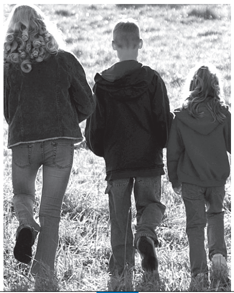

9

Use of Proficiency Levels

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INTRODUCTION

The values for student performance in reading, mathematics, and science literacy are usually considered as continuous latent variables. In order to facilitate the interpretation of the scores assigned to students, the reading, mathematics and science scales were designed to have an average score of 500 points and a standard deviation of 100 across OECD countries. This means that about two-thirds of the OECD member country students perform between 400 and 600 points.

In order to render PISA results more accessible to policy makers and educators, proficiency scales have been developed for the assessment domains. Since these scales are divided according to levels of difficulty and performance, both a ranking of student performance and a description of the skill associated with that proficiency level can be obtained. Each successive level is associated with tasks of increased difficulty.

In PISA 2000, five levels of reading proficiency were defined and reported in the PISA 2000 initial report *Knowledge and Skills for Life: First Results from PISA 2000* (OECD, 2001). In PISA 2003, six levels of mathematics proficiency levels were also defined and reported in the PISA 2003 initial report *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004a). In PISA 2006, six levels of science proficiency were defined and reported in the PISA 2006 initial report *Science Competencies for Tomorrow's World* (OECD, 2007a).

This chapter will show how to derive the proficiency levels from the PISA databases and how to use them.

GENERATION OF THE PROFICIENCY LEVELS

Proficiency levels are not included in the PISA databases, but they can be derived from the plausible values (PVs).

In PISA 2006, the cutpoints that frame the proficiency levels in science are 334.94, 409.54, 484.14, 558.73, 633.33 and 709.93.[1] While some researchers might understand that different possible scores can be assigned to a student, it is more difficult to understand that different levels can be assigned to a single student. Therefore, they might be tempted to compute the average of the five plausible values and then assign each student a proficiency level based on this average.

As discussed in Chapter 6 and Chapter 8, such a procedure is similar to assigning each student an expected *a posteriori* (EAP) score; the biases of such estimators are now well known. Since using EAP scores underestimates the standard deviation, the estimation of the percentages of students at each level of proficiency will consequently underestimate the percentages at the lowest and highest levels, and overestimate the percentages at the central levels.

As already stated, international education surveys do not aim to estimate the performance of particular students, but rather, they aim to describe population characteristics. Therefore, particular students can be allocated different proficiency levels for different plausible values. Thus, five plausible proficiency levels will be assigned to each student respectively according to their five plausible values. The SPSS® syntax for the generation of the plausible proficiency levels in science is provided in Box 9.1.

In Box 9.1, two vectors are defined. The first, labelled STUDEST, includes the five plausible values for the science combined scale (PV1SCIE to PV5SCIE) and the three science subscales (PV1EPS to PV5EPS, PV1ISI to PV5ISI, and PV1USE to PV5USE). The second, labelled PROFLEV, will create 20 new variables, labelled PL_PV1SCIE to PL_PV5SCIE for the science combined scale; PL_PV1EPS to PL_PV5EPS for the science/explaining phenomena scientifically subscale; PL_PV1ISI to PL_PV5ISI for the science/identifying scientific issues subscale; PL_PV1USE to PL_PV5USE to the science/use of scientific evidence subscale.

Box 9.1 **SPSS® syntax for generating the proficiency levels in science (*e.g.* PISA 2006)**

```
GET FILE="C:\PISA\2006\DATA\INT_STU06_DEC07.SAV".
SELECT IF (CNT="DEU").

DO REPEAT
STUDEST= PV1SCIE PV2SCIE PV3SCIE PV4SCIE PV5SCIE
         PV1EPS  PV2EPS  PV3EPS  PV4EPS  PV5EPS
         PV1ISI  PV2ISI  PV3ISI  PV4ISI  PV5ISI
         PV1USE  PV2USE  PV3USE  PV4USE PV5USE/
PROFLEV= PL_PV1SCIE PL_PV2SCIE PL_PV3SCIE PL_PV4SCIE PL_PV5SCIE
         PL_PV1EPS  PL_PV2EPS  PL_PV3EPS  PL_PV4EPS  PL_PV5EPS
         PL_PV1ISI  PL_PV2ISI  PL_PV3ISI  PL_PV4ISI  PL_PV5ISI
         PL_PV1USE  PL_PV2USE  PL_PV3USE  PL_PV4USE PL_PV5USE.

IF (STUDEST <= 334.94) PROFLEV=0.
IF (STUDEST > 334.94 & STUDEST <= 409.54) PROFLEV=1.
IF (STUDEST > 409.54 & STUDEST <= 484.14) PROFLEV=2.
IF (STUDEST > 484.14 & STUDEST <= 558.73) PROFLEV=3.
IF (STUDEST > 558.73 & STUDEST <= 633.33) PROFLEV=4.
IF (STUDEST > 633.33 & STUDEST <= 707.93) PROFLEV=5.
IF (STUDEST > 707.93) PROFLEV=6.

END REPEAT.

FORMATS
PL_PV1SCIE PL_PV2SCIE PL_PV3SCIE PL_PV4SCIE PL_PV5SCIE
PL_PV1EPS  PL_PV2EPS  PL_PV3EPS  PL_PV4EPS  PL_PV5EPS
PL_PV1ISI  PL_PV2ISI  PL_PV3ISI  PL_PV4ISI  PL_PV5ISI
PL_PV1USE  PL_PV2USE  PL_PV3USE  PL_PV4USE  PL_PV5USE  (F1.0).
EXE.

SAVE OUTFILE="C:\TEMP\DEU1.SAV".
```

The iterative process will recode each plausible value variable into a new variable with seven categories labelled 0 to 6 for science.

The computation of the percentage of students at each proficiency level and its respective standard error is similar to the computation of a mean estimate and its standard error, as described in Chapter 8, *i.e.*:

- For each plausible value, the percentage of students at each proficiency level and its respective standard error have to be computed. Per proficiency level, five percentage estimates denoted $\hat{\pi}_1$, $\hat{\pi}_2$, $\hat{\pi}_3$, $\hat{\pi}_4$ and $\hat{\pi}_5$ will be obtained. Out of the 80 replicates applied on each of the 5 proficiency level variables, per level of proficiency, 5 sampling variances will be estimated, denoted respectively $\sigma^2_{(\hat{\pi}_1)}$, $\sigma^2_{(\hat{\pi}_2)}$, $\sigma^2_{(\hat{\pi}_3)}$, $\sigma^2_{(\hat{\pi}_4)}$ and $\sigma^2_{(\hat{\pi}_5)}$. These five percentage estimates and their respective sampling variances are given in Table 9.1.
- The final percentage estimate is equal to the average of the five percentage estimates, *i.e.* $\hat{\pi} = \frac{1}{5}(\hat{\pi}_1 + \hat{\pi}_2 + \hat{\pi}_3 + \hat{\pi}_4 + \hat{\pi}_5)$
- The final sampling variance is equal to the average of the five sampling variances, *i.e.* $\sigma^2_{(\hat{\pi})} = \frac{1}{5}(\sigma^2_{(\hat{\pi}_1)} + \sigma^2_{(\hat{\pi}_2)} + \sigma^2_{(\hat{\pi}_3)} + \sigma^2_{(\hat{\pi}_4)} + \sigma^2_{(\hat{\pi}_5)})$
- The imputation variance, also denoted measurement error variance, is computed[2] as $\sigma^2_{(test)} = \frac{1}{4}\sum_{i=1}^{5}(\hat{\pi}_i - \hat{\pi})^2$
- The sampling variance and the imputation variance are combined to obtain the final error variance as $\sigma^2_{(error)} = \sigma^2_{(\hat{\pi})} + (1.2\,\sigma^2_{(test)})$
- The standard error is equal to the square root of the error variance.

This process is repeated for each proficiency level.

Table 9.1
The 405 percentage estimates for a particular proficiency level

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

In this way 405 percentages will be estimated per proficiency level. As there are 7 levels in science, 2 835 percentages will be estimated.

The seven proficiency levels in science are:

1. Below level 1,
2. Level 1,
3. Level 2,
4. Level 3,
5. Level 4,
6. Level 5,
7. Level 6.

Sequentially applying the MCR_SE_GRPPCT macro five times, as described in Chapter 7, will return, per proficiency level, five percentage estimates and five standard error estimates that can be combined to get the final estimate and its standard error.

Box 9.2 presents the SPSS® syntax for sequentially running the MCR_SE_GRPPCT macro five times. Table 9.2 presents the five estimates and their respective sampling variances, per proficiency level.

Box 9.2 **SPSS® syntax for computing the percentages of students by proficiency level in science and its standard errors (*e.g.* PISA 2006)**

```
INSERT FILE="C:\PISA\MACRO\MCR_SE_GRPPCT.SPS".

GRPPCT WITHIN = CNT/ GRP = PL_PV1SCIE/ LIMIT_CRITERIA = 100 10 5 1/
       INFILE = "C:\TEMP\DEU1.SAV"/.
SAVE OUTFILE="C:\TEMP\RESULTS1.SAV".
GRPPCT WITHIN = CNT/ GRP = PL_PV2SCIE/ LIMIT_CRITERIA = 100 10 5 1/
       INFILE = "C:\TEMP\DEU1.SAV"/.
SAVE OUTFILE="C:\TEMP\RESULTS2.SAV".
GRPPCT WITHIN = CNT/ GRP = PL_PV3SCIE/ LIMIT_CRITERIA = 100 10 5 1/
       INFILE = "C:\TEMP\DEU1.SAV"/.
SAVE OUTFILE="C:\TEMP\RESULTS3.SAV".
GRPPCT WITHIN = CNT/ GRP = PL_PV4SCIE/ LIMIT_CRITERIA = 100 10 5 1/
       INFILE = "C:\TEMP\DEU1.SAV"/.
SAVE OUTFILE="C:\TEMP\RESULTS4.SAV".
GRPPCT WITHIN = CNT/ GRP = PL_PV5SCIE/ LIMIT_CRITERIA = 100 10 5 1/
       INFILE = "C:\TEMP\DEU1.SAV"/.
SAVE OUTFILE="C:\TEMP\RESULTS5.SAV".
```

To combine the results:

- Per proficiency level, the five percentage estimates are averaged.
- Per proficiency level, the five sampling variances are averaged.
- By comparing the final estimate and the five PV estimates, the imputation variance is computed.
- The final sampling variance and the imputation variance are combined as usual to get the final error variance.
- The standard error is obtained by taking the square root of the error variance.

Table 9.2
Estimates and sampling variances per proficiency level in science for Germany (PISA 2006)

Level		PV1	PV2	PV3	PV4	PV5
Below Level 1	$\hat{\pi}_i$	4.12	3.82	4.25	4.03	4.13
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.60)^2$	$(0.59)^2$	$(0.72)^2$	$(0.67)^2$	$(0.71)^2$
Level 1	$\hat{\pi}_i$	11.93	11.8	11.03	11.09	10.70
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.86)^2$	$(0.81)^2$	$(0.72)^2$	$(0.73)^2$	$(0.71)^2$
Level 2	$\hat{\pi}_i$	20.26	21.59	21.87	21.16	21.91
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.73)^2$	$(0.71)^2$	$(0.73)^2$	$(0.80)^2$	$(0.76)^2$
Level 3	$\hat{\pi}_i$	28.70	27.46	27.33	27.92	27.93
	$\sigma^2_{(\hat{\pi}_i)}$	$(1.00)^2$	$(0.94)^2$	$(0.69)^2$	$(0.91)^2$	$(0.92)^2$
Level 4	$\hat{\pi}_i$	23.39	23.45	23.57	23.66	23.77
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.91)^2$	$(0.93)^2$	$(0.92)^2$	$(0.92)^2$	$(0.96)^2$
Level 5	$\hat{\pi}_i$	9.82	10.07	10.14	10.24	9.69
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.61)^2$	$(0.53)^2$	$(0.53)^2$	$(0.64)^2$	$(0.49)^2$
Level 6	$\hat{\pi}_i$	1.79	1.81	1.82	1.89	1.87
	$\sigma^2_{(\hat{\pi}_i)}$	$(0.25)^2$	$(0.28)^2$	$(0.23)^2$	$(0.20)^2$	$(0.21)^2$

The final results are presented in Table 9.3.

Table 9.3
Final estimates of the percentage of students, per proficiency level, in science and its standard errors for Germany (PISA 2006)

Proficiency level	%	S.E.
Below Level 1	4.07	0.68
Level 1	11.31	0.96
Level 2	21.36	1.06
Level 3	27.87	1.07
Level 4	23.57	0.95
Level 5	9.99	0.62
Level 6	1.84	0.24

A SPSS® macro has been developed for computing the percentage of students at each proficiency level as well as its respective standard error in one run. Box 9.3 presents the SPSS® syntax for running the macro and Table 9.4 presents the structure of the output data file.

Box 9.3 SPSS® syntax for computing the percentage of students by proficiency level in science and its standard errors (*e.g.* PISA 2006)

```
INSERT FILE="C:\PISA\MACRO\MCR_SE_PCTLEV.SPS".
PCTLEV   NREP=80/
         PROFLEV=PL_PV1SCIE PL_PV2SCIE PL_PV3SCIE PL_PV4SCIE PL_PV5SCIE/
         WITHIN=CNT/
         WGT=W_FSTUWT/
         RWGT=W_FSTR/
         CONS=0.05/
         LIMIT_CRITERIA=100 10 5 1/
         PSU=SCHOOLID/
         INFILE="C:\TEMP\DEU1.SAV"/.
```

This macro has nine arguments. Besides the usual arguments, the proficiency level variable names have to be specified. As indicated in Table 9.4, the number of cases at Level 6 is less than 100.

Table 9.4
Output data file from Box 9.3

CNT	PROFLEV	STAT	SE	FLAG_STD	FLAG_ SCH	FLAG_ PCT
DEU	0	4.07	0.68	0	0	1
DEU	1	11.31	0.96	0	0	0
DEU	2	21.36	1.06	0	0	0
DEU	3	27.87	1.07	0	0	0
DEU	4	23.57	0.95	0	0	0
DEU	5	9.99	0.62	0	0	0
DEU	6	1.84	0.24	1	0	1

As before, several breakdown variables can be used. For instance, the distribution of students across proficiency levels per gender can be obtained, as in Box 9.4.

Box 9.4 SPSS® syntax for computing the percentage of students by proficiency level and its standard errors by gender (*e.g.* PISA 2006)

```
PCTLEV   NREP=80/
         PROFLEV=PL_PV1SCIE PL_PV2SCIE PL_PV3SCIE PL_PV4SCIE PL_PV5SCIE /
         WITHIN=CNT ST04Q01/
         WGT=W_FSTUWT/
         RWGT=W_FSTR/
         CONS=0.05/
         LIMIT_CRITERIA=100 10 5 1 /
         PSU=SCHOOLID/
         INFILE="C:\TEMP\DEU1.SAV"/.
```

In this case, the sum of the percentages will be equal to 100 per country and per gender, as shown in Table 9.5.

Table 9.5
Output data file from Box 9.4

CNT	ST04Q01	PROFLEV	STAT	SE	FLAG_STD	FLAG_ SCH	FLAG_ PCT
DEU	1	0	3.73	0.67	1	0	1
DEU	1	1	12.12	1.19	0	0	0
DEU	1	2	21.08	1.26	0	0	0
DEU	1	3	29.94	1.47	0	0	0
DEU	1	4	23.29	1.07	0	0	0
DEU	1	5	8.42	0.73	0	0	1
DEU	1	6	1.42	0.38	1	0	1
DEU	2	0	4.39	0.84	0	0	1
DEU	2	1	10.55	1.09	0	0	0
DEU	2	2	21.62	1.23	0	0	0
DEU	2	3	25.93	1.21	0	0	0
DEU	2	4	23.83	1.35	0	0	0
DEU	2	5	11.46	1.03	0	0	0
DEU	2	6	2.22	0.37	1	0	1

As shown in Table 9.5, the percentage of males at Level 5 and 6 is higher than the percentage of females at Level 5 and 6.

The statistical significance of these differences cannot be evaluated with this procedure, however. More details on this issue will be provided in Chapter 11.

OTHER ANALYSES WITH PROFICIENCY LEVELS

Proficiency levels constitute a powerful tool for communicating the results on the cognitive test. Researchers and/or policy makers might therefore be interested in estimating the influence of some variables (such as the social background or self-confidence measures) on the proficiency levels.

PISA 2003, for instance, constructed an index of mathematics self-efficacy, denoted MATHEFF.

Analysing the relationship between proficiency levels and mathematics self-efficacy is relevant, as there is probably a reciprocal relationship between these two concepts. Better self-perception in mathematics is thought to increase a student's proficiency in mathematics, but an increase in the latter might in return affect the former.

Suppose that the statistic of interest is the average self-efficacy per proficiency level. In statistical terms, mathematics self-efficacy is considered as the dependent variable and the level of proficiency, the independent variable. There is no macro that can directly compute the mean of a continuous variable per proficiency level. On the other hand, the MCR_SE_UNIV macro described in Chapter 7 can be applied sequentially five times and the results could be combined in an Excel® spreadsheet for instance. This will be the case whenever proficiency levels are used as independent or as classification variables.

Box 9.5 presents SPSS® syntax for preparing the PISA 2003 data file.

Box 9.5 **SPSS® syntax for generating the proficiency levels in mathematics (*e.g.* PISA 2003)**

```
GET FILE="C:\PISA\2003\DATA\INT_STUI_2003.SAV".
SELECT IF (CNT="DEU").

DO REPEAT
STUDEST=PV1MATH PV2MATH PV3MATH PV4MATH PV5MATH/
PROFLEV=PL_PV1MATH PL_PV2MATH PL_PV3MATH PL_PV4MATH PL_PV5MATH.

IF (STUDEST <= 357.77) PROFLEV=0.
IF (STUDEST > 357.77 & STUDEST <= 420.07) PROFLEV=1.
IF (STUDEST > 420.07 & STUDEST <= 482.38) PROFLEV=2.
IF (STUDEST > 482.38 & STUDEST <= 544.68) PROFLEV=3.
IF (STUDEST > 544.68 & STUDEST <= 606.99) PROFLEV=4.
IF (STUDEST > 606.99 & STUDEST <= 669.30) PROFLEV=5.
IF (STUDEST > 669.30) PROFLEV=6.

END REPEAT.

FORMATS
PL_PV1MATH PL_PV2MATH PL_PV3MATH PL_PV4MATH PL_PV5MATH (F1.0).
EXE.
SAVE OUTFILE="C:\TEMP\DEU2.SAV".
```

Box 9.6 presents SPSS® syntax for computing the mean of student self-efficacy per proficiency level.

Box 9.6 **SPSS® syntax for computing the mean of self-efficacy in mathematics and its standard errors by proficiency level (*e.g.* PISA 2003)**

```
INSERT FILE=“C:\PISA\MACRO\MCR_SE_UNIV.SPS”.

UNIVAR STAT=MEAN/ DEP=MATHEFF/ GRP=CNT PL_PV1MATH/
INFILE=“C:\TEMP\DEU2.SAV”/.
COMPUTE PV=1.
STRING LEVEL (A5).
COMPUTE LEVEL=PL_PV1MATH.
SAVE OUTFILE=“C:\TEMP\RESULTS6.SAV”/DROP=PL_PV1MATH.

UNIVAR STAT=MEAN/ DEP=MATHEFF/ GRP=CNT PL_PV2MATH/
INFILE=“C:\TEMP\DEU2.SAV”/.
COMPUTE PV=2.
STRING LEVEL (A5).
COMPUTE LEVEL=PL_PV2MATH.
SAVE OUTFILE=“C:\TEMP\RESULTS7.SAV”/DROP=PL_PV2MATH.

UNIVAR STAT=MEAN/ DEP=MATHEFF/ GRP=CNT PL_PV3MATH/
INFILE=“C:\TEMP\DEU2.SAV”/.
COMPUTE PV=3.
STRING LEVEL (A5).
COMPUTE LEVEL=PL_PV3MATH.
SAVE OUTFILE=“C:\TEMP\RESULTS8.SAV”/DROP=PL_PV3MATH.

UNIVAR STAT=MEAN/ DEP=MATHEFF/ GRP=CNT PL_PV4MATH/
INFILE=“C:\TEMP\DEU2.SAV”/.
COMPUTE PV=4.
STRING LEVEL (A5).
COMPUTE LEVEL=PL_PV4MATH.
SAVE OUTFILE=“C:\TEMP\RESULTS9.SAV”/DROP=PL_PV4MATH.

UNIVAR STAT=MEAN/ DEP=MATHEFF/ GRP=CNT PL_PV5MATH/
INFILE=“C:\TEMP\DEU2.SAV”/.
COMPUTE PV=5.
STRING LEVEL (A5).
COMPUTE LEVEL=PL_PV5MATH.
SAVE OUTFILE=“C:\TEMP\RESULTS10.SAV”/DROP=PL_PV5MATH.

GET FILE=“C:\TEMP\RESULTS6.SAV”.
ADD FILES /FILE=*
 /FILE=“C:\TEMP\RESULTS7.SAV”
 /FILE=“C:\TEMP\RESULTS8.SAV”
 /FILE=“C:\TEMP\RESULTS9.SAV”
 /FILE=“C:\TEMP\RESULTS10.SAV”.
EXECUTE .
SORT CASES BY CNT(A) LEVEL(A) PV(A).
COMPUTE VAR=SE_MATHEFF*SE_MATHEFF.
AGGREGATE
  /OUTFILE=“C:\TEMP\AGR.SAV”
  /PRESORTED
  /BREAK=CNT LEVEL
  /STAT=MEAN(MATHEFF)
  /MES_ERROR=SD(MATHEFF)
  /SAMP_VAR=MEAN(VAR).
GET FILE=“C:\TEMP\AGR.SAV”.
COMPUTE FINAL_VAR=((MES_ERROR*MES_ERROR)*1.2)+(SAMP_VAR).
COMPUTE SE=SQRT( FINAL_VAR).
SAVE OUTFILE='C:\TEMP\FINAL.SAV'/KEEP = CNT LEVEL STAT SE.
GET FILE=“C:\TEMP\FINAL.SAV”.
```

Table 9.6 presents the mean estimates and standard errors for self-efficacy in mathematics per proficiency level.

Table 9.6
Mean estimates and standard errors for self-efficacy in mathematics per proficiency level (PISA 2003)

Level		PV1	PV2	PV3	PV4	PV5
Below Level 1	$\hat{\mu}_i$	-0.68	-0.70	-0.74	-0.72	-0.77
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.06)^2$	$(0.06)^2$	$(0.06)^2$	$(0.05)^2$	$(0.06)^2$
Level 1	$\hat{\mu}_i$	-0.44	-0.45	-0.42	-0.43	-0.40
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.06)^2$	$(0.05)^2$	$(0.06)^2$	$(0.04)^2$	$(0.05)^2$
Level 2	$\hat{\mu}_i$	-0.18	-0.16	-0.17	-0.18	-0.18
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 3	$\hat{\mu}_i$	0.09	0.09	0.12	0.11	0.10
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 4	$\hat{\mu}_i$	0.43	0.45	0.41	0.45	0.44
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$	$(0.03)^2$
Level 5	$\hat{\mu}_i$	0.85	0.84	0.86	0.79	0.82
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.04)^2$	$(0.04)^2$	$(0.03)^2$	$(0.04)^2$	$(0.04)^2$
Level 6	$\hat{\mu}_i$	1.22	1.23	1.27	1.28	1.29
	$\sigma^2_{(\hat{\mu}_i)}$	$(0.05)^2$	$(0.05)^2$	$(0.06)^2$	$(0.05)^2$	$(0.07)^2$

Table 9.7
Output data file from Box 9.6

CNT	LEVEL	STAT	SE
DEU	0	-0.72	0.07
DEU	1	-0.43	0.06
DEU	2	-0.17	0.03
DEU	3	0.10	0.03
DEU	4	0.44	0.03
DEU	5	0.83	0.05
DEU	6	1.26	0.07

To combine the results:

- Per proficiency level, the five mean estimates are averaged.
- Per proficiency level, the five sampling variances are averaged.
- By comparing the final estimate and the five PV estimates, the imputation variance is computed.
- The final sampling variance and the imputation variance are combined as usual to get the final error variance.
- The standard error is obtained by taking the square root of the error variance.

Final results are presented in Table 9.7. It shows that high self-efficacy in mathematics (STAT) is associated with higher proficiency levels (LEVEL).

CONCLUSION

This chapter has shown how to compute the percentage of students per proficiency level and its standard errors. As shown, the algorithm is similar to the one used for other statistics.

The difficulty of conducting analyses using proficiency levels as the explanatory (independent) variables was also discussed.

Notes

1. In PISA 2000, the cutpoints that frame the proficiency levels in reading are: 334.75, 407.47, 480.18, 552.89 and 625.61. In PISA 2003, the cutpoints that frame the proficiency levels in mathematics are: 357.77, 420.07, 482.38, 544.68, 606.99 and 669.3.

2. This formula is a simplification of the general formula provided in Chapter 5. M, denoting the number of plausible values, has been replaced by 5.

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Preparation of data files

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

SPSS® users

By running the SPSS® control files, the PISA data files are created in the SPSS® format. Before starting analysis in the following chapters, save the PISA 2000 data files in the folder of "c:\pisa2000\data\", the PISA 2003 data files in "c:\pisa2003\data\", and the PISA 2006 data files in "c:\pisa2006\data\".

SPSS® syntax and macros

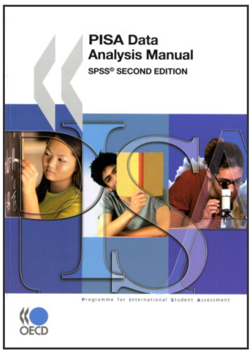
All syntaxes and macros in this manual can be copied from the PISA website (*www.pisa.oecd.org*). These macros were developed for SPSS 17.0. The 19 SPSS® macros presented in Chapter 17 need to be saved under "c:\pisa\macro\", before staring analysis. Each chapter of the manual contains a complete set of syntaxes, which must be done sequentially, for all of them to run correctly, within the chapter.

Rounding of figures

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

Country abbreviations used in this manual

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



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