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Mastery Probability in Cognitive Diagnosis: A Revisit

Cognitive diagnosis models (CDMs) are psychometric methods designed to classify examinees into latent classes defined by distinct attribute mastery profiles. Attributes are typically modeled as binary latent variables with two statuses: mastery or non-mastery. In applied settings, researchers often report *mastery probabilities*, i.e., the probability that an examinee has mastered a given attribute. Research has suggested that it should be interpreted as the level of classification certainty or confidence, rather than the amount of mastery, percent correct, or progress (Bradshaw & Levy, 2019). We revisit the interpretation of mastery probabilities as it could be more complex and may depend on the underlying nature of the latent variables.

This study systematically investigates the relationship between mastery probabilities and item response theory (IRT) abilities when data are generated under either the CDM or IRT model. Preliminary simulation results indicate that when data are generated from a multidimensional IRT model but analyzed using a CDM, the resulting mastery probabilities are strongly correlated with examinees' latent abilities. This finding suggests that mastery probabilities may, in practice, reflect levels of proficiency rather than purely classification certainty. The study contributes to a deeper understanding of how mastery probabilities could be interpreted and reported in diagnostic measurement.

Reference

Bradshaw, L., & Levy, R. (2019). Interpreting probabilistic classifications from diagnostic psychometric models. *Educational Measurement: Issues and Practice, 38*(2), 79-88. https://doi.org/10.1111/emip.12247