Digital Module 10: Rasch Measurement Theory

Jue Wang, The University of Miami
George Engelhard Jr., The University of Georgia

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Module Overview

In this digital ITEMS module, Dr. Jue Wang and Dr. George Engelhard Jr. describe the Rasch measurement framework for the construction and evaluation of new measures and scales. From a theoretical perspective, they discuss the historical and philosophical perspectives on measurement with a focus on Rasch's concept of specific objectivity and invariant measurement. Specifically, they introduce the origins of Rasch measurement theory, the development of model-data fit indices, as well as commonly used Rasch measurement models. From an applied perspective, they discuss best practices in constructing, estimating, evaluating, and interpreting a Rasch scale using empirical examples. They provide an overview of a specialized Rasch software program (*Winsteps*) and an *R* program embedded within Shiny (*Shiny_ERMA*) for conducting the Rasch model analyses. The module is designed to be relevant for students, researchers, and data scientists in various disciplines such as psychology, sociology, education, business, health and other social sciences. It contains audio-narrated slides, sample data, syntax files, access to Shiny_ERMA program, diagnostic quiz questions, data-based activities, curated resources, and a glossary.

Key words: Rasch measurement theory, invariant measurement, specific objectivity, scale development, fit indices, residual profile, Shiny_ERMA, Winsteps

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Prerequisite Knowledge

This ITEMS module assumes no prior knowledge of Rasch measurement theory. However, it is probably helpful to have a working knowledge of foundational assessment and statistical concepts such as:

- Basic descriptive statistics (e.g., mean, standard deviation)
- Basic mathematical transformation functions (e.g., logarithms, exponentiations)
- Statistical definition of probability
- Some familiarity with Guttman and Thurstone scaling
- Some familiarity with other measurement theories (e.g., classical test theory, generalizability theory, and item response theory)

The following NCME ITEMS modules may serve as a useful introduction to the prerequisite knowledge:

- Module 7: Comparison of 1-, 2-, and 3-Parameter IRT Models
- Module 14: Generalizability Theory
- Module 16: Comparison of Classical Test Theory and Item Response Theory

These modules and others are available for free in the ITEMS portal.

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Learning Objectives

Upon completion of this ITEMS module, learners should be able to:

- Describe key components of Rasch measurement theory
- Understand key principles of invariant measurement and Rasch's philosophy of measurement
- Apply Rasch measurement theory to scale construction
- Perform Rasch model analysis using computer programs (e.g., Winsteps, Shiny_ERMA)
- Evaluate the fit of a Rasch scale and interpret Rasch location measures
- Make suggestions and implications to scale development in operational practices

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Module Structure

The digital module is divided into the following sections, which can be reviewed sequentially or independently [*approximate completion times in parentheses*].

- Module Introduction [*5 Minutes*]
- Section 1: Conceptual Foundations [*20 Minutes*]
- Section 2: Rasch Measurement Theory [*30 Minutes*]
- Section 3: Creating a Rasch Scale [*25 Minutes*]
- Section 4: Winsteps & Shiny_ERMA [*20 Minutes*]
- Section 5: Data Activity [*30 Minutes*]
- Section 6: Quizzes [*30 Minutes*]

In the portal site, you can also find a video version of the core content as well as a handout with all core slides along with other materials.

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Module Components

This ITEMS module includes the following components, which are delivered within a web-delivered unified design shell that is compatible across platforms (i.e., laptops, desktops, tablets, cell phones) and was created with modern course development software (*Articulate 360*):

- integrated content slides that provide a structured walk-through of the content
- embedded didactic videos to demonstrate software implementations
- interactive quiz questions with diagnostic feedback
- sample data, syntax file, and access to the Shiny_ERMA program
- data-based activities with video solutions
- glossary of key terms
- supplementary digital resources

Additional materials may be added over time so check back periodically!

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Instructors

Jue Wang, *Assistant Professor at the University of Miami*

Jue is an assistant professor in Research, Measurement & Evaluation Program at the University of Miami. She received her Ph.D. from the University of Georgia in Quantitative Methodology under the Department of Educational Psychology. Her research focuses on examining rating quality and rater effects in rater-mediated assessments using a variety of measurement models including Rasch models, unfolding models, and multilevel item response models. She has published in leading journals related to measurement including *Educational and Psychological Measurement*, *Journal of Educational Measurement*, *Assessing Writing*, and *Measurement: Interdisciplinary Research and Perspectives*. She is currently completing a book with Professor George Engelhard entitled *Rasch models for solving measurement problems: Invariant measurement in the social sciences* that will be published by Sage as a part of their Quantitative Applications in the Social Sciences (QASS) series.

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George Engelhard Jr., *Professor at the University of Georgia*

George joined the faculty at The University of Georgia in the fall of 2013. He is professor emeritus at Emory University (1985 to 2013). Professor Engelhard received his Ph.D. in 1985 from The University of Chicago (MESA Program--measurement, evaluation, and statistical analysis). Professor Engelhard is the author of two books: *Invariant measurement with raters and rating scales: Rasch models for rater-mediated assessments* (2018 with Dr. Stefanie A. Wind) and *Invariant measurement: Using Rasch models in the social, behavioral, and health sciences* (2013). He is the co-editor of five books, and he has authored or co-authored over 200 journal articles, book chapters, and monographs. He serves on several national technical advisory committees on educational measurement and policy in several states in the United States. In 2015, he received the first Qiyas Award for Excellence in International Educational Assessment recognizing his contributions to the improvement of educational measurement at the local, national and international levels. Professor Engelhard is currently a co-editor of the *Journal of Educational Measurement*. He is a fellow of the American Educational Research Association.

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Jonathan Lehrfeld*, Psychometrician at Educational Testing Service (ETS)*

Jon graduated from Fordham University in 2016 with a Ph.D. in psychometrics and quantitative psychology, where his dissertation focused on integrating propensity score methods with structural equation modeling. After graduating, he worked at the Council for Aid to Education (CAE) for three years, serving as their psychometrician and Associate Director of Measurement Science. While at CAE, his operational and research work focused on practical problems in low-stakes testing. He most recently joined ETS where he currently works as a psychometrician on a large-scale state assessment team.

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André A. Rupp*, Research Director at Educational Testing Service (ETS)*

André is a research director in the psychometrics, statistics, and data sciences area at ETS. He is the co-author and co-editor of two award-winning interdisciplinary books entitled *Diagnostic Measurement: Theory, Methods, and Applications* (2010) and *The Handbook of Cognition and Assessment: Frameworks, Methodologies, and Applications* (2016); he is currently working on the *Handbook of Automated Scoring: Theory into Practice*. His synthesis- and framework-oriented research has appeared in a wide variety of prestigious peer-reviewed journals. Among other things, he is passionate about improving processes for interdisciplinary collaborations during the development and implementation of scoring solutions for digitally-delivered assessments. Consequently, he is very excited to serve as the associate editor / lead developer of the ITEMS portal for NCME whose mission is to provide free digital resources in educational measurement to support self-directed learning and professional development.

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