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Extending Log-Logistic IRT: A Multidimensional Model and Its Implementation in R

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Oral presentation

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Abstract

Unipolar log-logistic response models (LLRM) are a family of Item Response Theory (IRT) models intended for measuring traits that take only positive values and are asymmetrically (rightly skewed) distributed in the target population. Their two most distinctive features are that: (a) the item response functions are not ogives but power functions, and (b) the amount of information decreases with trait levels. LLRMs have be found to be appropriate in the measurement of certain clinical and forensic traits, symptoms checklists, addictive behaviours, and irrational beliefs among other applications.

LLRMs were originally intended for unidimensional instruments based on binary items (Lucke, 2015) and next extended to the graded-response case (Reise et al. 2021). Our research group has further extended the seminal proposals in two directions (Ferrando, et al. 2024, 2025). First, we have also considered double-bounded continuous-response items. Second, for each item format, we have started to develop multidimensional extensions. Specifically, we shall first present a novel LLRM we propose for multidimensional instruments based on continuous-response items: the Md-LL-CRM. Our presentation of this model has two parts. First, we aim to discuss its main features and functioning, particularly: basic equations, item response surfaces, multidimensional location and discrimination parameters and information functions.

The second part is more practical and includes proposed estimation and scoring procedures for LLRMs in general and Md-LL-CRM in particular, as well as their general implementation, and we shall introduce SkewIRT, a new R package designed to facilitate the usage of LLRMs. SkewIRT provides functions for model estimation, item and test information analysis, and individual scoring. Additionally, it includes visualization tools to explore item response surfaces and multidimensional trait information. By integrating these capabilities into a single framework, SkewIRT aims to make LLRMs more accessible to applied researchers in behavioral assessment.

SkewIRT will be released in the coming months, offering two versions: a code-based version for experienced R users and a Graphical User Interface (GUI) version developed with shiny (Chang et al., 2025), designed for researchers with limited programming experience.

In this presentation, we will demonstrate the main functionalities of SkewIRT through illustrative examples.

Keywords

LLRM, IRT, R

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