

Obtaining Reliability Coefficients Using SPSS Syntax

In this document I explain how to use SPSS to obtain reliability coefficients using SPSS syntax.

The data for these examples are in the SPSS dataset “**test anxiety data.sav**” In this study, test anxiety was measured at three times during the semester in an introductory statistics class (these are called times 2, 3, and 4 in the dataset). The test anxiety items were administered immediately after a course exam at each time point.

There are 20 test anxiety items at each time point, labeled ta2_1, ta2_2, etc. The first number (2) refers to the administration time: 2 means it was administered after the 2nd exam. The number after the underscore is the item number. So, item ta3_20 is the 20th item from the scale administered after the 3rd exam. At the end of the dataset are three total scores, tai2ttl, tai3ttl, and tai4ttl. These are the total (sum) scores of the 20 items at times 2, 3, and 4. Missing values are coded as periods ‘.’. The items are shown at the end of this document. The items have been recoded in such a way that a higher value for each item indicates a higher level of test anxiety.

SPSS offers several options for calculating reliability coefficients. Your choice will depend on the type of reliability coefficient you want to obtain. Here I explain how to obtain values for coefficient alpha (internal consistency), coefficients of stability (test-retest), and coefficients of equivalence (alternate forms) reliability coefficients.

Coefficients of stability or equivalence can be calculated by simply correlating the two total scores from different time points or test forms. If the total scores have already been entered into your data set, the correlation between them can be obtained using the **bivariate** option under the **correlations** menu. If the data are entered as answers to individual items, you will first need to compute the total score. Instructions for computing total scores are included at the end of this document.

Coefficient Alpha

To obtain coefficient alpha in SPSS, you must have scores on each individual item on the scale, as shown in the test anxiety dataset.

The following syntax will provide the value of coefficient alpha, the inter-item correlation matrix, the average item variance and inter-item correlation, and values of the corrected item-total correlation and alpha-if-item-deleted for the first 10 test anxiety items at the first time point.

RELIABILITY

```
/VARIABLES=ta2_1 ta2_2 ta2_3 ta2_4 ta2_5 ta2_6 ta2_7 ta2_8 ta2_9 ta2_10  
/SCALE('ALL VARIABLES') ALL  
/MODEL=ALPHA  
/STATISTICS=CORR  
/SUMMARY=TOTAL VARIANCE CORR.
```

The subcommand **MODEL=ALPHA** requests coefficient alpha.
The subcommand **STATISTICS=CORR** requests the inter-item correlation matrix.
Under the subcommand **SUMMARY=TOTAL VARIANCE CORR**, the keyword **TOTAL** requests the corrected item-total correlations and alpha-if-item-deleted values, and the keywords **VARIANCE** and **CORR** request the mean variance and inter-item correlation.

These commands will result in the output below.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.886	.887	10

The value of coefficient alpha is .886, based on 10 items. The value in the column labeled **Cronbach's Alpha Based on Standardized Items** should only be interpreted if all items are in z-score form or another form in which item standard deviations are equal.

Inter-Item Correlation Matrix

	ta2_1	ta2_2	ta2_3	ta2_4	ta2_5	ta2_6	ta2_7	ta2_8	ta2_9	ta2_10
ta2_1	1.000	.479	.436	.503	.313	.330	.515	.455	.433	.361
ta2_2	.479	1.000	.460	.497	.414	.421	.480	.521	.525	.372
ta2_3	.436	.460	1.000	.519	.426	.375	.570	.417	.423	.373
ta2_4	.503	.497	.519	1.000	.414	.512	.551	.519	.477	.369
ta2_5	.313	.414	.426	.414	1.000	.373	.439	.323	.313	.287
ta2_6	.330	.421	.375	.512	.373	1.000	.497	.372	.318	.364
ta2_7	.515	.480	.570	.551	.439	.497	1.000	.526	.434	.452
ta2_8	.455	.521	.417	.519	.323	.372	.526	1.000	.590	.486
ta2_9	.433	.525	.423	.477	.313	.318	.434	.590	1.000	.503
ta2_10	.361	.372	.373	.369	.287	.364	.452	.486	.503	1.000

This is the matrix of intercorrelations among all the items. Because alpha is determined largely by the magnitude of these correlations, examination of the matrix gives us an idea of how large alpha might be. Here we can see that the inter-item correlations are mostly in the moderate range.

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Variances	.692	.569	.842	.273	1.479	.009	10
Inter-Item Correlations	.439	.287	.590	.304	2.060	.006	10

The table above shows the means of the item variances and inter-item correlations across the 10 items. These values are useful in gauging the relative amounts of variance and correlation of the different items. Although somewhat simplistic, items with variances/correlations below the mean could be considered to have relatively “low” values, whereas items with values above the mean could be considered to have relatively “high” values.

The average item variance across the 10 items is .692, and the average inter-item correlation is .439.

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
ta2_1	17.50	27.693	.599	.389	.877
ta2_2	18.04	28.185	.658	.454	.872
ta2_3	18.06	28.041	.627	.430	.874
ta2_4	18.11	27.444	.690	.504	.870
ta2_5	18.53	29.420	.507	.292	.882
ta2_6	18.17	28.903	.551	.363	.880
ta2_7	18.13	27.460	.709	.533	.869
ta2_8	17.85	27.570	.669	.496	.871
ta2_9	17.82	27.223	.634	.476	.874
ta2_10	17.70	28.094	.557	.357	.880

The value of alpha, from the previous output, is .886. The numbers in the column labeled **Corrected Item-Total Correlation** are the correlation of that item with the total score (the sum of all the items). The “correction” is that the item being correlated with the total is not included in the total. For example, for tai2_1, the corrected item-total correlation is the correlation of tai2_1 with the sum of the other nine items.

The values under **Cronbach's Alpha If Item Deleted** tell us what the value of alpha would be if that item were not included on the scale. If alpha goes up when an item is left out of the scale, the item does not fit well on the scale because it is resulting in a lower scale reliability.

This may be because the item is measuring a somewhat different construct, or a different aspect of the construct. Other reasons for low values are that the item lacks variance or has a distribution that is different from that of most other items.

The items all have moderate to high corrected item-total correlations. In addition, none of the 10 items results in a value of alpha-if-item-deleted that is lower than the overall alpha value of .886. These results are not surprising given the moderate to high values of the inter-item correlations discussed previously. Coefficient alpha is driven primarily by the level of these correlations, resulting in the high value of .886 seen here.

Coefficients of Stability

Coefficients of stability, or test-retest reliability coefficients, are simply the correlations of total scores obtained at two different timepoints. There are three total test anxiety scores in this dataset. These were obtained by summing the item scores obtained at each of the three timepoints: after the second, third, and fourth examinations in an introductory statistics class. If total scores are not included in a dataset, these can be obtained by using the instructions under “Obtaining Total Scores” at the end of this document.

Correlations among the three total scores can be obtained using the following syntax:

CORRELATIONS

/VARIABLES=tai2ttl tai3ttl tai4ttl.

Running these commands will result in the output below.

Correlations

		tai2ttl	tai3ttl	tai4ttl
tai2ttl	Pearson Correlation	1	.850**	.806**
	Sig. (2-tailed)		.000	.000
	N	295	223	230
tai3ttl	Pearson Correlation	.850**	1	.849**
	Sig. (2-tailed)	.000		.000
	N	223	237	207
tai4ttl	Pearson Correlation	.806**	.849**	1
	Sig. (2-tailed)	.000	.000	
	N	230	207	248

** . Correlation is significant at the 0.01 level (2-tailed).

The correlations (stability coefficients) for taittl2 and taittl3 and for taittl3 and taittl4 are quite high, at .850 and .849, respectively. The coefficient for taittl2 and taittl4 is somewhat lower, at .806. This likely reflects the longer time interval between these two scores. Recall

that test-retest reliability is affected by the length of time between administration times, with longer intervals typically resulting in lower values of the coefficients.

Pairwise deletion is the default missing data treatment for the **correlations** command. In pairwise deletion, cases are included in the computation of the correlation for any pair of variables for which they have complete data. In contrast, in listwise missing data treatment cases are excluded from the computation of all correlations if the cases have missing data on any of the variables. For example, if a person had missing data for tai2ttl but had data for tai3ttl and tai4ttl, under pairwise deletion that person's data would be included in the correlation of tai3ttl and tai4ttl, but would not be included in the computation of any other correlations. Under listwise deletion, the person's data would not be included in the computation of any of the correlations.

Coefficients of Equivalence

Coefficients of equivalence are simply the correlations of total scores obtained from two parallel versions, or forms of the same test. Coefficients of equivalence can be obtained in the same way as coefficients of stability, by correlating the total scores from the two forms.

Obtaining Total Scores

For datasets that only include item scores, total scores can be obtained from the *compute* command. There are several ways of obtaining total scores and these differ in how missing values are handled.

The syntax for the first method is:

```
COMPUTE total=sum(ta2_1,ta2_2,ta2_3,ta2_4,ta2_5,ta2_6,ta2_7,ta2_8,ta2_9,ta2_10).  
EXECUTE.
```

In this method, the total will be computed from all items with non-missing values for each respondent. Thus, if a respondent has only answered 5 of the 10 items, that respondent's total score would be the sum of only the five items without missing values. (Respondents who do not answer any of the items are given missing values for the total score).

The syntax for the second method is:

```
COMPUTE total= ta2_1 + ta2_2 + ta2_3 + ta2_4 + ta2_5 + ta2_6 + ta2_7 + ta2_8 + ta2_9  
+ ta2_10).  
EXECUTE.
```

In this method, the total score will be designated as missing if *any* item score is missing. Thus, if a respondent had missing data for one of the 10 items they would be given a

missing value for the total score, even though their data for the other nine items was complete.

Finally, the **sum** keyword can be modified so that you can control the number of valid (nonmissing) responses a person must have to obtain a total score. For example, the syntax below will create a total score if a person has valid data on at least eight of the 10 items. Respondents with fewer than eight valid responses will be given a missing value for the total.

```
COMPUTE total = sum.8(ta2_1, ta2_2, ta2_3, ta2_4, ta2_5, ta2_6, ta2_7, ta2_8, Ta2_9,  
ta2_10).
```

```
EXECUTE.
```

Test Anxiety Items

A number of statements that people have used to describe their feelings about taking tests are given below. Please read each statement and then mark the category that indicates how you felt when taking this exam. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe how you felt about taking this test. Use the following codes for your answers:

- 1 = almost never
- 2 = sometimes
- 3 = often
- 4 = almost always

- _____ 1. I feel confident and relaxed while taking tests.
- _____ 2. While taking examinations I have an uneasy, upset feeling.
- _____ 3. Thinking about my grade in a course interferes with my work on tests.
- _____ 4. I freeze up on important exams.
- _____ 5. During exams I find myself thinking about whether I'll ever get through school.
- _____ 6. The harder I work at taking a test, the more confused I get.
- _____ 7. Thoughts of doing poorly interfere with my concentration on tests.
- _____ 8. I feel very jittery when taking an important test.
- _____ 9. Even when I'm well prepared for a test, I feel very nervous about it.
- _____ 10. I start feeling very uneasy just before getting a test paper back.
- _____ 11. During tests I feel very tense.
- _____ 12. I wish examinations did not bother me so much.
- _____ 13. During important tests I am so tense that my stomach gets upset.
- _____ 14. I seem to defeat myself while working on important tests.
- _____ 15. I feel very panicky when I take an important test.
- _____ 16. I worry a great deal before taking an important examination.
- _____ 17. During tests I find myself thinking about the consequences of failing.
- _____ 18. I feel my heart beating very fast during important tests.
- _____ 19. After an exam is over I try to stop worrying about it, but I just can't.
- _____ 20. During examinations I get so nervous that I forget facts I really know.