eRm - extended Rasch modelling

An R Package for the Application of Item Response Theory Models

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Item response theory models (IRT) are growingly established in social science research, particularly in the analysis of performance or attitudinal data in psychology, education, medicine, marketing and other fields where testing is relevant. However, there is still a lack of computational implementations apart from commercially available special-purpose software (a comprehensive list is given at http://www.winsteps.com/rasch.htm). Several solitary routines have been published but there is no tool that allows for computing the various models in an integrative manner. The R package ltm (Rizopoulos, 2005) allows to fit some IRT models using a marginal ML approach but has a different focus and is restricted to binary data. We propose the R package eRm (extended Rasch modelling) for computing Rasch models and several extensions.

The main characteristic of IRT models, the Rasch model being the most prominent, concerns the separation of two kinds of parameters, one that describes qualities of the subject under investigation, the other relates to qualities of the situation under which the response of a subject is observed. Using conditional maximum likelihood (CML) estimation both types of parameters may be estimated independently from each other. IRT models are well suited to cope with dichotomous and polytomous responses, where the response categories may be unordered as well as ordered. The incorporation of linear structures allows for modelling the effects of covariates and enables the analysis of repeated categorical measurements.

Another aspect of Rasch type models is the concept of subject specific effects. If there is heterogeneity among subjects one might think of variance components and random effects parameters. In fact, this type of models using conditional ML estimation accounts for a different amount of individual propensity to certain reactions and can be seen as mixture models, where no specification of the distribution of the random effects parameters is made. These properties allow for the formulation of simple but very flexible models for longitudinal categorical data.

In a first version the eRm package fits Rasch models for binary and ordinal data, the rating scale model and the partial credit model. Linear reparameterisations through covariate structures allow for modelling diverse data sets including repeated measurements. We use an unitary, efficient CML approach with Newton-Raphsen and quasi-Newton algorithms to estimate the parameters. Graphical and numeric tools for assessing goodness-of-fit are provided.

Keywords:
Rasch Models, rating scale model, partial credit model, conditional ML estimation.

References:

G.H. Fischer and I. Molenaar, *Rasch Models - Foundations, Recent Developments, and Applications*, New York: Springer, 1995