

Research Article

Cronbach's alpha

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Cronbach's alpha and omega are units of reliability of a set of items in a questionnaire. We discuss here how to calculate Cronbach's alpha and how to interpret the values.

In medicine and behavioural sciences, tests for different purposes. Some tests are used to measure knowledge; others are used to measure attitude and skills ^[1]. Yet other tests are used as survey tools, and measurement of concepts. Each test consist of several items that are measured on Likert Scale items. Likert scale items are items that have ordinal responses. For example, if an item contains the following stem and responses:

Question:

Poor control of COVID-19 worldwide indicates a failure of the management of the pandemic by the health systems.

Possible responses:

- Completely Agree
- Agree
- Neither agree nor disagree
- Disagree
- Completely disagree

This type of a question which involves multiple choice responses ordered in grades of opinion is referred to as a Likert scale response.

Test can measure a single concept or they can measure multiple concepts. When tests measure a single concept, then the issue of inter-relatedness of items and reliability (that is how repeatable or replicable these items may be) are important to measure. Hence, tests and surveys must be assessed for validity (that is, it must measure what it is meant to measure) and reliability (it must measure that

consistently). Reliability is linked to validity as if a test is not reliable it is not valid, but a test can be valid but it may not be reliable or consistent from sample to sample.

Reliability or consistency is measured with coefficient alpha; also referred to as Cronbach's alpha after Lee Cronbach (1951). This is convenient as it is measured with one test, and measures concepts/constructs that can have many items. It measures the inter-relatedness of items. The scores range between 0-1, where 0.70-0.95 are considered acceptable scores. Coefficient alpha can be used to calculate measurement error = $(1 - \alpha^2)$. Coefficient alpha is a lower bound estimate of reliability.

Three concepts related to alpha are internal consistency, which is a measure of inter-relatedness of items, homogeneity and unidimensionality of items which refer to the fact that the items together define a SINGLE concept or construct or single trait. Unidimensionality is also a measure of reliability.

If alpha is low, this could be because too few items were used to assess alpha, or the items were themselves not inter-related. If the items together do not define a single concept or construct but multiple constructs, then this is referred to as the test is NOT tau-equivalent, as there are multiple concepts.

Whether inter-relatedness is low can be measured with assessing $\text{corr}(\text{item}_i, \alpha)$ and observing the values; if the values are low for a particular item i , then that item will need to be discarded; alternatively, if the correlation is as high as 95%, then the item may be removed as well as it influences the results.

Whether there is tau-equivalence clause is violated, is tested by using factor analysis, ideally confirmatory factor analysis and testing whether more than one latent variable is a better model than a single latent variable model.

References

1. [△]Mohsen Tavakol, Reg Dennick. (2011). Making sense of Cronbach's alpha. *Int. J. Medical Education*, vol. 2, 53-55. doi:10.5116/ijme.4dfb.8dfd.

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