**Methods for Decision-Making in Survey Questionnaires with Continuous Variables**

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Abstract

There is a need to set up a cut-off point for opinion-based questionnaires on health care utilization, facilitating factors and barriers to arrive at a conclusion. It is also important to set up a cut-off point on overall items for assessing Knowledge, Attitude and Practice. Here, we show how to formulate a tool for decision-making in Norm-referenced survey questionnaires and readjust their cut-off points to incorporate the population variation for items containing continuous variables. This method can be used for setting up a cut-off point to arrive at a diagnosis in a newly developed instrument which does not have any gold-standard instrument for comparison.

**Keywords:** Point; cut-off; reliability; item; analysis; Cronbach’s alpha; correlation.

**BACKGROUND**

In order to assess how well a test or an instrument is functioning we need to look at how well its individual items perform. Item analysis provides a way to exercise additional quality control over the tests by providing feedbacks on how successful the assessment actually was. An item analysis gets at the question of how well does it discriminate. If there are lots of items that didn’t discriminate much at all then they need to be replaced by some better ones. Item analyses can also help the investigators diagnose why some items did not work especially well and suggest ways to improve them (Lentz FE, 1988; National Commission on Testing and Public Policy, 1990; Quinto F, McKenna B, 1977)

It is not ideal to set up a universal cut-off in any survey instrument to arrive at a diagnosis from various communities with diverse socio-cultural backgrounds. It is also difficult to set up a cut-off point on overall items considered to assess Knowledge, Attitude and Practice (KAP) levels in KAP-based questionnaires to decide whether the overall knowledge of the respondents is adequate or not, their overall attitude is positive or negative and their overall practice is satisfactory or unsatisfactory. Setting up a cut-off point is also necessary for opinion-based questionnaires on health care utilization, facilitating factors and barriers to arrive at a conclusion of whether people are utilizing or recommending a procedure adequately or not, but it is often difficult to determine it. In this background, a study was conducted to formulate a tool for decision-making in Norm-referenced survey questionnaires and readjust their cut-off to incorporate the population variation for items containing continuous variables.

**OBJECTIVE**

To determine the Cut-off Point of an instrument without any reference gold-standard

**Methods**

This procedure is applicable for items having Continuous Variables - e.g., scale of pain, scale of stress, scale of wellbeing were the respondents are instructed to provide their personal opinions or perceptions in a continuous Likert scale. The weightage of each response in each item is directly proportional to the Discrimination Index (DI) as well as Internal Reliability or Cronbach’s alpha. Hence, the weighted score for each response in each
item is obtained by getting the Observed Item Score multiplied by the product of Discrimination Index and Internal Reliability or Cronbach’s alpha. The “Correction Factor” is developed for making an adjustment in the overall cut-off value of the instrument. It is obtained from the ratio of the total weighted score and the total raw score. The overall cut-off value for the instrument is obtained by multiplying the “Correction Factor” with the (Mean of individual Raw Score – 2SEM) of each item and finally summing them up together. The detailed mathematical model for the determination of a cut-off level in test instrument is described below:

Calculation of Discrimination Index (DI) of individual items

\[ \text{DI} = \frac{\text{Observation Item Score} \times \text{Discrimination Index} \times \left(\text{Internal Reliability or Cronbach's alpha}\right)}{\text{Total Weighted score}} \]

(C) Correction Factor = \left(\frac{\text{Total Weighted score}}{\text{Total Raw Score}}\right)

(D) The cut-off point of an instrument without any gold standard

\[ \text{observed score} = \sum \left[\left(\text{Mean of Individual Raw Score} - 2\text{SEM}\right) \times \text{Correction Factor}\right] \]

**RESULTS**

The researchers often face incredible challenges while assessing Knowledge, Attitude and Practice (KAP) levels in KAP-based questionnaires to decide whether the overall knowledge of the respondents is adequate or not, their overall attitude is positive or negative and their overall practice is satisfactory or unsatisfactory. It is better not to set up an overall cut-off point for the Knowledge, Attitude and Practice (KAP) questionnaires. Each section of the questionnaire should have a separate cut-off point for better understanding. In other words, there should be separate cut-off points for each of the Knowledge, attitude and practice sections. Hence, the above-mentioned procedure can be directly adopted for perception or attitude related questionnaires.

However, for knowledge and practice based questionnaires, the cut-off points need to be stratified according to the respective knowledge, attitude and practice sections. The above-mentioned procedure needs to be first applied on a standardized population assumed of having high level of knowledge and practice. The same procedure again needs to be applied on a standardized population assumed of having very low level of knowledge and practice. The average (mean) of both the two cut-off points from the Sum [(Mean of Individual Raw Score – 2SEM) X (Correction Factor)] should then be considered as the actual cut-off points for the knowledge and practice sections separately. The assumptions on high and low levels of knowledge and practices can be drawn from previous studies or a descriptive study with focused group discussion prior to the main study.

**DISCUSSIONS**

Summated scales are often used in survey instruments to probe underlying constructs that the researcher wants to measure. These may consist of indexed responses to dichotomous or multi-point questionnaires, which are later summed to arrive at a resultant score associated with a particular respondent.\[^{5,6,7}\] Item discrimination indicates the extent to which success on an item corresponds to success on the whole test. Since all items in a test are intended to cooperate to generate an overall test score, any item with negative or zero discrimination undermines the test. The Discrimination Index (D) is computed from equal-sized high and low scoring groups on the test (Fuchs LS, Fuchs D;1986, Ebel RL;1954). The Point-biserial Correlation is the Pearson’s correlation between responses to a particular item and scores on the total test (with or without that item) (Ebel RL; 1954, Tzuriel D, Samuels MT; 2000, Symonds PM; 1928).

The development of assessment scales also need to follow predictor variables for use in objective models. The concept of reliability rises as the function of scales is stretched to encompass the realm of prediction.\[^{7,8,9}\] Reliability tests are especially important when derivative variables are intended to be used for subsequent predictive analyses. If the scale shows poor reliability, then individual items within the scale must be re-examined and modified or completely changed as needed. One of the most popular reliability statistics in use today is Cronbach’s alpha. It determines the internal consistency or average correlation of items in a survey instrument to gauge its internal reliability (Symonds PM; 1928, Cronbach LJ; 1951, Santos JRA; 1999).

The link between assessment and intervention is the critical step to the provision of effective interventions in health care, management and academic services. However, it is not possible to improvise every time the problem-solving model and also the development, implementation and evaluation of interventions. Hence, the implementation of effective interventions in any sector requires a significant amount of training, skill development and supervised practice (Volpe RJ, McConaughy SH; 2005, Fairbanks et al; 2007).

The development of hypotheses based on our knowledge of human development, identification of needs and the acquisition of academic and behavioral competencies and the confirmation of those hypotheses through assessment are necessary for proper evaluation of any intervention (Fuchs LS; 2003, Kaminski et al;...
However, due to lack of needs assessment followed by inadequate delivery of effective services and poor intervention support often result in poor programme outcomes. Hence, summative assessment always pays a key role in identifying the needs of the community and evaluating the effectiveness of an intervention (Santos JRA; 1999, Fuchs LS; 2003, Kaminski et al; 2008). Though summative assessment is hard, but still a rewarding work, particularly for the health care providers, managers, teachers, students and families in the community to whom any valuable service is provided.

Conclusion

The procedure discussed in this study will help the researchers to perform finer adjustments in the cut-off values of any Norm-referenced survey instrument based on the local population data. This method can also be used for setting up a cut-off point to arrive at a diagnosis in a newly developed instrument which does not have any gold-standard instrument for comparison.

References


