

# Fitting a Thurstonian IRT model to forced-choice data using Mplus

Anna Brown · Alberto Maydeu-Olivares

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**Abstract** To counter response distortions associated with the use of rating scales (a.k.a. Likert scales), items can be presented in a comparative fashion, so that respondents are asked to rank the items within blocks (forced-choice format). However, classical scoring procedures for these forced-choice designs lead to ipsative data, which presents psychometric challenges that are well described in the literature. Recently, Brown and Maydeu-Olivares (Educational and Psychological Measurement 71: 460–502, 2011a) introduced a model based on Thurstone's law of comparative judgment, which overcomes the problems of ipsative data. Here, we provide a step-by-step tutorial for coding forced-choice responses, specifying a Thurstonian item response theory model that is appropriate for the design used, assessing the model's fit, and scoring individuals on psychological attributes. Estimation and scoring is performed using Mplus, and a very straightforward Excel macro is provided that writes full Mplus input files for any forced-choice design. Armed with these tools, using a forced-choice design is now as easy as using ratings.

**Electronic supplementary material** The online version of this article (doi:10.3758/s13428-012-0217-x) contains supplementary material, which is available to authorized users.

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**Keywords** Forced-choice format · Thurstonian IRT model · Ipsative data · Multidimensional IRT · Mplus

Typical questionnaire and survey items are presented to respondents one at a time (single-stimulus items), which often leads to indiscriminate endorsement of all desirable items by respondents, resulting in systematic score inflation. *Forced-choice* response formats were designed to reduce such biases by forcing people to choose between similarly attractive options. In forced-choice questionnaires, items are presented in blocks of two, three, four, or more items at a time, and respondents are asked to rank the items within each block according to some instruction (e.g., in terms of how well the items describe their behavior or attitudes). Sometimes, the respondents are asked to indicate only the top and the bottom ranks (e.g., to select one item that best describes them and one that least describes them).

One special case of forced-choice is the so-called *multidimensional forced-choice* (MFC), in which each item is assumed to measure only one psychological attribute, and all items within a block measure different attributes. MFC questionnaires are popular in the psychological assessment industry because it is believed that this format is more robust against response sets, halo effects, and impression management, and experimental evidence supports these ideas (e.g., Bartram, 2007; Cheung & Chan, 2002; Christiansen, Burns, & Montgomery, 2005; Jackson, Wroblewski, & Ashton, 2000).

The standard scoring used with forced-choice questionnaires involves adding the inverted rank orders of items within blocks to their respective scales. As a fixed number of points are allocated in every block, the total number of points on the test is the same for every individual (*ipsative* data). In other words, one scale score can be determined from the remaining scales. Ipsativity leads to some highly undesirable consequences, namely:

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**Anastasiya A Lipnevich, Franzis  
Preckel, Richard D. Roberts**



## **Fitting A Thurstonian Irt Model To Forced Choice Data:**

**Assessing Competencies for Social and Emotional Learning** Jeremy Burrus, Samuel H. Rikoon, Meghan W. Brenneman, 2022-07-12 Assessing Competencies for Social and Emotional Learning explores the conceptualization development and application of assessments of competencies and contextual factors related to social and emotional learning SEL As programs designed to teach students social and emotional competencies are being adopted at an ever increasing rate new measurements are needed to understand their impact on student attitudes behaviors and academic performance This book integrates standards of fairness reliability and validity and lessons learned from personality and attitude assessment to facilitate the principled development and use of SEL assessments Education professionals assessment developers and researchers will be better prepared to systematically develop and evaluate measures of social and emotional competencies

*Measuring Human Capabilities* National Research Council, Division of Behavioral and Social Sciences and Education, Board on Behavioral, Cognitive, and Sensory Sciences, Committee on Measuring Human Capabilities: Performance Potential of Individuals and Collectives, 2015-04-10 Every year the U S Army must select from an applicant pool in the hundreds of thousands to meet annual enlistment targets currently numbering in the tens of thousands of new soldiers A critical component of the selection process for enlisted service members is the formal assessments administered to applicants to determine their performance potential Attrition for the U S military is hugely expensive Every recruit that does not make it through basic training or beyond a first enlistment costs hundreds of thousands of dollars Academic and other professional settings suffer similar losses when the wrong individuals are accepted into the wrong schools and programs or jobs and companies Picking the right people from the start is becoming increasingly important in today s economy and in response to the growing numbers of applicants Beyond cognitive tests of ability what other attributes should selectors be considering to know whether an individual has the talent and the capability to perform as well as the mental and psychological drive to succeed *Measuring Human Capabilities An Agenda for Basic Research on the Assessment of Individual and Group Performance Potential for Military Accession* examines promising emerging theoretical technological and statistical advances that could provide scientifically valid new approaches and measurement capabilities to assess human capability This report considers the basic research necessary to maximize the efficiency accuracy and effective use of human capability measures in the military s selection and initial occupational assignment process The research recommendations of *Measuring Human Capabilities* will identify ways to supplement the Army s enlisted soldier accession system with additional predictors of individual and collective performance Although the primary audience for this report is the U S military this book will be of interest to researchers of psychometrics personnel selection and testing team dynamics cognitive ability and measurement methods and technologies Professionals interested in of the foundational science behind academic testing job selection and human resources management will also find this report of interest *Advancing Methods for Psychological*

*Assessment Across Borders* Kai Ruggeri, Gabriela Diana Roman, Agnieszka Walczak, Sam Norton, Pietro Cipresso, Rocio Del Pino, Kristina Egumenovska, 2020-01-06      **The Wiley Handbook of Psychometric Testing** Paul Irwing, Tom Booth, David J. Hughes, 2018-02-12 A must have resource for researchers practitioners and advanced students interested or involved in psychometric testing Over the past hundred years psychometric testing has proved to be a valuable tool for measuring personality mental ability attitudes and much more The word psychometrics can be translated as mental measurement however the implication that psychometrics as a field is confined to psychology is highly misleading Scientists and practitioners from virtually every conceivable discipline now use and analyze data collected from questionnaires scales and tests developed from psychometric principles and the field is vibrant with new and useful methods and approaches This handbook brings together contributions from leading psychometricians in a diverse array of fields around the globe Each provides accessible and practical information about their specialist area in a three step format covering historical and standard approaches innovative issues and techniques and practical guidance on how to apply the methods discussed Throughout real world examples help to illustrate and clarify key aspects of the topics covered The aim is to fill a gap for information about psychometric testing that is neither too basic nor too technical and specialized and will enable researchers practitioners and graduate students to expand their knowledge and skills in the area Provides comprehensive coverage of the field of psychometric testing from designing a test through writing items to constructing and evaluating scales Takes a practical approach addressing real issues faced by practitioners and researchers Provides basic and accessible mathematical and statistical foundations of all psychometric techniques discussed Provides example software code to help readers implement the analyses discussed      **Decisions, Preferences, and Heuristics** Pere Mir-Artigues, 2023-08-14 This enlightening book comprehensively maps the current state of economic psychology and behavioural economics Exploring key concepts topics and models in the field it is also a launching pad for future research and provides useful insights on how good personal and professional decisions can be made advancing microeconomic discourse      Quantitative Psychology Research L. Andries van der Ark, Daniel M. Bolt, Wen-Chung Wang, Jeffrey A. Douglas, Marie Wiberg, 2016-08-04 The research articles in this volume cover timely quantitative psychology topics including new methods in item response theory computerized adaptive testing cognitive diagnostic modeling and psychological scaling Topics within general quantitative methodology include structural equation modeling factor analysis causal modeling mediation missing data methods and longitudinal data analysis These methods will appeal in particular to researchers in the social sciences The 80th annual meeting took place in Beijing China between the 12th and 16th of July 2015 Previous volumes to showcase work from the Psychometric Society's Meeting are *New Developments in Quantitative Psychology* Presentations from the 77th Annual Psychometric Society Meeting Springer 2013 *Quantitative Psychology Research* The 78th Annual Meeting of the Psychometric Society Springer 2015 and *Quantitative Psychology Research* The 79th Annual Meeting of the Psychometric Society Wisconsin USA 2014

Springer 2015      *Psychosocial Skills and School Systems in the 21st Century* Anastasiya A Lipnevich, Franzis Preckel, Richard D. Roberts, 2016-04-02 This book provides a comprehensive overview and in depth analysis of research on psychosocial skills examining both theory and areas of application It discusses students psychosocial skills both as components of academic success and desired educational outcomes in grades K through 12 The book describes an organizing framework for psychosocial skills and examines a range of specific constructs that includes achievement motivation self efficacy creativity emotional intelligence resilience and the need for cognition In addition it reviews specific school based interventions and examines issues that concern the malleability of psychosocial skills It addresses issues relating to the integration of psychosocial skills into school curriculum as well as large scale assessment policies Topics featured in this book include Development of psychosocial skills in grades K 12 Assessment of psychosocial skills Conscientiousness in education and its relation to meaningful educational outcomes Creativity in schools including theory assessment and interventions Academic emotions and their regulation through emotional intelligence Resilience and school based programs aimed at enhancing it Psychosocial Skills and School Systems in the 21st Century is a must have resource for researchers graduate students clinicians mental health professionals and policymakers in child and school psychology educational policy and politics public health social work developmental psychology and educational psychology      Quantitative Psychology Research Roger E. Millsap, Daniel M. Bolt, L. Andries van der Ark, Wen-Chung Wang, 2014-11-26 The 78th Annual Meeting of the Psychometric Society IMPS builds on the Psychometric Society's mission to share quantitative methods relevant to psychology The chapters of this volume present cutting edge work in the field Topics include studies of item response theory computerized adaptive testing cognitive diagnostic modeling and psychological scaling Additional psychometric topics relate to structural equation modeling factor analysis causal modeling mediation missing data methods and longitudinal data analysis among others The papers in this volume will be especially useful for researchers in the social sciences who use quantitative methods Prior knowledge of statistical methods is recommended The 78th annual meeting took place in Arnhem The Netherlands between July 22nd and 26th 2013 The previous volume to showcase work from the Psychometric Society's Meeting is New Developments in Quantitative Psychology Presentations from the 77th Annual Psychometric Society Meeting Springer 2014      **Organisational Psychology** Julia Yates, Lara Zibarras, Lynsey Mahmood, 2023-12-01 Organisational Psychology offers an accessible engaging and practical introduction to this fascinating discipline It explores the latest thinking reveals surprising truths about the way we work and explains how to craft a successful and fulfilling career in the field Organisational psychology is a complex and dynamic field that focuses on human behaviour in the workplace and explores how individuals groups and organisations function Structured in three parts the book combines an overview of the field with effective advice on how to become a successful organisational psychologist It offers a deep dive into the British Psychological Society's five core areas of organisational psychology Psychological Assessment at Work Learning Training and

Development Leadership Engagement and Motivation Well being and Work and Work Design Organisational Change and Development Chapters include key academic and theoretical concepts practical applications future directions for the field key learning points and further reading Written by highly qualified experts in the field this text is ideal for both undergraduate and postgraduate students taking programmes or modules in organisational psychology or related topics including work and business psychology and human resources as well as human resources practitioners This text will also be valuable for anyone interested in understanding how organisations function and the best ways to allow individuals and organisations to survive thrive and flourish

Tutoriais em análise de dados aplicados à psicometria Cristiane Faiad de Moura, Makilim Nunes Baptista, Ricardo Primi, 2022-04-06 Os conhecimentos propiciados pela Psicometria aliada metodologia de pesquisa s o fundamentais para auxiliar na valida o de diversas ferramentas que podem ser utilizadas no cotidiano da AP desde a constru o de um instrumento ex entrevista semi ou estruturada escala checklist perpassando por todos os tipos de evid ncias de validade at hoje explorados pela literatura cient fica A Psicometria pode ser considerada uma ci ncia multi reas que alia a utiliza o da matem tica aos modelos psicol gicos se valendo de t cnicas de estat stica na mensura o de vari veis psicol gicas contribuindo desde a compreens o destes fen menos aos profissionais de psicologia at a confec o e comprova o de teorias psicol gicas complexas nesse contexto que a obra Tutoriais em an lise de dados aplicados psicometria se destaca como uma iniciativa singular no Brasil no aux lio de profissionais que queiram conhecer e se aprimorar nesta rea Trecho da obra

*Quantitative Psychology* Marie Wiberg, Steven Culpepper, Rianne Janssen, Jorge González, Dylan Molenaar, 2018-04-20 This proceedings book highlights the latest research and developments in psychometrics and statistics Featuring contributions presented at the 82nd Annual Meeting of the Psychometric Society IMPS organized by the University of Zurich and held in Zurich Switzerland from July 17 to 21 2017 its 34 chapters address a diverse range of psychometric topics including item response theory factor analysis causal inference Bayesian statistics test equating cognitive diagnostic models and multistage adaptive testing The IMPS is one of the largest international meetings on quantitative measurement in psychology education and the social sciences attracting over 500 participants and 250 paper presentations from around the world every year This book gathers the contributions of selected presenters which were subsequently expanded and peer reviewed

**Decisions, preferències i heurístiques. Una introducció a la psicologia econòmica** Pere Mir, Artigues, 2022-09-05 Com es prenen les decisions econ miques Qu determi na les tries que fem cada dia Respondre aquestes q es tions s l objectiu de la psicologia econ mica una disci plina encara poc coneguda al nostre pa s de la qual aquest llibre ofereix una primera aproximaci Inspirat en els re sultats obtinguts pel programa de recerca de la racionalitat contextual el text explica en primer lloc els grans factors que guien les decisions econ miques les pre fer ncies les creences les emocions i la informaci que conservem a la mem ria En segon lloc exposa els prin cipals patrons en qu s emmarquen el recurs a les heu r stiques la reflexi deliberativa i la cessi volunt ria de la capacitat de decidir descrivint ne els principals algo

rismes Finalment proposa un model senzill dels mltiples elements que influeixen en les eleccions en el consum de bens i serveis La psicologia econmica ofereix doncs eines tils per identificar i triar l'opci satisfactria en tot tipus de decisions tant en l'mbit personal com professional

*A Comparison of the Psychometric Properties of the Forced Choice and Likert Scale Versions of a Personality Instrument* Tina Joubert, Ilke Inceoglu, David Bartram, Kim Dowdeswell, Yin Lin, 2015 The present research investigated if an item response theory IRT scored forced choice personality questionnaire has the same normative data structures as a similar version that uses a 5 point Likert scale instead The study was conducted using a sample of 349 training delegates who completed both an IRT scored forced choice and a normative single stimulus version of the questionnaire Results largely supported the scaling properties measurement precision and equivalence of the data structures of the two scoring methods

New Model-data Fit Indices for Item Response Theory (IRT): an Evaluation and Application, 2015

**Advances in Thurstonian Forced-Choice Modeling** Markus Thomas Jansen, 2023

**Handbook of Item Response Theory Modeling** Steven P. Reise, Dennis A. Revicki, 2014-11-20 Item response theory IRT has moved beyond the confines of educational measurement into assessment domains such as personality psychopathology and patient reported outcomes Classic and emerging IRT methods and applications that are revolutionizing psychological measurement particularly for health assessments used to demonstrate treatment effectiveness are reviewed in this new volume World renowned contributors present the latest research and methodologies about these models along with their applications and related challenges Examples using real data some from NIH PROMIS show how to apply these models in actual research situations Chapters review fundamental issues of IRT modern estimation methods testing assumptions evaluating fit item banking scoring in multidimensional models and advanced IRT methods New multidimensional models are provided along with suggestions for deciding among the family of IRT models available Each chapter provides an introduction describes state of the art research methods demonstrates an application and provides a summary The book addresses the most critical IRT conceptual and statistical issues confronting researchers and advanced students in psychology education and medicine today Although the chapters highlight health outcomes data the issues addressed are relevant to any content domain The book addresses IRT models applied to non educational data especially patient reported outcomes Differences between cognitive and non cognitive constructs and the challenges these bring to modeling The application of multidimensional IRT models designed to capture typical performance data Cutting edge methods for deriving a single latent dimension from multidimensional data A new model designed for the measurement of constructs that are defined on one end of a continuum such as substance abuse Scoring individuals under different multidimensional IRT models and item banking for patient reported health outcomes How to evaluate measurement invariance diagnose problems with response categories and assess growth and change Part 1 reviews fundamental topics such as assumption testing parameter estimation and the assessment of model and person fit New emerging and classic IRT models including modeling multidimensional data and the use of new

IRT models in typical performance measurement contexts are examined in Part 2 Part 3 reviews the major applications of IRT models such as scoring item banking for patient reported health outcomes evaluating measurement invariance linking scales to a common metric and measuring growth and change The book concludes with a look at future IRT applications in health outcomes measurement The book summarizes the latest advances and critiques foundational topics such as multidimensionality assessment of fit handling non normality as well as applied topics such as differential item functioning and multidimensional linking Intended for researchers advanced students and practitioners in psychology education and medicine interested in applying IRT methods this book also serves as a text in advanced graduate courses on IRT or measurement Familiarity with factor analysis latent variables IRT and basic measurement theory is assumed **The Effect**

**of Fitting a Unidimensional IRT Model to Multidimensional Data in Content-balanced Computerized Adaptive Testing** Tian Song,2010 This study investigates the effect of fitting a unidimensional irt model to multidimensional data in content balanced computerized adaptive testing cat Unconstrained cat with the maximum information item selection method is chosen as the baseline and the performances of three content balancing procedures the constrained cat ccat the modified multinomial model mmm and the modified constrained cat mccat are evaluated in terms of measurement precision item pool utilization and item exposure control Three simulation factors are considered 1 multidimensional structure 2 ability distribution and 3 difficulty level of content areas Simulation results show that overall the content balancing methods are similar to or even better than the maximum information method in terms of measurement precision especially when the content areas have uneven difficulty levels However there is no significant difference in item pool usage and item exposure control Finally overall the three content balancing methods perform very similarly but mmm has the most efficient item pool usage The dissertation citations contained here are published with the permission of ProQuest llc Further reproduction is prohibited without permission Copies of dissertations may be obtained by Telephone 800 1 800 521 0600 Web page <http://www.proquest.com/en-US/products/dissertations/individuals.shtml> Fit of Item Response Theory Models S.

Sinharay,Shelby J. Haberman,Helena Jia,2011 Standard 3.9 of the Standards for Educational and Psychological Testing American Educational Research Association American Psychological Association National Council for Measurement in Education 1999 demands evidence of model fit when an item response theory IRT model is used to make inferences from a data set We applied two recently suggested methods for assessing goodness of fit of IRT models generalized residual analysis Haberman 2009 and residual analysis for assessing item fit Bock Haberman 2009 to several operational data sets We assessed the practical significance of misfit whenever possible This report summarizes our findings Though evidence of misfit of the IRT model was found for all the data sets the misfit was not always practically significant Contains 3 tables 50 figures and 6 notes



## Whispering the Techniques of Language: An Emotional Quest through **Fitting A Thurstonian Irt Model To Forced Choice Data**

In a digitally-driven earth wherever screens reign supreme and instant connection drowns out the subtleties of language, the profound techniques and psychological subtleties hidden within words frequently go unheard. Yet, situated within the pages of **Fitting A Thurstonian Irt Model To Forced Choice Data** a charming literary value sporting with raw feelings, lies an extraordinary journey waiting to be undertaken. Penned by an experienced wordsmith, this enchanting opus attracts readers on an introspective trip, gently unraveling the veiled truths and profound impact resonating within the very fabric of every word. Within the mental depths of this moving evaluation, we shall embark upon a honest exploration of the book is primary themes, dissect its captivating writing design, and succumb to the strong resonance it evokes heavy within the recesses of readers hearts.

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