Problems with the Use of Chronbach's Alpha as a Test of Scale Reliability for Social Science Surveys

Dr. J A Simcox

D.Phil, L.L.M., BA, ACMA, DipM. MCIM,

Academic Director Asia, Mountbatten Institute Bangkok and St Mary's, University, London, England

Abstract: **Students who undertake quantitative or mixed methods research within the fields of Social Science are usually instructed to test the reliability of their survey scales. The most common method used is Chronbach's alpha. In fact it is the default test for scale reliability in SPSS. This article proposes that a traditional alpha analysis may be unsuitable for Social Science research as it's output often causes students to wrongly doubt the validity of their quantitative analysis. A high response, low response Chronbach's alpha analysis is suggested as a solution to this problem.**

Keywords: **Scale reliability test, Chronbach's Alpha, Social Science research.**

1. MAIN BODY

A Chronbach's alpha test or the reliability coefficient is usually used by student's to measure the internal consistency between the multiple measurements of the variables in a questionnaire. According to Hair et al. (2015) this test is the most widely used to assess the consistency of the entire scale.

Cronbach's alpha ranges in value from 0 to 1 and used to describe the reliability of factors extracted from questionnaires. According to Gliem and Gliem (2003), the closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale.

The following rules of thumb indicated acceptable of Cronbach's alpha coefficient: "_ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor, and _ < .5 – Unacceptable" (Gliem and Gliem (2003)).

However it must be remembered that this is a rough rule of thumb. Students often get concerned when they discover their scale variables have a low alpha. This paper explains why a low alpha may result due to the nature of the alpha calculation, which is based on the variance between responses to each survey question, eg covariance analysis.

The alpha is a numeric calculation it has no way of knowing the nature of the questions that the student asks in the questionnaire. The alpha analyses the responses in order to attempt to determine if the similarity of response to questions indicates that the questions are understood and the survey is measuring what it intends to measure. The alpha calculation has limited tolerance for inverse responses. Inverse responses result in high co-variances and could well be the most common reason for a low alpha score within Social Sciences. This low scale does not mean your analysis is not reliable but rather indicates a weakness in survey design.

In the test exercise below five variables were created and given the same score for each question.

	a	b	c	d	e	var
	8.00	8.00	8.00	8.00	8.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	
	7.00	7.00	7.00	7.00	7.00	

Variable View

The Alpha calculated from this data was a perfect 1. The calculation sees no variance in responses by variable.

Reliability Statistics

Cronbach's Alpha	N of Items
1.000	5

This is irrespective of any variance in responses to each individual question. If some respondents, respond high and others low to a questions this will not substantially effect the alpha. Within the physical sciences this could be expected, but within Social science this may indicate a weakness in the Alpha's presumed goal of are you measuring what you expect to measure as some level of consistency in response may be expected in Social Science research. See below

	a	b	c	d	e
1	8.00	8.00	8.00	7.00	7.00
2	7.00	7.00	7.00	7.00	7.00
3	7.00	7.00	7.00	7.00	7.00
4	7.00	7.00	7.00	7.00	7.00
5	7.00	7.00	7.00	7.00	7.00
6	7.00	7.00	7.00	7.00	7.00
7	7.00	7.00	7.00	7.00	7.00
8	3.00	3.00	3.00	3.00	3.00
9	3.00	3.00	3.00	3.00	3.00
10	3.00	3.00	3.00	3.00	3.00
11	3.00	3.00	3.00	3.00	3.00
12	3.00	3.00	3.00	3.00	3.00
13	3.00	3.00	3.00	3.00	3.00
14	3.00	3.00	3.00	3.00	3.00
15	3.00	3.00	3.00	3.00	3.00
16					
17					
18					

Data View Variable View

In the data above the responses are fairly evenly split between high and low responses, the alpha is below

Reliability Statistics

Cronbach's Alpha	N of Items
.999	5

Where students will find problems with a low alpha is where scale measurements are inverted. Then large variances will appear between responses producing a low alpha score. The tolerance of the alpha co-variance formula is limited.

Below only one variable is inverted.

	a	b	c	d	e	v
1	8.00	8.00	8.00	8.00	1.00	
2	7.00	7.00	7.00	7.00	1.50	
3	7.00	7.00	7.00	7.00	1.50	
4	7.00	7.00	7.00	7.00	1.50	
5	7.00	7.00	7.00	7.00	1.50	
6	7.00	7.00	7.00	7.00	1.50	
7	7.00	7.00	7.00	7.00	1.50	
8	7.00	7.00	7.00	7.00	1.50	
9	7.00	7.00	7.00	7.00	1.50	
10	7.00	7.00	7.00	7.00	1.50	
11	7.00	7.00	7.00	7.00	1.50	
12	7.00	7.00	7.00	7.00	1.50	
13	7.00	7.00	7.00	7.00	1.50	
14	7.00	7.00	7.00	7.00	1.50	
15	7.00	7.00	7.00	7.00	1.50	
16						
17						
18						

Data View Variable View

The alpha calculation tolerates this.

Reliability Statistics

Cronbach's Alpha	N of Items
.816	5

However when 2 or more variables are inverse it does not.

	a	b	c	d	e	va
1	8.00	8.00	8.00	1.00	1.00	
2	7.00	7.00	7.00	1.50	1.50	
3	7.00	7.00	7.00	1.50	1.50	
4	7.00	7.00	7.00	1.50	1.50	
5	7.00	7.00	7.00	1.50	1.50	
6	7.00	7.00	7.00	1.50	1.50	
7	7.00	7.00	7.00	1.50	1.50	
8	7.00	7.00	7.00	1.50	1.50	
9	7.00	7.00	7.00	1.50	1.50	
10	7.00	7.00	7.00	1.50	1.50	
11	7.00	7.00	7.00	1.50	1.50	
12	7.00	7.00	7.00	1.50	1.50	
13	7.00	7.00	7.00	1.50	1.50	
14	7.00	7.00	7.00	1.50	1.50	
15	7.00	7.00	7.00	1.50	1.50	
16						
17						
18						

Data View Variable View

Page | 227

Reliability Statistics

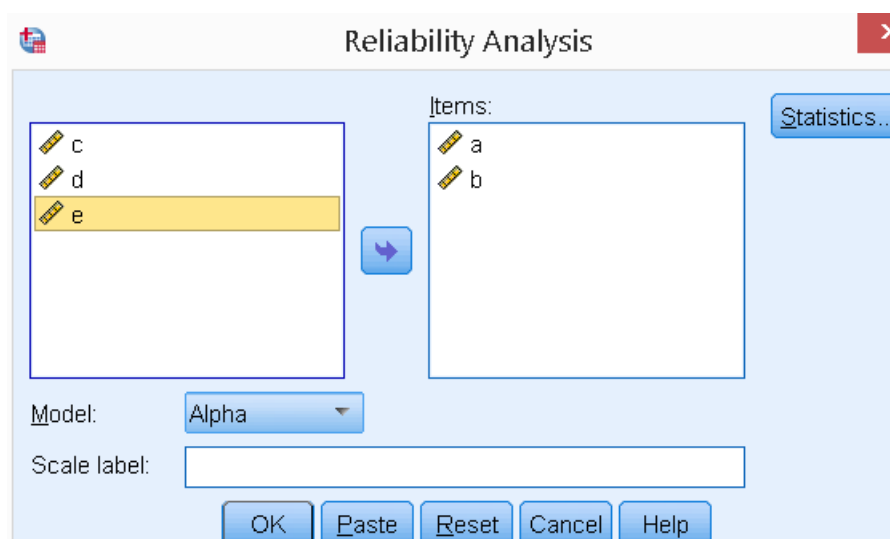| Cronbach's Alpha	N of Items
.156	5

The last of these producing what students then believe is a poor alpha score creating doubt as to the worth of their analysis.

2. THE SOLUTION

The obvious solution is for students to take more care in their survey design and avoid inverted scores in their survey data. This should result in a high alpha score and they will be happy. This may not be possible if the student is wrong or has no prior knowledge about how respondent's are likely to respond to a question.

In the later case, the solution I recommend is that students use an amended High response/Low response Chronbach's alpha test. In essence this is two tests. Scale questions with average of above the middle of the scale (usually 5 or 50) should be tested together in group a and the aplha calculated. So below group a would be the alpha for variables a,and b

a	b	c	d	e
8.00	8.00	2.00	2.00	2.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00
7.00	7.00	3.00	3.00	3.00

Reliability Analysis

Items:
- c
- d
- e

a
b

Statistics...

Model: Alpha

Scale label:

OK   Paste   Reset   Cancel   Help

And the resulting alpha for High Variables is;

Reliability Statistics

Cronbach's Alpha	N of Items
1.000	2

The a second Low variables alpha should be run testing variables c, d, e,, the calculations also below,

Reliability Statistics

Cronbach's Alpha	N of Items
1.000	3

Note when the alpha was run for all variables, high and low the following score resulted.

Reliability Statistics

Cronbach's Alpha[a]	N of Items
-5.000	5

The negative score being due to a negative covariance. Eg more respondents responded low rather than high to the questions.

3. CONCLUSIONS

The use of Chronbach's alpha as a test of scale reliability within Social Science research is worthy of a wide debate, and one this paper does not attempt to address. The fact is that students are instructed to use it by SPSS tutors and Dissertation supervisors. This paper just attempts to highlight the weaknesses of this method and suggest a solution for students.

REFERENCES

[1] Hair, J. F., Celsi, M., Money, A. H., Samouel, P., & Page, M. (2015). The essentials of business research methods. Third edition. New York: Routledge.

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