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Longitudinal diagnostic models for small sample size contexts

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Longitudinal diagnostic models for small sample size contexts

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Abstract

Cognitive diagnostic models (CDMs) constitute a family of confirmatory, restricted latent class models in which individuals are classified into different profiles based on their mastery or non-mastery of the measured attributes (e.g., skills, competences, psychological processes). Beyond their use in clinical or organizational psychology, CDMs have been widely applied in educational settings, where they directly impact students' learning by providing diagnostic feedback that guides remedial instruction based on their strengths and weaknesses. However, two main challenges hinder the applicability of CDMs for these purposes. First, most CDMs require large sample sizes (N > 500) for accurate estimation. Second, learning (or improvement, in a psychological context) can only be assessed through longitudinal designs. The first challenge was addressed by the development of the R-DINA model (Nájera et al., 2023), a parametric CDM specifically designed for small-scale assessments. The second challenge was tackled with the TDCM (Madison & Bradshaw, 2018), a general longitudinal diagnostic model. The present study combines these two advancements by proposing the integration of the R-DINA model into the TDCM to enable longitudinal diagnostic assessments in classroom-level settings. The performance of the longitudinal R-DINA model is tested and compared to traditional CDMs through an exhaustive simulation study focused on small sample size conditions (25 < N < 200). Different test lengths, numbers of attributes, item discrimination levels, and attribute correlations are explored. Results demonstrate the viability of the longitudinal R-DINA model for small-scale longitudinal assessments to track students'learning or patients'improvement. Implications and practical recommendations will be discussed.

Keywords

diagnostic modeling, longitudinal, latent class

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