World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

A Demonstration of How to Employ and Interpret Binary IRT Models Using the New IRT Procedure in SAS 9.4

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Abstract : Over the past few decades, great strides have been made towards improving the science in the measurement of psychological constructs. Item Response Theory (IRT) has been the foundation upon which statistical models have been derived to increase both precision and accuracy in psychological measurement. These models are now being used widely to develop and refine tests intended to measure an individual's level of academic achievement, aptitude, and intelligence. Recently, the field of clinical psychology has adopted IRT models to measure psychopathological phenomena such as depression, anxiety, and addiction. Because advances in IRT measurement models are being made so rapidly across various fields, it has become quite challenging for psychologists and other behavioral scientists to keep abreast of the most recent developments, much less learn how to employ and decide which models are the most appropriate to use in their line of work. In the same vein, IRT measurement models vary greatly in complexity in several interrelated ways including but not limited to the number of item-specific parameters estimated in a given model, the function which links the expected response and the predictor, response option formats, as well as dimensionality. As a result, inferior methods (a.k.a. Classical Test Theory methods) continue to be employed in efforts to measure psychological constructs, despite evidence showing that IRT methods yield more precise and accurate measurement. To increase the use of IRT methods, this study endeavors to provide a comprehensive overview of binary IRT models; that is, measurement models employed on test data consisting of binary response options (e.g., correct/incorrect, true/false, agree/disagree). Specifically, this study will cover the most basic binary IRT model, known as the 1-parameter logistic (1-PL) model dating back to over 50 years ago, up until the most recent complex, 4-parameter logistic (4-PL) model. Binary IRT models will be defined mathematically and the interpretation of each parameter will be provided. Next, all four binary IRT models will be employed on two sets of data: 1. Simulated data of N=500,000 subjects who responded to four dichotomous items and 2. A pilot analysis of real-world data collected from a sample of approximately 770 subjects who responded to four self-report dichotomous items pertaining to emotional consequences to alcohol use. Real-world data were based on responses collected on items administered to subjects as part of a scale-development study (NIDA Grant No. R44 DA023322). IRT analyses conducted on both the simulated data and analyses of real-world pilot will provide a clear demonstration of how to construct, evaluate, and compare binary IRT measurement models. All analyses will be performed using the new IRT procedure in SAS 9.4. SAS code to generate simulated data and analyses will be available upon request to allow for replication of results.

Keywords : instrument development, item response theory, latent trait theory, psychometrics
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020