

Obtaining Item Analysis Statistics for Noncognitive Items Using SAS

In this document I explain how to use SAS syntax to obtain item analysis statistics for noncognitive items.

The data for this example are from a scale measuring Attitudes Toward Same Sex Marriage that was developed as a class project. Some of the items were deliberately written to violate the item writing guidelines on pages 90-93 of the book. The items are shown at the end of this document. Items that were recoded are indicated with "R."

Data are in the file "Samesex.sas7bdat." Recoded items are indicated by the suffix "r."

For noncognitive items, a thorough item analysis includes examination of item frequency distributions; descriptive statistics, including the mean, standard deviation, skewness, and kurtosis values, inter-item correlations, corrected item-total correlations; and values of alpha-if-item-deleted.

Obtaining Descriptive Statistics using *Proc Means*

Both **proc means** and **proc univariate** can be used to obtain descriptive statistics. Here I use **proc means** because it allows me to choose only the statistics I want, whereas **proc univariate** produces a great deal of output that is not needed for item analysis.

The syntax below requests the mean, standard deviation, skewness, and kurtosis.

```
proc means data= samesex maxdec=2 mean std skew kurt;  
variables att1 att2 att3r att4 att5 att6r att7 att8r att9 att10r att11 att12 att13r att14 att15r  
att16 att17 att18r att19r att20r att21 att22 att23r;  
run;
```

The output is shown below:

Variable	Label	Mean	Std Dev	Skewness	Kurtosis
att1	att1	3.52	1.44	-0.64	-0.99
att2	att2	3.25	1.48	-0.27	-1.32
att3r	att3r	3.49	1.50	-0.53	-1.18
att4	att4	2.81	1.39	0.18	-1.19
att5	att5	3.48	1.36	-0.53	-0.81
att6r	att6r	3.63	1.41	-0.65	-0.93
att7	att7	3.59	1.35	-0.64	-0.84
att8r	att8r	3.24	1.49	-0.27	-1.38
att9	att9	3.08	1.49	-0.03	-1.48
att10r	att10r	3.61	1.27	-0.52	-0.81
att11	att11	3.17	1.27	-0.22	-0.81
att12	att12	3.39	1.42	-0.47	-1.12
att13r	att13r	3.33	1.25	-0.18	-0.92
att14	att14	2.89	1.48	0.12	-1.37
att15r	att15r	1.96	0.78	0.62	0.20
att16	att16	3.44	1.36	-0.42	-1.06
att17	att17	3.48	1.36	-0.52	-0.90
att18r	att18r	1.74	0.70	0.78	0.81
att19r	att19r	3.61	1.41	-0.52	-1.14
att20r	att20r	3.05	1.55	-0.07	-1.53
att21	att21	3.23	1.39	-0.16	-1.24
att22	att22	3.91	1.19	-0.89	-0.09
att23r	att23r	4.21	1.12	-1.36	1.05

Items with small standard deviations relative to the other items may be problematic because a small standard deviation indicates a lack of variability. The purpose of most noncognitive scales is to spread responses out along the entire range of the construct. By definition, items that lack variability do not have a good spread of responses. A lack of variability means that respondents' answers are very similar, and the item is therefore not doing its job of spreading people out across the construct's continuum.

Items 15r and 18r have standard deviations that are approximately half those of the other items. These two items read:

15r. There is more support for same-sex civil unions in today's society than there was 30 years ago.

18r. Many people disapprove of same-sex marriages.

Item 15r violates two item writing principles: *Avoid items that refer to the past* and *Avoid statements that are factual*. Respondents may not be familiar with attitudes from 30 years ago. Also, the level of support today versus 30 years ago is, presumably, a matter of historical record and therefore factual. For both of these reasons, many respondents may simply agree with the item or choose the neutral option.

Item 18r can also be interpreted as factual in the sense that data could supply an answer if such data were available. However, respondents are unlikely to have access to these data. Also, the item is written in such a wishy-washy way that it is difficult to disagree with it. Its low standard deviation is likely due to the fact that most respondents did agree with it.

High values of skewness indicate that most respondents have answered on the same side of the scale (either agree or disagree). This can be problematic for the same reason that low standard deviations can be problematic: high skewness indicates that responses are not well spread out.

High positive values of kurtosis indicate that responses are piled up at one response option or at adjacent response options. Again, this lack of spread may be problematic. In contrast, high negative values for kurtosis indicate that items are spread fairly evenly across the response options, which is generally a good thing.

A common cutoff value for “high” skew and kurtosis is $|2.0|$. Using this value, none of the values in the tables above are problematic. The highest value for skew is for item 23r at -1.358 . A negative skewness value indicates that responses are mainly at the positive, or agreement, end of the scale. However, this item has been recoded such that the values 1,2,3,4, and 5 have been changed to 5,4,3,2, and 1 (see the document “Recoding Items Using SAS” for more information on this topic). So, the negative skew in this case means most respondents answered at the *disagree* end of the scale. The item reads:

Gay people are incapable of monogamous relationships.

Given the item’s skewness value, respondents tended to disagree with this item.

Items 2, 8r, 9, and 20r have the highest values of kurtosis, although the values are not above the $|2.0|$ cutoff. However, these values are all negative, indicating a fairly even spread of responses across the five response options. The frequency distribution for item 2 is presented in the next section to illustrate this.

Obtaining Frequency Distributions Using Proc Freq

The syntax below will produce frequency distributions for each item:

```
proc freq data= samesex;  
  tables att1 att2 att3r att4 att5 att6r att7 att8r att9 att10r att11 att12 att13r att14 att15r  
att16 att17 att18r att19r att20r att21 att22 att23r;  
run;
```

In the interest of saving space, I do not present all the frequency distributions. Instead, I show those that indicate common problems. First, I show the distribution for item 2, which has a somewhat high, but negative value of kurtosis. This indicates a relatively equal spread of responses across the five response options, as can be seen in the table.

att2				
att2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	18	18.95	18	18.95
2	13	13.68	31	32.63
3	18	18.95	49	51.58
4	19	20.00	68	71.58
5	27	28.42	95	100.00

The distribution for item 11 illustrates two related problems. First, a large percentage (34.8%) of respondents chose option 3, labeled as *neutral*. This is often an indication that respondents are confused by the item. This interpretation is supported by the fact that 6 respondents did not answer the item. The item reads:

To ensure equal rights and to satisfy the heterosexual population who is against gay marriage, civil unions should be legal in all 50 states.

This is a classic example of a double-barreled item, and it is easy to see why it may have been confusing to some respondents. And frankly, the item does not make much sense.

att11				
att11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	13	14.61	13	14.61
2	10	11.24	23	25.84
3	31	34.83	54	60.67
4	19	21.35	73	82.02
5	16	17.98	89	100.00
Frequency Missing		= 6		

Item 15r was earlier flagged for its low standard deviation, and its frequency distribution reveals why. Nearly 96% of respondents answered 1, 2, or 3, or, because the item was recoded, these answers were actually 5, 4, or 3, indicating strong agreement with the item, which was worded:

There is more support for same-sex civil unions in today's society than there was 30 years ago.

att15r				
att15r	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	27	28.42	27	28.42
2	49	51.58	76	80.00
3	15	15.79	91	95.79
4	4	4.21	95	100.00

Item 23r (*Gay people are incapable of monogamous relationships*) had a moderate negative skew, indicating (because of its recoding) that most responses were at the disagree end of the scale. Its frequency distribution is shown below:

att23r				
att23r	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	4	4.21	4	4.21
2	4	4.21	8	8.42
3	15	15.79	23	24.21
4	17	17.89	40	42.11
5	55	57.89	95	100.00

Keeping in mind the item's recoding, nearly 76% of respondents chose options 1 (*strongly disagree*) or 2 (*disagree*).

Obtaining Correlations, Corrected Item-total Correlations, and Alpha-if-item-deleted values Using *Proc Corr*

Proc Corr can be used to obtain an inter-item correlation matrix, the value of coefficient alpha, and a table of item statistics including the values of the corrected item-total correlation (**Correlation with total**) and the value of alpha-if-item deleted (**Alpha**). The syntax is:

```
proc corr data= samesex alpha nomiss;
var att1 att2 att3r att4 att5 att6r att7 att8r att9 att10r att11 att12 att13r att14 att15r att16
att17 att18r att19r att20r att21 att22 att23r;
run;
```

The option **alpha** requests the value of coefficient alpha, corrected item-total correlation, and value of alpha-if-item-deleted.

The option **nomiss** invokes listwise deletion.

I show only part of the correlation matrix in the interest of space. Note the extremely low correlations of items 13r, 15r, and 18r with most of the other items. The latter two items were flagged previously because of their low standard deviations and lack of spread across response options.

	att13r	att14	att15r	att16	att17	att18r
att1 att1	-0.11432 0.2946	0.72319 <.0001	0.06190 0.5713	0.79159 <.0001	0.80750 <.0001	0.16804 0.1220
att2 att2	-0.04158 0.7038	0.65736 <.0001	0.04441 0.6847	0.71476 <.0001	0.83589 <.0001	0.15314 0.1592
att3r att3r	0.00823 0.9401	0.62461 <.0001	0.19594 0.0706	0.65359 <.0001	0.56659 <.0001	0.20219 0.0619
att4 att4	-0.00328 0.9761	0.53103 <.0001	-0.00434 0.9683	0.57763 <.0001	0.43974 <.0001	-0.13582 0.2124
att5 att5	-0.07979 0.4652	0.58473 <.0001	0.11893 0.2754	0.83082 <.0001	0.71506 <.0001	0.11245 0.3026
att6r att6r	-0.10438 0.3388	0.73780 <.0001	0.04361 0.6901	0.81053 <.0001	0.79412 <.0001	0.14388 0.1863
att7 att7	-0.10496 0.3362	0.61066 <.0001	-0.00941 0.9315	0.79763 <.0001	0.69785 <.0001	0.12081 0.2678
att8r att8r	0.05637 0.6062	0.72881 <.0001	0.07413 0.4976	0.71220 <.0001	0.66449 <.0001	0.21694 0.0448
att9 att9	0.17996 0.0973	0.73388 <.0001	0.16129 0.1379	0.63228 <.0001	0.61743 <.0001	0.18248 0.0926
att10r att10r	0.06562 0.5483	0.66830 <.0001	-0.02153 0.8440	0.65969 <.0001	0.73145 <.0001	0.15869 0.1445
att11 att11	-0.40629 0.0001	0.43699 <.0001	-0.05462 0.6174	0.70540 <.0001	0.56815 <.0001	0.09980 0.3606
att12 att12	-0.11281 0.3011	0.71949 <.0001	0.01855 0.8654	0.80959 <.0001	0.77364 <.0001	0.14031 0.1976

The next table shows the values of the corrected item-total correlation (*Correlation with total*) and the value of alpha-if-item deleted (*Alpha*). The values under the heading “raw variables” should be used unless variables have been standardized (i.e., converted to z-scores or into some other standardized metric). Because standardizing prior to analysis is not common, the values for raw variables are typically used.

Cronbach Coefficient Alpha with Deleted Variable					
Deleted Variable	Raw Variables		Standardized Variables		Label
	Correlation with Total	Alpha	Correlation with Total	Alpha	
att1	0.877815	0.953042	0.875174	0.947312	att1
att2	0.783849	0.954188	0.783406	0.948454	att2
att3r	0.734405	0.954816	0.736170	0.949037	att3r
att4	0.573251	0.956624	0.560913	0.951170	att4
att5	0.767173	0.954434	0.767805	0.948647	att5
att6r	0.900696	0.952786	0.896493	0.947045	att6r
att7	0.770521	0.954396	0.766462	0.948664	att7
att8r	0.851880	0.953326	0.848817	0.947641	att8r
att9	0.777129	0.954273	0.777851	0.948523	att9
att10r	0.804979	0.954104	0.799936	0.948249	att10r
att11	0.603848	0.956236	0.595846	0.950748	att11
att12	0.864708	0.953237	0.861255	0.947486	att12
att13r	0.010060	0.962163	0.008380	0.957602	att13r
att14	0.844233	0.953446	0.845025	0.947689	att14
att15r	0.070435	0.960010	0.068858	0.956919	att15r
att16	0.854345	0.953423	0.850367	0.947622	att16
att17	0.823536	0.953777	0.824070	0.947950	att17
att18r	0.185000	0.959157	0.183074	0.955616	att18r
att19r	0.793869	0.954104	0.791308	0.948356	att19r
att20r	0.818103	0.953740	0.820971	0.947988	att20r
att21	0.579862	0.956578	0.574179	0.951010	att21
att22	0.514987	0.957104	0.510334	0.951777	att22
att23r	0.602303	0.956254	0.600590	0.950691	att23r

The value of coefficient alpha for the 23-item scale is .957, which is quite high given the poor quality of many of the items. The high value for alpha is likely driven by the large number of items.

Based on the corrected item-total correlation and alpha-if-item deleted values, the three worst-performing items on the scale are 13r, 15r, and 18r. All three items have low corrected item-total correlations, supporting our earlier observation that they appear to have low correlations with most of the other items. The value of coefficient alpha would

increase slightly if any of the three items were removed from the scale, indicating that the three items are decreasing, rather than increasing, reliability.

Interestingly, all three items were reverse coded. Items 15r and 18r were flagged previously because of their low standard deviations. Item 13r reads:

Same-sex marriage should not be legalized, but civil unions that provide tax benefits should be allowed in order to be fair.

The wording is somewhat double-barreled and was likely confusing to respondents, as evidenced by its frequency distribution. As can be seen from the frequency distribution below, nearly 31% of respondents chose the neutral response option. Such large percentages of neutral response often signal a confusing item.

att13r				
att13r	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	8	8.51	8	8.51
2	16	17.02	24	25.53
3	29	30.85	53	56.38
4	19	20.21	72	76.60
5	22	23.40	94	100.00
Frequency Missing = 1				

Attitudes Toward Same Sex Marriage Items

Please respond to the following questions using the scale below. Place the number that best corresponds to your answer in the space next to each statement.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- _____ 1. Civil unions between same-sex couples should be legal.
- _____ 2. Same-sex couples should be able to adopt children together.
- __R__ 3. I believe homosexuality is sinful.
- _____ 4. I feel that same-sex marriage should be legal, but should be left up to the individual church.
- _____ 5. Same-sex couples should be recognized under Domestic Partnership laws.
- __R__ 6. Same-sex civil unions should **not** be legal in the United States.
- _____ 7. People in same-sex civil unions should have the same benefits as those in heterosexual marriages.
- __R__ 8. Same-sex marriage is morally wrong.
- _____ 9. Same-sex marriage should be legal in order to allow homosexual partners to have the same rights as heterosexual partners.
- __R__ 10. The homosexual culture has a negative effect on society.
- _____ 11. To ensure equal rights and to satisfy the heterosexual population who is against gay marriage, civil unions should be legal in all 50 states.
- _____ 12. I believe that same-sex civil unions should be allowed in all 50 states in the U.S.
- __R__ 13. Same-sex marriage should not be legalized, but civil unions that provide tax benefits should be allowed in order to be fair.
- _____ 14. I believe that same-sex marriage should be allowed in all 50 states in the U.S.
- __R__ 15. There is more support for same-sex civil unions in today's society than there was 30 years ago.
- _____ 16. A civil union should be granted the same rights as a heterosexual marriage.

_____ 17. The partner of a gay person who has children should be allowed to legally adopt those children.

__R__ 18. Many people disapprove of same-sex marriages.

__R__ 19. I do not believe that same-sex marriages should be allowed in any state or country, or that same-sex partners should be allowed any tax or health benefits.

__R__ 20. Marriage should be legal only between a man and a woman.

_____ 21. Prohibiting same-sex marriages strips away the constitutional rights of homosexuals.

_____ 22. Everyone should have the right to marriage.

__R__ 23. Gay people are incapable of monogamous relationships.