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Assessment and qualification system

The Kuder – Richardson index (Kr – 20)

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Every measuring instrument must have high values of reliability and acceptability as a main feature. As we usually say, they must be acceptable and reliable

The reliability in its internal consistency dimension refers to the level in which items or units being part of an instrument are correlated. If the items comprising this instrument must measure the same construct, they should show a high correlation, that is to say, that the instrument must have a high level of homogeneity.

In a testing or measuring instrument, reliability then represents the level of congruency or internal consistency of the obtained results when it is applied at different stages.

The reliable measuring instrument generates a matrix of results with very low variations when being used at different times to measure the same item. The reliability in this regard can be associated with stability and congruency.

The Kuder Richardson index, formula 20, determines the trustworthiness or reliability of a measuring instrument and of the items comprising it. This means, as explained before, measuring the internal consistency and, consequently, its homogeneity.

The KR-20 is related to evaluations and tests designed for a person to respond in a dichotomous manner. That is, true or false, yes or no, right or wrong.

It is applied to a set of questions measuring the same attribute, construct or concept to determine if the questions have the appropriate internal consistency, meaning if there is homogeneity among the items of the measuring instrument.

It will measure the level of consistency and internal congruency of the results in an analog manner when the instrument is replicated in different situations. Consequently, when the measuring instrument generates similar results when applied in several measurements to an invariable object or person, we are witnessing the temporal stability feature of the instrument.

However, the KR-20 measure is determined when using the instrument only once. It does not require the repetition of the calculation as the test-retest, since the internal consistency (homogeneity) can be calculated through the application of the testing instrument at a single situation to the same sample or population which is the object of our study.

Furthermore, the measuring instrument is reliable and, consequently, it has an internal consistency when verifying if homogenous responses are obtained from different questions about the same concept or content.

The reliability attribute is related to precision and/or accuracy. However, there is no measuring (evaluation) instrument totally and absolutely reliable. It has an error margin that can and should be solved reaching the minimum acceptable level.

To improve the instrument, the possibility of having the KR-20 measure is of great strategic importance.

“The internal consistency of an instrument varies depending on which population it is applied to. Consequently, it is necessary to inform the value every time it is applied.”
(“Psychometric properties of a scale: internal consistency”, Adalberto Campo-Arias y Heidi C. Oviedo, Bogotá, Colombia, 2008)

In our case, the KR-20 measure allows us to calculate the degree of reliability we can assign to the internal consistency of an evaluation instrument.

It must be remembered that the internal consistency refers to the fact that “the group of items measuring the same attribute, construct or concept show homogeneity between them.”

The KR-20 is very appropriate when the selected evaluated items correspond to a similar difficulty degree but not identical. It is a calculation admitting items of slightly different difficulty degrees.

The KR-20 formula is as follows:

$$KR20 = \frac{n}{n-1} \cdot \left(1 - \frac{\sum_{j=1}^n p_j \cdot q_j}{\sigma^2} \right)$$

n is the number of evaluation components, the number of items or questions

p_j is the probability that the person responds correctly to each item of the instrument. It is the quotient of the division between the number of correct responses to the item and the total amount of responses obtained (amount of evaluated people)

q_j is the complement of ***p_j*** (***q_j*** = 1 - ***p_j***). This means that it is the probability of having incorrectly responded the item.

Then, ***p · q_j*** is calculated (variance) for each of the items of the evaluation instrument and all of them are summed up.

σ² is the population variance of the obtained results.

The possible variation range for the KR-20 reliability measure is as follows:

$$0 \leq \rho_{KR-20} \leq 1$$

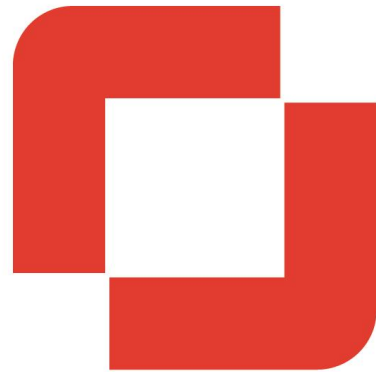
The index will adopt low values when the evaluated people respond to questions referring to the same item of content, construct, concept or to very closely related contents, in a very different manner to one or another question, and there is a correlation between the responses of the evaluated people to those different items.

There are very rigid opinions on the subject, such as the following: *“internal consistency values being lower to 0,70 indicate a poor correlation between the items and those which are superior to 0,90 indicate redundancy or duplication of the items, that is to say, that at least a couple of items measure exactly the same aspect of a construct and one of them must be eliminated.”* (“Psychometric properties of a scale: internal consistency”, Adalberto Campo-Arias y Heidi C. Oviedo, Bogotá, Colombia, 2008)

On a separate note, it is very important to take into account the size of the sample or population of the study in most of the quantitative analyses. The reliability measurement in its internal consistency dimension with KR-20 is more relevant and appropriate when an instrument has more than five and even twenty evaluation items. Additionally, it is recommendable (but not required) to have at least between five and twenty participants for each item.

The KR-20 index can be also presented in a very different manner in samples or populations with very different characteristics. For example, when the same instrument is applied to samples of different ages, social positions, culture, very different values are obtained as results.

The importance of knowing the KR-20 index lies in the possibility of improving the evaluation instrument by eliminating and replacing those items with low correlation with the group, that have poor quality, which is reflected in the difficulty and differentiation indexes. It is advisable to replace an item which does not make a proper differentiation to increase the quality of our evaluation instrument.



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