

SPSS Syntax for Classical Item Analysis

Pui-Wa Lei and Qiong Wu

The Pennsylvania State University

CTTITEM_D.sps and CTTITEM_P.sps were developed for dichotomous item analysis and polytomous item analysis respectively. Use CTTITEM_D.sps for dichotomously scored items, and CTTITEM_P.sps for polytomously scored items. The following instructions on how to use the syntax apply to both cases.

How to run CTTITEM_D and CTTITEM_P

Input data

Input data should be in text format. The first line should contain the correct options for dichotomous items and the number of score categories for polytomous items (If you are analyzing data of the Likert type and need reverse scoring, the program assumes that your responses/scores for the polytomous items start from 1 with an interval of 1). For dichotomous items, item response data start from the second line with each line representing one case. For polytomous items, the second line instructs the program whether to reversely score the items (0) or not (1). Examinee scores start from the third line for polytomous items. Use a space for a missing value. Missing value will be treated as incorrect for the calculation of item and test statistics for dichotomous items. Listwise deletion is used for missing values in polytomous items.

The program will score dichotomous items as right (coded as '1') or wrong (coded as '0') based on the answer keys provided by the user. For polytomous items, the program will reversely score the items instructed by the user (i.e., '0's on the second line of the data file). For example, if the user would like to have high scores to represent high levels of the trait being measured, then a '1' should be entered on the second line of the data file for all positively stated items and a '0' for all negatively stated items. See MC.txt and polyitem.dat for examples of input data.

Syntax

A few changes need to be made to the syntax to fit the current data structure. They have been highlighted in bold in the syntax files included in the Appendices and are briefly described below.

1. File locations.

There are several file paths in the syntax. The first one specifies the location of the data file; all other file paths specify where you want to store and retrieve the intermediate results. We recommend that you use the same folder for the data as well as the output files. The easiest way to change all the file paths is to replace all "c:\temp" with the file path for your designated analysis folder using the SPSS "replace all" function.

2. Variable names:

In addition to the file paths, you need to change the variable names to fit the current data structure. They have all been highlighted, starting from the first one in the data list statement at the beginning of the syntax,

```
DATA LIST FILE='C:\temp\MC.TXT'
  / MC1 TO MC15 1-15.
```

“MC1 to MC15” assign names to the variables to be read from “MC.TXT”, and “1-15” indicate the location of the variables in the dataset. The example used one column for each variable, starting from the 1st to the 15th column.

Note: “MC1 TO MC15” can be used because all the variables are labeled consecutively. If the variables are not consecutively named, you should specify them separately (e.g., MC2 MC5 MC10 MC6).

Use the same rule to modify other places that have been highlighted. Make sure that variable names should be consistent across the syntax. Notice that variable list (e.g., MC1 to MC15) does not work in the CROSSTABS statement. You should list all the variable names (e.g., MC1 MC2 MC3 etc.) for the CROSSTABS statement at the end of the CTTITEM_D syntax file.

```
CROSSTABS
  /TABLES=GRP BY MC1 MC2 MC3 MC4 MC5 MC6 MC7 MC8 MC9 MC10 MC11 MC12 MC13
    MC14 MC15
```

Note: this syntax file does not calculate biserial correlation. Enzmann (2002) has written a SPSS macro to compute biserial correlation. It is accessible through http://www2.jura.uni-hamburg.de/instkrim/kriminologie/Mitarbeiter/Enzmann/Software/Enzmann_Software.html

Output

Outputs produced from our example data are available from the package. See MC_Output.spo for dichotomous items and polyitem_Output.spo for polytomous items.

The first part of the output includes the statistics of the total score distribution. Note that a normal distribution has a kurtosis of 0 in SPSS.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TOTAL SCORE	100	5.00	15.00	12.5900	2.43333	-1.054	.241	.571	.478
Valid N (listwise)	100								

The reliability analysis results that follow include Cronbach's alpha, summary statistics for inter-item correlations, and item-total statistics. The “corrected item-total correlation” is commonly called the corrected point-biserial correlation.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.727	.743	15

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.161	-.123	.652	.775	-5.298	.020	15

The covariance matrix is calculated and used in the analysis.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MC1	11.6300	5.569	.337	.	.716
MC2	11.6000	5.798	.235	.	.725
MC3	11.6200	5.632	.319	.	.719
MC4	11.6900	5.650	.125	.	.731
MC5	11.7400	5.204	.359	.	.710
MC6	11.8000	5.010	.406	.	.704
MC7	11.7600	5.134	.377	.	.708
MC8	11.6700	5.415	.340	.	.713
MC9	11.8800	4.975	.363	.	.710
MC10	11.8600	5.213	.250	.	.725
MC11	11.9400	4.966	.339	.	.714
MC12	11.7100	5.178	.428	.	.703
MC13	11.8100	5.044	.376	.	.708
MC14	11.7600	4.952	.492	.	.694
MC15	11.7900	5.137	.341	.	.712

P value and D-index are then listed for every item in its original order. (For polytomous items, *p value* is replaced by item mean and D_INDEX does not apply).

ITEM_NUM	PVALUE	D_INDEX
1	.96	.10
2	.99	.03
3	.97	.10
4	.90	.21
5	.85	.34
6	.79	.48
7	.83	.41
8	.92	.21
9	.71	.59

10	.73	.48
11	.65	.72
12	.88	.41
13	.78	.45
14	.83	.55
15	.80	.48

If your data are dichotomously scored, frequencies of options endorsed by the low- and high- scoring groups (distractor analysis) will be displayed.

GROUP * MC3 Crosstabulation

Count		MC3			Total
		1	3	4	
GROUP	HIGH	29	0	0	29
	LOW	26	1	2	29
Total		55	1	2	58

Note that only the options that are endorsed by at least one examinee in any of the two groups will appear in this cross table.

If your data are polytomously scored, score point frequencies for every item will be available.

IT1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	8.8	8.8	8.8
	2	22	27.5	27.5	36.3
	3	21	26.3	26.3	62.5
	4	13	16.3	16.3	78.8
	5	8	10.0	10.0	88.8
	6	9	11.3	11.3	100.0
Total		80	100.0	100.0	

In addition to the above statistics available from the output window, score information is also saved in separate datasets for later use. For dichotomous items, ITEMSCORE.sav and TOTSCORE.sav contain the item score and total score of every subject; PD.sav includes p value and D-index statistics for every item. For polytomous items, ITEMSCORE.sav contains information for both item score and total score.

Interpreting item statistics

Item difficulty. For dichotomous items, p-values range from 0 to 1 with a higher value indicating easier items. Mid range *p-values* (around .50) are desired for norm-referenced tests because they tend to produce larger score variances which in turn lead to higher score reliability estimates. For multiple-choice or true-false items where guessing may be a factor,

the optimal *p-value* is around $.50 + \frac{.50}{k}$, where k is the number of options and $.5/k$ is added to adjust for random guessing (e.g., Crocker & Algina, 1986, p.313). Because examinees do not actually guess randomly but eliminate options first before guessing, the actual optimal *p-value* is slightly higher than $.50 + \frac{.50}{k}$.

Discrimination indices. The D-index ranges from -1 to 1 with a higher value indicating stronger discriminating power. According to Ebel and Frisbie (1991), an item that has a D-index of .4 or higher is satisfactory, between .30 and .39 requires little or no revision, between .20 and .29 needs revision, and lower than .19 should probably be eliminated or completely revised. Point-biserial and biserial provide the item-total correlation information, and their difference is that biserial assumes a normal distribution of ability underlying the dichotomous responses. Biserial correlation is constantly larger than its point biserial counterpart (by at least 25%) and can be larger than one when the total scores are not normally distributed (e.g., Cohen, Cohen, West, & Aiken, 2003, p. 57). Biserial or point-biserial correlations should not be negative if the items are discriminating in the proper direction. Furthermore, Emslie and Emslie (2002) suggested that an adequately discriminating item should have corrected point-biserial correlation of .3 or larger (which is roughly equivalent to biserial correlation of .4 or larger).

Distractor analyses. For multiple-choice items, analysis of distractors can also provide useful information. If a multiple-choice item is functioning properly, more high-scoring than low-scoring examinees should choose the correct option, and the distractors should be equally plausible to examinees who do not know the correct answer (e.g., Aiken, 1997, p.65-85). Distractor analysis is often helpful in identifying miskeyed items (e.g., the high-scoring group selects a “distractor” more frequently than the “keyed” option), ambiguous options (e.g., the high-scoring group selects a distractor as frequently as the keyed option), blind guessing (e.g., responses of the high-scoring group distribute evenly among the alternatives), or examinee misconceptions (see Ebel & Frisbie, 1991 for more detailed discussion of option analysis).

REFERENCE

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- Ebel, R. L. & Frisbie, D. A. (1991). *Essentials of educational measurement, 5th ed.* Englewood Cliffs: Prentice-Hall.
- Emslie, J. R., & Emslie, G. R. (2002). *Using Statistical Criteria to Improve Classroom Multiple-Choice Tests: A Worked Example*. Retrieved January 8, 2006, from http://www.ccs.ryerson.ca/fac_staff/index.cfm?cblockID=1155
- Kelley, T. L. (1939). Selection of upper and lower groups for the validation of test items. *Journal of Educational Psychology*, 30, 17-24.

Appendix A

CTTITEM_D.sps -- SPSS syntax file for dichotomous items

DATA LIST FILE='C:\temp\MC.TXT'

/ MC1 TO MC15 1-15.

MISSING VALUES ALL ().

SET MXLOOPS=300 /MPRINT=NO.

*Change variable names, be consistent with the previous statement.

MATRIX.

GET RAW

/VARIABLES=MC1 TO MC15

/FILE=*

/MISSING=ACCEPT

/SYSMIS=-9.

COMPUTE NCASE=NROW(RAW)-1.

COMPUTE NITEM=NCOL(RAW).

COMPUTE SCORE=MAKE(NCASE,NITEM,0).

COMPUTE RAWN=MAKE(NCASE,NITEM,0).

/*****SCORING ITEMS*****/

LOOP N=2 TO NROW(RAW).

- LOOP I=1 TO NITEM.

- DO IF(RAW(N,I)=RAW(1,I)).

- COMPUTE SCORE((N-1),I)=1.

ELSE.

- COMPUTE SCORE((N-1),I)=0.

- END IF.

-END LOOP.

END LOOP.

LOOP N=2 TO NROW(RAW).

- LOOP I=1 TO NITEM.

- COMPUTE RAWN((N-1),I)=RAW(N,I).

-END LOOP.

END LOOP.

/*****COMPUTE TOTAL SCORE*****/

*Change file location('C:\temp') in the following several statements.

*It is recommended that you put all datasets in the same directory.

```
COMPUTE TOTSC=RSUM(SCORE).
```

```
SAVE TOTSC
```

```
/OUTFILE='C:\temp\TOTSCORE.SAV'
```

```
/VARIABLES=TOTSC.
```

```
*****
```

```
*Change variable names 'MC1 TO MC15', be consistent with previous statements.
```

```
*****
```

```
SAVE SCORE
```

```
/OUTFILE='C:\temp\ITEMSCORE.SAV'
```

```
/VARIABLES=MC1 TO MC15.
```

```
COMPUTE R=GRADE(TOTSC).
```

```
COMPUTE RSC={R,TOTSC}.
```

```
COMPUTE GRP=MAKE(NCASE,1,0).
```

```
COMPUTE #LOW=0.
```

```
COMPUTE LOWCUT=0.
```

```
LOOP I=1 TO NCASE.
```

```
-DO IF(RSC(I,1)/NCASE<=0.27) AND (LOWCUT<RSC(I,2)).
```

```
  COMPUTE LOWCUT=RSC(I,2).
```

```
  ELSE.
```

```
-END IF.
```

```
END LOOP.
```

```
LOOP I=1 TO NCASE.
```

```
-DO IF(RSC(I,2)<=LOWCUT).
```

```
-COMPUTE #LOW=#LOW+1.
```

```
-COMPUTE GRP(I,1)=3.
```

```
  ELSE.
```

```
-END IF.
```

```
END LOOP.
```

```
COMPUTE UPCUT=NITEM.
```

```
LOOP I=1 TO NCASE.
```

```
-DO IF(RSC(I,1)/NCASE>=0.73) AND (UPCUT>RSC(I,2)).
```

```
  COMPUTE UPCUT=RSC(I,2).
```

```
  ELSE.
```

```
-END IF.
```

```
END LOOP.
```

```
COMPUTE #UP=0.
```

```
LOOP I=1 TO NCASE.
```



```

-DO IF(RSC(I,2)>=UPCUT).
- COMPUTE GRP(I,1)=1.
- COMPUTE #UP=#UP+1.
  ELSE.
-END IF.
END LOOP.

```

```

*****

```

```

*Change file location 'C:\temp' and variable names 'MC1 to MC15'.

```

```

*Be consistent with previous statements.

```

```

*****

```

```

COMPUTE RAWGRP={GRP,RAWN}.

```

```

SAVE RAWGRP

```

```

/OUTFILE='C:\temp\RAWGRP.SAV'

```

```

/VARIABLES=GRP MC1 TO MC15.

```

```

COMPUTE ITEMGRP={GRP,SCORE}.

```

```

COMPUTE DINDEX=MAKE(NITEM,1,-9).

```

```

COMPUTE TOHI=MAKE(NITEM,1,0).

```

```

COMPUTE TOLO=MAKE(NITEM,1,0).

```

```

LOOP I=1 TO NITEM.

```

```

-LOOP N=1 TO NCASE.

```

```

-DO IF(ITEMGRP(N,1)=1).

```

```

-      COMPUTE TOHI(I,1)=ITEMGRP(N,I+1)+TOHI(I,1).

```

```

-ELSE.

```

```

-END IF.

```

```

-END LOOP.

```

```

END LOOP.

```

```

LOOP I=1 TO NITEM.

```

```

-LOOP N=1 TO NCASE.

```

```

-DO IF(ITEMGRP(N,1)=3).

```

```

-      COMPUTE TOLO(I,1)=ITEMGRP(N,I+1)+TOLO(I,1).

```

```

-ELSE.

```

```

-END IF.

```

```

-END LOOP.

```

```

END LOOP.

```

```

COMPUTE DINDEX=TOHI/#UP-TOLO/#LOW.

```

```

COMPUTE PVALUET=CSUM(SCORE)/NCASE.

```

```

COMPUTE PVALUE=TRANSPOS(PVALUET).

```

```

COMPUTE PD={PVALUE,DINDEX}.

```

```
*****.
*Change file location 'C:\temp'.
*****.
```

```
SAVE PD
/OUTFILE=C:\temp\PD.SAV'
/VARIABLES=PVALUE D_INDEX.
```

```
END MATRIX.
*****
*****.
*Change file location 'C:\temp'.
*****.
```

```
GET FILE=C:\temp\TOTSCORE.SAV'.
TITLE '*****'.
TITLE '**TEST STATISTICS--TOTAL SCORE DISTRIBUTION**'.
TITLE '*****'.
EXECUTE.
VARIABLE LABELS
TOTSC 'TOTAL SCORE'.
DESCRIPTIVES
  VARIABLES=TOTSC
  /STATISTICS=MEAN STDDEV MIN MAX SKEWNESS KURTOSIS.
EXECUTE.
```

```
*****.
*Change file location 'C:\temp'.
*****.
GET FILE=C:\temp\ITEMSCORE.SAV'.
TITLE '*****'.
TITLE '**RELIABILITY ANALYSIS**'.
TITLE '*****'.
EXECUTE.
RELIABILITY
  /VARIABLES=ALL
  /FORMAT=NOLABELS
  /SCALE(ALPHA)=ALL/MODEL=ALPHA
  /SUMMARY=TOTAL CORR.
```

```
EXECUTE.
*****.
*Change file location 'C:\temp'.
*****.
GET FILE=C:\temp\PD.SAV'.
TITLE '*****'.
```

TITLE '*****P VALUE AND DISCRIMINATION INDEX*****'.

TITLE '*****'.

EXECUTE.

COMPUTE ITEM_NUM=\$CASENUM.

FORMAT ITEM_NUM (F5.0).

LIST VARIABLES=ITEM_NUM PVALUE D_INDEX.

EXECUTE.

*****.

*Change file location 'C:\temp'.

*****.

GET FILE='C:\temp\RAWGRP.SAV'.

TITLE '*****'.

TITLE '*****DISTRACTOR ANALYSIS*****'.

TITLE '*****'.

EXECUTE.

VARIABLE LABELS

GRP 'GROUP'.

VALUE LABELS

GRP 1 'HIGH' 3 'LOW'.

USE ALL.

COMPUTE filter_\$=(GRP>0).

VARIABLE LABEL filter_\$ 'GRP>0 (FILTER)'.

VALUE LABELS filter_\$ 0 'Not Selected' 1 'Selected'.

FORMAT filter_\$ (f1.0).

FILTER BY filter_\$.

EXECUTE .

FORMAT ALL (F1.0).

MISSING VALUE ALL (-9).

*****.

*Change variable names:list all your item names after "BY"

*The abbreviated form does not work here.

*****.

CROSSTABS

/TABLES=GRP BY MC1 MC2 MC3 MC4 MC5 MC6 MC7 MC8 MC9 MC10 MC11 MC12 MC13 MC14 MC15

/FORMAT= AVALUE TABLES

/CELLS= COUNT

/COUNT ROUND CELL.

Appendix B

CTTITEM_P.sps -- SPSS syntax file for polytomous items

DATA LIST FILE='C:\temp\polyitem.DAT'

/ IT1 TO IT22 1-22.

MISSING VALUES ALL ().

SET MXLOOPS=300 /MPRINT=NO.

MATRIX.

GET RAW

/VARIABLES=IT1 TO IT22

/FILE=*

/MISSING=ACCEPT

/SYSMIS=-9.

COMPUTE NCASE=NROW(RAW)-2.

COMPUTE NITEM=NCOL(RAW).

COMPUTE SCORE=MAKE(NCASE,NITEM,0).

LOOP N=3 TO NROW(RAW).

- LOOP I=1 TO NITEM.

- DO IF RAW(N,I)=-9.

- COMPUTE SCORE(N-2,I)=-9.

- ELSE IF RAW(2,I)=1.

- COMPUTE SCORE((N-2),I)=RAW(N,I).

- ELSE IF RAW(2,I)=0.

- COMPUTE SCORE((N-2),I)=RAW(1,I)+1-RAW(N,I).

-END IF.

-END LOOP.

END LOOP.

*****COMPUTE TOTAL SCORE

SAVE SCORE

/OUTFILE='C:\temp\ITEMSCORE.SAV'

/VARIABLES=IT1 TO IT22.

END MATRIX.

GET FILE='C:\temp\ITEMSCORE.SAV'.

TITLE '*****'.

TITLE '*****TOTAL SCORE DISTRIBUTION*****'.

TITLE '*****'.

EXECUTE.

COMPUTE TOTSC=SUM(IT1 TO IT22).

DESCRIPTIVES

VARIABLES=TOTSC

/STATISTICS=MEAN STDDEV MIN MAX SKEWNESS KURTOSIS.

EXECUTE.

TITLE '*****'

TITLE '*****RELIABILITY ANALYSIS*****'

TITLE '*****'

EXECUTE.

MISSING VALUE ALL (-9).

RELIABILITY

/VARIABLES= IT1 TO IT22

/FORMAT=NOLABELS

/SCALE(ALPHA)=ALL/MODEL=ALPHA

/SUMMARY=TOTAL CORR .

EXECUTE.

TITLE '*****'

TITLE '*****ITEM MEAN FOR EVERY ITEM*****'

TITLE '*****'

EXECUTE.

DESCRIPTIVES

VARIABLES= IT1 TO IT22

/STATISTICS=MEAN.

EXECUTE.

FORMAT ALL (F1.0).

TITLE '*****'

TITLE '*****SCORE FREQUENCY DISTRIBUTION*****'

TITLE '*****'

EXECUTE.

FREQUENCIES

VARIABLES= IT1 TO IT22.

EXECUTE.
