



CRONBACH ALPHA IS AN INSTRUMENT TO ASSESS THE RELIABILITY OF A LIKERT SCALE IN THE CONTEXT OF BUSINESS RESEARCH

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ABSTRACT

While collecting data or information on various fields of research in the social sciences, marketing, medicine, business etc, the researchers face difficulty in measurement relating to attitudes, emotions, opinions, personalities, and so on. Specially when the concepts involve description's of people's environment they are complex and abstract in nature.

In the process of constructing a measure for such problems researchers tend to develop customised scales for measurement. As individuals attempt to quantify constructs which are not directly measurable they often use multiple-item scales and summated ratings to quantify the construct(s) of interest. Especially when attitudes, opinions etc are required to be measured we use multiple item summated scales following the pattern of a Likert scale, having 3, 4 or 5 point scales.

The Likert scale's invention is attributed to Rensis Likert (1931), who described this technique for the assessment of attitudes. These scales have a limitation that they measure the variable to the nearest value and will not be an exact estimate. Therefore these scales and constructs are always under a scanner for their reliability and thereby posing a need to test for their reliability. To check this reliability of such scales statistics provides a most useful instrument in the form of a ratio similar to correlation co-efficient, called cronbach alpha(α).

Now, the purpose of this paper is to throw light on the assessment of reliability of the scales, sub-scales for measuring variables and constructs based on the concept of cronbachs alpha and inturn to help draw proper conclusions. An attempt is made here to explain how to workout and use cronbachs alpha with an illustration and a small demonstration of

procedure to calculate the alpha using SPSS. Further it is also narrated here as to how to interpret the results of the SPSS work out in the subsequent paragraphs of the paper.

Key Words

Reliability, Scale, Multi-item scales, Likert scales, construct, questionnaire, sub scale.
Alpha, uni-dimensionality, consistency, homogeneity,

Introduction While collecting data or information on various fields of research in the social sciences, marketing, medicine, business etc, the researchers face difficulty in measurement relating to attitudes, emotions, opinions, personalities, and so on. Specially when the concepts involve description's of people's environment they are complex and abstract in nature.

In the process of constructing a measure for such problems researchers tend to develop customised scales for measurement. As individuals attempt to quantify constructs which are not directly measurable they often use multiple-item scales and summated ratings to quantify the construct(s) of interest. Especially when attitudes, opinions etc are required to be measured we use multiple item summated scales following the pattern of a Likert scale, having 3, 4 or 5 point scales.

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Therefore the objectives of the paper are :

- to understand the meaning and nature of the ratio cronbach alpha
- to demonstrate the procedure for calculation of cronbach alpha using SPSS

- to list out the possible uses of cronbachs alpha from the business research point of view.

What is Cronbach alpha?

Lee Cronbach developed a ratio in the year 1951 to provide a measure of the internal consistency of a test or scale which is popularly named as Cronbach Alpha. It is a ratio similar to correlation co-efficient, whose value ranges between 0 and 1 (i.e $0 \leq \alpha \leq 1$). In other words Cronbach coefficient Alpha is a measure of squared correlation between observed scores and true scores. Again put in a different way, reliability is measured in terms of the ratio of true score variance to observed score variance of a scale

The formula for cronbach's alpha (α) as parameterised by Cortina(1993) is

$$\alpha = N^2 (\text{Mean}(\text{cov}) / \text{Sum}(\text{Var/cov}))$$

Where,

N is the number of items in the scale

Mean(cov) is the mean inter item covariance of the scale

Sum(Var/Cov) is the sum of all elements in the variance –covariance matrix.

Cronbach alpha provides an estimate of the internal consistency of the test or scale or construct.

In this paper we are more focussed on the application of the cronbach alpha and its procedure to calculate the ratio than the statistical theory behind the concept and as well as the derivation of the ratio cronbach alpha. Therefore based on the statistical theory as explained in Brown 1998 & 2001, we may summerise here that the observed score is equal to the true score plus the measurement error ($Y = T + E$). For example, I know 70% of the material but my score is 75% because of guessing. In this case, my observed score is 75 while my true score is 70. The additional five points are due to the measurement error. It is assumed that a reliable test should minimize the measurement error so that the error is not highly correlated with the true score. On the other hand, the relationship between true score and observed score should be strong. In addition, it is assumed that the mean of the measurement error should be zero. Which means that, the error scores should be random and uncorrelated with each other. Failure of meeting this assumption may lead to an overestimation of Cronbach Alpha though in practice this assumption cannot be fully met.

In continuation to the above let us shall attempt to workout cronbach alpha and by taking an illustration in the form of a miniature business research problem focussing on the assessment

of the reliability (internal consistency) of one subscale of a survey instrument. Within which for the purposes of illustration we shall take a portion of the questionnaire on assessment of effectiveness of salesman's work in increasing sales of an electronic gadget is discussed here below :

Research question shall be What is the reliability of the Salesman subscale of the survey instrument? For which the subscale and the related question is extracted from the part-I of

Part I – Salesman.						
Please read each statement and assess the effectiveness of the Salesman by rating him or her on a 1-5 Likert scale (1 = <i>Strongly Disagree</i> ; 5 = <i>Strongly Agree</i>). Place an “X” in the appropriate box next to each statement.						
Questio No	Salesman	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1	The Salesman had proper product knowledge and expertise to demonstrate the product					
2.	The salesman was well prepared to Demonstrate the Product while sale					
3.	The Salesman explained the product features well					
4.	The Salesman really aware of all the technology of the products					
5.	The salesman has effectively explained the product features and its uses					
6.	The Salesman has demonstrated all the features of the product well.					

questionnaire be as under :

Table 1. *Part-I of the pilot survey questionnaire for assessing the effectiveness of the Salesman*

Further, the pilot sample survey data of 20 questionnaires is tabulated using the SPSS package 16.0 version and the data of 20 records is coded into the SPSS worksheet by defining all the

six variables viz V1, V2, V3, V4, V5, V6. Against each question the questionnaire above and the data is fed to SPSS worksheet as shown below in table 2.

Name	Type	Width	Decimals	Lable	Values	Missing	Columns	Align	Measure
V1	Numeric	8	2		None	None	8	Right	Sclare
V2	Numeric	8	2		None	None	8	Right	Sclare
V3	Numeric	8	2		None	None	8	Right	Sclare
V4	Numeric	8	2		None	None	8	Right	Sclare
V5	Numeric	8	2		None	None	8	Right	Sclare
V6	Numeric	8	2		None	None	8	Right	Sclare

Table 2 : Variable view of the coded data in a SPSS Data sheet.

Further each variable is labeld for feeding data as 1 for Value Strongly Disagree , 2 for Disagree, 3 for Not Sure , 4 for Agree. And lastly 5 for Strongly Agree for all the questions from Q1 to Q6. Next feed the data for 20 records and the data table looks as below in table 3.

Record No	V1	V2	V3	V4	V5	V6
1	4.0	4.0	5.0	5.0	4.0	4.0
2	5.0	5.0	5.0	5.0	5.0	5.0
3	3.0	4.0	2.0	3.0	1.0	4.0
4	4.0	1.0	4.0	4.0	4.0	1.0
5	2.0	4.0	1.0	3.0	2.0	4.0
.....
.....
20	4.0	4.0	4.0	4.0	5.0	4.0

Table 3 : Data view of the coded data in a SPSS Data sheet

Further, we analyse the above data using SPSS Reliability analysis option with the following steps.

1. Select Analyse
2. Select Reliability Analysis option
3. Select Scale option

4. Select Alpha option

Then by selecting OK option we will be able to generate the SPSS output showing the cronback alpha calculation as shown in the following table 4.

Reliability Case Processing Summary

	N	%
Cases	10	100.0
Valid	0	0.0
Excluded		
(a)	10	100.0
Total		

Table 4 SPSS Output:

Cronbach's Alpha	No of Items
.959	6

Table 5 SPSS Output:

The reliability coefficient for the salesman subscale is .959. which means subscale to measure the salesmans performance is reliable and can be implemented.

From table 5 above it is clear that, the alpha value is 0.959 indicating the high correlation for the scale or construct, and are appropriate for measurement. The scale and subscale of the questionnaire are reliable and acceptable for further data collection and implementation. The interpretation to cronbach's alpha is in similar lines to that of correlation coefficient with little modification as detailed below.

Numerical values of alpha

There are different reports about the acceptable values of alpha, ranging from 0.70 to 0.95. A low value of alpha could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs. For example if a low alpha is due to poor correlation between items then some should be revised or discarded. The easiest method to find them is to compute the correlation of each test item with the total score test; items with low

correlations (approaching zero) are deleted. If alpha is too high it may suggest that some items are redundant as they are testing the same question but in a different guise. A maximum alpha value of 0.90 has been recommended.

Value of α	Interpretation
1.0	Perfect or Too good a scale to be implemented
0.90 to 0.99	Incredibly good and acceptable beyond doubt
0.80 to 0.89	Very Good and the scale is acceptable
0.70 to 0.79	Acceptable with errors or some extent of impurity in the scale
0.60 to 0.69	High errors and not acceptable
Below 0.60	There is no proper scale and need to rebuild

Table 6 : Values of alpha and its interpretation

It is to be noted that, the number of test items, item interrelatedness and dimensionality affect the value of alpha.

If the items in a scale are correlated to each other, the value of alpha is increased. However, a high coefficient alpha does not always mean a high degree of internal consistency. This is because alpha is also affected by the length of the scale. If the scale length is too short, the value of alpha is reduced. Thus, to increase alpha, more related items testing the same concept should be added to the scale. It is also important to note that alpha is a property of the scores on a test from a specific sample of tests. Therefore investigators should not rely on published alpha estimates and should measure alpha each time the test is administered.

Limitations of Cronbach's alpha

Improper use of alpha can lead to situations in which either a test or scale is wrongly discarded or the scale is criticised for not generating trustworthy results. To avoid this situation an understanding of the associated concepts of internal consistency, homogeneity or uni-dimensionality can help to improve the use of alpha. Internal consistency is concerned with the interrelatedness of a sample of test items, whereas homogeneity refers to uni-dimensionality. A measure is said to be uni-dimensional if its items measure a single latent trait or construct. Internal consistency is a Tavakol *et al.* Cronbach's alpha necessary but not sufficient condition for measuring homogeneity or uni-dimensionality in a sample of test items. Fundamentally, the concept of reliability assumes that uni-dimensionality exists in a

sample of test items and if this assumption is violated it does cause a major underestimate of reliability.

It has been well documented that a multidimensional test does not necessarily have a lower alpha than a uni-dimensional test. Thus a more rigorous view of alpha is that it cannot simply be interpreted as an index for the internal consistency of a test. Factor Analysis can be used to identify the dimensions of a test. Alpha, therefore, does not simply measure the uni-dimensionality of a set of items, but can be used to confirm whether or not a sample of items is actually uni-dimensional.

Conclusions

Alpha is an important concept in the evaluation of assessments and questionnaires. It is mandatory that assessors and researchers should estimate this quantity to add validity and accuracy to the interpretation of their data. Nevertheless alpha has frequently been reported in an uncritical way and without adequate understanding and interpretation. In this paper we have attempted to explain the assumptions underlying the calculation of alpha, the factors influencing its magnitude and the ways in which its value can be interpreted.

High quality tests are important to evaluate the reliability of data supplied in an examination or a research study. Alpha is a commonly employed index of test reliability. Alpha is affected by the test length and dimensionality. A low alpha appears if these assumptions are not met. Alpha does not simply measure test homogeneity or uni-dimensionality as test reliability is a function of test length. A high value of alpha (> 0.90) may suggest redundancies and show that the test length should be shortened.

We hope that business researchers in future will be more critical when reporting values of alpha in their studies.

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