RESEARCH COMMUNICATION

Cronbach's alpha

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In statistics, Cronbach's (alpha)[1] is a coefficient of internal consistency. It is commonly used as an estimate of the reliability of a psychometric test for a sample of examinees. It was first named alpha by Lee Cronbach in 1951, as he had intended to continue with further coefficients. The measure can be viewed as an extension of the Kuder-Richardson Formula 20 (KR-20), which is an equivalent measure for dichotomous items. Alpha is not robust against missing data. Several other Greek letters have been used by later researchers to designate other measures used in a similar context.[2] Somewhat related is the average variance extracted (AVE).

This article discusses the use of in psychology, but Cronbach's alpha statistic is widely used in the social sciences, business, nursing, and other disciplines. The term item is used throughout this article, but items could be anything - questions, raters, indicators - of which one might ask to what extent they "measure the same thing." Items that are manipulated are commonly referred to as variables.

CRONBACH ALPHA IS CALCULATED USING SPSS PACKAGE

The theoretical value of alpha varies from zero to 1, since it is the ratio of two variances. However, depending on the estimation procedure used, estimates of alpha can take on any value less than or equal to 1, including negative values, although only positive values make sense. Higher values of alpha are more desirable. Some professionals as a rule of thumb, require a reliability of 0.70 or higher (obtained on a substantial sample) before they will use an instrument. Obviously, this rule should be applied with caution when has been computed from items that systematically violate its assumptions. Furthermore, the appropriate degree of reliability depends upon the use of the instrument. For example, an instrument designed to be used as part of a battery of tests may be intentionally designed to be as short as possible, and therefore somewhat less reliable. Other situations may require extremely precise measures with very high reliabilities.

In the extreme case of a two-item test, the Spearman-Brown prediction formula is more appropriate than Cronbach's alpha. This has resulted in a wide variance of test reliability. In the case of psychometric tests, most fall within the range of 0.75 to 0.83 with at least one claiming a Cronbach's alpha above 0.90.

INTERNAL CONSISTENCY

Cronbach's alpha will generally increase as the

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intercorrelations among test items increase, and is thus known as an internal consistency estimate of reliability of test scores. Because intercorrelations among test items are maximized when all items measure the same construct, Cronbach's alpha is widely believed to indirectly indicate the degree to which a set of items measures a single unidimensional latent construct. However, the average intercorrelation among test items is affected by skew just like any other average. Thus, whereas the modal intercorrelation among test items will equal zero when the set of items measures several unrelated latent constructs, the average intercorrelation among test items will be greater than zero in this case. Indeed, several investigators have shown that alpha can take on quite high values even when the set of items measures several unrelated latent constructs. As a result, alpha is most appropriately used when the items measure different substantive areas within a single construct. When the set of items measures more than one construct, coefficient omega hierarchical is more appropriate. Alpha treats any covariance among items as true-score variance, even if items covary for spurious reasons. For example, alpha can be artificially inflated by making scales which consist of superficial changes to the wording within a set of items or by analyzing speeded tests. A commonly accepted] rule of thumb for describing internal consistency using Cronbach's alpha is as follows, however, a greater number of items in the test can artificially inflate the value of alpha and a sample with a narrow range can deflate it, so this rule of thumb should be used with caution:

Cronbach's alpha	Internal consistency
$\alpha = 0.9$	Excellent (High-Stakes testing)
$0.7 = \alpha < 0.9$	Good (Low-Stakes testing)
$0.6 = \alpha < 0.7$	Acceptable
$0.5 = \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

GENERALIZABILITY THEORY

Cronbach and others generalized some basic assumptions of classical test theory in their generalizability theory. If this theory is applied to test construction, then it is assumed that the items that constitute the test are a random sample from a larger universe of items. The expected score of a person in the universe is called the universe score, analogous to a true score. The generalizability is defined analogously as the variance of the universe scores divided by the variance of the observable scores, analogous to the concept of reliability in classical test theory. In this theory, Cronbach's alpha is an unbiased estimate of the generalizability. For this to be true the assumptions of essential - equivalence or parallelness are not needed. Consequently, Cronbach's alpha can be viewed as a measure of how well the sum score on the selected items capture the expected score in the entire domain, even if that domain is heterogeneous.

INTRA-CLASS CORRELATION

Cronbach's alpha is said to be equal to the stepped-up consistency version of the intra-class correlation coefficient, which is commonly used in observational studies. But this is only conditionally true. In terms of variance components, this condition is, for item sampling: if and only if the value of the item (rater, in the case of rating) variance component equals zero. If this variance component is negative, alpha will underestimate the stepped-up intra-class correlation coefficient; if this variance component is positive, alpha will

overestimate this stepped-up intra-class correlation coefficient.

FACTOR ANALYSIS

Cronbach's alpha also has a theoretical relation with factor analysis. As shown by Zinbarg, Revelle, Yovel and Li alpha may be expressed as a function of the parameters of the hierarchical factor analysis model which allows for a general factor that is common to all of the items of a measure in addition to group factors that are common to some but not all of the items of a measure. Alpha may be seen to be quite complexly determined from this perspective. That is, alpha is sensitive not only to general factor saturation in a scale but also to group factor saturation and even to variance in the scale scores arising from variability in the factor loadings. Coefficient omega hierarchical has a much more straightforward interpretation as the proportion of observed variance in the scale scores that is due to the general factor common to all of the items comprising the scale.

REFERENCES

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QUOTES

Five key words for success: purpose, team, mentor, tenacity, gratitude.
Ravi Venkatesan, ex-Microsoft India

We believe in bootstrapping; the lack of resources can lead to competitive advantage through creativity.
Sandipan Chattopadhyay, Justdial

The next big thing is the one that makes the last big thing usable.
Blake Ross, Mozilla