Multilevel Rasch model and item response theory

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Abstract

The analysis of response data to test items requires psychometric methods to investigate characteristics of items and individuals that answer those items. Item Response Models (IRMs) consider that a latent variable explains these responses. The applications of IRT modeling have increased considerably in recent years because of its utility in developing of measuring instruments. Often the relations between the items and latent variable are of interest. Some procedures (factor analysis, discriminant analysis) allow the links between the items and the latent variables to be defined, but none of them make direct estimation of latent variable.

In 1960 Georg Rasch suggested a statistical Rasch Model (RM) that makes it possible to define these links and obtain scales with a good fit of an IRM. It transforms the cumulative raw scores (achieved by a subject across items or by an item across subjects) into linear continuous measures of ability of person and difficulty of item. Unidimensionality is a primary assumption of the Rasch model, that is, responses to the items should measure a single construct so the Rasch model is a unidimensional IRM. In Rasch model, raw data from a rating scale is converted to an equal interval scale measured in logits (log odd units) that allows one to use more variant parametric statistics instead of nonparametric statistics.

RM actually is a member of Hierarchical Generalized Linear Model (HGLM). In the simpler formulation of this model it is possible to consider a dichotomous RM as a two-level multilevel logistic model with random intercept, where the items and subjects are the level-1 and level-2 units, respectively and also item parameter is fixed and the person parameter is random. So with RM it is possible to incorporate a nested structure of the data and to include covariates at different hierarchical levels.

In this paper, we will present Item Response Theory and Multilevel Rasch Model, and will show the results on the basis of a data set of quality of life (SF36) by running WINSTEPS software.

Keywords

Multilevel Rasch model, Item response theory, Quality of life.

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