and imputation variance. Chapter 14 of *Methods and Procedures: TIMSS 2019 Technical Report* provides details about estimating standard errors in the TIMSS 2019 results (Foy & LaRoche, 2020).

The IEA IDB Analyzer consists of two modules—the Merge Module and the Analysis Module. The Merge Module is used to create analysis datasets by combining data files of different types (e.g., student and teacher context data files) and from different countries, and selecting subsets of variables for analysis. The Analysis Module provides procedures for computing various statistics and their standard errors.

Installing and Launching the IEA IDB Analyzer

The latest version of the IEA IDB Analyzer—version 4.0—is available for download from the IEA website: *https://www.iea.nl/data*. Once installed, the IEA IDB Analyzer application can be accessed by using the START menu in Windows or by clicking its icon, which is typically installed on the computer's desktop window.

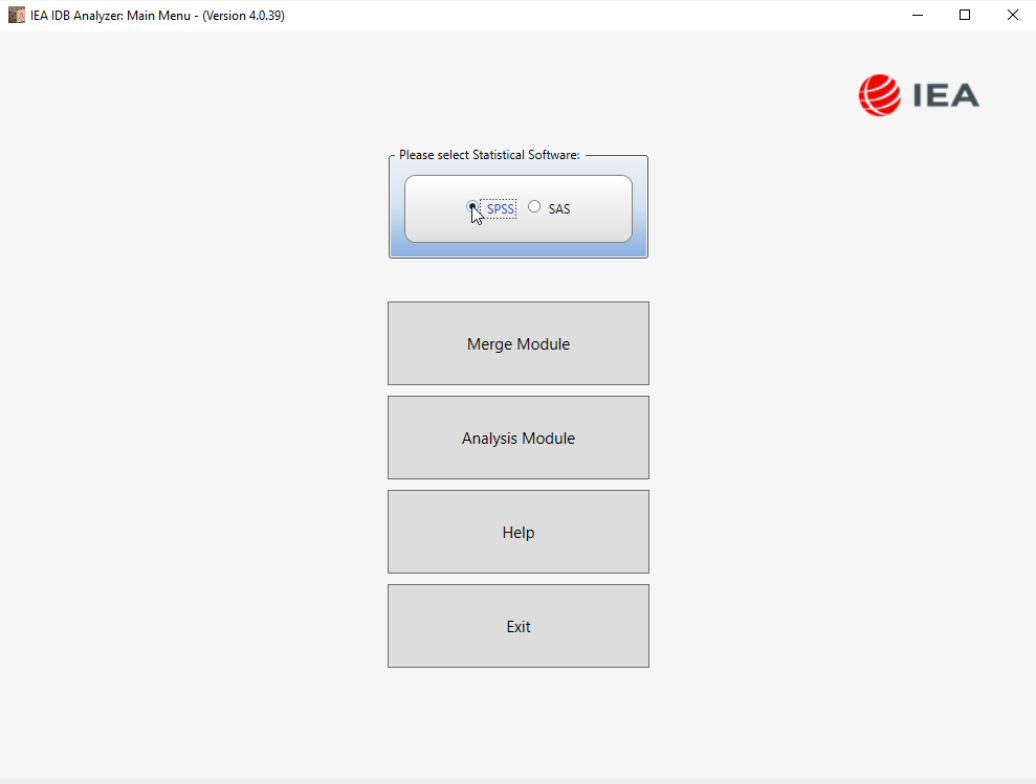
When the IEA IDB Analyzer application is launched, the main window will appear, as shown in Exhibit 1.1. Users are first directed to choose either SPSS or SAS as their statistical software of choice. The examples in this chapter use SPSS; however, the IDB Analyzer interface is the same for both.[1]

The main window directs users to the **Merge Module**, the **Analysis Module**, the **Help** manual, or simply **Exit** the application.

The IEA IDB Analyzer has an extensive manual, accessible through the Help button, which users are encouraged to consult for full details on all the functionalities and features of the IEA IDB Analyzer.

[1] The *TIMSS 2015 User Guide for the International Database* presents parallel examples using SAS (Foy, 2017).

Exhibit 1.1: IEA IDB Analyzer Main Window



Merging Data Files with the IEA IDB Analyzer

The IEA IDB Analyzer uses the data files available from the TIMSS 2019 International Database and User Guide webpage and from the IEA Study Data Repository. The TIMSS 2019 fourth grade and eighth grade data files are disseminated separately by file type (i.e., data source) and for each country. 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, home, teacher, and school) into one SPSS or SAS dataset for subsequent analysis.

Before doing any statistical analysis with the TIMSS 2019 International Database, users should download and copy the contents of the International Database either on their computer or on a server. For the examples in this chapter, all data files are copied within the

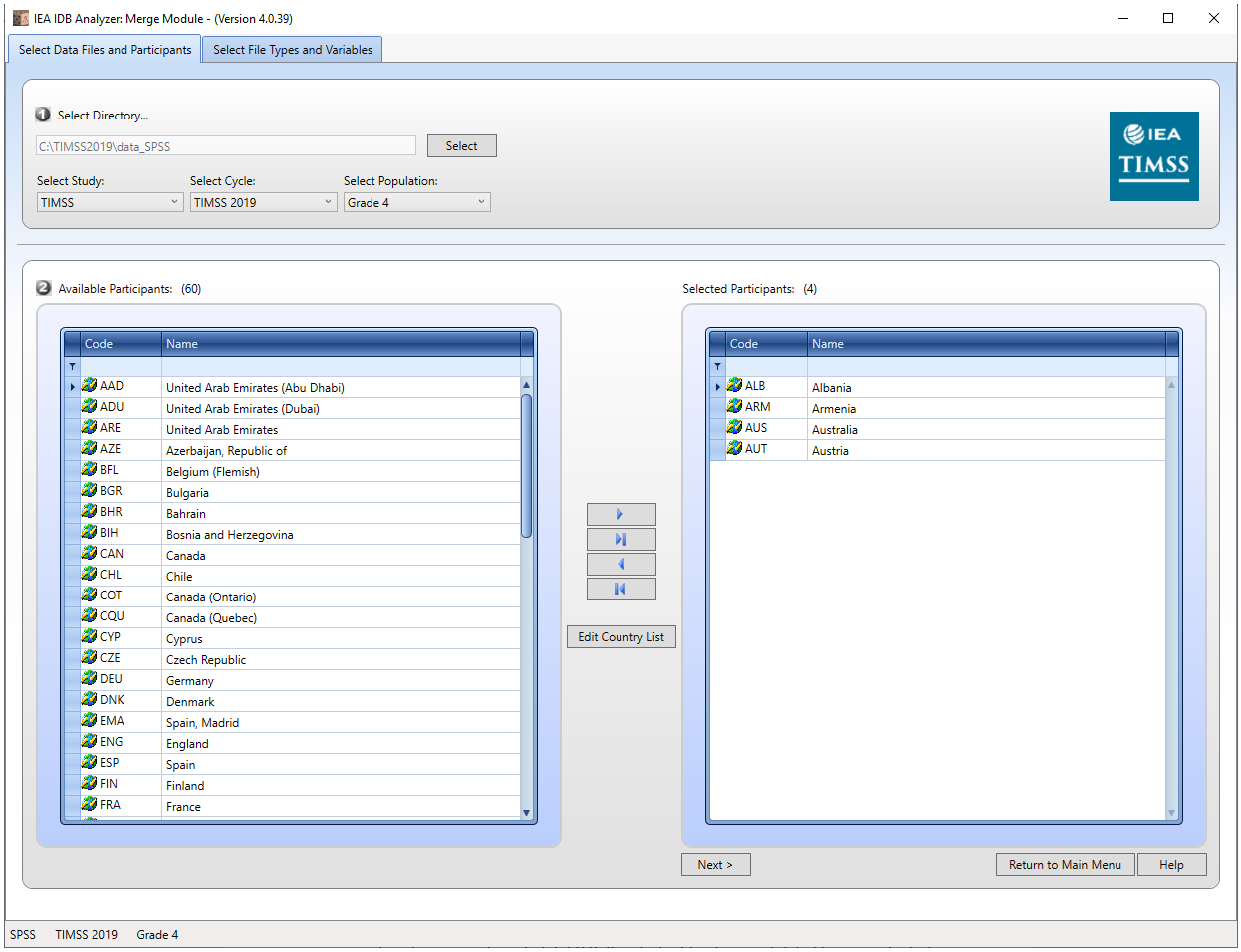
folder titled "C:\TIMSS2019\data_SPSS." Users working with SAS export files (*.EXP) need to convert the files into SAS data files (see Chapter 3).[2]

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

1. Start the IEA IDB Analyzer and click the **Merge Module** button.
2. Under the **Select Data Files and Participants** tab and in the **Select Directory** field, browse to the folder where all data files are located. For example, in Exhibit 1.2, all SPSS data files are located in the folder "C:\TIMSS2019\data_SPSS." The program will automatically recognize and complete the **Select Study**, **Select Cycle**, and **Select Population** fields and list all countries available in this folder as possible to merge. If the folder contains data from more than one IEA study (e.g., TIMSS, PIRLS), cycle (e.g., TIMSS 2015, TIMSS 2019, TIMSS 2019 Bridge), or population (e.g., Grade 4, Grade 8), users should select the desired combination. TIMSS 2019 Grade 4 is selected in Exhibit 1.2.
3. Click a country of interest from the **Available Participants** list and click the **right arrow** (▸) button to move it to the **Selected Participants** panel. Individual countries can be moved directly to the **Selected Participants** panel by double-clicking on them. To select multiple countries, hold the CTRL key of the keyboard when clicking countries. Click the **tab-right arrow** (▸|) button to move all countries to the **Selected Participants** panel. In Exhibit 1.2, Albania, Armenia, Australia, and Austria are selected.
4. Click the **Next >** button to proceed to the next step. The software will open the **Select File Types and Variables** tab of the Merge Module, as shown in Exhibit 1.3, to select the file types and the variables to be included in the merged data file.

[2] Because SAS data files may not be readable in all environments, the TIMSS 2019 International Database also provides data files in SAS export (*.EXP) format, along with a special SAS program to convert the export files to SAS data files suitable for analysis with the IEA IDB Analyzer (see Chapter 3).

Exhibit 1.2: IEA IDB Analyzer Merge Module: Select Data Files and Participants

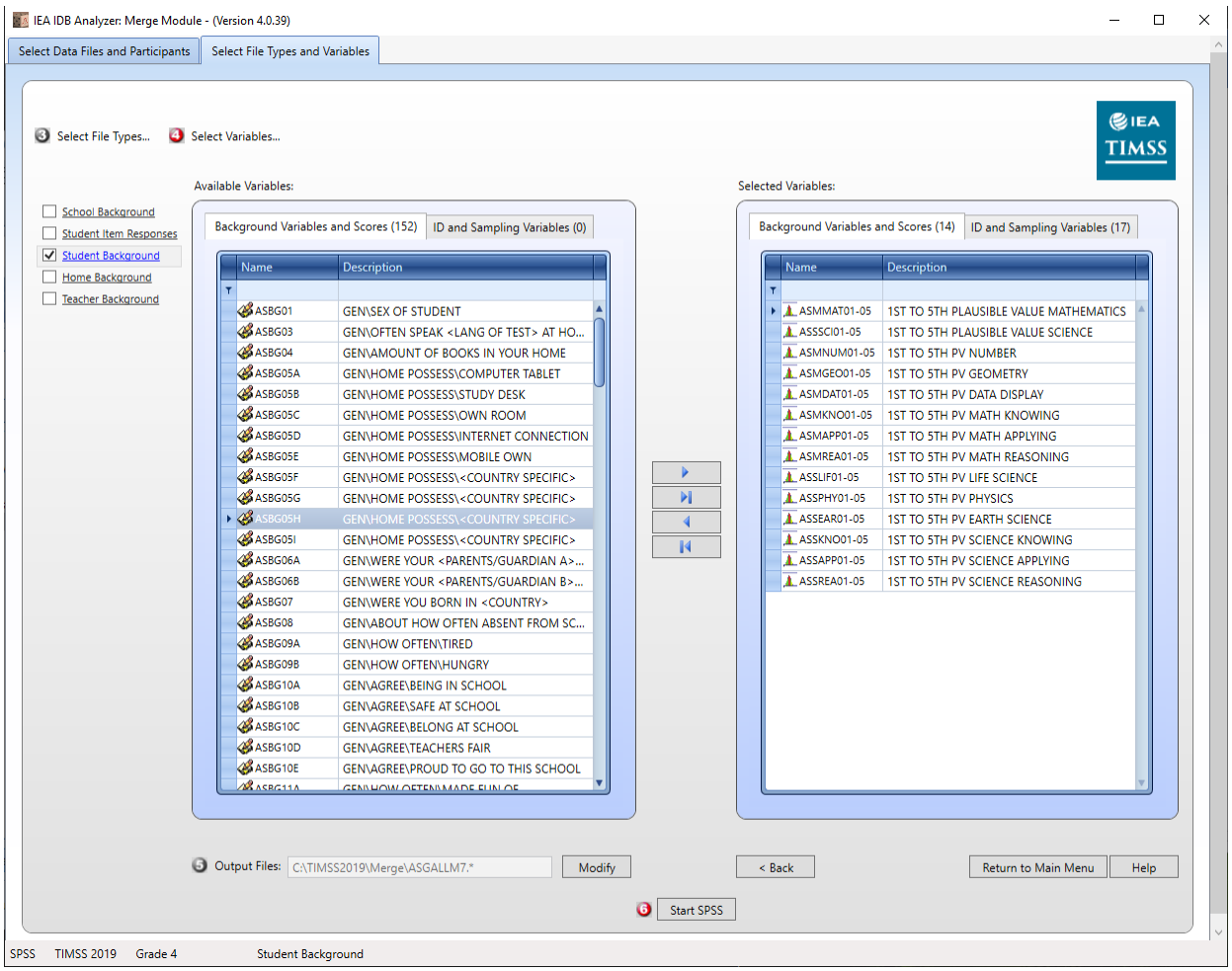


5. Select the files for merging by checking the appropriate boxes to the left of the window. For example, in Exhibit 1.3, the "student background" data files are selected, indicating the TIMSS student context data files are selected.[3]
6. Select the variables of interest from the **Available Variables** list in the left panel. The codebook files (described in Chapter 2 of this User Guide) as well as Supplement 1 to this User Guide provide the variable names for storing the data from all questions in the TIMSS 2019 Context Questionnaires. Variables are selected by clicking on them and moved to the **Selected Variables** list by clicking the **right arrow** (▸) button. Clicking the **tab-right arrow** (▸|) button selects and moves all variables to the **Selected Variables** list. Note that there are two tabs under the **Selected Variables**

[3] The IEA IDB Analyzer uses the term "background" when referring to context data files or variables.

list: **Background Variables and Scores** and **ID and Sampling Variables**. All achievement scores and all identification and sampling variables are selected automatically by the IEA IDB Analyzer.

Exhibit 1.3: IEA IDB Analyzer Merge Module: Select File Types and Variables



7. Specify the desired name for the merged data file and the folder where it will be stored in the **Output Files** field by clicking the **Define/Modify** button. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the merge. In the example shown in Exhibit 1.3, the syntax file ASGALLM7.SPS and the merged data file ASGALLM7.SAV both will be created and stored in the folder "C:\TIMSS2019\Merge." In SAS, it will be the syntax file ASGALLM7.SAS and the

merged data file ASGALLM7.SAS7BDAT. The merged data file will contain all the variables listed in the **Selected Variables** panel on the right.

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

Once SPSS or SAS has completed its execution, it is important to check the SPSS output window or SAS log for possible warnings. If warnings appear, they should be examined carefully, as they might indicate that the merge process was not performed properly and that the resulting merged data file might not be as expected.[4]

Merging Student and Teacher Context Data Files

The teachers in the TIMSS 2019 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.

TIMSS teacher context data are analyzed by linking the student records to their teachers by using the student-teacher linkage data files. The IEA IDB Analyzer does this automatically. To merge teacher data for analysis, it is sufficient to select the **Teacher Background** file type in the **Select File Types and Variables** tab of the IEA IDB Analyzer Merge Module. To analyze student and teacher context data simultaneously, however, both the **Student Background** and **Teacher Background** file types must be selected in the **Select File Types and Variables** tab. The variables of interest need to be selected separately for both file types, as follows:

1. Click the checkbox next to the **Student Background** file type so that it appears checked and highlighted. The **Background Variables and Scores** listed in the left-hand **Available Variables** panel will include all variables from the student context data files.

[4] For more information on how to use the IEA IDB Analyzer, and for troubleshooting, users should consult the Help manual.

2. Select the variables of interest from the left panel and click the **right arrow** (▸) button to move these variables to the **Selected Variables** panel on the right. Click the **tab-right arrow** (▸|) button to select all available variables.
3. Click the checkbox next to the **Teacher Background** file type, and select the variables of interest from the **Background Variables and Scores** panel on the left in the same manner shown in Steps 1 and 2.
4. Specify the folder and merged data file name in the **Output Files** field, as described in the previous section.
5. Click the **Start SPSS** (or Start SAS) button to create the syntax file that will produce the merged data file. The SPSS syntax file is executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** (🏃) button (or select **Submit** in the **Run** menu).

Steps 1 and 2 above are required only if student data (achievement or context) and teacher context data are analyzed simultaneously. It is not recommended to combine both types of files and analyze only student data, as the results may not be correct (see the *Sampling and Weighting Variables* section in Chapter 2 of this User Guide).

Merging Student and School Context Data Files

Because TIMSS 2019 includes 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 results. For this reason, it is preferable to analyze school context variables as attributes of the students, rather than as elements in their own right. Therefore, analyzing school context data should be done by linking the students to their schools.

To merge the student and school context data files, select both the **Student Background** and **School Background** file types in the **Select File Types and Variables** tab 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 described above in *Merging Student and Teacher Context Data Files* and using the same set of instructions.

Merging Student and Home Context Data Files

The parents of the fourth grade students participating in TIMSS 2019 responded to the home questionnaire, also called the "Early Learning Survey." Their responses are included in the home context data files (named beginning with "ASH"). Although home context variables are

located in their own files, they are in essence attributes of the students and must be analyzed in the same manner as student context variables. This will require users to merge the home context data files with the student context data files by selecting both the **Home Background** and **Student Background** file types in the Merge Module of the IEA IDB Analyzer. Variables of interest to be included in the merged data file are chosen separately by file type, as described above in *Merging Student and Teacher Context Data Files* and using the same set of instructions.

Merged Data Files for the User Guide Examples

To conduct the analysis examples presented in this chapter, a number of merged data files were created following the instructions provided above. Because the examples presented in this User Guide are all about TIMSS 2019 fourth grade, merged data files were produced with all countries that participated in TIMSS 2019 at the fourth grade. A full list of countries and their participation in TIMSS 2019 is provided in Chapter 2.

The following merged data files were created with all available context variables and achievement scores selected:

ASGALLM7_CMB	Merged student context data files with all variables selected for all countries and benchmarking participants
ASHALLM7_CMB	Merged home and student context data files with all variables selected for all countries and benchmarking participants
ATGALLM7_CMB	Merged teacher and student context data files with all variables selected for all countries and benchmarking participants
ACGALLM7_CMB	Merged school and student context data files with all variables selected for all countries and benchmarking participants

Conducting Analyses with the IEA IDB Analyzer

The IEA IDB Analyzer can perform statistical analyses on any files created using the Merge Module. The **Analysis Module** of the IEA IDB Analyzer allows users to specify the type of analysis and select variables from a merged data file as analysis variables. To conduct analyses using plausible values (achievement scores), after selecting a **Statistic Type**, users should select the **Use PVs** option from the **Plausible Value Option** drop-down menu.

All statistical procedures offered in 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 (Foy & LaRoche, 2020). 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.

Description of Statistical Procedures in the IEA IDB Analyzer

The following statistical procedures are available in the **Analysis Module** of the IEA IDB Analyzer. The various variables to define for analysis are described in the following section.

Percentages and Means
Compute percentages, means, and standard deviations for selected analysis variables by subgroups defined by grouping variable(s). Plausible values can be included as analysis variables. This statistic is used in Examples 1, 2, 5, 6, and 7 of this chapter.

Percentages only
Compute percentages by subgroups defined by grouping variable(s).

Linear Regression
Compute linear regression coefficients for selected independent variables to predict a continuous dependent variable by subgroups defined by grouping variable(s). Plausible values can be included as dependent or independent variables. This statistic is used in Example 3 of this chapter.

Logistic Regression
Compute logistic regression coefficients for selected independent variables to predict a dichotomous dependent variable by subgroups defined by grouping variable(s). Plausible values can be included as dependent or independent variables. When used as a dependent variable, plausible values will be dichotomized using a specified cutpoint, such as one of the TIMSS International Benchmarks.

Correlations
Compute means, standard deviations, and correlation coefficients for selected analysis variables by subgroups defined by grouping variable(s). Plausible values can be included as analysis variables.

Benchmarks
Compute percentages of students meeting a set of user-specified achievement benchmarks, in particular the TIMSS International Benchmarks, by subgroups defined by grouping variable(s). This statistic is used in Example 4 of this chapter.

Percentiles
Compute the score points that separate a given proportion of the distribution of a continuous analysis variable by subgroups defined by the grouping variable(s). Plausible values can be included as analysis variables.

Definition of Analysis Variables in the IEA IDB Analyzer

The various variables required to conduct an analysis are input into specific variable fields according to their purpose. All available features of the IEA IDB Analyzer are described extensively in its Help manual.

Grouping Variables
This is a list of variables to define subgroups of interest. 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 can be selected from the available list. If the **Exclude Missing from Analysis** option is checked, 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, percentages, correlations, or percentiles are to be computed. Usually, more than one analysis variable can be selected. To compute statistics based on achievement scores, after choosing the **Statistic Type** it is necessary to select the **Use PVs** option in the **Plausible Value Option** drop-down menu and select the achievement scores of interest in the **Plausible Values** field.

Plausible Values
This section is used to identify the set of plausible values to be used when achievement scores are the analysis variable for computing statistics. After choosing the **Statistic Type**, select the **Use PVs** option in the **Plausible Value Option** drop-down menu before specifying the achievement scores in the **Plausible Values** field.

Independent Variables

This is a list of variables to be treated as independent variables for a linear or logistic regression analysis. More than one independent variable can be selected. Categorical variables and continuous variables can be specified as independent variables. When specifying categorical variables as independent variables, they can be treated either as "effect coding" or "dummy coding" using the **Contrast** drop-down menu (dummy coding is used in Example 3).[5] Achievement scores also can be included as an independent variable. To specify achievement scores as an independent variable, it is necessary to select the **Use PVs** option in the **Plausible Value Option** drop-down menu and select the achievement scores of interest in the **Plausible Values** field.

Dependent Variable

This is the variable to be used as the dependent variable when a linear or logistic regression analysis is specified. Only one dependent variable can be listed and can be either a context variable or achievement scores. To use achievement scores as the dependent variable, select the **Use PVs** option in the **Plausible Value Option** drop-down menu, click on the **Plausible Values** radio button in the **Dependent Variable** section, and select the achievement scores of interest in the **Plausible Values** field.

Achievement Benchmarks

These are the values that will be used as cutpoints on an achievement scale, selected in the **Plausible Values** section, for computing the percentages of students meeting the specified benchmarks. Multiple cutpoints can be specified, each separated by a blank space. A drop-down menu is available to select the four TIMSS International Benchmarks.

Percentiles

These are the percentiles that will be calculated from the distribution of a continuous analysis variable selected in the **Analysis Variables** section. Achievement scores can be selected as an analysis variable. Select the **Use PVs** option in the **Plausible Value Option** drop-down menu and select the achievement scores of interest in the **Plausible Values** field. Multiple percentiles can be specified, each separated by a blank space.

[5] Effect coding and dummy coding of categorical variables are described in the Help manual for the IEA IDB Analyzer.

Weight Variable

This is the sampling weight variable 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, but SENWGT and HOUWGT also are available for student-level analyses with student, home, or school context data. For both the fourth and eighth grades, MATWGT will be used when analyzing mathematics teacher data, SCIWGT when analyzing science teacher data. Chapter 2 of this User Guide provides more information on the TIMSS 2019 sampling weights.

Conducting Analyses with TIMSS Student Context Data

Many types of analysis can be conducted using the student context data files from the TIMSS 2019 International Database. This section presents examples of actual analyses used to produce exhibits in the *TIMSS 2019 International Results in Mathematics and Science* report, including percentages and means, linear regression, and international benchmark analyses.

The examples in this section use the TIMSS 2019 fourth grade context data file described earlier under *Merging Data Files with the IEA IDB Analyzer*, including all countries and benchmarking participants and all available variables. Example 1 computes average achievement by country, whereas Example 2 computes national average achievement by gender. In both cases, the IEA IDB Analyzer uses the sampling weights, implements the jackknife repeated replication method to compute appropriate sampling errors, effectively performs the computations five times (once for each plausible value), and aggregates the results to produce accurate estimates of average achievement and standard errors that incorporate both sampling and imputation errors. Example 3 expands on the second example by performing a test of statistical significance on the gender difference using linear regression. Lastly, Example 4 computes the percentages of fourth grade students reaching each of the TIMSS 2019 International Benchmarks.

Example 1 – Analysis of Average Achievement with Student Context Data

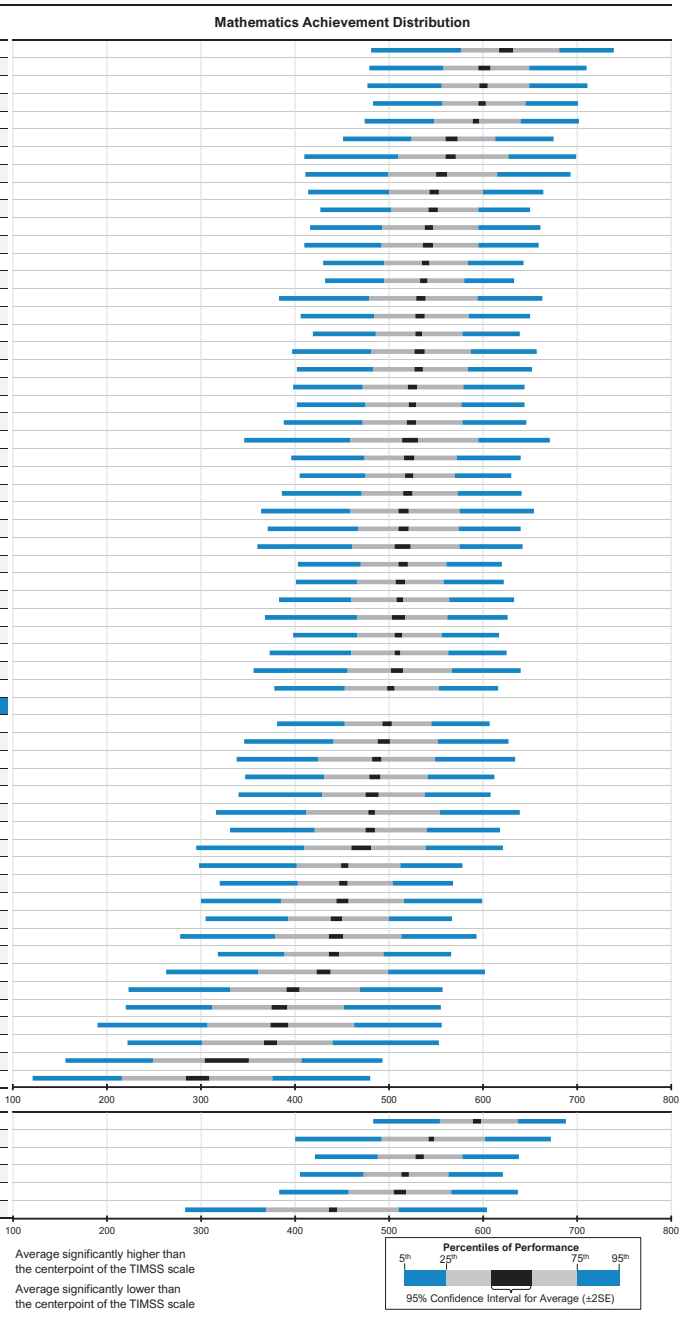
This first example replicates the analysis of the overall distribution of mathematics achievement using the example TIMSS 2019 fourth grade student context file (ASGALLM7_CMB), described earlier under *Merging Data Files with the IEA IDB Analyzer*. The results of this analysis are presented in Exhibit 1.1 of *TIMSS 2019 International Results in Mathematics and Science,* repeated below in Exhibit 1.4.

Exhibit 1.4: Exhibit of Example 1 – Analysis of Average Achievement with Student Context Data (Exhibit 1.1 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

Exhibit 1.1: Average Mathematics Achievement and Scale Score Distributions

Country	Average Scale Score	
[3] Singapore	625 (3.9)	▲
† Hong Kong SAR	602 (3.3)	▲
Korea, Rep. of	600 (2.2)	▲
Chinese Taipei	599 (1.9)	▲
Japan	593 (1.8)	▲
[2] Russian Federation	567 (3.3)	▲
† Northern Ireland	566 (2.7)	▲
[2] England	556 (3.0)	▲
Ireland	548 (2.5)	▲
[2] Latvia	546 (2.6)	▲
† Norway (5)	543 (2.2)	▲
[2] Lithuania	542 (2.8)	▲
Austria	539 (2.0)	▲
≡ Netherlands	538 (2.2)	▲
[2] † United States	535 (2.5)	▲
Czech Republic	533 (2.5)	▲
† Belgium (Flemish)	532 (1.9)	▲
Cyprus	532 (2.9)	▲
Finland	532 (2.3)	▲
[2] Portugal	525 (2.6)	▲
† Denmark	525 (1.9)	▲
Hungary	523 (2.6)	▲
[2] Turkey (5)	523 (4.4)	▲
Sweden	521 (2.8)	▲
Germany	521 (2.3)	▲
Poland	520 (2.7)	▲
Australia	516 (2.8)	▲
Azerbaijan	515 (2.7)	▲
Bulgaria	515 (4.3)	▲
Italy	515 (2.4)	▲
[2] Kazakhstan	512 (2.5)	▲
[1 2] Canada	512 (1.9)	▲
[2] Slovak Republic	510 (3.5)	▲
Croatia	509 (2.2)	▲
Malta	509 (1.4)	▲
[2] Serbia	508 (3.2)	▲
Spain	502 (2.1)	
TIMSS Scale Centerpoint	**500**	
Armenia	498 (2.5)	
Albania	494 (3.4)	
[2] New Zealand	487 (2.6)	▽
France	485 (3.0)	▽
[1] Georgia	482 (3.7)	▽
United Arab Emirates	481 (1.7)	▽
Bahrain	480 (2.6)	▽
North Macedonia	472 (5.3)	▽
Montenegro	453 (2.0)	▽
Bosnia and Herzegovina	452 (2.4)	▽
Qatar	449 (3.4)	▽
[2] Kosovo	444 (3.0)	▽
Iran, Islamic Rep. of	443 (3.9)	▽
Chile	441 (2.7)	▽
Oman	431 (3.7)	▽
[2] Saudi Arabia	398 (3.6)	▽
Morocco	383 (4.3)	▽
Kuwait	383 (4.7)	▽
South Africa (5)	374 (3.6)	▽
[2 Ψ] Pakistan	328 (12.0)	▽
[2 Ψ] Philippines	297 (6.4)	▽
Benchmarking Participants		
Moscow City, Russian Fed.	593 (2.2)	▲
[2] Dubai, UAE	544 (1.6)	▲
Quebec, Canada	532 (2.3)	▲
Madrid, Spain	518 (2.2)	▲
[2] Ontario, Canada	512 (3.3)	▲
Abu Dhabi, UAE	441 (2.2)	▽



The TIMSS achievement scale was established in 1995 based on the combined achievement distribution of all countries that participated in TIMSS 1995. To provide a point of reference for country comparisons, the scale centerpoint of 500 was located at the mean of the combined achievement distribution. The units of the scale were chosen so that 100 scale score points corresponded to the standard deviation of the distribution.

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.

See Appendix B.2 for population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.

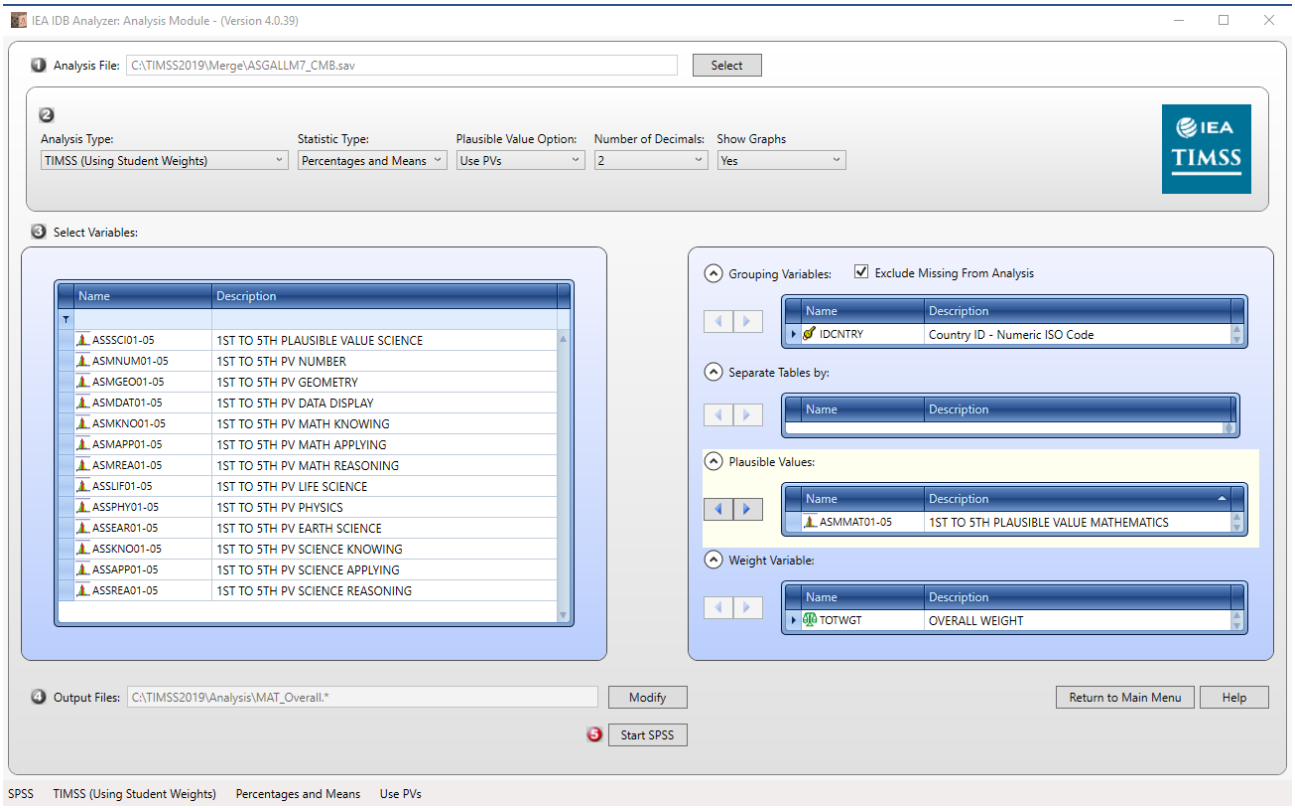
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Because the results in Exhibit 1.4 are based on plausible values, users should make sure they are included as selected variables when creating the file using the **Merge Module**, and also indicate that the analysis will make use of achievement scores with **Use PVs** option. The **Percentages and Means** statistic type with the **Use PVs** option selected will compute percentages and average achievement scores based on plausible values and their respective standard errors.

After creating the merged data file ASGALLM7_CMB, the **Analysis Module** of the IEA IDB Analyzer is used to conduct the analysis in the following steps. The completed **Analysis Module** for this example is shown in Exhibit 1.5.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Select the merged data file ASGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the **Analysis Type**.
4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce two bar graphs in the SPSS or SAS output file: one for average achievement by country, and one for average percent of total students by country.
8. The IDB Analyzer automatically selects the variable IDCNTRY for the **Grouping Variables**. No additional grouping variables are needed for this analysis. The IEA IDB Analyzer automatically checks the **Exclude Missing from Analysis**, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.
9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the IEA IDB Analyzer Help manual for more information.
10. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.

Exhibit 1.5: IEA IDB Analyzer Analysis Module Setup for Example 1 – Analysis of Average Achievement with Student Context Data



11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis uses student context data.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.5, the syntax file MAT_Overall.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** ( ) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

The IDB Analyzer produces and saves the results outputs in three file formats within the folder specified in Step 12—SPSS output file (*.SPV), SPSS data file (*.SAV), and Microsoft Excel Worksheet (*.XLSX). Graphs are included only in the SPSS output files. In addition, the IEA IDB Analyzer produces a results file in SPV and XLSX formats indicating the significance of differences in the outcome variable (achievement) by the grouping variable (IDCNTRY). For this example, the outputs indicate the significance of the differences in achievement between each possible combination of two countries. See the IEA IDB Analyzer Help manual for more information.

Exhibit 1.6 displays the results in the SPSS output file with four example countries: Albania, Azerbaijan, Australia, and Austria.

Exhibit 1.6: SPSS Output for Example 1 – Analysis of Average Achievement with Student Context Data

Average for ASMMAT0 by IDCNTRY

Country ID - Numeric ISO Code	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)	ASMMAT0 (Mean)	ASMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)	pctmiss
Albania	4426	31091	893.04	.13	.00	494.02	3.38	85.83	2.38	.00
Azerbaijan	5245	149829	3602.98	.64	.02	515.45	2.73	84.38	1.68	.00
Australia	5890	302574	5815.87	1.28	.03	515.88	2.78	86.99	1.87	.00
Austria	4464	78459	2184.52	.33	.01	539.22	2.02	64.60	1.09	.00

Each country's results are presented on a single line, with countries ordered sequentially according to their numeric ISO 3166 code (see Chapter 2). The results for "Table Average" are based on all countries included in the data file, including benchmarking participants. The countries are identified in the first column (Country ID) and the second column reports the number of valid cases (N of Cases). The third column reports the sum of weights of the sampled students (Sum of TOTWGT), indicating the estimated total fourth grade population. The fourth column is the standard error of the sum of weights (Sum of TOTWGT (s.e.)). The next two columns report the percentage of students by the grouping variable (Percent), which for this analysis is the percentage of all students in each country, and its standard error (Percent (s.e.)). The next two columns report the estimated average for the outcome variable, in this case mathematics achievement (ASMMAT0) and its standard error (ASMMAT0 (s.e.)). The standard deviation of the achievement scores (Std.Dev) and its standard error (Std.Dev (s.e.)) are reported in the next two columns, and the last column reports the percentage of cases with missing data (pctmiss).

As shown in the first line of Exhibit 1.6, Albania had valid data for 4,426 students, and these sampled students represented a population of 31,091 eligible students indicated by the sum of the weights. The average fourth grade mathematics achievement in Albania was 494.02 (standard error of 3.38) and its standard deviation was 85.83 (standard error of 2.38).

Example 2 – Analysis of Average Achievement by Gender with Student Context Data

The second example using student context data replicates another set of results presented in the *TIMSS 2019 International Results in Mathematics and Science* report. This analysis investigates the relationship between fourth grade students' gender and mathematics achievement. These results, presented in Exhibit 1.5 of *TIMSS 2019 International Results in Mathematics and Science*, are repeated below in Exhibit 1.7.

Because the results are based on plausible values, users should make sure they are included when creating the analysis file using the **Merge Module**, and also indicate that the analysis will make use of achievement scores with the **Use PVs** option. The **Percentages and Means** statistic type with the **Use PVs** option selected will compute percentages and average achievement scores based on plausible values and their respective standard errors.

The results of this analysis are also based on characteristics of students. In general, before conducting analysis using TIMSS contextual variables, users should refer to the relevant codebook for the data file to identify the appropriate variables and understand the coding scheme. Supplement 1 of this User Guide presents all the context questionnaires administered in TIMSS 2019 and the associated variable names under which the data are saved. Supplement 2 should also be checked for any national adaptations made to the questionnaire items that may impact international comparability.

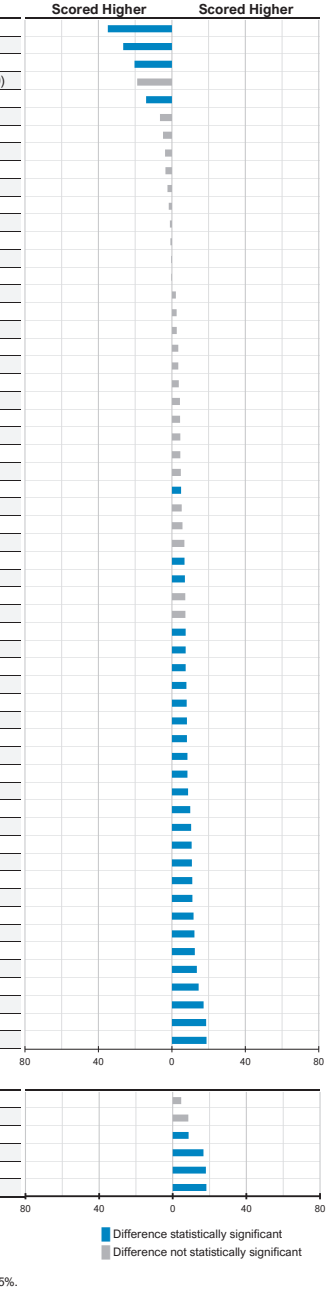
The codebook for fourth grade student context data files indicates that the ID variable ITSEX contains categorical information on the gender of students (and is typically preferred for analysis instead of the student-reported questionnaire variable). The **Percentages and Means** statistic type and the **Use PVs** plausible value option will allow us to compute the percentages and average achievement based on plausible values and their respective standard errors.

Exhibit 1.7: Exhibit of Example 2 – Analysis of Average Achievement by Gender with Student Context Data (Exhibit 1.5 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

Exhibit 1.5: Average Mathematics Achievement by Gender

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
[2] Ψ Philippines	48 (0.7)	315 (6.6)	52 (0.7)	280 (6.4)	35 (3.7)	
[2] Saudi Arabia	48 (0.8)	412 (4.9)	52 (0.8)	385 (5.8)	26 (8.1)	
South Africa (5)	50 (0.6)	384 (4.0)	50 (0.6)	364 (3.7)	20 (2.9)	
[2] Ψ Pakistan	45 (4.7)	338 (16.4)	55 (4.7)	319 (11.8)	19 (16.0)	
Oman	50 (0.7)	438 (3.6)	50 (0.7)	424 (4.4)	14 (2.9)	
Kuwait	47 (2.6)	387 (6.0)	53 (2.6)	380 (6.9)	7 (8.9)	
Bahrain	49 (1.2)	482 (3.2)	51 (1.2)	477 (3.5)	5 (4.3)	
Azerbaijan	47 (0.9)	517 (3.1)	53 (0.9)	514 (3.1)	4 (3.0)	
Morocco	49 (0.7)	385 (4.8)	51 (0.7)	382 (4.3)	3 (2.9)	
Armenia	48 (0.8)	499 (2.6)	52 (0.8)	497 (3.2)	2 (2.8)	
[2] Serbia	50 (0.9)	509 (3.4)	50 (0.9)	507 (4.0)	2 (3.9)	
Qatar	50 (1.5)	450 (5.1)	50 (1.5)	449 (3.2)	1 (5.2)	
Japan	48 (0.5)	593 (2.2)	52 (0.5)	593 (1.9)	1 (2.2)	
[2] Kazakhstan	49 (0.7)	512 (3.0)	51 (0.7)	512 (2.6)	0 (2.4)	
North Macedonia	48 (0.6)	472 (5.9)	52 (0.6)	472 (5.4)	0 (4.0)	
Bulgaria	48 (0.9)	514 (4.7)	52 (0.9)	516 (4.6)	2 (3.6)	
Finland	49 (0.9)	531 (2.9)	51 (0.9)	533 (2.8)	3 (3.2)	
Albania	49 (0.9)	493 (3.8)	51 (0.9)	495 (3.9)	3 (3.6)	
† Northern Ireland	50 (1.0)	564 (3.2)	50 (1.0)	568 (3.7)	3 (4.2)	
[2] Turkey (5)	52 (1.4)	521 (4.5)	48 (1.4)	525 (5.6)	3 (4.9)	
Chinese Taipei	48 (0.6)	597 (2.4)	52 (0.6)	601 (2.3)	4 (2.7)	
† Norway (5)	48 (0.9)	540 (2.7)	52 (0.9)	545 (2.9)	4 (3.5)	
[2] Kosovo	49 (1.0)	442 (3.1)	51 (1.0)	447 (3.7)	5 (3.3)	
[2] Lithuania	49 (0.9)	540 (2.9)	51 (0.9)	544 (3.7)	5 (3.8)	
[2] Latvia	50 (0.9)	544 (2.9)	50 (0.9)	548 (3.0)	5 (2.7)	
Montenegro	47 (0.6)	450 (2.6)	53 (0.6)	455 (2.4)	5 (3.0)	
Korea, Rep. of	47 (0.7)	597 (2.3)	53 (0.7)	602 (2.8)	5 (2.5)	
[2] New Zealand	48 (1.3)	484 (3.7)	52 (1.3)	490 (3.3)	5 (4.6)	
† Hong Kong SAR	46 (1.3)	599 (3.5)	54 (1.3)	604 (3.9)	6 (3.3)	
Ireland	50 (1.1)	545 (3.2)	50 (1.1)	552 (2.9)	7 (3.7)	
† Denmark	50 (0.8)	521 (2.2)	50 (0.8)	528 (2.6)	7 (2.9)	
Sweden	50 (1.1)	518 (3.2)	50 (1.1)	525 (3.1)	7 (2.8)	
[2] England	50 (1.0)	552 (4.0)	50 (1.0)	560 (3.0)	7 (3.8)	
Iran, Islamic Rep. of	49 (2.1)	439 (6.4)	51 (2.1)	447 (5.3)	7 (8.8)	
Malta	49 (0.7)	505 (2.1)	51 (0.7)	513 (1.9)	7 (2.7)	
[1] Georgia	49 (0.9)	478 (3.9)	51 (0.9)	486 (4.1)	7 (3.3)	
Austria	49 (1.0)	535 (2.8)	51 (1.0)	543 (2.1)	8 (2.9)	
[3] Singapore	49 (0.5)	621 (4.0)	51 (0.5)	629 (4.2)	8 (2.8)	
Poland	49 (0.8)	516 (3.0)	51 (0.8)	524 (3.0)	8 (2.8)	
United Arab Emirates	50 (1.1)	477 (2.5)	50 (1.1)	486 (2.3)	8 (3.4)	
[2] Russian Federation	51 (1.1)	563 (3.6)	49 (1.1)	571 (3.5)	8 (2.5)	
≡ Netherlands	49 (1.0)	533 (2.2)	51 (1.0)	542 (3.0)	9 (3.0)	
Chile	50 (1.3)	437 (3.4)	50 (1.3)	445 (3.1)	9 (3.7)	
Bosnia and Herzegovina	49 (0.7)	447 (2.7)	51 (0.7)	456 (2.8)	9 (2.6)	
Australia	49 (0.8)	511 (2.9)	51 (0.8)	521 (3.3)	10 (2.9)	
Germany	50 (0.8)	516 (2.8)	50 (0.8)	526 (2.4)	10 (2.5)	
† Belgium (Flemish)	51 (0.8)	527 (2.1)	49 (0.8)	538 (2.8)	11 (3.2)	
Czech Republic	49 (0.9)	527 (2.7)	51 (0.9)	538 (3.1)	11 (2.9)	
[2] † United States	49 (0.8)	529 (3.0)	51 (0.8)	540 (2.9)	11 (2.9)	
Hungary	48 (1.0)	518 (3.0)	52 (1.0)	529 (3.1)	11 (3.0)	
Croatia	50 (1.2)	504 (2.6)	50 (1.2)	515 (2.7)	12 (3.1)	
Italy	50 (0.8)	509 (2.7)	50 (0.8)	521 (3.2)	12 (3.4)	
[2] Slovak Republic	49 (1.0)	503 (3.5)	51 (1.0)	516 (4.2)	12 (3.6)	
France	49 (1.0)	478 (3.3)	51 (1.0)	491 (3.5)	14 (3.0)	
Spain	47 (0.8)	495 (2.5)	53 (0.8)	509 (2.6)	15 (2.8)	
[2] Portugal	48 (0.9)	516 (2.9)	52 (0.9)	533 (2.9)	17 (2.6)	
Cyprus	52 (0.7)	523 (3.0)	48 (0.7)	542 (3.5)	19 (3.2)	
[1 2] Canada	49 (0.8)	502 (2.5)	51 (0.8)	521 (2.0)	19 (2.4)	
International Average	**49 (0.2)**	**499 (0.5)**	**51 (0.2)**	**503 (0.5)**		
Benchmarking Participants						
Abu Dhabi, UAE	50 (1.5)	438 (2.8)	50 (1.5)	443 (3.2)	5 (4.0)	
[2] Dubai, UAE	49 (2.4)	540 (3.2)	51 (2.4)	548 (2.3)	9 (4.4)	
Moscow City, Russian Fed.	49 (1.0)	588 (2.5)	51 (1.0)	597 (2.5)	9 (2.2)	
Madrid, Spain	49 (1.0)	510 (2.6)	51 (1.0)	526 (2.4)	17 (2.7)	
Quebec, Canada	48 (0.8)	523 (3.0)	52 (0.8)	541 (2.4)	18 (3.0)	
[2] Ontario, Canada	49 (1.6)	502 (4.9)	51 (1.6)	521 (3.2)	18 (4.4)	



Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

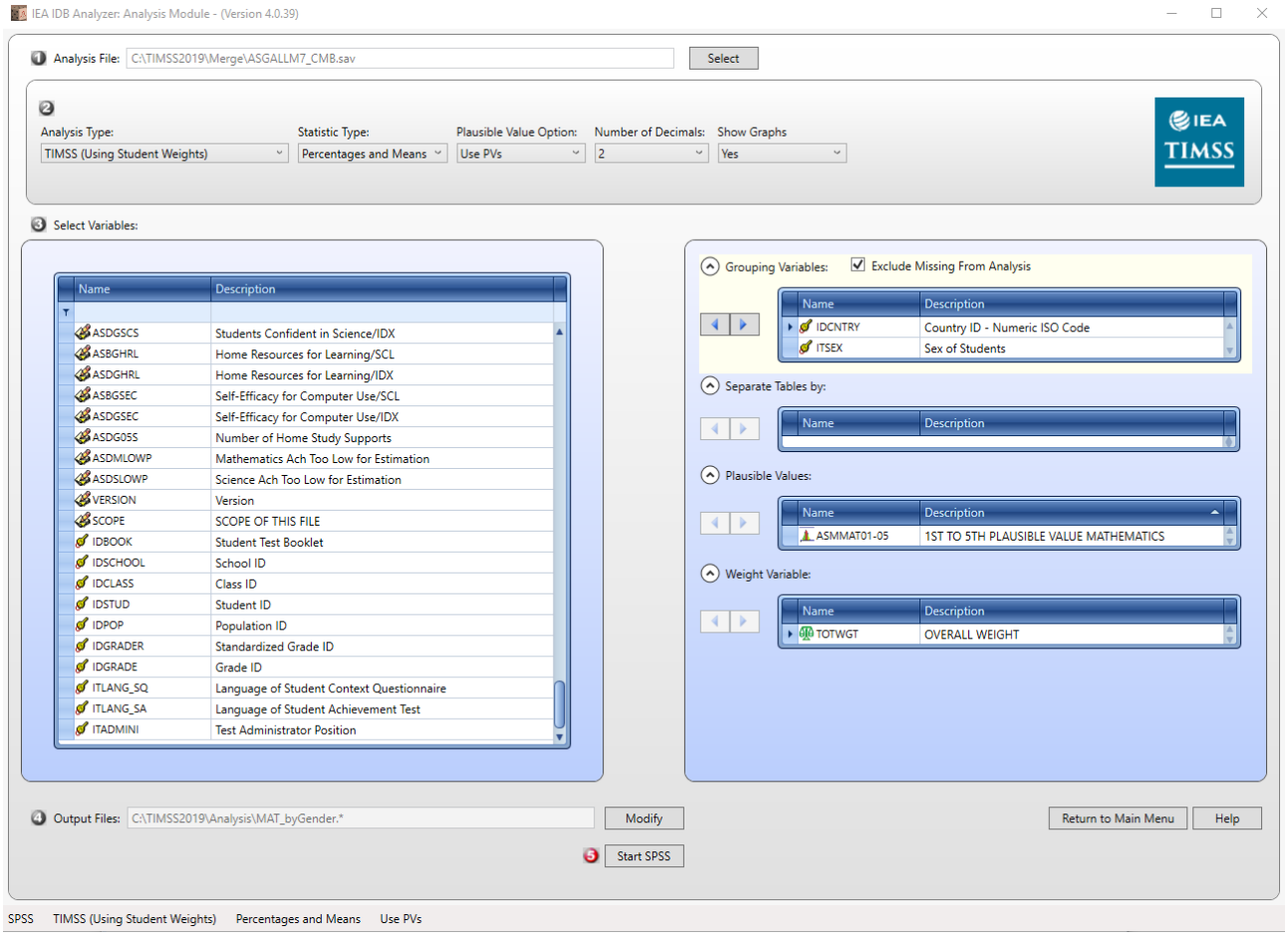
The **Analysis Module** of the IEA IDB Analyzer is used to conduct this analysis using the following steps. Exhibit 1.8 presents the completed **Analysis Module** for this example.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Select the merged data file ASGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the Analysis Type.
4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce three graphs in the SPSS or SAS output file: a line graph of average achievement for each gender by country, a clustered bar graph of average achievement for each gender by country, and a stacked bar graph of average percent of students for each gender by country.
8. Specify the variable ITSEX as a second grouping variable by first clicking the **Grouping Variables** field to activate it. Then, select ITSEX from the list of variables in the left panel, and move it to the **Grouping Variables** field by clicking the **right arrow** (▸) button**.** The IEA IDB Analyzer automatically checks the **Exclude Missing from Analysis**, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.
9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the Help manual for more information.
10. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.
11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis uses student context data.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name

and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.8, the syntax file MAT_byGender.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder. The various results output files produced by the IEA IDB Analyzer when using the **Percentages and Means** statistic are explained under Example 1.

13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** ( ) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Exhibit 1.8: IEA IDB Analyzer Analysis Module Setup for Example 2 – Analysis of Average Achievement by Gender with Student Context Data



The results of Example 2 as shown in the SPSS output file are presented in Exhibit 1.9 with example countries Albania, Azerbaijan, Australia, and Austria.

Exhibit 1.9: SPSS Output for Example 2 – Analysis of Average Achievement by Gender with Student Context Data

Average for ASMMAT0 by IDCNTRY ITSEX

Country ID - Numeric ISO Code	Sex of Students	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)	ASMMAT0 (Mean)	ASMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)	pctmiss
Albania	Female	2164	15202	565.93	48.89	.94	492.64	3.77	84.84	2.59	.00
	Male	2262	15889	498.54	51.11	.94	495.34	3.87	86.73	3.15	.00
Azerbaijan	Female	2404	69704	2320.09	46.52	.87	517.44	3.10	81.49	2.19	.00
	Male	2841	80125	2100.87	53.48	.87	513.73	3.11	86.77	2.09	.00
Australia	Female	2902	148861	3667.02	49.20	.76	510.82	2.93	81.82	1.98	.00
	Male	2988	153713	3733.95	50.80	.76	520.78	3.29	91.45	2.28	.00
Austria	Female	2148	38604	1377.88	49.20	.99	535.39	2.80	63.01	1.43	.00
	Male	2316	39855	1298.41	50.80	.99	542.93	2.12	65.88	1.29	.00

Countries are ordered sequentially according to their numeric ISO 3166 code (see Chapter 2). The results for "Table Average" are based on all countries included in the data file, including benchmarking participants. Each country's results are displayed on two lines, one for each value of the grouping variable (ITSEX). The countries are identified in the first column (Country ID) and the second column (Sex of Students) indicates the category of the grouping variable ITSEX being reported according to the value labels. The third column reports the number of valid cases (N of Cases), the fourth column reports the sum of weights of the sampled students (Sum of TOTWGT), indicating the estimated total students in the population represented by the sample, and the fifth column is the standard error of the sum of weights (Sum of TOTWGT (s.e.)).

The next two columns report the percentage of students in the particular category of the second grouping variable (Percent), which for this analysis is the percent of students in each category of ITSEX within IDCNTRY, and its standard error (Percent (s.e.)). The next two columns report the estimated average for the outcome variable for the group, in this case average mathematics achievement (ASMMAT0) and its standard error (ASMMAT0 (s.e.)). The standard deviation of the achievement scores (Std.Dev) and its standard error (Std.Dev (s.e.)) are reported in the next two columns, and the last column reports the percentage of cases with missing data (pctmiss).

From the first two lines of results in Exhibit 1.9, 48.89% of fourth grade students in Albania were girls (standard error of 0.94) and 51.11% were boys (standard error of 0.94). The average mathematics achievement of girls was 492.64 (standard error of 3.77) and it was 495.34 for boys (standard error of 3.87).

The significance of the gender differences, reported in the "Gender Difference" column of Exhibit 1.7, can be determined by examining the significance output file "MAT_byGender_ASMMAT0_by_ITSEX_sig," provided in SPSS data (*.SAV) and Excel (*.XLSX) file formats. This example refers to the XLSX version. For each country, the average achievement difference between the reference group (reported in column B) and the comparison group (reported in column C) is reported in column F, labeled "mnpvdiff." Dividing this value by its standard error in column L ("mnpvdiff_se") gives a *t*-statistic for evaluating whether the difference is statistically significant. The *t*-statistic is reported in column Q ("mnpvdiff_t"). Values greater than 1.96 (the upper threshold limit for 95% confidence) indicate the reference group average is significantly greater than the comparison group average. Values less than –1.96 (the lower threshold limit for 95% confidence) indicate the comparison group average is significantly greater.

Example 3 – Linear Regression Analysis with Student Context Data

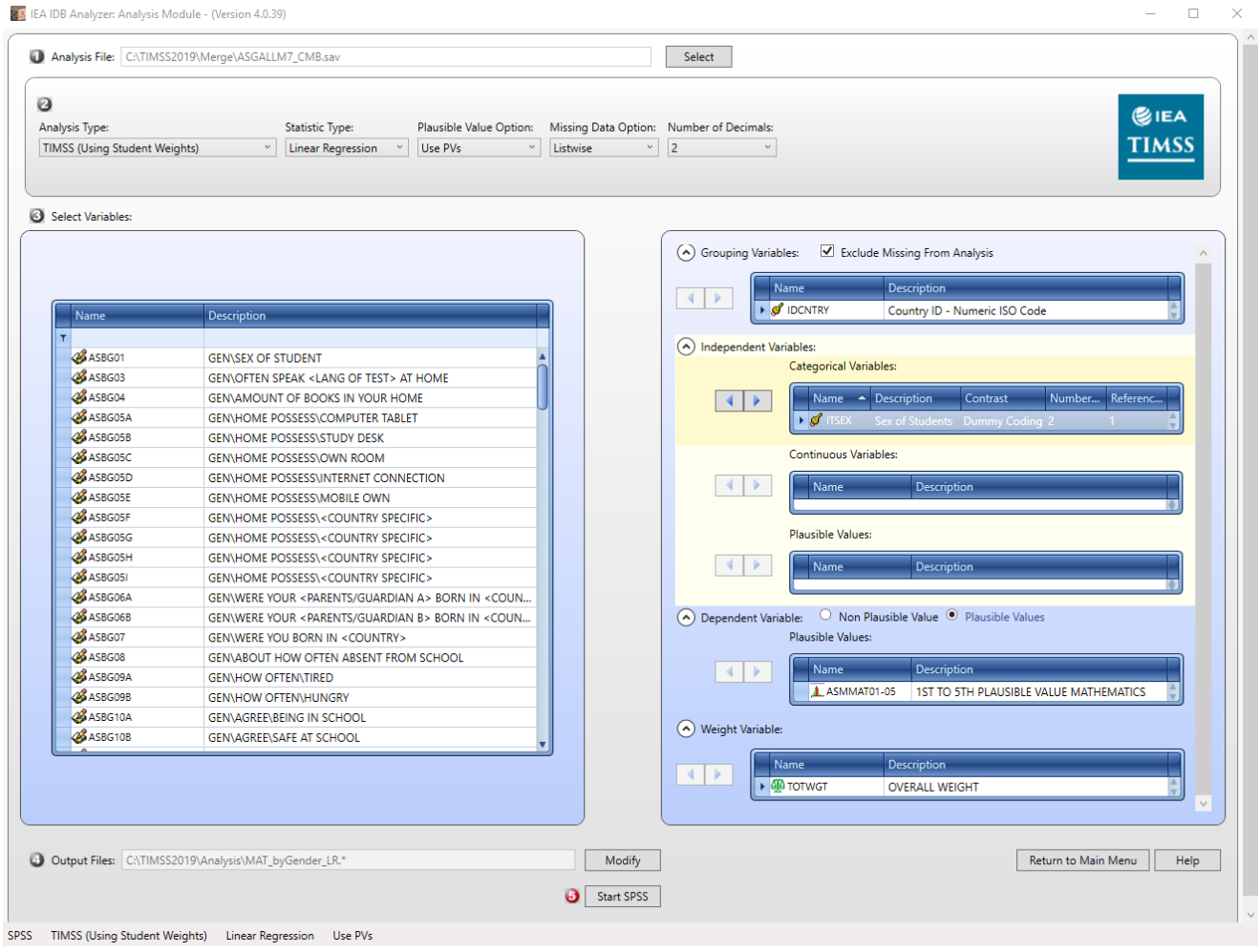
The third example is an extension of the previous (Example 2), and describes an alternative method to examining the difference in fourth grade mathematics achievement between girls and boys and determining if it is statistically significant. This example also demonstrates the **Dummy Coding** feature of the IEA IDB Analyzer. Like Example 2, the results of this example are presented in Exhibit 1.5 of *TIMSS 2019 International Results in Mathematics and Science* and are shown above in Exhibit 1.7 in the column labeled "Gender Difference."

The ITSEX variable has a value of one (1) for girls and two (2) for boys. By using ITSEX as a categorical variable in the IEA IDB Analyzer with **Dummy Coding**, and defining category 1 (girls) as the reference category, the regression intercept estimate is the average mathematics achievement of girls, and the regression slope is the estimated change in average mathematics achievement for boys.

The **Analysis Module** of the IEA IDB Analyzer is used to conduct the analysis, with **Linear Regression** defined as the statistic type in the following steps. Exhibit 1.10 shows the completed **Analysis Module** for this example.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Select the merged data file ASGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the **Analysis Type**.
4. Select **Linear Regression** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**.
6. The default **Missing Data Option** of **Listwise** is used for this example. This option will remove all records with missing values on any of the analysis the variables. See the IEA IDB Analyzer Help manual for more information.

Exhibit 1.10: IEA IDB Analyzer Analysis Module Setup for Example 3 – Linear Regression Analysis with Student Context Data



7. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
8. The IDB Analyzer automatically selects the variable IDCNTRY for the **Grouping Variables**. No additional grouping variables are needed for this analysis. The box for **Exclude Missing from Analysis** should be checked for this analysis.
9. Specify ITSEX as a **Categorical Variable** in the **Independent Variables** section, first by clicking the **Categorical Variables** field to activate it. Then, select ITSEX from the list of available variables in the left panel, and move it to the right **Categorical Variables** field by clicking the **right arrow** (▸) button. Next, click the **Contrast** field of ITSEX, and its drop-down menu will appear. **Dummy Coding** is selected by default, and the IEA IDB Analyzer determines the **Number of Categories** for the ITSEX (2). By default, category 1 (girls) will be selected as the **Reference Category**. These settings should not be changed.
10. In the **Dependent Variable** section, click the **Plausible Values** radio button. Specify the achievement scores to be used as the **Dependent Variable** by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right Plausible Values field by clicking the **right arrow** (▸) button.
11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis uses student context data.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.10, the syntax file MAT_byGender_LR.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** (🏃) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Linear Regression Analysis in the IEA IDB Analyzer produces several results output files. The main results for this example are the regression coefficients, reported in the files named "MAT_byGender_LR_Coef" and described below. Output files are also produced with descriptive statistics by country ("MAT_byGender_LR_Desc") for the intercept (girls' average

achievement) and the regression coefficients (change in achievement from girls to boys). Lastly, output files for the model are produced ("MAT_byGender_LR_Model") reporting the estimated *R*-square values for the regression model.

Exhibit 1.11 displays the main results for this example analysis—the regression coefficients—in the SPSS output file for example countries Albania, Armenia, Australia, and Austria. Countries are ordered *alphabetically* with their results each displayed on two lines: the first for the intercept (CONSTANT) and the second for the ITSEX coefficient (ITSEX_D2). Generally, there will be as many lines per country as there are regression coefficients, including the intercept. The results for "Table Average" are based on all countries included in the data file, including benchmarking participants.

The countries are identified in the first column (IDCNTRY) and the second column (Variable) indicates the intercept (CONSTANT) or the regression coefficient being reported. The third column reports the "Regression Coefficient," indicating, for the intercept, the average value of the dependent variable for the reference group (girls in this case), and for the regression coefficients, the average difference in the dependent variable from the intercept. The fourth column is the standard error of the regression coefficient (Regression Coefficient (s.e.)). The fifth column reports the value of the *t*-statistic for the regression coefficient (Regression Coefficient (t-value)). The IEA IDB Analyzer also computes standardized regression coefficients in the last three columns, corresponding to the third, fourth, and fifth columns, whereby the dependent and independent variables are standardized to have a mean of zero (0) and standard deviation of one (1).

Exhibit 1.11: SPSS Regression Coefficient Output for Example 3 – Linear Regression Analysis with Student Context Data

Regression Coefficients

IDCNTRY	Variable	Regression Coefficient	Regression Coefficient (s.e.)	Regression Coefficient (t-value)	Stndrdzd. Coefficient	Stndrdzd. Coefficient (s.e.)	Stndrdzd. Coefficient (t-value)
Albania	(CONSTANT)	492.64	3.77	130.84	.	.	.
	ITSEX_D2	2.70	3.60	.75	.02	.02	.75
Armenia	(CONSTANT)	499.45	2.56	195.18	.	.	.
	ITSEX_D2	-2.44	2.85	-.86	-.02	.02	-.86
Australia	(CONSTANT)	510.82	2.93	174.36	.	.	.
	ITSEX_D2	9.96	2.88	3.47	.06	.02	3.50
Austria	(CONSTANT)	535.39	2.80	191.19	.	.	.
	ITSEX_D2	7.55	2.91	2.59	.06	.02	2.60

The first line of results in Exhibit 1.11 labeled "(CONSTANT)" indicates the estimated average mathematics achievement of fourth grade girls in Albania: 492.64 with a standard error of 3.77. This estimate concurs with the results obtained in the previous example (Exhibit 1.9). From the second line of results labeled "ITSEX_D2," the fourth grade boys in Albania had a positive average mathematics achievement difference from girls of 2.70 with an estimated standard error of 3.60. The *t*-value for the coefficient is less than 1.96 (the upper threshold limit for 95% confidence), indicating this achievement difference is not statistically significant at the 95% confidence level. Counting the two regression coefficients together (492.64 + 2.70) yields the estimated average mathematics achievement of fourth grade boys in Albania, which was 495.34 in Exhibit 1.9.

Example 4 – Analysis of TIMSS International Benchmarks

This section describes how to use the IEA IDB Analyzer to perform analyses of student achievement in relation to the TIMSS International Benchmarks. This example computes the percentages of students reaching each of the four TIMSS 2019 International Benchmarks of fourth grade mathematics achievement (Advanced, High, Intermediate, and Low) using the merged ASGALLM7_CMB data file described earlier under *Merging Data Files with the IEA IDB Analyzer*. These results, presented in Exhibit 1.8 of the TIMSS 2019 International Results report, are shown below in Exhibit 1.12.

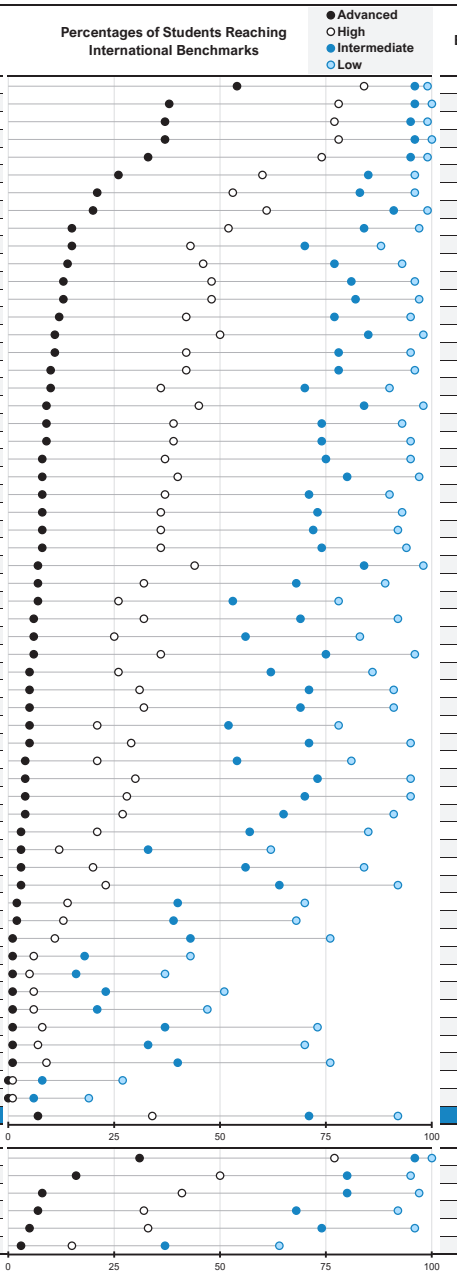
This example is conducted by the **Analysis Module** of the IEA IDB Analyzer with the following steps. The completed **Analysis Module** is shown in Exhibit 1.13.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Specify the data file ASGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the **Analysis Type**.
4. Select **Benchmarks** as the **Statistic Type**.
5. Select the **Cumulative** option under the **Benchmark Option** drop-down menu to get cumulated percentages of students reaching the TIMSS International Benchmarks.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The variable IDCNTRY is selected automatically for **Grouping Variables**. No additional grouping variables are needed for this analysis.

Exhibit 1.12: Exhibit of Example 4 – Analysis of TIMSS International Benchmarks (Exhibit 1.8 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

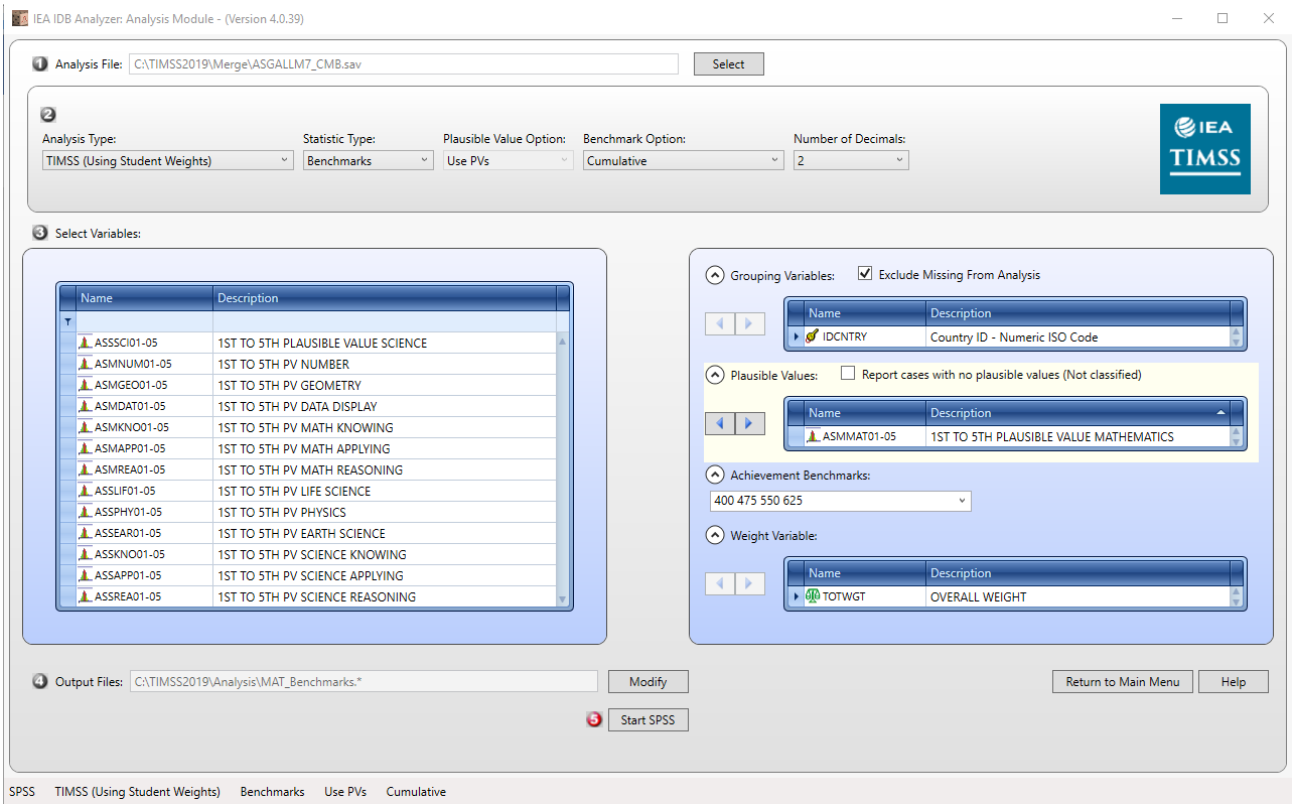
Exhibit 1.8: Percentages of Students Reaching International Benchmarks of Mathematics Achievement



Country	Advanced Benchmark (625)	High Benchmark (550)	Intermediate Benchmark (475)	Low Benchmark (400)
[3] Singapore	54 (2.2)	84 (1.5)	96 (0.7)	99 (0.3)
† Hong Kong SAR	38 (1.9)	78 (1.6)	96 (0.7)	100 (0.2)
Korea, Rep. of	37 (1.4)	77 (1.2)	95 (0.5)	99 (0.2)
Chinese Taipei	37 (1.3)	78 (1.1)	96 (0.5)	100 (0.2)
Japan	33 (1.3)	74 (0.9)	95 (0.4)	99 (0.2)
† Northern Ireland	26 (1.4)	60 (1.4)	85 (1.1)	96 (0.6)
[2] England	21 (1.4)	53 (1.5)	83 (1.2)	96 (0.5)
[2] Russian Federation	20 (1.6)	61 (1.9)	91 (1.0)	99 (0.3)
Ireland	15 (1.0)	52 (1.4)	84 (1.0)	97 (0.5)
[2] Turkey (5)	15 (1.3)	43 (1.8)	70 (1.7)	88 (1.3)
[2] † United States	14 (0.8)	46 (1.3)	77 (1.1)	93 (0.6)
[2] Lithuania	13 (1.1)	48 (1.6)	81 (1.1)	96 (0.6)
† Norway (5)	13 (0.9)	48 (1.3)	82 (1.2)	97 (0.6)
Cyprus	12 (0.9)	42 (1.6)	77 (1.3)	95 (0.6)
[2] Latvia	11 (0.9)	50 (1.7)	85 (1.2)	98 (0.6)
Finland	11 (0.8)	42 (1.3)	78 (1.2)	95 (0.6)
Czech Republic	10 (1.0)	42 (1.5)	78 (1.3)	96 (0.6)
Australia	10 (0.9)	36 (1.2)	70 (1.3)	90 (1.0)
Austria	9 (0.7)	45 (1.4)	84 (1.1)	98 (0.4)
Hungary	9 (0.8)	39 (1.4)	74 (1.3)	93 (0.8)
[2] Portugal	9 (0.7)	39 (1.6)	74 (1.2)	95 (0.7)
† Denmark	8 (0.9)	37 (1.3)	75 (1.0)	95 (0.5)
† Belgium (Flemish)	8 (0.5)	40 (1.2)	80 (1.2)	97 (0.4)
Bulgaria	8 (0.6)	37 (1.7)	71 (1.9)	90 (1.5)
Poland	8 (0.8)	36 (1.4)	73 (1.4)	93 (0.6)
Azerbaijan	8 (0.6)	36 (1.3)	72 (1.5)	92 (0.8)
Sweden	8 (0.8)	36 (1.7)	74 (1.4)	94 (0.7)
≡ Netherlands	7 (0.9)	44 (1.7)	84 (1.1)	98 (0.4)
[2] Serbia	7 (0.7)	32 (1.4)	68 (1.5)	89 (1.1)
United Arab Emirates	7 (0.3)	26 (0.6)	53 (0.8)	78 (0.7)
‡ [2] Canada	6 (0.6)	32 (1.0)	69 (0.9)	92 (0.6)
[2] New Zealand	6 (0.5)	25 (1.2)	56 (1.3)	83 (0.9)
Germany	6 (0.6)	36 (1.5)	75 (1.2)	96 (0.6)
Albania	5 (0.6)	26 (1.4)	62 (1.8)	86 (1.3)
[2] Slovak Republic	5 (0.7)	31 (1.7)	71 (1.7)	91 (1.2)
Malta	5 (0.5)	32 (0.9)	69 (0.8)	91 (0.6)
North Macedonia	5 (0.8)	21 (1.8)	52 (2.4)	78 (1.7)
[2] Kazakhstan	5 (0.6)	29 (1.5)	71 (1.4)	95 (0.6)
Bahrain	4 (0.4)	21 (1.0)	54 (1.2)	81 (1.0)
Italy	4 (0.5)	30 (1.5)	73 (1.3)	95 (0.5)
Croatia	4 (0.6)	28 (1.3)	70 (1.5)	95 (0.7)
Spain	4 (0.4)	27 (0.9)	65 (1.3)	91 (1.0)
France	3 (0.5)	21 (1.2)	57 (1.6)	85 (1.2)
Oman	3 (0.8)	12 (1.3)	33 (1.5)	62 (1.3)
[1] Georgia	3 (0.4)	20 (1.4)	56 (2.0)	84 (1.4)
Armenia	3 (0.5)	23 (1.4)	64 (1.6)	92 (0.7)
Qatar	2 (0.4)	14 (1.2)	40 (1.6)	70 (1.4)
Iran, Islamic Rep. of	2 (0.3)	13 (1.0)	39 (1.6)	68 (1.5)
Montenegro	1 (0.2)	11 (0.7)	43 (0.9)	76 (0.9)
Morocco	1 (0.8)	6 (1.1)	18 (1.4)	43 (1.7)
South Africa (5)	1 (0.2)	5 (0.5)	16 (1.1)	37 (1.5)
[2] Saudi Arabia	1 (0.2)	6 (0.6)	23 (1.2)	51 (1.4)
Kuwait	1 (0.2)	6 (0.9)	21 (1.6)	47 (1.8)
[2] Kosovo	1 (0.2)	8 (0.8)	37 (1.5)	73 (1.4)
Chile	1 (0.1)	7 (0.6)	33 (1.4)	70 (1.5)
Bosnia and Herzegovina	1 (0.2)	9 (0.7)	40 (1.5)	76 (1.1)
[2] Ψ Pakistan	0 (0.1)	1 (0.3)	8 (1.5)	27 (4.7)
[2] Ψ Philippines	0 (0.1)	1 (0.2)	6 (0.8)	19 (1.8)
International Median	**7**	**34**	**71**	**92**
Benchmarking Participants				
Moscow City, Russian Fed.	31 (1.5)	77 (1.4)	96 (0.5)	100 (0.2)
[2] Dubai, UAE	16 (0.9)	50 (0.9)	80 (0.8)	95 (0.5)
Quebec, Canada	8 (0.8)	41 (1.4)	80 (1.3)	97 (0.5)
[2] Ontario, Canada	7 (1.0)	32 (1.8)	68 (1.6)	92 (0.9)
Madrid, Spain	5 (0.5)	33 (1.2)	74 (1.5)	96 (0.6)
Abu Dhabi, UAE	3 (0.2)	15 (0.6)	37 (1.0)	64 (1.1)

Ψ Reservations about reliability because the percentage of students with achievement too low for estimation exceeds 15% but does not exceed 25%.
See Appendix B.2 for target population coverage notes 1, 2, and 3. See Appendix B.5 for sampling guidelines and sampling participation notes †, ‡, and ≡.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Exhibit 1.13: IEA IDB Analyzer Analysis Module Setup for Example 4 – Analysis of TIMSS International Benchmarks



8. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.
9. In the **Achievement Benchmarks** field, specify the average achievement score for each of the TIMSS International Benchmarks in ascending order—400, 475, 550, and 625 (Low, Intermediate, High, and Advanced, respectively). These values can be entered manually with each separated by a blank space, or they can be selected by clicking on the drop-down menu available for this field.
10. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis uses student data.
11. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name

and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.13, the syntax file MAT_Benchmarks.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.

12. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** ( ) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Exhibit 1.14 presents the results of Example 4 as shown in the SPSS output, which is provided in three file formats described in Example 1.

Exhibit 1.14: SPSS Output for Example 4 – Analysis of TIMSS International Benchmarks

Percent reaching benchmarks of ASMMAT0

Country ID - Numeric ISO Code	Performance Group	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)
Albania	1.At or Above 400	3876	26857	848.87	86.38	1.29
	2.At or Above 475	2810	19199	728.39	61.75	1.76
	3.At or Above 550	1211	8008	486.69	25.76	1.42
	4.At or Above 625	263	1639	188.94	5.27	.56
Azerbaijan	1.At or Above 400	4875	137696	3454.28	91.90	.78
	2.At or Above 475	3902	107497	3482.44	71.75	1.50
	3.At or Above 550	2063	53397	2349.32	35.64	1.28
	4.At or Above 625	482	11613	903.62	7.75	.58
Australia	1.At or Above 400	5293	272877	6287.17	90.18	1.03
	2.At or Above 475	4068	210497	5671.65	69.57	1.28
	3.At or Above 550	2109	107682	4220.49	35.59	1.24
	4.At or Above 625	585	30457	2611.60	10.07	.86
Austria	1.At or Above 400	4386	77132	2163.90	98.31	.37
	2.At or Above 475	3724	65553	2015.57	83.55	1.06
	3.At or Above 550	2006	34937	1475.28	44.53	1.36
	4.At or Above 625	417	7268	519.26	9.26	.67

Countries are ordered according to their numeric ISO 3166 code (see Chapter 2), and each country's results are displayed on four lines, one for each of the International Benchmarks. The countries are identified in the first column (Country ID) and the second column (Performance Group) indicates the benchmark level being reported. The third column reports the number of valid cases (N of Cases), the fourth column reports the sum of weights of the sampled students (Sum of TOTWGT) corresponding to the number of students in the population represented by the sample, and the fifth column is the standard

error of the sum of weights (Sum of TOTWGT (s.e.)). The last two columns report the cumulative percentage of students reaching each benchmark or lower (Percent) and its standard error (Percent (s.e.)).

As shown in the four lines of results for Australia, 90.18% of the fourth grade students in Australia performed at or above the Low International Benchmark of 400, with a standard error of 1.03; 69.57% of students reached the Intermediate International Benchmark, with a standard error of 1.28; 35.59% of students reached the High International Benchmark, with a standard error of 1.24; and 10.07% of students reached the Advanced International Benchmark, with a standard error of 0.86.

Conducting Analyses with TIMSS Home Context Data

This section presents an analysis conducted using the IEA IDB Analyzer with home context data from the TIMSS 2019 International Database. Home context data were collected from the parents of fourth grade students' with the TIMSS 2019 Home Questionnaire, or "Early Learning Survey." Like the previous section, the example below is an actual analysis used to produce exhibits in the *TIMSS 2019 International Results in Mathematics and Science* report.

In general, before conducting analysis using TIMSS contextual variables such as those in the home context data files, users should refer to the relevant codebook for the data file to identify the appropriate variables and understand the coding scheme. Supplement 1 of this User Guide presents all the context questionnaires administered in TIMSS 2019 and the associated variable names under which the data are saved. Supplement 2 should also be checked for any national adaptations made to the questionnaire items that may impact international comparability.

Analyzing home context data from the TIMSS 2019 International Database requires that the home context data files (named beginning with "ASH") be merged with either a student achievement file ("ASA") or student context file ("ASG") to retrieve the achievement scores and required sample design variables. This example uses home context data merged with student context data described earlier in the chapter under *Merging Data Files with the IEA IDB Analyzer* (ASHALLM7_CMB). Example 5 computes the average score on a context questionnaire scale, along with the percentages of students—with their average achievement—for each of the categories of the scale's corresponding index. The analysis replicates Exhibit 7.7 of *TIMSS 2019 International Results in Mathematics and Science*, repeated below in Exhibit 1.15.

Exhibit 1.15: Exhibit of Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data (Exhibit 7.7 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

IEA TIMSS 2019

Exhibit 7.7: Parents' Perceptions of Their Child's School

Students' Results based on Parents' Reports

Country		Very Satisfied		Somewhat Satisfied		Less than Satisfied		Average Scale Score
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Albania		90 (0.8)	497 (3.4)	9 (0.7)	484 (8.6)	2 (0.4)	~ ~	11.5 (0.05)
Armenia		88 (1.0)	500 (2.6)	11 (0.9)	486 (5.5)	1 (0.1)	~ ~	11.5 (0.05)
Kazakhstan		87 (1.0)	513 (2.6)	12 (0.9)	514 (5.0)	1 (0.2)	~ ~	11.5 (0.05)
Malta	r	85 (0.7)	516 (1.7)	14 (0.7)	515 (3.5)	1 (0.2)	~ ~	11.2 (0.03)
Kosovo		84 (0.8)	448 (3.0)	14 (0.6)	440 (5.2)	2 (0.3)	~ ~	11.1 (0.04)
Saudi Arabia		80 (0.9)	404 (3.7)	17 (0.7)	390 (6.1)	3 (0.3)	393 (10.8)	11.0 (0.05)
Northern Ireland	s	79 (1.2)	590 (3.9)	19 (1.1)	566 (5.5)	2 (0.3)	~ ~	11.0 (0.06)
Georgia		79 (1.1)	482 (3.8)	19 (1.0)	490 (4.8)	2 (0.2)	~ ~	10.9 (0.05)
North Macedonia		79 (1.1)	473 (5.9)	18 (0.9)	482 (7.7)	3 (0.5)	473 (10.9)	10.8 (0.05)
Azerbaijan		78 (1.1)	524 (2.8)	19 (1.0)	514 (4.3)	3 (0.3)	514 (8.0)	10.9 (0.06)
Bulgaria		78 (1.4)	513 (4.0)	19 (1.1)	529 (7.0)	4 (0.4)	526 (15.3)	10.9 (0.07)
Montenegro		77 (0.8)	455 (2.2)	20 (0.8)	454 (3.4)	3 (0.3)	455 (10.3)	10.9 (0.03)
Ireland		77 (1.1)	552 (2.4)	21 (1.0)	552 (4.4)	2 (0.4)	~ ~	10.8 (0.05)
Turkey (5)		77 (1.7)	522 (4.8)	20 (1.5)	523 (7.6)	3 (0.4)	551 (14.1)	10.9 (0.08)
Oman		76 (1.0)	442 (4.1)	21 (0.8)	407 (4.7)	3 (0.3)	370 (8.3)	10.8 (0.05)
South Africa (5)	r	76 (0.9)	384 (3.7)	21 (0.7)	353 (4.3)	3 (0.3)	336 (9.7)	10.8 (0.04)
Bosnia and Herzegovina		76 (1.2)	452 (2.5)	21 (1.0)	453 (3.8)	3 (0.3)	449 (8.7)	10.8 (0.06)
Pakistan	r	76 (2.7)	340 (13.9)	22 (2.6)	301 (12.3)	2 (0.5)	~ ~	10.9 (0.10)
Philippines		75 (1.3)	308 (6.5)	23 (1.2)	271 (7.1)	2 (0.2)	~ ~	10.9 (0.06)
Serbia		75 (1.3)	506 (3.6)	22 (1.1)	520 (3.9)	3 (0.4)	521 (8.4)	10.8 (0.06)
Qatar	r	72 (1.4)	457 (3.4)	24 (1.2)	446 (5.6)	4 (0.5)	417 (12.3)	10.7 (0.07)
Morocco		72 (1.7)	392 (4.5)	25 (1.5)	367 (6.9)	4 (0.5)	351 (14.5)	10.5 (0.07)
Portugal		71 (1.1)	531 (2.8)	25 (1.0)	519 (3.0)	4 (0.4)	519 (7.0)	10.5 (0.05)
Iran, Islamic Rep. of		70 (1.4)	447 (4.3)	26 (1.2)	439 (5.8)	4 (0.4)	420 (10.1)	10.4 (0.06)
Italy		68 (1.4)	518 (2.7)	28 (1.3)	512 (3.1)	4 (0.4)	513 (8.0)	10.4 (0.06)
Spain		68 (1.3)	508 (3.0)	27 (1.0)	509 (2.6)	5 (0.5)	482 (6.7)	10.4 (0.06)
Lithuania	r	67 (1.3)	546 (3.3)	29 (1.1)	536 (4.0)	4 (0.5)	543 (8.3)	10.3 (0.06)
Cyprus		67 (1.4)	537 (3.1)	29 (1.1)	533 (3.0)	5 (0.5)	519 (9.2)	10.3 (0.06)
Bahrain		64 (1.1)	486 (3.0)	31 (0.9)	474 (3.1)	5 (0.5)	462 (6.7)	10.3 (0.05)
Singapore		63 (0.8)	632 (4.1)	33 (0.7)	620 (4.0)	4 (0.3)	592 (7.1)	10.3 (0.03)
Kuwait	r	63 (1.2)	397 (5.2)	30 (1.0)	378 (6.0)	8 (0.5)	342 (8.7)	10.2 (0.05)
Slovak Republic		61 (1.1)	510 (4.3)	34 (0.9)	513 (3.5)	5 (0.4)	519 (5.8)	10.2 (0.05)
Austria		60 (1.4)	545 (2.5)	34 (1.1)	539 (2.8)	6 (0.5)	520 (5.7)	10.0 (0.06)
Hungary		58 (1.4)	525 (3.1)	35 (1.1)	528 (3.5)	6 (0.5)	519 (5.9)	10.0 (0.06)
Canada	s	58 (0.9)	525 (2.7)	36 (0.8)	524 (2.3)	6 (0.4)	503 (5.7)	10.1 (0.04)
Finland		55 (1.3)	539 (2.8)	41 (1.2)	533 (2.7)	4 (0.4)	511 (8.3)	9.9 (0.05)
Hong Kong SAR		54 (1.2)	610 (3.7)	40 (1.2)	599 (3.7)	5 (0.6)	579 (6.4)	9.9 (0.05)
Russian Federation		52 (1.4)	566 (4.1)	42 (1.2)	571 (3.2)	6 (0.6)	555 (5.3)	9.7 (0.06)
Denmark	s	51 (1.6)	544 (2.9)	37 (1.3)	538 (3.8)	12 (1.0)	522 (5.7)	9.5 (0.08)
Belgium (Flemish)		50 (1.1)	536 (2.6)	46 (1.0)	533 (2.2)	4 (0.4)	519 (6.4)	9.7 (0.04)
Latvia		48 (1.1)	548 (3.2)	44 (0.9)	548 (2.7)	7 (0.6)	535 (5.0)	9.6 (0.05)
Chinese Taipei		46 (1.2)	598 (2.2)	48 (1.1)	600 (2.5)	6 (0.5)	603 (5.3)	9.6 (0.05)
Germany	s	45 (1.6)	539 (3.2)	45 (1.4)	531 (2.9)	11 (0.9)	514 (5.3)	9.3 (0.07)
Sweden	r	44 (1.7)	530 (4.0)	48 (1.5)	528 (2.8)	8 (0.8)	511 (5.2)	9.4 (0.07)
Chile		44 (1.5)	444 (3.3)	49 (1.2)	442 (3.2)	8 (0.7)	436 (6.7)	9.4 (0.07)
Croatia		43 (1.1)	512 (2.9)	50 (1.0)	508 (2.4)	7 (0.5)	514 (6.2)	9.5 (0.05)
Poland		42 (1.3)	520 (4.1)	52 (1.1)	523 (2.4)	6 (0.5)	524 (5.1)	9.5 (0.06)
France		37 (1.1)	493 (4.1)	55 (1.1)	487 (3.3)	8 (0.7)	472 (6.4)	9.1 (0.05)
Czech Republic	r	36 (1.9)	541 (3.9)	51 (1.5)	541 (2.8)	13 (1.0)	542 (4.0)	9.0 (0.09)
Korea, Rep. of		15 (0.9)	603 (4.3)	70 (0.9)	600 (2.4)	14 (0.7)	599 (3.3)	8.2 (0.04)
Japan		9 (0.8)	598 (5.2)	68 (0.9)	595 (1.7)	24 (0.9)	590 (2.8)	7.8 (0.04)
Australia		- -	- -	- -	- -	- -	- -	- -
England		- -	- -	- -	- -	- -	- -	- -
Netherlands		- -	- -	- -	- -	- -	- -	- -
Norway (5)		- -	- -	- -	- -	- -	- -	- -
United States		- -	- -	- -	- -	- -	- -	- -
United Arab Emirates	x	71 (0.7)	507 (2.3)	25 (0.5)	491 (3.3)	5 (0.3)	472 (5.5)	10.6 (0.03)
New Zealand	x	64 (1.7)	513 (3.9)	31 (1.5)	511 (4.3)	5 (0.6)	490 (10.3)	10.3 (0.07)
International Average		**64 (0.2)**	**504 (0.6)**	**31 (0.2)**	**497 (0.6)**	**5 (0.1)**	**495 (1.2)**	
Benchmarking Participants								
Dubai, UAE	s	69 (1.2)	563 (2.2)	26 (1.2)	546 (3.6)	5 (0.3)	531 (7.0)	10.5 (0.05)
Madrid, Spain		66 (1.3)	523 (2.7)	28 (1.2)	519 (3.1)	6 (0.6)	505 (7.0)	10.3 (0.05)
Ontario, Canada	s	57 (1.5)	528 (5.4)	35 (1.3)	523 (3.6)	8 (0.7)	499 (8.3)	9.9 (0.07)
Quebec, Canada	r	51 (1.3)	540 (3.1)	45 (1.3)	537 (3.2)	4 (0.5)	528 (5.8)	9.8 (0.05)
Moscow City, Russian Fed.		38 (1.3)	589 (3.0)	49 (1.1)	597 (2.3)	13 (0.8)	588 (3.5)	9.1 (0.06)
Abu Dhabi, UAE	y	- -	- -	- -	- -	- -	- -	- -

This TIMSS context questionnaire scale was established in 2015 based on the combined response distribution of all countries that participated in TIMSS 2015. To provide a point of reference for country comparisons, the scale centerpoint of 10 was located at the mean of the combined distribution. The units of the scale were chosen so that 2 scale score points corresponded to the standard deviation of the distribution.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

A dash (-) indicates comparable data not available. A tilde (~) indicates insufficient data to report achievement.

An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution. A "y" indicates data are available for less than 40% of the students.

Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data

As described in Chapter 16 of *Methods and Procedures: TIMSS 2019 Technical Report* (Yin & Fishbein, 2020), TIMSS 2019 reports some context questionnaire data by creating context questionnaire scales based on Rasch modeling. The context questionnaire scales are available in the TIMSS 2019 International Database for analysis within the context data file corresponding to the respondent of the questionnaire items. Each context questionnaire scale variable is a Rasch score with an international centerpoint of 10 and an internationally set standard deviation of 2. From each context questionnaire scale, an index is derived that divides the range of scores on that scale into usually three categories: the most desirable scores (high values), the least desirable scores (low values), and the remaining scores in between.

These context questionnaire scales and their corresponding indices were reported in *TIMSS 2019 International Results in Mathematics and Science*. Exhibit 1.15 shows one such example, Exhibit 7.7 of the report, with results for the TIMSS 2019 *Parents' Perceptions of Their Child's School* scale, based on parents' responses to a set of eight statements on this topic. Results on the Rasch scale are reported for each country as an "Average Scale Score" and its corresponding index is reported as the percentages of students in each category—"very satisfied," "somewhat satisfied," and "less than satisfied"—along with their average mathematics achievement in each category.

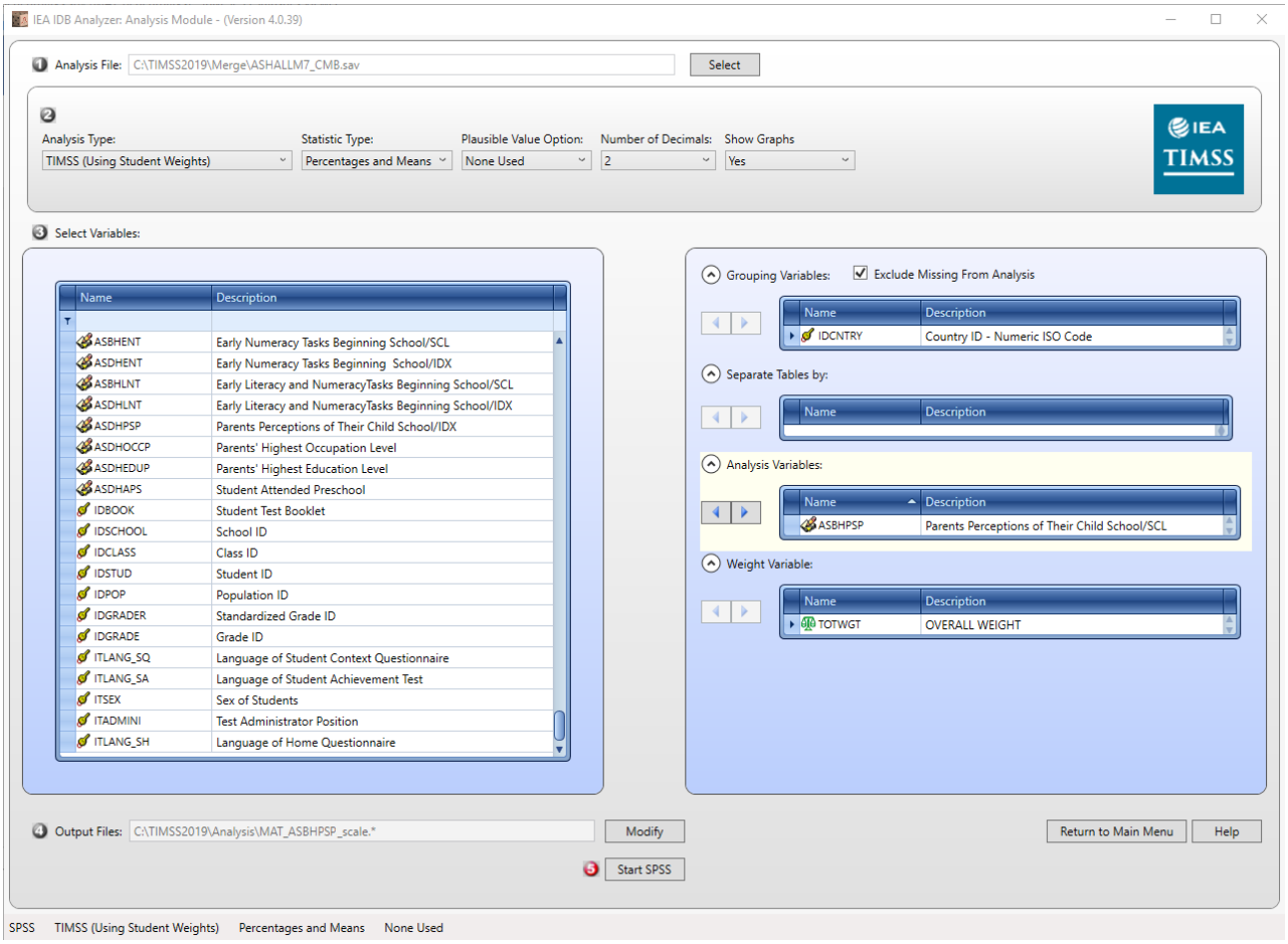
This example includes replicating both the average scale score column of Exhibit 1.15 and the columns reporting percentages of students and their average achievement in each category. This is accomplished in two analysis steps, both using the merged ASHALLM7_CMB data file.

Step 1: Compute Average Scale Score

The first step of Example 5 will compute the average scale score of the *Parents' Perceptions of Their Child's School* scale for each country, using the scale variable ASBHPSP. It is conducted in the **Analysis Module** of the IEA IDB Analyzer using the following steps. The completed **Analysis Module** for this step is shown in Exhibit 1.16.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Specify the data file ASHALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the **Analysis Type**.

Exhibit 1.16: IEA IDB Analyzer Analysis Module Setup for Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data (Step 1)



4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **None Used** as the **Plausible Value Option**, because achievement scores are not used for this part of the analysis.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce two bar graphs in the SPSS or SAS output file: one for average scale score by country, and one for average percent of the total students in each country.

8. The IDB Analyzer automatically selects the variable IDCNTRY for the **Grouping Variables**. No additional grouping variables are needed for this analysis. The IEA IDB Analyzer automatically checks the **Exclude Missing from Analysis**, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.
9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the IEA IDB Analyzer Help manual for more information.
10. Specify the variable ASBHPSP to be used for the analysis by first clicking the **Analysis Variables** field to activate it. Then, select ASBHPSP from the list of available variables in the left panel, and move it to the right **Analysis Variables** field by clicking the **right arrow** (▸) button.
11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis uses student context data combine with home context data.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.16, the syntax file MAT_ASBHPSP_scale.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** (🏃) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Exhibit 1.17 shows the results for the first step of Example 5 in the SPSS output file with four example countries: Albania, Austria, Bahrain, and Armenia. This step of the analysis produces the same results output files as described for Example 1, with IDCNTRY as the grouping variable and the scale variable ASBHPSP as the outcome instead of ASMMAT0. On average, students in Armenia scored 11.54 on the *Parents' Perceptions of Their Child's School* context questionnaire scale, with a standard error of 0.05. Note that this is markedly above the international centerpoint of 10.

Exhibit 1.17: SPSS Output for Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data (Step 1)

Average for ASBHPSP by (IDCNTRY)

Country ID - Numeric ISO Code	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)	ASBHPSP (Mean)	ASBHPSP (s.e.)	Std.Dev.	Std.Dev. (s.e.)	Percent Missing
Albania	4237	29987.75	875.91	.18	.01	11.51	.05	1.48	.06	3.55
Austria	4019	71347.64	2166.78	.43	.01	10.04	.06	1.99	.02	9.06
Bahrain	5289	17542.58	215.99	.11	.00	10.28	.05	1.99	.03	8.13
Armenia	5155	35214.66	1097.80	.21	.01	11.54	.05	1.41	.04	3.83

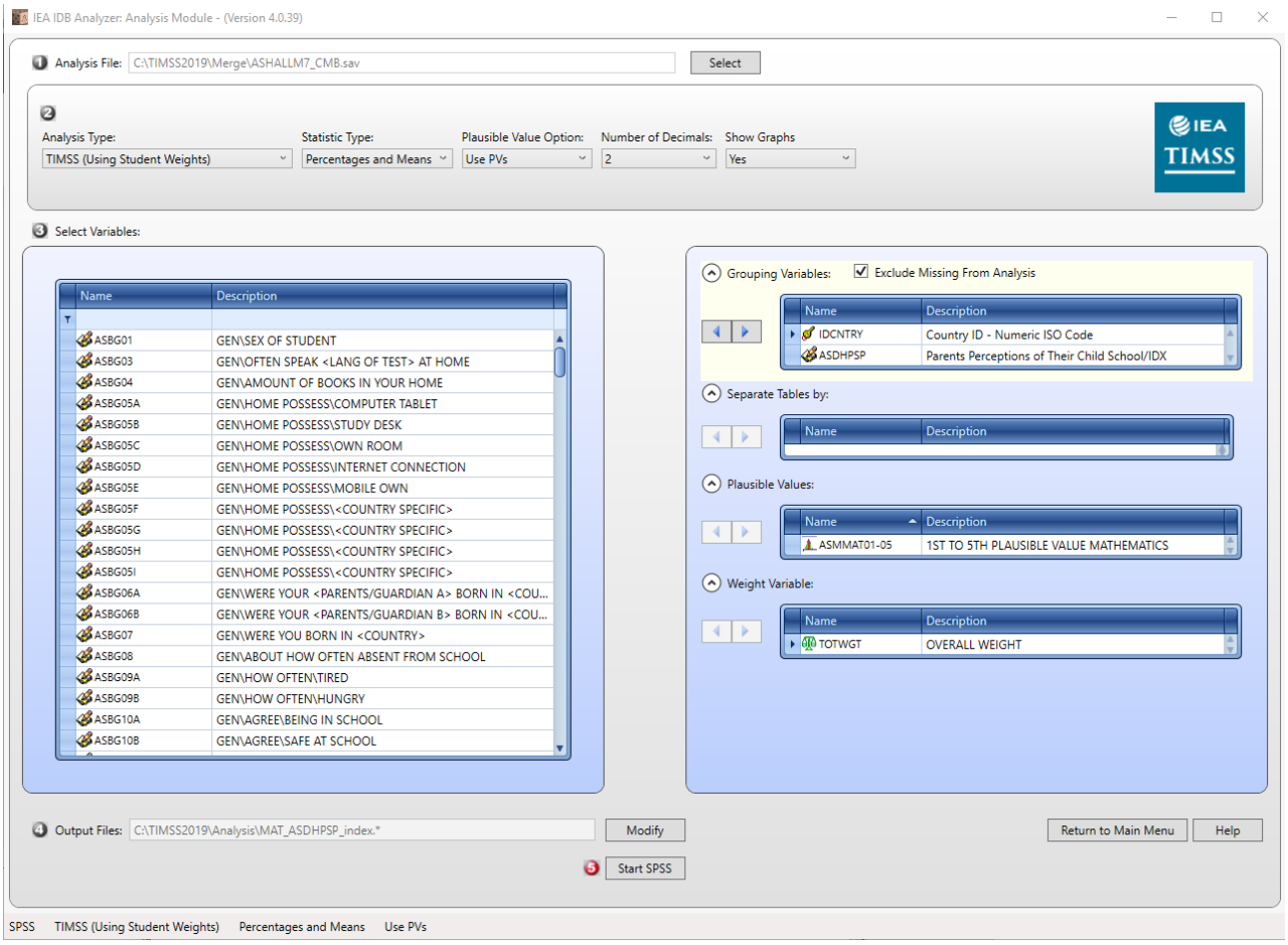
Step 2: Compute Percentages of Students and Average Achievement by Scale Category

In the second step of this example, the percentages of students are computed—with their average mathematics achievement—in each category of the corresponding index variable ASDHPSP. This step is conducted by the **Analysis Module** of the IEA IDB Analyzer using the following steps. Exhibit 1.18 shows the completed **Analysis Module** for this step.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Specify the data file ASHALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Student Weights)** as the **Analysis Type**.
4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**, because average achievement will be computed by the grouping variable ASDHPSP.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce three graphs in the SPSS or SAS output file: a line graph of average achievement for each scale category by country, a clustered bar graph of average achievement for each scale category by country, and a stacked bar graph of average percent of students for each scale category by country.
8. Specify the variable ASDHPSP as a second grouping variable by first clicking the **Grouping Variables** field to activate it. Then, select ASDHPSP from the list of variables in the left panel, and move it to the **Grouping Variables** field by clicking the **right arrow** (▸) button. The IEA IDB Analyzer automatically checks the **Exclude**

Missing from Analysis, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.

Exhibit 1.18: IEA IDB Analyzer Analysis Module Setup for Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data (Step 2)



9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the Help manual for more information.
10. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.

11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because this example analysis combines student context data with home context data.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.18, the syntax file MAT_ASDHPSP_index.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** ( ) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Exhibit 1.19 shows the results for the second step of Example 5 with four example countries: Albania, Austria, Bahrain, and Armenia. This analysis produces the results output files consistent with those described for Example 2, with ASDHPSP as the second grouping variable instead of ITSEX. Each country's results are displayed on three lines, one for each value of the scale index variable.

Exhibit 1.19: SPSS Output for Example 5 – Analysis of a Context Questionnaire Scale with Home Context Data (Step 2)

Average for ASMMAT0 by IDCNTRY ASDHPSP

Coutnry ID - Numeric ISO Code	Parents Perceptions of Their Child School/IDX	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)	ASMMAT0 (Mean)	ASMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)	pctmiss
Albania	Very Satisfied	3805	26965	758.95	89.92	.77	496.55	3.44	84.67	2.53	.00
	Somewhat Satisfied	372	2572	238.63	8.58	.68	484.41	8.61	90.17	5.83	.00
	Less than Satisfied	60	450	112.38	1.50	.37	478.41	26.23	96.55	13.47	.00
Austria	Very Satisfied	2424	42945	1670.14	60.19	1.38	545.30	2.47	63.06	1.31	.00
	Somewhat Satisfied	1358	23939	1032.54	33.55	1.12	538.65	2.78	65.07	1.84	.00
	Less than Satisfied	237	4463	409.27	6.26	.53	519.96	5.72	61.16	3.95	.00
Bahrain	Very Satisfied	3332	11245	260.04	64.10	1.13	486.03	3.01	87.35	2.22	.00
	Somewhat Satisfied	1663	5374	161.92	30.63	.91	474.11	3.11	85.92	2.09	.00
	Less than Satisfied	294	924	88.17	5.26	.50	462.28	6.69	84.44	5.04	.00
Armenia	Very Satisfied	4524	31142	1004.41	88.43	.96	500.28	2.62	67.36	1.74	.00
	Somewhat Satisfied	586	3839	353.36	10.90	.92	486.36	5.50	73.20	2.11	.00
	Less than Satisfied	45	234	48.88	.66	.14	489.08	8.89	61.39	9.98	.00

As shown in the last three lines of the results for Armenia, 88.43% of fourth grade students in Armenia had parents who were "very satisfied" with their child's school (standard error of 0.96) and their average mathematics achievement was 500.28 (standard error of 2.62); 10.90% of students had parents who were "somewhat satisfied" (standard error of 0.92) and their average reading achievement was 486.36 (standard error of 5.50); and 0.66% of students had parents who were "less than satisfied" (standard error of 0.14) and their average reading achievement was 489.08 (standard error of 8.89). Average achievement for the "less than satisfied" category should be interpreted with caution. As shown in Exhibit 1.15, TIMSS does not report achievement for percentages of students smaller than 3% after rounding.

Conducting Analyses with TIMSS Teacher Context Data

This section presents an analysis conducted using the IEA IDB Analyzer with teacher context data from the TIMSS 2019 International Database. Analyses with TIMSS teacher context data seek to make inferences about students whose teachers have a given characteristic, attitude, or instructional practice. Because the teachers in TIMSS do not constitute representative samples of teachers, inferences should not be made about teachers themselves.

As an example of an analysis using teacher context data, Example 6 investigates the relationship between students' achievement and their teachers' major areas of study. The results of such an analysis are presented in Exhibit 9.5 of *TIMSS 2019 International Results in Mathematics and Science,* and are repeated below in Exhibit 1.20. Because this example analyzes teacher context data with student achievement, teacher context data should be merged with student context data through the student-teacher linkage file to retrieve the achievement scores and required sample design variables (see earlier section under *Merging Data Files with the IEA IDB Analyzer*).

Example 6 – Analysis of Average Achievement by Teachers' Major Area of Study

This example involves using the **Percentages and Means** statistic type with the **Use PVs** option to estimate the percentages of students with their average mathematics achievement by reporting categories of teachers' major in primary education or mathematics.

Exhibit 1.20: Exhibit of Example 6 – Analysis of Average Achievement by Teachers' Major Area of Study (Exhibit 9.5 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

IEA TIMSS 2019

Exhibit 9.5: Teachers Majored in Education and Mathematics

Students' Results based on Teachers' Reports

Country	Major in Primary Education and Major (or Specialization) in Mathematics		Major in Primary Education but No Major (or Specialization) in Mathematics		Major in Mathematics but No Major in Primary Education		All Other Majors		No Formal Education Beyond Upper-Secondary*	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Albania r	15 (3.3)	512 (9.7)	65 (4.8)	491 (5.1)	1 (0.1)	~ ~	1 (1.1)	~ ~	17 (3.7)	498 (7.8)
Armenia	40 (4.0)	498 (4.5)	7 (2.2)	500 (6.7)	11 (2.7)	504 (6.2)	1 (0.7)	~ ~	42 (4.2)	495 (4.1)
Australia	16 (2.6)	522 (10.2)	80 (2.9)	518 (2.9)	0 (0.1)	~ ~	4 (1.2)	477 (13.1)	0 (0.0)	~ ~
Austria	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Azerbaijan r	54 (4.1)	515 (4.0)	21 (3.4)	510 (6.3)	5 (1.7)	511 (19.1)	6 (2.0)	505 (14.1)	14 (2.9)	524 (6.9)
Bahrain	44 (3.3)	477 (4.0)	5 (1.2)	503 (15.0)	45 (3.2)	479 (3.8)	5 (1.6)	491 (7.7)	0 (0.0)	~ ~
Belgium (Flemish)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Bosnia and Herzegovina	41 (3.4)	454 (4.1)	54 (3.4)	452 (4.0)	1 (0.8)	~ ~	2 (1.0)	~ ~	0 (0.3)	~ ~
Bulgaria r	8 (2.2)	521 (16.1)	87 (3.5)	513 (4.3)	0 (0.3)	~ ~	5 (2.8)	476 (64.3)	0 (0.0)	~ ~
Canada r	11 (1.4)	509 (5.5)	74 (1.9)	515 (2.4)	2 (0.9)	~ ~	13 (1.4)	504 (4.3)	0 (0.0)	~ ~
Chile	63 (3.7)	449 (3.2)	35 (3.6)	425 (5.6)	1 (0.9)	~ ~	1 (0.5)	~ ~	0 (0.0)	~ ~
Chinese Taipei	33 (3.6)	597 (3.5)	46 (4.0)	597 (2.7)	3 (1.4)	614 (4.5)	18 (3.0)	602 (4.6)	0 (0.0)	~ ~
Croatia	13 (2.6)	508 (6.8)	84 (2.7)	509 (2.4)	0 (0.0)	~ ~	2 (0.9)	~ ~	0 (0.5)	~ ~
Cyprus	24 (3.1)	543 (5.1)	73 (3.2)	530 (3.4)	1 (0.7)	~ ~	2 (1.1)	~ ~	0 (0.0)	~ ~
Czech Republic	2 (0.9)	~ ~	81 (2.3)	535 (2.9)	1 (0.5)	~ ~	11 (1.9)	528 (7.3)	5 (1.5)	523 (11.3)
Denmark r	31 (4.4)	518 (3.9)	8 (2.4)	552 (7.6)	42 (4.5)	525 (3.3)	11 (2.5)	517 (6.4)	8 (2.5)	520 (7.6)
England s	20 (4.6)	563 (9.9)	56 (5.1)	553 (6.6)	3 (2.1)	578 (14.5)	20 (4.2)	558 (11.8)	0 (0.0)	~ ~
Finland	9 (2.0)	541 (8.4)	84 (2.5)	532 (2.5)	0 (0.1)	~ ~	7 (1.7)	530 (7.4)	0 (0.4)	~ ~
France r	12 (2.3)	470 (7.4)	31 (4.0)	492 (5.0)	21 (3.7)	484 (7.1)	31 (3.7)	484 (6.9)	5 (1.9)	491 (14.4)
Georgia r	81 (3.6)	477 (4.6)	4 (2.0)	482 (9.2)	12 (3.1)	494 (12.3)	2 (0.9)	~ ~	1 (1.2)	~ ~
Germany r	67 (3.3)	520 (3.3)	22 (3.1)	523 (6.7)	3 (1.5)	522 (12.0)	8 (2.1)	517 (10.0)	0 (0.0)	~ ~
Hong Kong SAR	53 (4.8)	602 (4.6)	20 (3.8)	605 (7.7)	20 (4.2)	596 (10.9)	8 (2.6)	621 (16.8)	0 (0.0)	~ ~
Hungary r	4 (1.4)	528 (16.7)	95 (1.6)	522 (3.6)	0 (0.0)	~ ~	1 (0.7)	~ ~	0 (0.0)	~ ~
Iran, Islamic Rep. of	13 (2.7)	440 (9.0)	43 (3.3)	445 (7.0)	8 (2.2)	461 (14.1)	34 (3.8)	438 (7.7)	2 (1.1)	~ ~
Ireland	12 (2.5)	550 (5.0)	84 (2.8)	549 (3.0)	2 (1.0)	~ ~	3 (1.1)	535 (13.7)	0 (0.2)	~ ~
Italy	3 (1.2)	509 (12.5)	9 (2.9)	531 (6.7)	6 (1.9)	506 (7.8)	21 (3.2)	515 (4.6)	60 (3.6)	513 (2.8)
Japan	21 (3.3)	598 (3.8)	62 (3.8)	591 (2.3)	2 (0.8)	~ ~	15 (2.6)	591 (4.1)	0 (0.0)	~ ~
Kazakhstan	55 (3.9)	515 (3.3)	44 (3.8)	509 (4.4)	0 (0.0)	~ ~	1 (0.8)	~ ~	0 (0.2)	~ ~
Korea, Rep. of	19 (3.4)	600 (6.7)	78 (3.4)	599 (2.4)	0 (0.0)	~ ~	2 (1.0)	~ ~	0 (0.0)	~ ~
Kuwait	45 (4.7)	382 (7.0)	4 (1.5)	437 (25.9)	44 (4.7)	379 (9.6)	4 (1.7)	413 (24.0)	3 (1.4)	350 (27.7)
Latvia	42 (3.9)	550 (3.4)	53 (3.6)	546 (3.7)	3 (1.5)	511 (33.5)	1 (0.6)	~ ~	1 (0.9)	~ ~
Lithuania	15 (2.8)	529 (6.8)	80 (3.2)	543 (2.9)	1 (0.9)	~ ~	3 (1.3)	504 (22.0)	0 (0.0)	~ ~
Malta	24 (0.4)	503 (2.6)	48 (0.5)	511 (2.0)	4 (0.1)	505 (6.8)	18 (0.3)	514 (2.3)	7 (0.2)	506 (4.0)
Montenegro	46 (2.6)	449 (3.2)	53 (2.5)	453 (2.9)	2 (0.7)	~ ~	0 (0.2)	~ ~	0 (0.0)	~ ~
Morocco s	3 (1.5)	317 (13.3)	6 (1.8)	359 (33.8)	14 (2.2)	434 (26.9)	29 (4.2)	377 (9.7)	48 (4.2)	377 (8.6)
New Zealand	13 (1.9)	500 (10.1)	79 (2.7)	483 (3.1)	1 (0.5)	~ ~	8 (1.8)	481 (13.7)	0 (0.0)	~ ~
North Macedonia s	11 (3.7)	442 (29.4)	58 (5.6)	471 (7.6)	6 (2.6)	466 (20.7)	16 (4.3)	495 (14.6)	10 (3.0)	457 (15.0)
Northern Ireland r	15 (3.1)	557 (8.2)	66 (4.7)	570 (4.6)	1 (1.2)	~ ~	13 (3.1)	553 (9.5)	5 (2.4)	552 (17.6)
Norway (5) r	63 (4.2)	545 (2.7)	30 (3.8)	547 (5.4)	6 (2.1)	530 (12.2)	1 (0.5)	~ ~	0 (0.0)	~ ~
Oman	55 (3.2)	436 (5.6)	13 (2.2)	422 (11.7)	17 (2.4)	436 (9.7)	13 (2.6)	407 (12.9)	2 (1.1)	~ ~
Pakistan	23 (4.1)	318 (14.7)	7 (2.2)	304 (38.5)	22 (8.2)	344 (38.7)	12 (3.8)	299 (20.1)	35 (7.7)	344 (20.0)
Philippines	18 (3.5)	289 (10.8)	41 (4.0)	285 (9.5)	14 (2.5)	324 (11.9)	15 (2.9)	318 (20.2)	13 (3.0)	286 (15.2)
Poland	11 (2.4)	515 (6.3)	0 (0.0)	~ ~	89 (2.4)	521 (2.9)	0 (0.0)	~ ~	0 (0.0)	~ ~
Portugal	42 (3.3)	525 (4.2)	56 (3.4)	526 (3.5)	0 (0.3)	~ ~	1 (0.6)	~ ~	0 (0.0)	~ ~
Qatar	33 (4.0)	458 (5.7)	13 (2.4)	502 (10.7)	39 (4.1)	421 (6.1)	16 (3.0)	459 (10.4)	0 (0.0)	~ ~
Russian Federation	41 (3.2)	566 (4.8)	49 (3.3)	569 (4.7)	1 (0.6)	~ ~	2 (1.1)	~ ~	6 (1.6)	568 (12.2)
Saudi Arabia	31 (3.6)	391 (8.3)	2 (1.2)	~ ~	53 (3.5)	400 (5.4)	7 (1.8)	405 (15.7)	6 (1.6)	392 (17.8)
Serbia	43 (3.8)	506 (4.5)	55 (3.8)	511 (4.7)	0 (0.1)	~ ~	1 (0.5)	~ ~	1 (0.6)	~ ~
Singapore	66 (2.6)	624 (4.9)	11 (1.7)	643 (8.4)	14 (2.0)	618 (9.9)	9 (1.6)	629 (10.4)	0 (0.3)	~ ~
Slovak Republic	25 (3.0)	503 (7.8)	71 (3.3)	512 (4.1)	3 (1.2)	504 (21.7)	1 (0.8)	~ ~	0 (0.0)	~ ~
South Africa (5)	48 (4.3)	375 (6.3)	13 (2.4)	397 (15.2)	19 (2.9)	353 (7.9)	15 (3.1)	381 (11.8)	5 (1.5)	340 (11.7)
Spain	30 (3.4)	504 (6.1)	53 (3.6)	500 (3.8)	4 (1.3)	538 (9.4)	13 (2.7)	505 (5.3)	0 (0.0)	~ ~
Sweden	77 (3.8)	524 (3.6)	11 (3.0)	522 (5.9)	5 (1.7)	529 (8.7)	3 (1.8)	502 (13.9)	3 (1.3)	495 (10.3)
Turkey (5)	62 (3.7)	522 (5.8)	1 (0.7)	~ ~	35 (3.6)	532 (7.6)	1 (1.1)	~ ~	0 (0.0)	~ ~
United Arab Emirates r	39 (2.2)	479 (4.5)	16 (0.8)	473 (6.0)	37 (2.0)	482 (3.8)	8 (0.8)	492 (8.7)	1 (0.3)	~ ~
United States	10 (1.5)	538 (6.9)	71 (2.5)	537 (3.0)	2 (0.8)	~ ~	17 (1.9)	525 (7.2)	0 (0.0)	~ ~
Kosovo x	43 (6.7)	443 (7.0)	43 (7.1)	439 (9.0)	0 (0.0)	~ ~	0 (0.0)	~ ~	14 (4.1)	444 (13.1)
Netherlands y	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
International Average	**32 (0.4)**	**497 (1.1)**	**43 (0.4)**	**503 (1.4)**	**11 (0.3)**	**487 (2.6)**	**8 (0.3)**	**490 (2.7)**	**6 (0.3)**	**457 (3.1)**
Benchmarking Participants										
Ontario, Canada r	12 (2.7)	514 (8.9)	70 (3.3)	515 (4.8)	3 (1.8)	496 (7.7)	15 (2.6)	504 (6.0)	0 (0.0)	~ ~
Quebec, Canada	9 (1.9)	522 (6.8)	82 (2.7)	534 (2.6)	1 (0.8)	~ ~	8 (2.1)	535 (5.1)	0 (0.0)	~ ~
Moscow City, Russian Fed.	54 (4.3)	591 (3.0)	44 (4.3)	597 (3.4)	0 (0.0)	~ ~	0 (0.0)	~ ~	2 (1.0)	~ ~
Madrid, Spain	30 (3.4)	520 (3.5)	59 (3.8)	516 (3.2)	3 (1.4)	521 (10.1)	8 (2.0)	517 (8.5)	0 (0.0)	~ ~
Abu Dhabi, UAE r	42 (2.6)	435 (5.3)	26 (2.2)	429 (6.5)	23 (2.5)	454 (8.3)	8 (1.5)	469 (15.5)	1 (0.7)	~ ~
Dubai, UAE r	38 (3.5)	552 (4.0)	20 (2.2)	555 (5.3)	33 (3.4)	530 (4.8)	9 (1.4)	548 (9.6)	0 (0.3)	~ ~

* Countries have been increasing their certification requirements and providing professional development to teachers certified under earlier guidelines.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A dash (-) indicates comparable data not available. A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.
An "x" indicates data are available for at least 40% but less than 50% of the students—interpret with caution. A "y" indicates data are available for less than 40% of the students.

Before conducting analyses using TIMSS contextual variables, users should refer to the relevant codebook for the data file to identify the appropriate variables related to teachers' major areas of study and understand the coding scheme. Supplement 1 of this User Guide presents all the context questionnaires administered in TIMSS 2019 and the associated variable names under which the data are saved. Supplement 2 should also be checked for any national adaptations made to the questionnaire items that may impact international comparability.

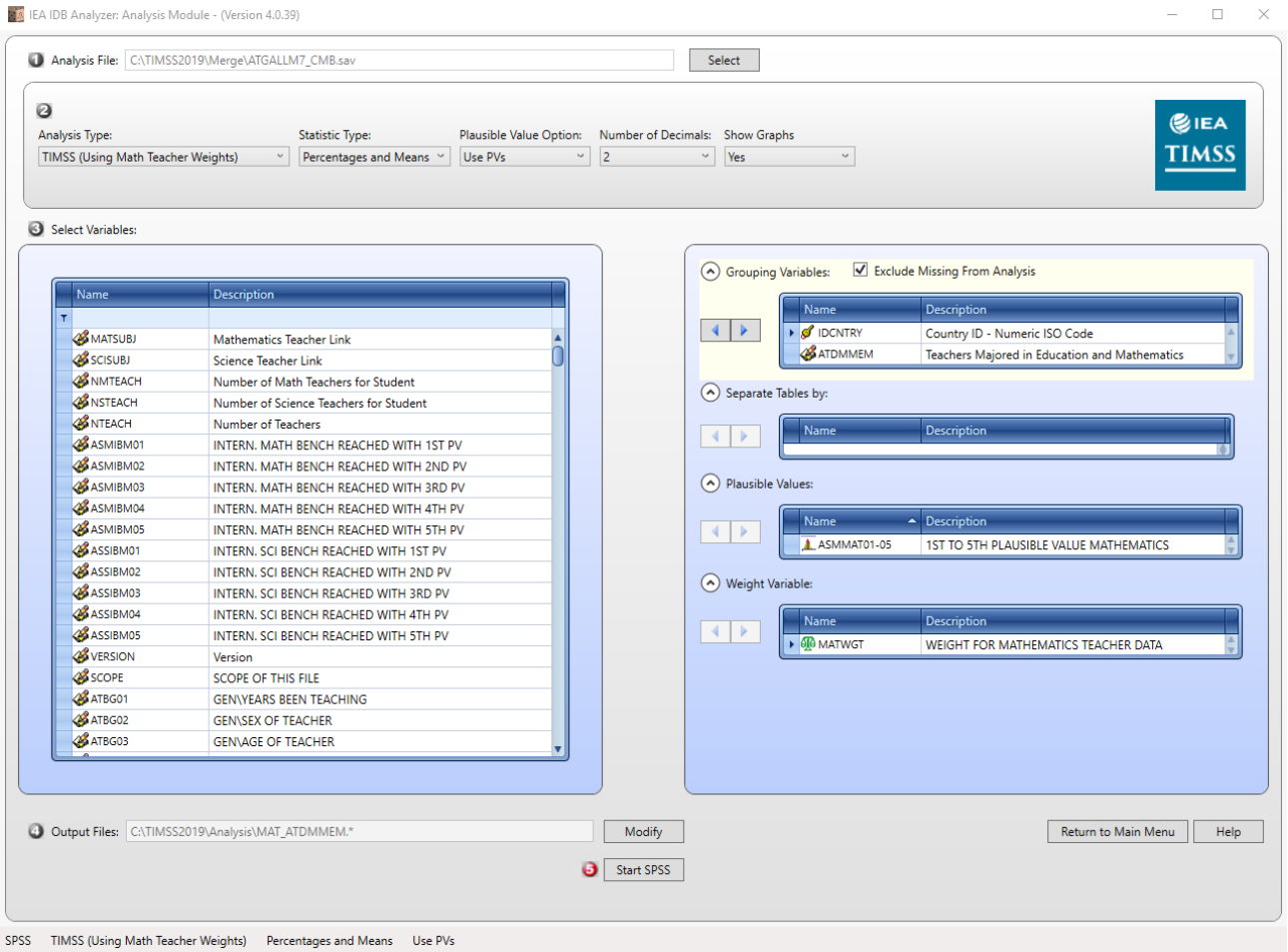
The codebook for the fourth grade teacher context data file indicates that the derived variable ATDMMEM contains information on fourth grade teachers' major in primary education or mathematics in five categories represented by the columns of Exhibit 1.20. As described in Supplement 3 to this User Guide, four source variables were used to derive ATDMMEM: ATBG04, about teachers' level of formal education; ATBG05AA, about whether teachers majored in primary education; ATBG05AC, about whether teachers majored in mathematics; and ATBG05BA, for teachers who majored in education, about whether they specialized in mathematics.

This example analysis replicates the columns in Exhibit 1.20 using the merged ATGALLM7_CMB data file described earlier in this chapter under *Merging Data Files with the IEA IDB Analyzer*. The analysis is conducted in the **Analysis Module** of the IEA IDB Analyzer, shown completed in Exhibit 1.21, using the following steps:

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Select the merged data file ATGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select **TIMSS (Using Math Teacher Weights)** as the **Analysis Type**.
4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**, because average achievement will be computed by the grouping variable ATDMMEM.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce three graphs in the SPSS or SAS output file: a line graph of average achievement for each category of teachers' major by country, a clustered bar graph of average achievement for each category of teachers' major by country, and a

stacked bar graph of average percent of students for each category of teachers' major by country.

Exhibit 1.21: IEA IDB Analyzer Analysis Module Setup for Example 6 – Analysis of Average Achievement by Teachers' Major Area of Study



8. Specify the variable ATDMMEM as a second grouping variable by first clicking the **Grouping Variables** field to activate it. Then, select ATDMMEM from the list of variables in the left panel, and move it to the **Grouping Variables** field by clicking the **right arrow** (▸) button. The IEA IDB Analyzer automatically checks the **Exclude Missing from Analysis**, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.

9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the Help manual for more information.
10. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.
11. The **Weight Variable** is selected automatically by the software; MATWGT is selected by default because of the **Analysis Type** selected in step 3.
12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.21, the syntax file MAT_ATDMMEM.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the **Run** (🏃) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

Exhibit 1.22 shows the results as shown in the SPSS output file with three example countries: Bulgaria, Czech Republic, and Denmark. This analysis produces the results output files in the same manner as described for Example 2, with countries identified in the first column and the second column describing the categories of the analysis variable ATDMMEM.

Each country's results are displayed on up to five lines, one for each value of the ATDMMEM variable. There are fewer lines if any category does not have any observations. For example, in Exhibit 1.22, Bulgaria has only four lines of results because no teacher fell into the "no formal education beyond upper secondary" category.

Exhibit 1.22: SPSS Output for Example 6 – Analysis of Average Achievement by Teachers' Major Areas of Study

Average for ASMMAT0 by IDCNTRY ATDMMEM

Country ID - Numeric ISO Code	Teachers Majored in Education and Mathematics	N of Cases	Sum of MATWGT	Sum of MATWGT (s.e.)	Percent	Percent (s.e.)	ASMMAT0 (Mean)	ASMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)	pctmiss
Bulgaria	Major in Edu and Math	302	3830	1177.63	7.51	2.25	521.05	16.15	81.71	5.16	.00
	Major in Edu but not Math	2943	44267	2305.88	86.86	3.50	513.10	4.26	86.28	2.98	.00
	Major in Math but not Edu	21	159	158.80	.31	.31	506.17	4.64	73.32	2.22	.00
	All Other Majors	116	2708	1456.48	5.31	2.80	476.32	64.31	115.26	35.30	.00
Czech Republic	Major in Edu and Math	92	2093	980.85	1.99	.93	555.50	20.19	74.15	9.67	.00
	Major in Edu but not Math	3517	85829	4525.08	81.44	2.27	534.90	2.86	73.85	2.06	.00
	Major in Math but not Edu	50	893	543.44	.85	.52	493.73	16.05	65.33	12.09	.00
	All Other Majors	514	11070	2045.69	10.50	1.94	527.98	7.26	77.94	4.24	.00
	No Edu Beyond Upper Secondary	271	5511	1564.57	5.23	1.52	522.90	11.28	75.25	4.54	.00
Denmark	Major in Edu and Math	852	16508	2393.88	30.84	4.40	517.75	3.92	74.31	1.51	.00
	Major in Edu but not Math	216	4459	1277.28	8.33	2.40	552.46	7.58	68.37	3.72	.00
	Major in Math but not Edu	1101	22550	2632.58	42.13	4.47	525.45	3.33	72.66	1.82	.00
	All Other Majors	300	5878	1333.74	10.98	2.50	516.85	6.44	73.08	3.55	.00
	No Edu Beyond Upper Secondary	188	4134	1375.70	7.72	2.55	519.62	7.61	64.38	3.29	.00

As shown in the last four lines of results for Denmark, 30.84% (standard error of 4.40) of fourth grade students were taught by mathematics teachers with majors in both primary education and mathematics, and their average achievement was 517.75 (standard error of 3.92). Many fourth grade students in Denmark were taught by mathematics teachers with majors in only one area: 8.33% (standard error of 2.40) had teachers with a major in primary education but not mathematics, and their average achievement was 552.46 (standard error of 7.58); and 42.13% (standard error of 4.47) had teachers with a major in mathematics but not primary education, and their average achievement was 525.45 (standard error of 3.33). On average, 10.98% (standard error of 2.50) of students were taught by mathematics teachers with other majors, and their average achievement was 516.85 (standard error of 6.44); and, lastly, 7.72% (standard error of 2.55) were taught by teachers with no formal education beyond upper-secondary, and these students had an average achievement of 519.62 (standard error of 7.61).

Conducting Analyses with TIMSS School Context Data

When analyzing school context data from the TIMSS 2019 International Database, it is preferable that they be analyzed to make inferences about students attending schools with a given characteristic, rather than about schools of a given characteristic. Analyzing school context data with student achievement requires that the school context data files be merged with the student context data files to retrieve the achievement scores and required sample design variables.

This section presents an analysis conducted using the IEA IDB Analyzer with school context data collected from principals of schools attended by fourth grade students with the TIMSS 2019 School Questionnaire. Example 7 uses school context data merged with student context data to compute the percentages and average achievement of fourth grade students who attend schools composed of students with different levels of socioeconomic background. The results of this analysis are presented in Exhibit 6.2 of *TIMSS 2019 International Results in Mathematics and Science*, repeated below in Exhibit 1.23.

Example 7 – Analysis of Average Achievement by School Socioeconomic Composition

In this example, the **Percentages and Means** statistic type is used along with the **Use PVs** option to estimate the percentages of students with their average reading achievement by reporting categories of students' socioeconomic background as reported by school principals. Exhibit 1.23 shows the results for this analysis, which is Exhibit 6.2 of *TIMSS 2019 International Results in Mathematics and Science*.

Before conducting analysis using school context variables, users should refer to the relevant codebook for the data file to identify the appropriate variables related to the school's composition of students by socioeconomic background and understand the coding scheme. Supplement 1 of this User Guide presents all the context questionnaires administered in TIMSS 2019 and the associated variable names under which the data are saved. Supplement 2 should also be checked for any national adaptations made to the questionnaire items that may impact international comparability.

The information for this analysis is found in the school-level derived variable ACDGSBC (see Supplement 3 to this User Guide), where schools are characterized as "more affluent," "more disadvantaged," or "neither more affluent nor more disadvantaged." This example uses the merged data file ACGALLM7_CMB described earlier in this chapter under *Merging Data Files with the IEA IDB Analyzer*.

Exhibit 1.23: Exhibit of Example 7 – Analysis of Average Achievement by School Socioeconomic Composition (Exhibit 6.2 of *TIMSS 2019 International Results in Mathematics and Science*)

Mathematics • Grade 4

Exhibit 6.2: School Composition by Socioeconomic Background of the Student Body

Students' Results based on Principals' Reports

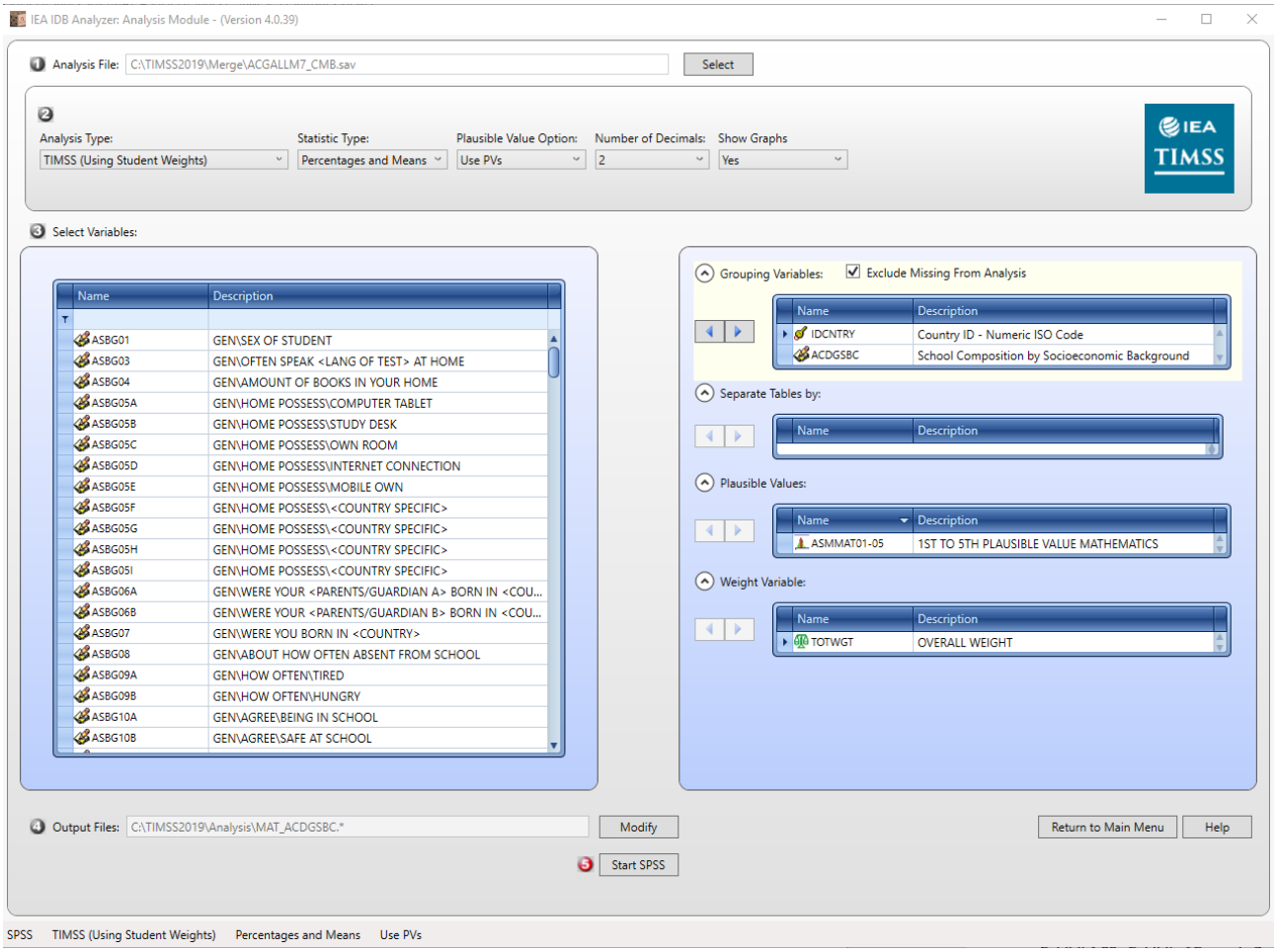
Country	More Affluent: Schools where more than 25% of the student body comes from economically affluent homes and not more than 25% from economically disadvantaged homes		Neither More Affluent Nor More Disadvantaged		More Disadvantaged: Schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% from economically affluent homes	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Albania	36 (4.3)	516 (5.7)	22 (3.7)	481 (7.1)	42 (4.2)	478 (6.4)
Armenia	49 (4.8)	502 (4.2)	28 (3.9)	491 (4.4)	23 (4.2)	499 (5.1)
Australia r	34 (3.5)	542 (4.4)	38 (3.8)	512 (5.0)	28 (3.4)	485 (8.0)
Austria	30 (3.4)	554 (2.6)	40 (3.5)	545 (3.4)	29 (2.8)	515 (4.1)
Azerbaijan	14 (2.6)	510 (10.0)	30 (3.7)	505 (5.7)	56 (4.0)	521 (4.6)
Bahrain	38 (2.4)	475 (4.0)	36 (2.7)	488 (4.9)	26 (2.5)	474 (4.3)
Belgium (Flemish)	63 (3.7)	542 (2.6)	20 (3.8)	527 (5.0)	17 (2.9)	502 (6.3)
Bosnia and Herzegovina	44 (4.3)	460 (3.6)	34 (4.3)	451 (4.7)	22 (3.4)	451 (5.1)
Bulgaria	35 (3.3)	548 (4.1)	44 (4.2)	522 (9.2)	21 (3.1)	465 (10.7)
Canada	43 (2.5)	530 (3.0)	35 (2.5)	505 (2.8)	22 (2.2)	486 (4.1)
Chile	14 (2.0)	510 (5.8)	17 (3.5)	457 (7.2)	69 (3.7)	422 (3.8)
Chinese Taipei	25 (3.9)	607 (3.6)	71 (3.9)	599 (2.1)	4 (1.6)	566 (17.6)
Croatia	57 (4.2)	514 (3.1)	30 (3.7)	507 (4.4)	13 (2.7)	497 (5.3)
Cyprus	47 (4.6)	543 (4.5)	40 (4.7)	529 (4.8)	13 (2.9)	502 (7.3)
Czech Republic	55 (4.4)	542 (3.3)	37 (4.4)	526 (4.5)	8 (2.3)	502 (9.0)
Denmark r	56 (4.1)	530 (3.0)	33 (3.9)	522 (4.2)	10 (2.2)	508 (6.6)
England s	13 (3.5)	620 (13.7)	53 (5.6)	550 (4.0)	34 (5.3)	540 (5.6)
Finland	36 (4.0)	541 (3.1)	54 (4.1)	530 (3.4)	10 (2.3)	512 (7.1)
France	43 (3.9)	511 (3.6)	25 (3.8)	485 (6.2)	32 (3.5)	453 (5.0)
Georgia	39 (4.6)	488 (6.6)	40 (4.4)	478 (5.8)	21 (3.5)	479 (9.5)
Germany r	29 (3.2)	541 (3.9)	44 (2.9)	528 (3.4)	27 (2.6)	484 (5.6)
Hong Kong SAR	34 (3.6)	612 (5.1)	25 (4.0)	607 (6.3)	41 (4.3)	590 (5.8)
Hungary	35 (3.7)	557 (4.1)	38 (4.6)	517 (5.2)	27 (3.9)	484 (6.4)
Iran, Islamic Rep. of	24 (3.3)	486 (8.2)	32 (3.2)	452 (6.0)	44 (3.2)	415 (4.6)
Ireland	49 (4.4)	557 (4.0)	27 (4.0)	555 (5.5)	24 (3.0)	522 (4.9)
Italy	38 (3.7)	522 (3.7)	45 (4.3)	517 (3.9)	17 (3.3)	498 (4.9)
Japan	48 (4.3)	602 (2.6)	45 (4.3)	585 (2.4)	8 (2.4)	583 (3.5)
Kazakhstan	81 (3.2)	514 (3.1)	17 (3.0)	503 (5.5)	2 (1.1)	~ ~
Korea, Rep. of	26 (3.3)	620 (4.1)	57 (4.1)	594 (3.0)	17 (3.1)	583 (4.4)
Kosovo s	55 (6.0)	445 (5.2)	26 (4.7)	448 (9.1)	19 (4.4)	428 (8.7)
Kuwait r	37 (4.5)	388 (12.4)	42 (5.3)	376 (8.7)	21 (3.9)	377 (14.3)
Latvia r	54 (4.3)	552 (3.4)	41 (4.2)	538 (5.4)	5 (1.7)	539 (12.6)
Lithuania	73 (3.1)	552 (3.4)	19 (3.1)	525 (4.9)	8 (2.0)	492 (12.4)
Malta	48 (0.4)	519 (2.0)	45 (0.4)	505 (1.8)	7 (0.2)	472 (4.8)
Montenegro	43 (0.6)	459 (2.4)	34 (0.5)	448 (3.7)	23 (0.3)	443 (3.8)
Morocco r	4 (1.8)	451 (14.2)	26 (3.9)	393 (9.7)	70 (4.2)	372 (7.2)
Netherlands s	57 (5.3)	545 (3.1)	32 (5.2)	533 (3.5)	11 (3.6)	515 (6.2)
New Zealand	38 (3.2)	526 (4.1)	35 (3.5)	482 (4.7)	27 (2.7)	441 (4.6)
North Macedonia	66 (4.2)	489 (5.9)	10 (2.4)	459 (11.8)	24 (3.8)	445 (14.6)
Northern Ireland r	39 (4.3)	586 (5.9)	30 (4.9)	576 (4.6)	30 (3.9)	539 (5.1)
Norway (5) r	52 (4.9)	548 (3.6)	40 (4.6)	542 (3.5)	7 (2.2)	522 (7.6)
Oman	47 (3.9)	438 (6.9)	37 (3.7)	428 (6.1)	16 (2.3)	410 (10.5)
Pakistan r	12 (7.0)	372 (58.2)	30 (5.6)	297 (20.0)	58 (6.9)	338 (16.9)
Philippines	18 (2.8)	359 (14.1)	32 (4.6)	287 (10.3)	50 (4.4)	284 (8.0)
Poland	25 (4.0)	534 (5.7)	64 (4.3)	521 (3.3)	11 (3.1)	493 (7.9)
Portugal	27 (2.9)	541 (5.1)	39 (3.8)	524 (4.1)	33 (3.8)	513 (4.1)
Qatar	66 (3.8)	458 (5.7)	24 (3.5)	443 (10.0)	11 (2.6)	419 (8.2)
Russian Federation	80 (2.7)	572 (3.7)	16 (2.5)	551 (5.9)	4 (1.4)	544 (10.1)
Saudi Arabia s	38 (4.3)	425 (6.2)	38 (4.4)	393 (9.3)	24 (3.7)	371 (8.1)
Serbia	31 (4.1)	522 (5.1)	41 (4.2)	507 (4.5)	28 (3.7)	497 (6.9)
Singapore	53 (0.0)	635 (5.2)	37 (0.0)	623 (5.7)	10 (0.0)	584 (13.4)
Slovak Republic	45 (4.1)	530 (3.3)	41 (4.0)	510 (4.7)	13 (2.3)	445 (9.0)
South Africa (5) r	9 (1.9)	502 (14.5)	13 (2.6)	379 (17.5)	78 (3.0)	364 (4.7)
Spain	60 (3.7)	512 (3.9)	27 (3.5)	501 (4.5)	13 (2.7)	472 (9.8)
Sweden r	75 (3.7)	533 (3.1)	11 (2.7)	511 (8.0)	14 (2.9)	473 (8.8)
Turkey (5)	27 (3.7)	565 (6.2)	29 (3.6)	519 (11.0)	44 (4.2)	501 (6.9)
United Arab Emirates r	50 (1.8)	484 (2.4)	26 (1.6)	477 (3.3)	24 (1.2)	471 (4.6)
United States	23 (2.3)	574 (5.7)	19 (2.2)	550 (3.2)	58 (2.7)	516 (3.4)
International Average	**41 (0.5)**	**521 (1.3)**	**34 (0.5)**	**499 (0.9)**	**25 (0.4)**	**479 (1.1)**
Benchmarking Participants						
Ontario, Canada	40 (3.8)	535 (5.6)	35 (4.2)	510 (4.4)	26 (3.9)	478 (5.1)
Quebec, Canada	55 (4.6)	541 (2.8)	29 (4.0)	520 (4.2)	16 (3.4)	523 (6.3)
Moscow City, Russian Fed.	87 (3.1)	593 (2.5)	11 (2.9)	589 (6.0)	2 (1.2)	~ ~
Madrid, Spain	65 (3.9)	528 (2.1)	23 (3.3)	506 (4.9)	13 (2.9)	483 (8.0)
Abu Dhabi, UAE r	56 (1.2)	445 (2.9)	22 (1.3)	411 (4.4)	22 (1.5)	439 (8.4)
Dubai, UAE r	51 (0.3)	554 (2.1)	32 (0.3)	543 (3.7)	17 (0.3)	513 (3.4)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insufficient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students. An "s" indicates data are available for at least 50% but less than 70% of the students.

This example analysis is conducted in the **Analysis Module** of the IEA IDB Analyzer using the following steps. The completed **Analysis Module** is shown in Exhibit 1.24.

1. Open the **Analysis Module** of the IEA IDB Analyzer.
2. Select the merged data file ACGALLM7_CMB as the **Analysis File** by clicking the **Select** button.
3. Select TIMSS (**Using Student Weights**) as the **Analysis Type,** because the school context data is analyzed as student attributes.
4. Select **Percentages and Means** as the **Statistic Type**.
5. Select **Use PVs** as the **Plausible Value Option**, because average achievement will be computed by the grouping variable ACDGSBC.
6. The default value in the **Number of Decimals** drop-down menu is **2**. Changing this value affects only the number of visible decimal places in the output files.
7. The default value selected in the **Show Graphs** menu is **Yes**. For this analysis, selecting **Yes** will produce three graphs in the SPSS or SAS output file: a line graph of average achievement for each category of school composition by country, a clustered bar graph of average achievement for each category of school composition by country, and a stacked bar graph of average percent of students for each category of school composition by country.
8. Specify the variable ACDGSBC as a second grouping variable by first clicking the **Grouping Variables** field to activate it. Then, select ACDGSBC from the list of variables in the left panel, and move it to the **Grouping Variables** field by clicking the **right arrow** (▸) button. The IEA IDB Analyzer automatically checks the **Exclude Missing from Analysis**, which excludes cases with missing values on the grouping variables from the analysis. This box should be checked for this analysis.
9. The **Separate Tables by** field should be empty for this analysis. This field is used to separately analyze several grouping variables or several continuous dependent (not achievement) variables. See the Help manual for more information.
10. Specify the achievement scores to be used for the analysis by first clicking the **Plausible Values** field to activate it. Then, select ASMMAT01–05 from the list of available variables in the left panel, and move it to the right **Plausible Values** field by clicking the **right arrow** (▸) button.
11. The **Weight Variable** is selected automatically by the software; TOTWGT is selected by default because of the **Analysis Type** selected in Step 3 for this analysis which uses school context data linked to student context data.

Exhibit 1.24: IEA IDB Analyzer Analysis Module Setup for Example 7 – Analysis of Average Achievement by School Socioeconomic Composition



12. Specify the desired name for the output files and the folder they will be stored in by clicking the **Define/Modify** button in the **Output Files** field. The IEA IDB Analyzer also will create an SPSS syntax file (*.SPS) or SAS syntax file (*.SAS) of the same name and in the same folder, with the code necessary to perform the analysis. In Exhibit 1.24, the syntax file MAT_ACDGSBC.SPS and the output files with the same name will be created and stored in the "C:\TIMSS2019\Analysis" folder.
13. Click the **Start SPSS** button to create the SPSS syntax file and open it in an SPSS syntax editor window ready for execution. The SPSS syntax file can be executed by opening the **Run** menu of SPSS and selecting the **All** menu option. In SAS, click the

Run ( ) button (or select **Submit** in the **Run** menu). The IEA IDB Analyzer will display a warning if it is about to overwrite an existing file in the specified folder.

The results as shown in the SPSS output file are presented in Exhibit 1.25 with four example countries. In this example, each country's results are presented on three lines, one for each value of the ACDGSBC variable. The results are presented in the same manner as in Example 2, with countries identified in the first column and the second column describing the categories of ACDGSBC.

Exhibit 1.25: SPSS Output for Example 7 – Analysis of Average Achievement by School Socioeconomic Composition

Average for ASMMAT0 by IDCNTRY ACDGSBC

Country ID - Numeric ISO Code	School Composition by Socioeconomic Background	N of Cases	Sum of TOTWGT	Sum of TOTWGT (s.e.)	Percent	Percent (s.e.)	ASMMAT0 (Mean)	ASMMAT0 (s.e.)	Std.Dev	Std.Dev. (s.e.)	pctmiss
Croatia	More Affluent	2333	21603	1743.95	56.67	4.18	514.50	3.08	67.20	2.34	.00
	Neither More Aff Nor Dis	965	11531	1423.69	30.25	3.74	507.50	4.38	67.89	2.88	.00
	More Disadvantaged	458	4988	1045.00	13.08	2.74	496.51	5.30	62.89	4.25	.00
France	More Affluent	1800	318875	27664.73	43.25	3.90	511.07	3.59	71.78	2.12	.00
	Neither More Aff Nor Dis	872	184223	29260.57	24.98	3.77	485.07	6.25	80.13	2.48	.00
	More Disadvantaged	1146	234255	29972.77	31.77	3.46	452.65	4.99	77.36	2.03	.00
Japan	More Affluent	1925	477868	44935.55	47.52	4.34	602.46	2.56	70.68	1.74	.00
	Neither More Aff Nor Dis	1816	452257	44020.83	44.97	4.34	584.75	2.38	69.01	1.42	.00
	More Disadvantaged	294	75550	23930.46	7.51	2.38	582.98	3.54	66.69	2.90	.00
Latvia	More Affluent	2311	8888	805.20	53.51	4.26	552.16	3.39	65.59	1.64	.00
	Neither More Aff Nor Dis	1255	6893	703.90	41.50	4.16	538.38	5.39	70.65	3.48	.00
	More Disadvantaged	107	829	276.11	4.99	1.65	538.58	12.59	65.48	4.58	.00

As shown in the three lines of results for Latvia, 53.51% (standard error of 4.26) of fourth grade students attended "more affluent" schools and their average achievement was 552.16 (standard error of 3.39); 41.50% (standard error of 4.16) attended "neither more affluent not more disadvantaged" and their average achievement was 538.38 (standard error of 5.39); and 4.99%(standard error of 1.65) attended "more disadvantaged" schools and their average achievement was 538.58 (standard error of 12.59).

Additional Analyses Conducted with the IEA IDB Analzyer

Computing Correlations

In addition to the analyses described above, the IEA IDB Analyzer is able to compute **Correlations** among a set of variables. Thus it can compute correlations between context variables (such as the context questionnaire scales *Students Like Mathematics* and *Home Resources for Learning*), between achievement scores (such as mathematics and science),

and between a combination of both (such as students' age and their mathematics achievement). While these types of analyses are not demonstrated here, the steps for conducting them are similar to those described previously: select the grouping variables, the analysis variables, the achievement scores (if necessary), and confirm the weight variable. The output will display, for each group defined by the grouping variables, the correlation coefficients for each possible pair of variables.

Calculating Percentiles of a Distribution

The **Percentiles** statistic type is an additional tool provided by the IEA IDB Analyzer for analyzing the TIMSS 2019 data. This procedure will compute the percentiles of a distribution within any specified subgroups, along with appropriate standard errors. The distribution can be either a non-PV based analysis variable—such as a context questionnaire scale—or a specified set of plausible values.

Performing Logistic Regression

The IEA IDB Analyzer can perform a **Logistic Regression**, with or without plausible values. Logistic regression is used to predict a dichotomous outcome based on one or more predictor variables. Users can specify grouping variables, independent variables—with or without interactions—that can be categorical, continuous, or plausible values, and a dependent variable. Users will find useful information on performing logistic regression in the IEA IDB Analyzer's Help manual.

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CHAPTER 2

Contents and Structure of the TIMSS 2019 International Database

Overview

This chapter describes the contents of the TIMSS 2019 International Database with a special emphasis on the actual data files used in Chapter 1 of this User Guide to analyze the TIMSS 2019 assessment results with the IEA IDB Analyzer (IEA, 2021). The various data files and related materials included in the database are described, in accordance with the structure summarized in Exhibit 2.1. Descriptions of data files include the conventions for naming the various file types and variables as well as codes for missing values.

Exhibit 2.1: Contents of the TIMSS 2019 International Database

Contents	Description
User Guide	User Guide and supplements
Achievement Items	TIMSS 2019 Item information, IRT item parameters, and percent correct statistics
International Database	
SPSS Data	TIMSS 2019 student, home, teacher, and school data files in SPSS data format
SAS Data	TIMSS 2019 student, home, teacher, and school data files in SAS data or export format
Curriculum Data	TIMSS 2019 curriculum questionnaire data Excel files
Codebooks	Codebook files describing all variables in the TIMSS 2019 International Database
Data Almanacs	Summary statistics for all TIMSS 2019 achievement items and context variables
TCMA	National item selection for the Test-Curriculum Matching Analysis
Special Programs	SPSS and SAS programs to score achievement data and process SAS export files

The TIMSS 2019 International Database contains student achievement data and student, home, teacher, and school context data collected in the 64 countries and 8 benchmarking participants that took part in TIMSS 2019, including the TIMSS 2019 Bridge and the fourth grade less difficult mathematics assessment. Exhibit 2.2 lists all of the countries and benchmarking participants included in the TIMSS 2019 International Database, along with the identification codes used in the data files comprising the database.

Exhibit 2.2: Countries in the TIMSS 2019 International Database

Countries	Identification Codes		Grade 4				Grade 8		
	Alpha	Numeric	pT	LD	eT	Br	pT	eT	Br
Albania	ALB	8		●					
Armenia	ARM	51	●						
Australia	AUS	36	●				●		
Austria	AUT	40			●	●			
Azerbaijan	AZE	31	●						
Bahrain	BHR	48	●				●		
Belgium (Flemish)	BFL	956	●						
Bosnia and Herzegovina	BIH	70		●					
Bulgaria	BGR	100	●						
Canada	CAN	124			●	●			
Chile	CHL	152			●	●		●	●
Chinese Taipei	TWN	158			●	●		●	●
Croatia	HRV	191			●	●			
Cyprus	CYP	196	●				●		
Czech Republic	CZE	203			●	●			
Denmark	DNK	208			●	●			
Egypt	EGY	818					●		
England	ENG	926			●	●		●	●
Finland	FIN	246			●	●		●	
France	FRA	250			●	●		●	
Georgia	GEO	268			●	●		●	●
Germany	DEU	276			●	●			
Hong Kong SAR	HKG	344			●	●		●	●
Hungary	HUN	348			●	●		●	●
Iran, Islamic Rep. of	IRN	364	●				●		
Ireland	IRL	372	●				●		
Israel	ISR	376						●	●
Italy	ITA	380			●	●		●	●
Japan	JPN	392	●				●		
Jordan	JOR	400					●		
Kazakhstan	KAZ	398	●				●		
Korea, Rep. of	KOR	410			●	●		●	●
Kosovo	XKX	411		●					
Kuwait	KWT	414		●			●		
Latvia	LVA	428	●						
Lebanon	LBN	422					●		
Lithuania	LTU	440			●	●		●	●
Malaysia	MYS	458						●	●
Malta	MLT	470			●				
Montenegro	MNE	499		●					

pT paperTIMSS ● **LD** Less Difficult Mathematics ● **eT** eTIMSS ● **Br** Bridge

Exhibit 2.2: Countries in the TIMSS 2019 International Database (continued)

Countries	Identification Codes		Grade 4				Grade 8		
	Alpha	Numeric	pT	LD	eT	Br	pT	eT	Br
Morocco	MAR	504		●			●		
Netherlands	NLD	528			●	●			
New Zealand	NZL	554	●				●		
North Macedonia	MKD	807		●					
Northern Ireland	NIR	928	●						
Norway	NOR	578			●	●		●	●
Oman	OMN	512	●				●		
Pakistan	PAK	586		●					
Philippines	PHL	608		●					
Poland	POL	616	●						
Portugal	PRT	620			●	●		●	
Qatar	QAT	634			●	●		●	●
Romania	ROM	642					●		
Russian Federation	RUS	643			●	●		●	●
Saudi Arabia	SAU	682		●			●		
Serbia	SRB	688	●						
Singapore	SGP	702			●	●		●	●
Slovak Republic	SVK	703			●	●			
South Africa	ZAF	710		●			●		
Spain	ESP	724			●	●			
Sweden	SWE	752			●	●		●	●
Turkey	TUR	792			●			●	●
United Arab Emirates	ARE	784			●	●		●	●
United States	USA	840			●	●		●	●
Benchmarking Participants									
Ontario, Canada	COT	9132			●			●	
Quebec, Canada	CQU	9133			●			●	
Moscow City, Russian Fed.	RMO	643001			●			●	
Madrid, Spain	EMA	724005			●				
Gauteng, RSA	ZGT	710003					●		
Western Cape, RSA	ZWC	710004					●		
Abu Dhabi, UAE	AAD	7842			●			●	
Dubai, UAE	ADU	7841			●			●	

pT paperTIMSS ● **LD** Less Difficult Mathematics ● **eT** eTIMSS ● **Br** Bridge

All downloads from the TIMSS 2019 International Database include equivalent files or information for the TIMSS 2019 Bridge. The TIMSS 2019 Bridge data were collected in countries participating in eTIMSS that also participated in TIMSS 2015. Over half the

participating countries in 2019 chose to administer eTIMSS—the computer-based version of TIMSS—with the other half retaining the traditional paper-based administration—referred to as paperTIMSS. To form a link between eTIMSS and paperTIMSS and maintain comparability of trend measurements overtime, eTIMSS countries that also participated in TIMSS 2015 were required to administer a set of paper booklets ("bridge booklets") consisting entirely of paperTIMSS trend items to randomly selected, equivalent groups of students. TIMSS 2019 Bridge data allowed for directly comparing and linking the psychometric properties of the items available in both modes of administration.

All downloads from the TIMSS 2019 International Database pertaining to fourth grade assessment also include equivalent files or information for the less difficult mathematics assessment. Countries participating in TIMSS 2019 at the fourth grade had the option to administer a less difficult version of the mathematics assessment. Results for the two versions of the assessment were linked and reported on the same TIMSS mathematics achievement scale. Countries administering the less difficult mathematics assessment also administered the regular fourth grade science assessment. Most aspects of the less difficult mathematics assessment are identical to the TIMSS 2019 fourth grade assessment in terms of database structure and content. All references to TIMSS 2019 in general, or to the TIMSS 2019 fourth grade assessment in particular, also apply to the TIMSS 2019 less difficult mathematics assessment unless explicitly stated otherwise.

Supplements to the TIMSS 2019 User Guide

The User Guide is accompanied by the following supplements:

- **Supplement 1: International Versions of the TIMSS 2019 Context Questionnaires**—Supplement 1 includes the international version of all context questionnaires administered in TIMSS 2019, including the Curriculum Questionnaires. This supplement serves as a reference of all items included in the context questionnaires and the associated names under which the responses are recorded in the International Database.
- **Supplement 2: National Adaptations to the TIMSS 2019 Context Questionnaires**—Supplement 2 provides details on national adaptations that were made to the national versions of the TIMSS 2019 Context Questionnaires. Users should refer to this supplement for any special national adaptations to context variables that could potentially affect the interpretation of analysis results.

- **Supplement 3: Variables Derived from the TIMSS 2019 Student, Home, Teacher, and School Context Data**—Supplement 3 describes how the derived context variables were computed to produce exhibits in *TIMSS 2019 International Results in Mathematics and Science* (Mullis, Martin, Foy, Kelly, & Fishbein, 2020).

Restricted Use Version of the TIMSS 2019 International Database

There are two versions of the TIMSS 2019 International Database. The public use version is available for immediate access from the TIMSS 2019 International Database webpage and the IEA Study Data Repository. A number of variables have been removed from the public use version in order to minimize the risk of disclosing confidential information. Exhibit 2.3 lists the variables removed from the public use version of the TIMSS 2019 International Database that are available in the restricted use version. More details for all of these variables are available in the appropriate codebook files, described later in this chapter. Users who require any of the removed variables to conduct their analyses should contact the IEA through its Study Data Repository to obtain permission and access to the restricted use version of the TIMSS 2019 International Database. Note that variables reporting students' age remains available in the public use version of the International Database.

Exhibit 2.3: Variables Available in the Restricted Use Version of the TIMSS 2019 International Database

Variable	Description
ITBIRTHY / ITBIRTHM	Students' year and month of birth from the tracking forms
ITDATE	TIMSS 2019 testing date from the tracking forms
ITMODE_x	Mode of administration for the TIMSS assessments and context questionnaires
ITDEV	Type of digital device used for the eTIMSS assessment
ASBG02A / ASBG02B BSBG02A / BSBG02B	Students' year and month of birth from the student questionnaire
ACBG01 / BCBG01	Total school enrollment from the school questionnaire
ACBG02 / BCBG02	School enrollment in the target grade from the school questionnaire

Achievement Items Documentation

A number of documents related to the TIMSS 2019 achievement items are available for download along with the TIMSS 2019 International Database. They include summary information on the TIMSS 2019 items, the IRT item parameters estimated from the

TIMSS 2019 item calibrations and their associated linear transformation constants, and percent correct statistics for the TIMSS 2019 achievement items.

Item Information

Item information files include characteristics of each achievement item in the TIMSS 2019 assessments. The TIMSS 2019 International Database provides item information in ZIP files for the fourth grade and eighth grade, respectively, with separate Excel files for paperTIMSS ("T19"), eTIMSS ("eT19"), Bridge ("T19Br"), and, for the fourth grade, less difficult mathematics ("T19_G4LD"). These files include the following information for each item in the TIMSS 2019 assessments:

- **Item ID**, the item's unique identifier
- The item's **Block** and **Block Seq**, its sequential location within the block
- A **Subject** column showing if the item was a mathematics ("M") item or science ("S") item
- An indicator for the assessment **Cycle** when the item was first presented (see later section: *Item Variable Naming Convention*)
- The item's **Secure Status**, indicating whether the item was secured after the 2019 assessment to administer again in TIMSS 2023
- **Scaling Status**, indicating whether the item was included in the IRT scaling
- The **Content Domain**, **Topic Area**, **Topic**, and **Cognitive Domain** assessed by the item, according to the *TIMSS 2019 Assessment Frameworks* (Mullis & Martin, 2017)
- The item's **Maximum Points** value
- The **Item Type**, either multiple-choice or constructed responses
- The number of **Options** for multiple-choice items
- The correct response **Key** for multiple-choice items
- A **Label** for the item.

IRT Item Parameters

The International Database includes Excel files with the IRT item parameters estimated for all TIMSS 2019 and TIMSS 2015 items from the concurrent item calibrations and the subsequent calibration for eTIMSS 2019 items through the link with the TIMSS 2019 Bridge data. Users will also find IRT item parameters estimated from concurrent item calibration models combining TIMSS Numeracy 2015 data and TIMSS 2019 less difficult mathematics

data. The TIMSS 2019 International Database webpage provides ZIP files for each grade including separate Excel files for paperTIMSS including Bridge ("T19"), eTIMSS ("eT19"), and less difficult mathematics assessments ("T19_G4LD"). These item parameters are presented in Chapter 12 of *Methods and Procedures: TIMSS 2019 Technical Report* (Foy, Fishbein, von Davier, & Yin, 2020).

Scale Transform Constants

The ZIP files for IRT Item Parameters also include Excel files with the linear transformation constants that were used to set the TIMSS 2019 achievement scores on the TIMSS trend scales. The same transformation constants were used for paperTIMSS (including Bridge) and eTIMSS, reported the Excel file beginning with "T19." For the fourth grade, an additional file beginning with "T19_LD" includes the linear transformation constants used for the TIMSS 2019 less difficult mathematics achievement scores.

Item Percent Correct Statistics

The International Database includes percent correct statistics for all TIMSS 2019 items at both grades, including items from the TIMSS 2019 Bridge data. These files are available in Excel and PDF format within ZIP files for the fourth grade and eighth grade, respectively. The ZIP file for each grade contains separate Excel files by subject for paperTIMSS ("T19"), eTIMSS ("eT19"), Bridge ("T19Br"), and fourth grade less difficult ("T19_LD"). PDF files for each subject include separate sections for each assessment.

TIMSS 2019 Data Files

The TIMSS 2019 International Database includes the actual data from all instruments administered to the students and their parents, teachers, and school principals. This includes the student responses to the achievement items and the responses to the student, home, teacher, and school context questionnaires. These data files also include the achievement scores estimated for participating students, as well as context variables derived for reporting in *TIMSS 2019 International Results in Mathematics and Science*. National Research Coordinators' responses to the curriculum questionnaires also are part of the International Database and are described later in this chapter.

The next few sections describe the format and contents of the TIMSS 2019 data files, including the TIMSS 2019 Bridge data. With the exception of the curriculum data files, the TIMSS 2019 data files are provided in SPSS (IBM Corporation, 2016) format (*.SAV) and SAS (SAS Institute, 2016) data (*.SAS7BDAT) and export (.EXP) formats. Data files are

provided for each country that participated in TIMSS 2019 and the TIMSS 2019 Bridge. The TIMSS 2019 Bridge data files are included in all TIMSS 2019 data downloads from the TIMSS 2019 International Database webpage.

The file names given to the various data file types in TIMSS 2019—including eTIMSS, paperTIMSS, and less difficult mathematics—are shown in Exhibit 2.4. For example, ASGKORM7.SAV is an SPSS file that contains Korea's TIMSS 2019 fourth grade student context questionnaire data. The TIMSS 2019 Bridge data files are described in Exhibit 2.5. 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, beginning with the student achievement data files.

Exhibit 2.4: TIMSS 2019 Data File Names

Assessment	File Name	Description
Grade 4	ACG●●●M7	Grade 4 school context data files
	ASA●●●M7	Grade 4 student achievement data files
	ASG●●●M7	Grade 4 student context data files
	ASH●●●M7	Grade 4 home context data files
	ASR●●●M7	Grade 4 within-country scoring reliability data files
	AST●●●M7	Grade 4 student-teacher linkage files
	ATG●●●M7	Grade 4 teacher context data files
Grade 8	BCG●●●M7	Grade 8 school context data files
	BSA●●●M7	Grade 8 student achievement data files
	BSG●●●M7	Grade 8 student context data files
	BSR●●●M7	Grade 8 within-country scoring reliability data files
	BST●●●M7	Grade 8 student-teacher linkage files
	BTM●●●M7	Grade 8 mathematics teacher context data files
	BTS●●●M7	Grade 8 science teacher context data files

●●● = 3-character country abbreviation based on the ISO 3166 alpha coding scheme (see Exhibit 2.2)

Exhibit 2.5: TIMSS 2019 Bridge Data File Names

Assessment	File Name	Description
Grade 4	ACG●●●B7	Grade 4 school context data files
	ASA●●●B7	Grade 4 student achievement data files
	ASG●●●B7	Grade 4 student context data files
	ASH●●●B7	Grade 4 home context data files
	ASR●●●B7	Grade 4 within-country scoring reliability data files
	AST●●●B7	Grade 4 student-teacher linkage files
	ATG●●●B7	Grade 4 teacher context data files
Grade 8	BCG●●●B7	Grade 8 school context data files
	BSA●●●B7	Grade 8 student achievement data files
	BSG●●●B7	Grade 8 student context data files
	BSR●●●B7	Grade 8 within-country scoring reliability data files
	BST●●●B7	Grade 8 student-teacher linkage files
	BTM●●●B7	Grade 8 mathematics teacher context data files
	BTS●●●B7	Grade 8 science teacher context data files

●●● = 3-character country abbreviation based on the ISO 3166 alpha coding scheme (see Exhibit 2.2)

Student Achievement Data Files (ASA/BSA)

The TIMSS 2019 student achievement data files contain the student responses to the individual achievement items in the TIMSS 2019 assessments. The student achievement data files are best suited for performing item-level analyses. Achievement scores (plausible values) for all of the TIMSS 2019 achievement scales and sampling and weighting variables are available in the student achievement data files, as well as in the student context data files and student-teacher linkage data files (described in a later section).

As TIMSS 2019 began the transition from paper-based assessment to computer-based assessment, the TIMSS 2019 student achievement data files include separate sets of items by mode of administration. As such, all student achievement data files include variables for all paperTIMSS and eTIMSS mathematics and science items, and the less difficult mathematics items in the fourth grade files. However, paperTIMSS countries have responses for the paperTIMSS items only, eTIMSS countries for eTIMSS items only. Similarly, only

countries that participated in less difficult mathematics at the fourth grade have responses to the less difficult items.

The student achievement data files also contain process data variables related to the actions taken by the student when responding to computer-based achievement items, and as such are available only for countries that participated in eTIMSS. Process data is limited to the total time spent by the student on each item screen and the frequency of distinct visits to each item screen.

As described in *TIMSS 2019 Assessment Frameworks* (Mullis & Martin, 2017), students who participated in TIMSS 2019 were administered one of 14 assessment booklets (known as "item block combinations" in eTIMSS), each with a series of mathematics and science items.[1] Students who participated in the TIMSS 2019 less difficult mathematics assessment also were administered one of 14 assessment booklets, consisting of less difficult mathematics items (including some overlapping with regular mathematics) and regular science items. For the TIMSS 2019 Bridge, there were eight booklets administered at each grade. In all the booklets administered as part of TIMSS 2019, some of the items were multiple-choice and some were constructed response. The student achievement data files contain the actual responses to the multiple-choice questions (e.g., where 1 corresponds to the first option, 2 to the second option, and so on), and the score codes assigned to the constructed response items based on the TIMSS 2019 scoring guides.[2]

Item Variable Naming Convention

The achievement item variable names are based on a 9-character alphanumeric code, which observes the following rules:

- The first character is either "M" for mathematics items, or "S" for science items.
- The second character indicates the assessment mode or type. The letter "P" indicates paperTIMSS, "E" indicates eTIMSS, and "N" indicates less difficult mathematics.
- The third character indicates the assessment cycle when the item was first presented in TIMSS. The code "1" was used for items introduced in TIMSS 1995. The items in the TIMSS 2019 assessment have "5" for items introduced in 2011, "6" for items

[1] The eTIMSS 2019 assessment also included extended mathematics and science assessment tasks called Problem Solving and Inquiry Tasks, or PSIs. These items are not included in the TIMSS 2019 International Database at this time, but will be added at a later date.

[2] The TIMSS 2019 scoring guides are described in *TIMSS 2019 Item Writing Guidelines* (Mullis, Martin, Cotter, & Centurino, 2017).

introduced in 2015, or “7” for new items in 2019. The less difficult mathematics items have the code "1" for items introduced in 2015 or code “2” for items developed in 2019.

- The fourth character is either “1” for fourth grade items or “2” for eighth grade items.
- The fifth through seventh characters represent a unique three-digit number used to identify the items.
- The eighth character indicates the item part, and appears only when required. It is generally a letter from “A” to “H,” depending on how many parts there are to a particular item. The letter “Z” is used to represent derived items from the TIMSS 2011 assessment (derived items are described later in this chapter).
- A ninth character is present when an item part itself consists of further parts, usually used to define a derived item.

As an example of an item variable name, MP71151A is the first part (part A) of a fourth grade mathematics paperTIMSS item introduced in 2019 and whose unique identification number is 151.

Item Response Codes

A series of conventions were adopted to code the item responses included in the TIMSS 2019 student achievement data files. The value assigned to each item response depends on the item format.

For multiple-choice items, numerical values 1, 2, 3, 4, etc., are used to correspond to the response options A, B, C, D, etc., respectively. For these items, the correct response key is included in the item information files (described earlier) and as part of the variable label in the achievement codebook files (described in a later section). SPSS and SAS programs are included as part of the TIMSS 2019 International Database to derive correctness scores (or score points) for these items based on their item response codes (see Chapter 3).

Each constructed response item has its own scoring guide that relies on a two-digit coding scheme to provide diagnostic information. The first digit designates the score point value of the response: “2” for a response worth 2 score points, “1” for a response worth 1 score point, and “7” for an incorrect response worth zero points. The second digit, combined with the first, represents 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” is used for pre-defined international codes at each correctness level, while a second digit of “9” corresponded to “other” types of responses which fell within the

appropriate correctness level but which did not fit any of the pre-defined international codes. A special two-digit code, 99, is used for responses left completely blank. Chapter 3 describes SPSS and SAS programs that convert the two-digit response codes into correctness scores.

Derived Items

For some items, students were asked to provide more than one answer or a multiple-part answer, each one being scored appropriately. The pattern of responses across these item parts determined the score on the item as a whole. These multi-part items can be worth either 1 or 2 score points, according to their scoring guide. A list of all derived items in the TIMSS 2019 assessments and the rules for awarding item response codes is provided in Appendix 10F of *Methods and Procedures: TIMSS 2019 Technical Report* (Fishbein, Foy, & Tyack, 2020).

The schemes for naming and assigning response codes for derived items follow the same conventions for constructed response items described in the previous *Item Variable Naming Convention* and *Item Response Codes* sections. The item variables for derived items first presented in TIMSS 2011 may include a "Z" at the end of the name. For 2-point derived items, code 20 was used to award 2 points, code 10 or 11 was used to award 1 score point, and code 70 or 79 for zero points. One-point derived items were awarded either code 10 for 1 score point, or code 79 for zero points. The total score for the item is contained in a derived variable, identified by the word "DERIVED" in the item label.

For example, derived item variable SE71017 contains the combined score for its five parts labeled SE71017A through SE71017E. This derived item response was assigned a code 10 (1 score point) if all five parts were answered correctly and code 79 (0 points) otherwise.

Codes for Missing Values

A subset of values was reserved for specific item response codes related to different categories of missing data. It is recommended that users read this section with particular care, as the way in which these missing codes are used may have implications for subsequent analyses.

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:

- Item not assigned to the student—All students participating in TIMSS 2019 received one of 14 available test booklets or item block combinations, and students participating in the Bridge received one of 8 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, either part 1 or part 2 of an assessment booklet or item block combination, all items 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 student, the corresponding variable was coded as "Not Administered."
- Item mistranslated or deleted—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."

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

"Omitted" response codes were used for items that a student should have answered but did not. An omitted response code was given when an item was left blank or when two or more response options were checked for a multiple-choice item. Omitted responses generally are treated as incorrect.

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 no other items completed in the remainder of that part of the booklet. For most purposes, TIMSS 2019 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 Chapter 12 of *Methods and Procedures: TIMSS 2019 Technical Report*; Foy et al., 2020).

Process Variable Naming Convention

There are two sets of process data variables associated with the eTIMSS items present in the TIMSS 2019 student achievement data files. The first set consists of total time spent on

each item screen in seconds and the second set the frequency of distinct visits per item screen. The variable names include a unique alphanumeric ID for each screen, followed by the suffix "_F" for the frequency of screen visits and "_S" for the time spent. The screen ID indicates the specific screen, or item, from which a student's response(s) were recorded and follows the same naming convention as the variable for the item shown on the screen. Typically, a screen displays a single item and thus will have the same ID as the item shown.

However, there are occasional screens that display more than one item sharing a common stem but requiring separate responses. In these instances, the variable names consist of the first 7 common characters of the corresponding item names. For example, ME72083A and ME72083B are two eighth grade mathematics items with separate responses but share the same stem and are shown on the same screen. The process data variable names associated with that screen are ME72083_F for the frequency of visits and ME72083_S for the time spent on that specific screen.

TIMSS Achievement Scores

Achievement scales were produced for mathematics and science and their content and cognitive domains at both grades, as shown in Exhibit 2.6. A total of 14 achievement scales were produced at the fourth grade and 16 at the eighth grade. It is important to note that the TIMSS 2019 Bridge data files include only the overall mathematics and overall science achievement scores. A detailed description of the TIMSS 2019 scaling approach and how these achievement scales were created is available in Chapter 12 of *Methods and Procedures: TIMSS 2019 Technical Report* (Foy et al., 2020). For each achievement scale, the TIMSS 2019 International 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 2019 International Database, and should be used as the outcome measure in any study of student achievement. It is important to note that these plausible values are not suitable measures of individual student achievement, as explained in Chapter 11 of *Methods and Procedures: TIMSS 2019 Technical Report* (von Davier, 2020). Plausible values can be analyzed readily using the IEA IDB Analyzer, as described in Chapter 1 of this User Guide.

Exhibit 2.6: TIMSS 2019 Achievement Scales

Assessment	Achievement Scales				
Grade 4	Overall	MAT	Mathematics	SCI	Science
	Content Domains	NUM	Number	LIF	Life Science
		GEO	Measurement and Geometry	PHY	Physical Science
		DAT	Data Display	EAR	Earth Science
	Cognitive Domains	KNO	Knowing	KNO	Knowing
		APP	Applying	APP	Applying
		REA	Reasoning	REA	Reasoning
Grade 8	Overall	MAT	Mathematics	SCI	Science
	Content Domains	NUM	Number	BIO	Biology
		ALG	Algebra	CHE	Chemistry
		GEO	Geometry	PHY	Physics
		DAT	Data and Probability	EAR	Earth Science
	Cognitive Domains	KNO	Knowing	KNO	Knowing
		APP	Applying	APP	Applying
		REA	Reasoning	REA	Reasoning

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

- The first character 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 student score variable.
- The third character is either “M” for a mathematics score, or “S” for a science score, whether it is an overall score, a content domain score, or a cognitive domain score.
- The fourth through sixth characters are a three-character code describing the achievement scale, as shown in Exhibit 2.6.
- The seventh and eighth characters are a two-digit number indicating the plausible value—01, 02, 03, 04, or 05.

For example, ASMAPP01 is the first plausible value on the fourth grade mathematics applying cognitive domain achievement scale.

TIMSS International Benchmarks of Achievement

To help users of the TIMSS 2019 International Database, as well as readers of results reports, 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 of Achievement. As shown in Exhibit 2.7, the TIMSS International Benchmark scores are 625, 550, 475, and 400, which correspond to the Advanced International Benchmark, the High International Benchmark, the Intermediate International Benchmark, and the Low International Benchmark, respectively. TIMSS 2019 used a technique known as scale anchoring to summarize and describe student achievement at these four points on the scale (see Chapter 15 of *Methods and Procedures: TIMSS 2019 Technical Report* (Mullis & Fishbein, 2020). The *TIMSS 2019 International Results in Mathematics and Science* report presents the results of this scale anchoring, and reports the percentage of students in each country reaching each of the TIMSS International Benchmarks.

Exhibit 2.7: TIMSS 2019 International Benchmarks of Mathematics and Science Achievement

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

The TIMSS 2019 International Database contains a set of variables indicating which International Benchmark the students have reached. There are five benchmark variables for each plausible value of the overall mathematics and overall 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 defined for all the benchmark variables are described in Exhibit 2.8.

Exhibit 2.8: TIMSS 2019 International Benchmark Variable Codes

Code	Description
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

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

The TIMSS 2019 within-country scoring reliability data files contain data that can be used to investigate the reliability of the TIMSS constructed response item scoring for human-scored items. The scoring reliability data files contain one record for each student whose responses to constructed responses items, in whole or in part, were double scored during the within-country scoring reliability exercise (see Chapter 10 of *Methods and Procedures: TIMSS 2019 Technical Report*; Fishbein et al., 2020). For each constructed response item requiring human scoring, the following three variables are included in the scoring reliability data files:

- **Original Score:** the two-digit score assigned by the first scorer and also present in the student achievement files
- **Second Score:** the two-digit score assigned by the second scorer and present only in the scoring reliability files
- **Score Agreement:** a dichotomous variable indicating 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 International Database and presented in *TIMSS 2019 International Results in Mathematics and Science*.

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 for the achievement item variables discussed earlier. The Second Score and Score Agreement variables have one more character added to the Original variable as follows:

- The **Original Score** variable follows the item variable naming convention described earlier. The second character has the letter "P" for a paperTIMSS item, the letter "E" for an eTIMSS item, or the letter "N" for a less difficult mathematics item.
- The **Second Score** variable has the letter "R" added to the Original Score variable after the second character (e.g., MPR71201).
- The **Score Agreement** variable has the letter "I" added to the Original Score variable after the second character (e.g., MPI71201).

Scoring Reliability Codes

The values contained in both the Original Score and Second Score variables are the two-digit diagnostic codes specified in the TIMSS 2019 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 2.9.

Exhibit 2.9: TIMSS 2019 Score Agreement Variable Codes

Code	Description
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)

Context Data Files

This section describes the TIMSS 2019 context data files and the conventions for naming the various files and variables and coding the data. There are six types of TIMSS 2019 context data files: the first four context data files correspond to the four types of context questionnaires administered in TIMSS 2019 (student, home, teacher, and school); the fifth data file serves to link the student and teacher context data; and the sixth data file corresponds to the TIMSS 2019 Curriculum Questionnaire administered to the National Research Coordinators of each participating country. The Curriculum Data are provided separately from the other data files in the TIMSS 2019 International Database. Comprising mostly descript, narrative information about the national education systems, these data are provided in Excel format (see later section).

The four context data files for student, home, teacher, and school questionnaires contain the responses to the questions asked in their respective context questionnaires, plus some

additional derived variables used for reporting (see Supplement 3 to this User Guide). The home questionnaire—the Early Learning Survey—is administered only at the fourth grade.

Student Context Data Files (ASG/BSG)

All students who participated in TIMSS 2019 were administered a context questionnaire with questions related to their home context, school experiences, and attitudes towards mathematics and science. Regardless of whether they were participating in paperTIMSS or eTIMSS, and including the Bridge, students were administered a questionnaire at the end of their testing session. Students participating in eTIMSS also were administered a small set of questions after the testing session to share their experience with digital devices. The student context data files contain students' responses to all of these questions. They also contain students' mathematics and science achievement scores (plausible values) to facilitate analyses of relationships between student characteristics and achievement.

Two versions of the student questionnaire were administered at the eighth grade. One version is for educational systems where science is taught as an integrated subject (General/Integrated Science version). The other version is for educational systems where the sciences—biology, physics, chemistry, and earth science—are taught as separate subjects (Separate Science version). For eighth grade students who were administered the General/Integrated 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/Integrated Science version were coded as "Not Administered." At the fourth grade, there was a single version of the student questionnaire, tailored for general science.

The student context 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 *TIMSS 2019 International Results in Mathematics and Science*. These variables are described later in this chapter (see later section on *Structure and Design Variables*).

Home Context Data Files (ASH)

Countries participating in TIMSS 2019 at the fourth grade, including the TIMSS 2019 less difficult mathematics assessment and the TIMSS 2019 Bridge, administered a home questionnaire (also called the Early Learning Survey), which was completed by the students' parent or guardian. It asks questions about preparations for primary schooling, including attendance in preschool and literacy and numeracy activities in the home before the child

began school, such as reading books, writing letters or words, and adding and subtracting. Parents answered questions about home resources in addition to information about their highest level of education and their employment situations. Analyzing data from the home questionnaire requires that the home context data files be merged with the student context data files using the country and student identification variables (see later section on *Structure and Design Variables*). Details of the merging procedure with the IEA IDB Analyzer are described in Chapter 1 of this User Guide.

School Context Data Files (ACG/BCG)

The school context data files contain principals' responses to the questions in the TIMSS 2019 School Context 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 context data files must be merged with the student context data files using the country and school identification variables (see later section on *Structure and Design Variables*). Details of the merging procedure with the IEA IDB Analyzer are described in Chapter 1 of this User Guide.

Teacher Context Data Files (ATG/BTM/BTS)

The mathematics and science teachers of the students that were sampled in TIMSS 2019 were administered at least one questionnaire with questions pertaining to their teaching context and attitudes 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 context 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 multiple questionnaires, but respond only once to general context questions and multiple, separate class- or subject-specific questions for each class they taught. In some cases, although the teacher responded to more than one questionnaire, responses to only one were obtained. In these cases, there were as many records entered in the teacher context data file as sampled classes were taught by the teacher, and the context 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. As described in Exhibits 2.4 and 2.5, the responses of teachers to the mathematics questionnaire are found in the BTM

files and the responses of teachers to the science questionnaire are found in the BTS files. 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 context data files at both grades, each teacher has a unique identification number (IDTEACH) and a link number (IDLINK) that is specific to the sampled 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.[3] Thus, students linked to teachers identified by the same IDTEACH but different IDLINK are taught by the same teacher but in different classes. The teacher context data files cannot be merged directly with the student data files and they do not contain sampling and weighting information, nor achievement scores. The student-teacher linkage data files, described next, serve that purpose.

It is important to note that the teachers in the teacher context 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. Chapter 1 of this User Guide describes student-level analyses combining the teacher data and the student-teacher linkage data files with the IEA IDB Analyzer software.

Student-Teacher Linkage Data Files (AST/BST)

The TIMSS 2019 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, the file has three entries corresponding to that student. The sole purpose of the student-teacher linkage data files is to link teacher-level data with student-level data in order to perform appropriate student-level analyses where teacher characteristics are considered as attributes of the students. The student-teacher linkage data files also include sampling and weighting information and achievement scores to facilitate the analyses of teacher data (see later section on *Structure and Design Variables*).

[3] The IDTEALIN variable is a concatenation of IDTEACH and IDLINK and is available in the TIMSS 2019 International Database.

Curriculum Data Files

The TIMSS 2019 curriculum data files contain the responses provided by the TIMSS National Research Coordinators of the participating countries to the TIMSS 2019 Curriculum Questionnaires. There are two separate curriculum data files for the fourth and eighth grades. These files are available to download as Excel files from the TIMSS 2019 International Database website.

Context Variable Naming Convention

The context variable naming convention for the variables in the student, home, teacher, and school context data files uses a 7- or 8-character string. The following rules are applied in naming the context 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" identifies data from the school principals, the letter "T" for teacher data, and the letter "S" for student and parent data.
- The third character is used to indicate the source of the data. The letter "B" is used for all context variables reporting responses to the context questionnaires. The letter "D" is used for variables derived from responses in the context questionnaires. In addition, the letter "B" is used for the Rasch scores to context questionnaire scales derived from questionnaire data, and the letter "D" is used for the index variables constructed from these context questionnaire scale Rasch scores.[4]
- The fourth character is used to indicate the subject or topic to which a context question refers. The following letters are used:

  G—General questions (not subject specific)

  H—Home questionnaire questions

  M—Questions related to mathematics

  S—Questions related to science

  B—Questions related to biology

  C—Questions related to chemistry

  E—Questions related to earth science

[4] The context questionnaire scales are described in Chapter 16 of *Methods and Procedures: TIMSS 2019 Technical Report* (Yin & Fishbein, 2020).

P—Questions related to physics or physical science.

- The fifth through eighth characters of all context variables represent the sequential numbering of the questions as presented in their respective questionnaires.

In TIMSS 2019, students who participated in the eTIMSS assessment also answered supplemental questions on their experiences with digital devices at the end of the assessment. These questions also use the letter "E" as the fourth character of their variable names. However, the item sequence numbers for these variables are in the range 01 to 04 and do not clash with the variable names of earth science questions. Questions related to biology, chemistry, earth science, and physics apply only to the eighth grade Student Questionnaire—Separate Science Version.

The curriculum data files follow their own variable naming convention whereby the first three characters of a variable name are as follows:

- GEN—General questions (not subject specific)
- MA4—Questions related to fourth grade mathematics
- SC4—Questions related to fourth grade science
- MA8—Questions related to eighth grade mathematics
- SC8—Questions related to eighth grade science.

The remaining characters in the curriculum data variable naming convention refer to the question location, as shown in Supplement 1 to this User Guide.

Context Variable Location Convention

The context variable naming convention indicates explicitly the ordering of questions in the context questionnaires. Each question was assigned a unique location code. This unique code includes the sequence number of the question within the questionnaire—the same sequence number found in the question's variable name—appended to a three-character string corresponding to the questionnaire source as shown in Exhibit 2.10. For example, if the location variable is given as SQG-08A, it refers to part A of general question 8 in the student context questionnaire. This convention is followed in the codebooks, the data almanacs, and in the description of the variables included in the Supplements to this User Guide.

Exhibit 2.10: TIMSS 2019 Context Variable Location Convention

Questionnaire	Location Variable Name	Description
Student Questionnaire	SQG-●●●	Both grades general questions
	SQMS-●●●	Grade 4 mathematics and science questions
	SQM-●●●	Grade 8 mathematics questions
	SQIS-●●●	Grade 8 integrated science questions
	SQSS-●●●	Grade 8 separate science questions
	SQE-●●●	Both grades digital devices experience questions
Home Questionnaire	HQ-●●●	Grade 4 parent questions
Teacher Questionnaire	TQG-●●●	Both grades general questions
	TQM-●●●	Both grades mathematics questions
	TQS-●●●	Both grades science questions
School Questionnaire	SCQ-●●●	Both grades school questions
Curriculum Questionnaire	CQG-●●●	Both grades general questions
	CQM4-●●●	Grade 4 mathematics questions
	CQS4-●●●	Grade 4 science questions
	CQM8-●●●	Grade 8 mathematics questions
	CQS8-●●●	Grade 8 science questions

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

Context Variable Response Codes

The values assigned to each of the context 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 second response option with a 2, etc. Open-ended questions such as “How many students are in this class?” are coded with the actual number given as a response.

Codes for Missing Values

A subset of values was reserved for specific item response codes related to different categories of missing data. It is recommended that users read this section with particular

care, as the way in which these missing codes are used may have implications for subsequent analyses.

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 entire questionnaire was not completed or a specific 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 was removed—Variables corresponding to questions in the student, home, teacher, or school context questionnaires that were considered not appropriate in some countries were not included in the national versions of the questionnaires. These questions were coded as "Not Administered."
- 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."
- Question 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 coded as "Not Administered."

Supplement 2 of this User Guide reports all instances of removed questions or questions modified such that the data were not internationally comparable.

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

"Omitted" response codes were used for questions that a student, parent, 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. No distinction is 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 Applicable Response Codes (SAS: .B ; SPSS: 6, 96, 996, ...)

"Not Applicable" response codes were used for the context questionnaire items for which responses were dependent upon a filter question. Generally, a "No" response to a filter question lead to any follow-up questions being coded as "Not Applicable" because there were no appropriate responses to these follow-up questions. For example, in the eighth grade Student Questionnaire—Separate Science Version, if a student answers "No" to being asked if they studied biology in school this year, all items corresponding to biology were coded as "Not Applicable."

Context Questionnaire Scales and Derived Variables

In the TIMSS 2019 Context Questionnaires, there are instances where several questions are asked about various aspects of a single construct. In these cases, responses to the individual items were combined to create a score, using Rasch scaling, which provided a more comprehensive interpretation of the construct of interest than the individual variables could on their own. These context questionnaire scales also were categorized, usually into three groups, to create an index. The context questionnaire scales and their indices are included in the TIMSS 2019 International Database context data files and described in Chapter 16 of *Methods and Procedures: TIMSS 2019 Technical Report* (Yin & Fishbein, 2020).

Additional variables were derived from responses to multiple questions to provide more pertinent information for analysis and reporting. Parents' education is an example where responses from both parents were combined into a single variable to report a single educational level. Supplement 3 to the User Guide provides a description of the derived variables included in the TIMSS 2019 International Database.

Sampling and Weighting Variables

Several sampling and weighting variables are included in the TIMSS 2019 data files—they are listed and described in Exhibit 2.11. Exhibit 2.12 indicates the location of the various sampling and weighting variables among the different types of data files in the TIMSS 2019 International Database. It is important to note that the teacher context data files, home context data files, and scoring reliability data files do not have any sampling and weighting variables.

Exhibit 2.11: TIMSS 2019 Sampling and Weighting Variables

Variable	Description
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
TOTWGT	Total student weight—sums to the national student population
SENWGT	Student senate weight—sums to 500 in each country
HOUWGT	Student house weight—sums to the national student sample size
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
SCHWGT	Total school weight—the product of WGTFAC1 and WGTADJ1
STOTWGTU	Sum of TOTWGT at the school level
TCHWGT	Overall teacher weight
MATWGT	Mathematics teacher weight
SCIWGT	Science teacher weight
WGTFAC1	School weighting factor
WGTADJ1	School weighting adjustment
WGTFAC2	Class weighting factor
WGTADJ2	Class weighting adjustment
WGTFAC3	Student weighting factor
WGTADJ3	Student weighting adjustment

As a general rule, TOTWGT—the overall student sampling weight—is the preferred sampling weight to use when analyzing student-level data. Although TOTWGT has desirable properties, it may have 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 countries should be treated equally, TIMSS provides SENWGT, a transformation of TOTWGT, that results in a weighted sample size of 500 in each country. Additionally, because TOTWGT inflates sample sizes to estimate the population size, software systems that use the actual sample size to perform significance tests may 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 and school-level files, including the home context data files. The weight variable SCHWGT is designed for use in school-level analyses where the schools are the units of analysis. The weight variable STOTWGTU is a school-level weight which is the sum of TOTWGT for all students within a school.

Exhibit 2.12: Locations of Sampling and Weighting Variables in TIMSS 2019 Data Files

Variable	Data File			
	ASA/BSA	ASG/BSG	AST/BST	ACG/BCG
JKREP	●	●	●	
JKZONE	●	●	●	
TOTWGT	●	●		
SENWGT	●	●		
HOUWGT	●	●		
JKCREP				●
JKCZONE				●
SCHWGT				●
STOTWGTU				●
TCHWGT			●	
MATWGT			●	
SCIWGT			●	
WGTFAC1	●	●		●
WGTADJ1	●	●		●
WGTFAC2	●	●		
WGTADJ2	●	●		
WGTFAC3	●	●		
WGTADJ3	●	●		

Exhibits 2.4 and 2.5 describe file name convention.

The weight variables TCHWGT, MATWGT, and SCIWGT are specifically designed for using teacher context 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 context data files (ATG, BTM, and BTS). Analyses with teacher data will be weighted properly 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" provide insight into the multi-stage sampling and weighting methodology applied to the TIMSS data. All weighting variables are described in Chapter 3 of *Methods and Procedures: TIMSS 2019 Technical Report* (LaRoche, Joncas, & Foy, 2020).

A word of caution to prospective users of the TIMSS 2019 International Database is in order. As tempting as it seems to merge all file types into one all-encompassing data file, analyses with student, home, and school context data may not produce correct results. This problem arises from the student-teacher linkage and how it apportions student weights (TOTWGT) to the student-teacher linkage records. Although unusual, there are instances of students not attending a mathematics class or a science class, and consequently are not physically linked to either a mathematics or science teacher. When this happens, the sampling weights of these students cannot be attributed to any of the teacher weights—TCHWGT, MATWGT, and SCIWGT. Thus using a teacher weight will not include the weights of these "unlinked" students, producing inaccurate results. Using TOTWGT from this all-encompassing data file also will lead to inaccurate results due to having some students linked to more than one mathematics or science teacher.

Structure and Design Variables

Besides the variables used to store responses to the context questionnaires and achievement booklets, the TIMSS 2019 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 2019 data files, several identification variables are included that provide information to identify countries, students, teachers, or schools. These variables also are used to link, or merge, cases between the different data file types. The identification variables have the prefix "ID" and are described below.

IDCNTRY
IDCNTRY is a six-digit country identification code based on the ISO 3166 classification as shown in Exhibit 2.2. This variable should always be used as the first linking variable whenever files are linked within and across countries.

IDSCHOOL
IDSCHOOL is a four-digit identification code that uniquely identifies the participating schools within each country. The school codes are generated and assigned specifically for TIMSS 2019 and are not meant to represent actual school identifiers in the participating countries. They are not unique across countries. Schools across countries can be identified uniquely 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 identified uniquely 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 identified uniquely in the database by the combination of IDCNTRY and IDSTUD as linking variables.

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.

IDTEALIN

IDTEALIN is an aggregation of IDTEACH and IDLINK. It can be used with IDCNTRY, instead of IDTEACH and IDLINK, to uniquely identify all teacher-class combinations in the database.

IDGRADE

IDGRADE identifies the target grade of the participating students. In TIMSS 2019, the usual values are "4" and "8" for most countries.

IDBOOK

IDBOOK identifies the specific assessment booklet that was administered to each student. The booklets or block combinations are given a numerical value from "1" through "14" in the TIMSS 2019 data and a value from "1" through "8" in TIMSS 2019 bridge data.

Exhibit 2.13 shows in which data files the various identification variables are located. Cells are shaded to indicate the combinations of variables used to identify uniquely the records contained in the different data file types.

Exhibit 2.13: Location of Identification Variables in TIMSS 2019 Data Files

Variable	Data File					
	ASA/BSA	ASG/BSG	AST/BST	ATG/ BTM/BTS	ACG/BCG	ASH
IDCNTRY	●	●	●	●	●	●
IDSCHOOL	●	●	●	●	●	●
IDCLASS	●	●	●			●
IDSTUD	●	●	●			●
IDTEACH			●	●		
IDLINK			●	●		
IDTEALIN			●	●		
IDGRADE	●	●	●	●	●	●
IDBOOK	●	●	●			●

Shading indicates combinations of variables that allow for uniquely identifying records across data files.
Exhibits 2.4 and 2.5 describe file name convention.

In the student context, home context, 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 context data files is needed to identify uniquely all

teachers and the classes they teach. Teacher context 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 context data to corresponding students or teachers.

Tracking Variables

Information about students, teachers, and schools provided by the survey tracking forms is stored in the tracking variables.[5] These variables have the prefix "IT." All tracking variables are included in the student context data files. ITLANG is included in the student achievement data files, student context data files, and home context 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. Both variables are available only in the restricted use version of the TIMSS 2019 International Database.

ITDATE
Testing date for each student. This variable is available only in the restricted use version of the TIMSS 2019 International Database.

ITLANG_x
Language of testing for the TIMSS assessments and context questionnaires, where "x" can take the values "SA", "SH", "SQ", "C", and "T", to denote the various TIMSS survey instruments. The valid codes are specified in the codebook files.

ITDEV
Type of digital device used for the eTIMSS assessment. This variable is available only in the restricted use version of the TIMSS 2019 International Database.

ITMODE_x
Mode of administration for the TIMSS assessments and context questionnaires, where "x" can take the values "SA", "SH", "SQ", "C", and "T", to denote the various TIMSS survey instruments. This variable is available only in the restricted use version of the TIMSS 2019 International Database.

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

Codebooks

All information related to the structure of the TIMSS 2019 data files, as well as the source, format, descriptive labels, and response option codes for all variables, is contained in codebook files. Codebooks can be download in ZIP files for the fourth grade and eighth grade, each containing two Excel files for the TIMSS 2019 codebook ("T19") and the TIMSS 2019 Bridge codebook ("T19Br"), respectively.

In the codebook Excel files, there is a tab for each appropriate data file type in the TIMSS 2019 International Database. These tabs describe the contents and structure of the individual TIMSS 2019 data files. Important codebook fields include LABEL, which contains extended textual information for all variables, QUESTION LOCATION, which provides the location of questions and achievement items within their respective survey instruments, and VALUE SCHEME DETAILED, which lists the acceptable responses allowed for each variable.

Data Almanacs

Data almanacs provide weighted summary statistics for all variables in the TIMSS 2019 data files. There are two basic types of data almanacs: achievement data almanacs for the achievement items and context data almanacs for the context variables. Users can download ZIP files for the fourth grade and eighth grade, each containing separate folders for achievement and context almanacs. All data almanac files are provided in Word format, printable PDF format, and Excel 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 2019 assessments. For each grade, subfolders in the ZIP file contain almanacs separate by subject for paperTIMSS ("T19"), eTIMSS ("eT19"), Bridge ("T19Br"), and less difficult ("T19_G4LD").

The achievement data **Item Almanacs** display for each item its classification in the content and cognitive domains, the item block to which it belongs, a brief description of the item, its variable name, whether it is a multiple-choice or constructed response item, its point value, 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 2015 and 2019 assessments. The **Mode Item Almanacs** provide summary statistics for the achievement items used in both paper-based bridge booklets and the computer-

based eTIMSS. Countries that participated in eTIMSS and also the Bridge are included in the mode item almanacs. The achievement data almanac files available in the International Database are listed in Exhibit 2.14.

Exhibit 2.14: TIMSS 2019 Achievement Data Almanacs

Assessment	Grade 4	Grade 8
paperTIMSS	T19_G4_MAT_ItemAlmanac T19_G4_MAT_TrendItemAlmanac T19_G4_SCI_ItemAlmanac T19_G4_SCI_TrendItemAlmanac	T19_G8_MAT_ItemAlmanac T19_G8_MAT_TrendItemAlmanac T19_G8_SCI_ItemAlmanac T19_G8_SCI_TrendItemAlmanac
Less Difficult	T19_G4LD_MAT_ItemAlmanac T19_G4LD_MAT_TrendItemAlmanac T19_G4LD_SCI_ItemAlmanac T19_G4LD_SCI_TrendItemAlmanac	
eTIMSS	eT19_G4_MAT_ItemAlmanac eT19_G4_SCI_ItemAlmanac	eT19_G8_MAT_ItemAlmanac eT19_G8_SCI_ItemAlmanac
Bridge	T19Br_G4_MAT_ItemAlmanac T19Br_G4_MAT_TrendItemAlmanac T19Br_G4_MAT_ModeItemAlmanac T19Br_G4_SCI_ItemAlmanac T19Br_G4_SCI_TrendItemAlmanac T19Br_G4_SCI_ModeItemAlmanac	T19Br_G8_MAT_ItemAlmanac T19Br_G8_MAT_TrendItemAlmanac T19Br_G8_MAT_ModeItemAlmanac T19Br_G8_SCI_ItemAlmanac T19Br_G8_SCI_TrendItemAlmanac T19Br_G8_SCI_ModeItemAlmanac

The achievement 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:

- 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, etc., —The percent of students choosing each one of the response options for a multiple-choice item
- Scoring Guide Codes (e.g., 20, 21, 10, 11, 70, 71)—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 and V2—The percent of students that scored 1 point or better on the item (V1) or 2 points (V2) for constructed-response items
- GIRL PCT RIGHT and BOY PCT 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.

Context Data Almanacs

Context data almanac files contain weighted summary statistics for each participating country on each variable in the student, home, teacher, and school context questionnaires, including the context questionnaire scales and their indices and the derived variables based on these context variables. Among the statistics reported are mean mathematics and science achievement by response category. The context 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 context data almanac files available in the International Database are listed in Exhibit 2.15.

Exhibit 2.15: TIMSS 2019 Context Data Almanacs

Assessment	Grade 4	Grade 8
TIMSS 2019	T19_G4_MAT_StudentAlmanac T19_G4_MAT_HomeAlmanac T19_G4_MAT_TeacherAlmanac T19_G4_MAT_SchoolAlmanac T19_G4_SCI_StudentAlmanac T19_G4_SCI_HomeAlmanac T19_G4_SCI_TeacherAlmanac T19_G4_SCI_SchoolAlmanac	T19_G8_MAT_StudentAlmanac — T19_G8_MAT_TeacherAlmanac T19_G8_MAT_SchoolAlmanac T19_G8_SCI_StudentAlmanac — T19_G8_SCI_TeacherAlmanac T19_G8_SCI_SchoolAlmanac
TIMSS 2019 Bridge	T19Br_G4_MAT_StudentAlmanac T19Br_G4_MAT_HomeAlmanac T19Br_G4_MAT_TeacherAlmanac T19Br_G4_MAT_SchoolAlmanac T19Br_G4_SCI_StudentAlmanac T19Br_G4_SCI_HomeAlmanac T19Br_G4_SCI_TeacherAlmanac T19Br_G4_SCI_SchoolAlmanac	T19Br_G8_MAT_StudentAlmanac — T19Br_G8_MAT_TeacherAlmanac T19Br_G8_MAT_SchoolAlmanac T19Br_G8_SCI_StudentAlmanac — T19Br_G8_SCI_TeacherAlmanac T19Br_G8_SCI_SchoolAlmanac

The context 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 separate sets of context almanacs to report mean mathematics and mean science achievement by response category. The TIMSS 2019 context almanacs (in the "T19" subfolder of the ZIP file) include paperTIMSS, eTIMSS, and less difficult countries together since the same context questionnaires were administered regardless of mode or assessment type. There are separate sets of context almanacs for the Bridge data in the "T19Br" subfolder of the ZIP file.

There are two types of displays in the context 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 following:

- The sample size (number of students, parents, 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, as well as "Not Applicable" codes when used)
- 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" also is displayed, along with the corresponding weighted mean achievement.

The almanac display for continuous variables includes the following:

- The sample size (number of students, parents, 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 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" also is displayed.

It is important to note that all statistics reported in the context data almanacs, with the exception of the sample sizes and the number of valid cases, always are based on student-level calculations—for example, the percentage of students whose teachers or schools gave a particular response to a question, because teacher data and school data usually are analyzed as student attributes.

Test-Curriculum Matching Analysis (TCMA)

The Test-Curriculum Matching Analysis (TCMA) was conducted to investigate the degree that the mathematics and science curricula of the participating countries match the TIMSS 2019 mathematics and science assessments. To that end, participating countries were asked to indicate which items in the TIMSS 2019 assessments assessed topics covered by their national curricula. Based on psychometric models tailored to each country's set of curriculum-relevant items, 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 curricula in other countries. The analytical method used and the results of the TCMA are presented in Appendix C of *TIMSS 2019 International Results in Mathematics and Science*.

The International Database contains ZIP files for the fourth grade and eighth grade TCMA files in Excel and PDF formats. At the fourth grade, separate files are provided for mathematics, science, and less difficult mathematics. At the eighth grade, separate files are provided for mathematics and science. The files show which items were selected by each participating country.

Special SPSS and SAS Programs

The TIMSS 2019 International Database includes a number of SPSS and SAS programs designed to facilitate the manipulation of the TIMSS 2019 data files. It includes SPSS and SAS syntax files which will recode the responses to individual items from the achievement

data files to their appropriate score levels. In addition, for users that require the use of SAS export files, the International Database contains SAS programs that convert the SAS export files into SAS data files. These SPSS and SAS programs are described in Chapter 3 of this User Guide.

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CHAPTER 3

Special SPSS and SAS Programs

Overview

This chapter presents special SPSS (IBM Corporation, 2016) and SAS (SAS Institute, 2016) programs essential to make full use of the TIMSS 2019 International Database. The first set of SAS programs converts the SAS export files into SAS data files, needed as input to the IEA IDB Analyzer (IEA, 2021). There is a second set of SPSS and SAS programs to recode the responses to the individual TIMSS 2019 items from the achievement data files to their appropriate score levels.

Users who intend to run the IEA IDB Analyzer with SPSS should make use of the SPSS programs. Users who intend to run the IEA IDB Analyzer with SAS should make use of the SAS programs described in this chapter, in particular the conversion programs if they must use the SAS export files in their computing environment.

Converting the SAS Export Files

The TIMSS 2019 International Database provides data files in two SAS formats. The SAS data files come with the file extension .SAS7BDAT and can be readily used by the IEA IDB Analyzer. However, they may not be readable on some computing platforms. Should this occur, users should use the SAS Export files, with the file extension .EXP, and convert them to SAS data files that will work in their computing environment.

The TIMSS 2019 International Database provides two SAS programs—T19_CONVERT.SAS and T19Br_CONVERT.SAS—to convert the SAS export files provided in the International Database into SAS data files. This conversion is necessary because the IEA IDB Analyzer requires the use of SAS data files; it will not function with the SAS export files. The T19_CONVERT.SAS program will convert the TIMSS 2019 SAS export files with suffix "M7". The T19Br_CONVERT.SAS program will convert the TIMSS 2019 SAS export files with suffix "B7", associated with the TIMSS bridge data. Both programs will work for either grade.

The T19_CONVERT.SAS program is presented in Exhibit 3.1. The T19Br_CONVERT.SAS program has a similar structure. This example converts the SAS export files of all fourth grade and eighth grade data file types for all countries. For this example, all SAS export files are located in the folder "C:\TIMSS2019\Data\SAS_Data," where the converted SAS data files also will be located.

Exhibit 3.1: The T19_CONVERT.SAS Program

```
%MACRO DOIT (TYPE   = ,
             INDIR  = ,
             OUTDIR = ) ;

   .  .  .

      %LET COUNTRY = <List of TIMSS 2019 countries> ;

   .  .  .

      PROC CIMPORT FILE="&INDIR\&FTYPE&CTRY.M7.EXP"
                   DATA=OUTDIR.&FTYPE&CTRY.M7 ;
      RUN ;

   .  .  .

%MEND DOIT ;

%DOIT (TYPE   = ACG ASA ASG ASH ASR AST ATG
                BCG BSA BSG BSR BST BTM BTS ,
       INDIR  = C:\TIMSS2019\Data\SAS_Data ,
       OUTDIR = C:\TIMSS2019\Data\SAS_Data ) ;
```

To convert SAS export files into SAS data files, users should perform the following steps:

1. Open T19_CONVERT.SAS or T19Br_CONVERT.SAS with the SAS software.
2. At the end of the program, specify the data file types of interest, each separated by a blank space, in the parameter "TYPE." By default, both programs list all fourth grade and eighth grade data file types.
3. Specify the folder where the SAS export files are located in the parameter "INDIR."
4. Specify the folder where the converted SAS data files will be located in the parameter "OUTDIR."
5. List all the countries of interest in the parameter "COUNTRY." By default, all appropriate TIMSS 2019 countries are listed and the programs will automatically select the appropriate country list by grade based on the file type specified.
6. Submit the edited code for processing by SAS.

SAS users are advised to run the T19_CONVERT and T19Br_CONVERT programs for all countries and all file types. The file types at the fourth grade are ACG, ASA, ASG, ASH, ASR,

AST, and ATG. At the eighth grade, the file types are BCG, BSA, BSG, BSR, BST, BTM, and BTS. These file types are described in Chapter 2 of this User Guide. In principle, these two programs need to be run only once for all file types and countries and should be one of the first things users do with the TIMSS 2019 International Database before undertaking any data analyses with SAS and the IEA IDB Analyzer, in particular the data analysis examples in this User Guide, if the SAS data files provided in the TIMSS 2019 International Database are not useable on their computing platform.

Scoring the TIMSS 2019 Items

Student achievement in TIMSS 2019 is represented by sets of five plausible values for mathematics and science and their content and cognitive domains. They 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 may require that the individual items in the TIMSS 2019 International 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 on constructed response items. The International Database provides SPSS and SAS programs to perform this task.

For multiple-choice items and some of the new eTIMSS items, the numbers 1 through 4 are used to represent response options A through D, respectively, in the TIMSS 2019 achievement data files.[1] These responses must 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 either a total of one or two points, two-digit codes are used in the achievement data files to represent the students' constructed responses. These codes also must be recoded to represent the correct point values of the responses—either zero, one, or two points.

For all items, special codes are set aside to represent missing data as either "Not Administered," "Omitted," or "Not Reached." These special missing codes also may 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 are recoded as incorrect. These default settings can be modified within the score programs, depending on the requirements of the item-level analyses. For example, "Not Reached"

[1] Some eTMSS items offer more than 4 response options and therefore will use numbers beyond 4 to represent them. This information is provided in the codebooks and the item information spreadsheets.

responses were treated as missing for the purpose of calibrating the TIMSS 2019 items, whereas they were treated as incorrect when deriving achievement scores for students.

The TIMSS 2019 International Database includes four SPSS programs and four SAS programs to recode the responses to individual items from the achievement data files (ASA/BSA) to their appropriate score levels. The ASASCRM7 and BSASCRM7 programs score the fourth grade and eighth grade items, respectively, for the data files with the "M7" suffix. The ASASCRB7 and BSASCRB7 programs score the fourth grade and eighth grade items, respectively, for the data files with the "B7" suffix associated with the TIMSS 2019 bridge data. The score programs with the "M7" suffix list all TIMSS 2019 items including paperTIMSS and eTIMSS items at both grades, and the less difficult mathematics items at the fourth grade. The score programs with the "B7" suffix list the paperTIMSS 2019 trend items at both grades relevant for the TIMSS 2019 bridge data.

The score programs use merged data files as input. Consequently, users first must create a merged data file of all required student achievement data files (ASA/BSA) using the merge module of the IEA IDB Analyzer, as described in Chapter 1 of this User Guide. The score programs will then create a merged data file with scored achievement items that can be used by the analysis module of the IEA IDB Analyzer.

Exhibit 3.2 shows a condensed version of the ASASCRM7.SAS program to score the individual TIMSS 2019 fourth grade items. All SAS and SPSS score programs have a similar structure. To score each individual TIMSS 2019 item, the program code in the SAS score program must be adapted by completing the following steps:

1. Open ASASCRM7.SAS, BSASCRM7.SAS, ASASCRB7.SAS, or BSASCRB7.SAS with the SAS software.
2. At the end of the program, specify the folder where the merged SAS data file of student achievement data files is located in the parameter "INDIR."
3. Specify the folder where the merged SAS data file of scored achievement items will be located in the parameter "OUTDIR."
4. Specify the name of the merged SAS data file of student achievement data files in the parameter "INFILE."
5. Submit the edited code for processing by SAS.

Exhibit 3.2: The ASASCRM7.SAS Program

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

   .  .  .

%MEND SCOREIT ;

%MACRO DOIT (INDIR  = ,
             OUTDIR = ,
             INFILE = ) ;

   .  .  .

  %LET ARIGHT = <List of multiple choice items where A is correct> ;
  DO OVER ARIGHT ; %SCOREIT (ARIGHT, "MC", 1, .R, .A, ., .I) ; END ;
  %LET BRIGHT = <List of multiple choice items where B is correct> ;
  DO OVER BRIGHT ; %SCOREIT (BRIGHT, "MC", 2, .R, .A, ., .I) ; END ;
  %LET CRIGHT = <List of multiple choice items where C is correct> ;
  DO OVER CRIGHT ; %SCOREIT (CRIGHT, "MC", 3, .R, .A, ., .I) ; END ;
  %LET DRIGHT = <List of multiple choice items where D is correct> ;
  DO OVER DRIGHT ; %SCOREIT (DRIGHT, "MC", 4, .R, .A, ., .I) ; END ;
  %LET CONSTR = <List of constructed response items> ;
  DO OVER CONSTR ; %SCOREIT (CONSTR, "CR",  , .R, .A, ., .I) ; END ;

   .  .  .

%MEND DOIT ;

%DOIT (INDIR  = C:\TIMSS2019\Data ,
       OUTDIR = C:\TIMSS2019\Data ,
       INFILE = ASAALLM7 ) ;
```

In this example, the merged SAS data file of student achievement data files is called ASAALLM7, located in the folder C:\TIMSS2019\Data, and contains the fourth grade achievement items. The resulting merged data file of scored achievement items will be called ASAALLM7_SCR and located in the same folder. The merged data file of scored achievement items will have the same data structure as the student achievement data files (ASA/BSA), but with the score levels stored in the item variables instead of the student responses. The analysis module of the IEA IDB Analyzer will be able to conduct analyses with this merged data file.

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

```
IF &ITEM = &NR THEN SCORE = 0 ; * Not Reached ;
```

with this statement:

```
IF &ITEM = &NR THEN SCORE = . ; * Not Reached ;
```

Users should be careful to use the score program appropriate for the student achievement data files under consideration; the ASASCRM7 and BSASCRM7 programs for the fourth grade and eighth grade items, respectively, in suffix "M7" files; and the ASASCRB7 and BSASCRB7 programs for the fourth grade and eighth grade items, respectively, in suffix "B7" files.

Executing the equivalent SPSS programs requires the same steps as the SAS programs. Exhibit 3.3 shows a condensed version of the ASASCRM7.SPS program to score the individual TIMSS 2019 fourth grade items.

Exhibit 3.3: The ASASCRM7.SPS Program

```
DEFINE SCOREIT <List of macro parameters> .

   .  .  .

!ENDDEFINE .

DEFINE DOIT (INDIR  = !CHAREND('/') /
             OUTDIR = !CHAREND('/') /
             INFILE = !CHAREND('/') ) .

   .  .  .

SCOREIT TYPE = MC / ITEM = <List of multiple choice items where A is correct> /
        RIGHT = 1 / NR = 6 / NA = SYSMIS / OM =  9 / OTHER =  7 .
SCOREIT TYPE = MC / ITEM = <List of multiple choice items where B is correct> /
        RIGHT = 2 / NR = 6 / NA = SYSMIS / OM =  9 / OTHER =  7 .
SCOREIT TYPE = MC / ITEM = <List of multiple choice items where C is correct> /
        RIGHT = 3 / NR = 6 / NA = SYSMIS / OM =  9 / OTHER =  7 .
SCOREIT TYPE = MC / ITEM = <List of multiple choice items where D is correct> /
        RIGHT = 4 / NR = 6 / NA = SYSMIS / OM =  9 / OTHER =  7 .
SCOREIT TYPE = CR / ITEM = <List of constructed response items> /
        RIGHT = 0 / NR = 6 / NA = SYSMIS / OM = 99 / OTHER = 90 .

  .  .  .

!ENDDEFINE .

DOIT INDIR  = C:\TIMSS2019\Data /
     OUTDIR = C:\TIMSS2019\Data /
     INFILE = ASAALLM7 .
```

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

```
(!NR = 0) /* Not Reached */
```

with this statement:

```
(!NR = SYSMIS) /* Not Reached */
```

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APPENDIX

Organizations and Individuals Responsible for TIMSS 2019

Introduction

TIMSS 2019 was a collaborative effort involving hundreds of individuals around the world. This appendix acknowledges the individuals and organizations for their contributions. Given that the work on TIMSS 2019 spanned more than four years and involved so many people and organizations, this list may not include all who contributed. Any omission is inadvertent. TIMSS 2019 also acknowledges the students, parents, teachers, and school principals who contributed their time and effort to the study. This report would not be possible without them.

Management and Coordination

TIMSS is a major undertaking of IEA, and together with the Progress in International Reading Literacy Study (PIRLS), comprises the core of IEA's regular cycles of studies. The TIMSS assessment at the fourth grade complements PIRLS, which regularly assesses reading achievement at fourth grade.

TIMSS 2019 was conducted by IEA's TIMSS & PIRLS International Study Center at Boston College, which has responsibility for the overall direction and management of TIMSS and PIRLS, including design, development, and implementation. For TIMSS 2019, this also included managing the transition of TIMSS to a digital assessment, with the development of eTIMSS. Headed by Executive Directors Drs. Ina V.S. Mullis, Michael O. Martin, and Matthias von Davier, the study center is located in the Lynch School of Education and Human Development. The TIMSS & PIRLS International Study Center worked closely with IEA Amsterdam, which managed country participation, was responsible for verification of all translations produced by the participating countries, and coordinated the school visits by International Quality Control Monitors. In addition to developing the software system used to create and deliver the eTIMSS 2019 digital assessments, staff at IEA Hamburg worked closely with participating countries to organize sampling and data collection operations and to check all data for accuracy and consistency within and across countries. Statistics Canada in Ottawa was responsible for school and student sampling activities. Educational Testing Service in Princeton, New Jersey

consulted on psychometric methodology, provided software for scaling the achievement data, and replicated the achievement scaling for quality assurance.

The Project Management Team, comprising the study directors and representatives from the TIMSS & PIRLS International Study Center, IEA Amsterdam, IEA Hamburg, and Statistics Canada met twice a year throughout the study to discuss the study's progress, procedures, and schedule. In addition, the study directors met with members of IEA's Technical Executive Group twice each year to review technical issues.

To work with the international team and coordinate within-country activities, each participating country designates an individual to be the TIMSS National Research Coordinator (NRC). The NRCs have the challenging task of implementing TIMSS in their countries in accordance with the TIMSS guidelines and procedures. In addition, the NRCs contribute to the development of the TIMSS assessments and provide input throughout the course of the project. The quality of the TIMSS assessment and data depends on the work of the NRCs and their colleagues in carrying out the complex sampling, data collection, and scoring tasks. NRCs from countries participating in eTIMSS were responsible for carrying out additional tasks related to the transition of TIMSS to a digital assessment. Continuing the tradition of exemplary work established in previous cycles of TIMSS, the TIMSS 2019 NRCs performed their many tasks with dedication, competence, energy, and goodwill, and demonstrated a commitment to the project and high quality work.

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