



# AN INTRODUCTION TO MULTILEVEL MODELING TECHNIQUES

RONALD H. HECK • SCOTT L. THOMAS

# An Introduction To Multilevel Modeling Techniques

## Quantitative Methodology Series

**Ronald H. Heck, Scott L. Thomas**



## **An Introduction To Multilevel Modeling Techniques Quantitative Methodology Series:**

An Introduction to Multilevel Modeling Techniques Ronald Heck, Scott L. Thomas, 2020-03-24 Multilevel modelling is a data analysis method that is frequently used to investigate hierarchical data structures in educational behavioural health and social sciences disciplines Multilevel data analysis exploits data structures that cannot be adequately investigated using single level analytic methods such as multiple regression path analysis and structural modelling This text offers a comprehensive treatment of multilevel models for univariate and multivariate outcomes It explores their similarities and differences and demonstrates why one model may be more appropriate than another given the research objectives New to this edition An expanded focus on the nature of different types of multilevel data structures e g cross sectional longitudinal cross classified etc for addressing specific research goals Varied modelling methods for examining longitudinal data including random effect and fixed effect approaches Expanded coverage illustrating different model building sequences and how to use results to identify possible model improvements An expanded set of applied examples used throughout the text Use of four different software packages i e Mplus R SPSS Stata with selected examples of model building input files included in the chapter appendices and a more complete set of files available online This is an ideal text for graduate courses on multilevel longitudinal latent variable modelling multivariate statistics or advanced quantitative techniques taught in psychology business education health and sociology Recommended prerequisites are introductory univariate and multivariate statistics

**An Introduction to Multilevel Modeling Techniques** Ronald H. Heck, Scott L. Thomas, 1999-11 Multilevel modelling is a data analysis method that is frequently used to investigate hierarchical data structures in educational behavioural health and social sciences disciplines Multilevel data analysis exploits data structures that cannot be adequately investigated using single level analytic methods such as multiple regression path analysis and structural modelling This text offers a comprehensive treatment of multilevel models for univariate and multivariate outcomes It explores their similarities and differences and demonstrates why one model may be more appropriate than another given the research objectives Provided by Publisher

An Introduction to Multilevel Modeling Techniques Ronald H. Heck, Scott L. Thomas, 2015-03-05 Univariate and multivariate multilevel models are used to understand how to design studies and analyze data in this comprehensive text distinguished by its variety of applications from the educational behavioral and social sciences Basic and advanced models are developed from the multilevel regression MLM and latent variable SEM traditions within one unified analytic framework for investigating hierarchical data The authors provide examples using each modeling approach and also explore situations where alternative approaches may be more appropriate given the research goals Numerous examples and exercises allow readers to test their understanding of the techniques presented Changes to the new edition include The use of Mplus 7.2 for running the analyses including the input and data files at [www.routledge.com/9781848725522](http://www.routledge.com/9781848725522) Expanded discussion of MLM and SEM model building that outlines the steps taken in the process the relevant Mplus syntax and tips

on how to evaluate the models Expanded pedagogical program now with chapter objectives boldfaced key terms a glossary and more tables and graphs to help students better understand key concepts and techniques Numerous varied examples developed throughout which make this book appropriate for use in education psychology business sociology and the health sciences Expanded coverage of missing data problems in MLM using ML estimation and multiple imputation to provide currently accepted solutions Ch 10 New chapter on three level univariate and multilevel multivariate MLM models provides greater options for investigating more complex theoretical relationships Ch 4 New chapter on MLM and SEM models with categorical outcomes facilitates the specification of multilevel models with observed and latent outcomes Ch 8 New chapter on multilevel and longitudinal mixture models provides readers with options for identifying emergent groups in hierarchical data Ch 9 New chapter on the utilization of sample weights power analysis and missing data provides guidance on technical issues of increasing concern for research publication Ch 10 Ideal as a text for graduate courses on multilevel longitudinal latent variable modeling multivariate statistics or advanced quantitative techniques taught in psychology business education health and sociology this book s practical approach also appeals to researchers Recommended prerequisites are introductory univariate and multivariate statistics

*An Introduction to Multilevel Modeling Techniques* Ronald H. Heck, Scott L. Thomas, 2015-01-30 Univariate and multivariate multilevel models are used to understand how to design studies and analyze data in this comprehensive text distinguished by its variety of applications from the educational behavioral and social sciences Basic and advanced models are developed from the multilevel regression MLM and latent variable SEM traditions within one unified analytic framework for investigating hierarchical data The authors provide examples using each modeling approach and also explore situations where alternative approaches may be more appropriate given the research goals Numerous examples and exercises allow readers to test their understanding of the techniques presented Changes to the new edition include The use of Mplus 7.2 for running the analyses including the input and data files at [www.routledge.com/9781848725522](http://www.routledge.com/9781848725522) Expanded discussion of MLM and SEM model building that outlines the steps taken in the process the relevant Mplus syntax and tips on how to evaluate the models Expanded pedagogical program now with chapter objectives boldfaced key terms a glossary and more tables and graphs to help students better understand key concepts and techniques Numerous varied examples developed throughout which make this book appropriate for use in education psychology business sociology and the health sciences Expanded coverage of missing data problems in MLM using ML estimation and multiple imputation to provide currently accepted solutions Ch 10 New chapter on three level univariate and multilevel multivariate MLM models provides greater options for investigating more complex theoretical relationships Ch 4 New chapter on MLM and SEM models with categorical outcomes facilitates the specification of multilevel models with observed and latent outcomes Ch 8 New chapter on multilevel and longitudinal mixture models provides readers with options for identifying emergent groups in hierarchical data Ch 9 New chapter on the utilization of sample weights power analysis and

missing data provides guidance on technical issues of increasing concern for research publication Ch 10 Ideal as a text for graduate courses on multilevel longitudinal latent variable modeling multivariate statistics or advanced quantitative techniques taught in psychology business education health and sociology this book s practical approach also appeals to researchers Recommended prerequisites are introductory univariate and multivariate statistics

**Multilevel and Longitudinal Modeling with IBM SPSS** Ronald H. Heck, Scott L. Thomas, Lynn N. Tabata, 2013-08-22 This book demonstrates how to use multilevel and longitudinal modeling techniques available in the IBM SPSS mixed effects program MIXED Annotated screen shots provide readers with a step by step understanding of each technique and navigating the program Readers learn how to set up run and interpret a variety of models Diagnostic tools data management issues and related graphics are introduced throughout Annotated syntax is also available for those who prefer this approach Extended examples illustrate the logic of model development to show readers the rationale of the research questions and the steps around which the analyses are structured The data used in the text and syntax examples are available at [www.routledge.com/9780415817110](http://www.routledge.com/9780415817110) Highlights of the new edition include Updated throughout to reflect IBM SPSS Version 21 Further coverage of growth trajectories coding time related variables covariance structures individual change and longitudinal experimental designs Ch 5 Extended discussion of other types of research designs for examining change e g regression discontinuity quasi experimental over time Ch 6 New examples specifying multiple latent constructs and parallel growth processes Ch 7 Discussion of alternatives for dealing with missing data and the use of sample weights within multilevel data structures Ch 1 The book opens with the conceptual and methodological issues associated with multilevel and longitudinal modeling followed by a discussion of SPSS data management techniques which facilitate working with multilevel longitudinal and cross classified data sets Chapters 3 and 4 introduce the basics of multilevel modeling developing a multilevel model interpreting output and trouble shooting common programming and modeling problems Models for investigating individual and organizational change are presented in chapters 5 and 6 followed by models with multivariate outcomes in chapter 7 Chapter 8 provides an illustration of multilevel models with cross classified data structures The book concludes with ways to expand on the various multilevel and longitudinal modeling techniques and issues when conducting multilevel analyses It s ideal for courses on multilevel and longitudinal modeling multivariate statistics and research design taught in education psychology business and sociology

**Multilevel Analysis** Joop Hox, Mirjam Moerbeek, Rens van de Schoot, 2017-09-14 Applauded for its clarity this accessible introduction helps readers apply multilevel techniques to their research The book also includes advanced extensions making it useful as both an introduction for students and as a reference for researchers Basic models and examples are discussed in nontechnical terms with an emphasis on understanding the methodological and statistical issues involved in using these models The estimation and interpretation of multilevel models is demonstrated using realistic examples from various disciplines including psychology education public health and sociology Readers are introduced to a

general framework on multilevel modeling which covers both observed and latent variables in the same model while most other books focus on observed variables In addition Bayesian estimation is introduced and applied using accessible software

**Multilevel Modeling of Categorical Outcomes Using IBM SPSS** Ronald H Heck, Scott Thomas, Lynn

Tabata, 2013-05-07 This is the first workbook that introduces the multilevel approach to modeling with categorical outcomes using IBM SPSS Version 20 Readers learn how to develop estimate and interpret multilevel models with categorical outcomes The authors walk readers through data management diagnostic tools model conceptualization and model specification issues related to single level and multilevel models with categorical outcomes Screen shots clearly demonstrate techniques and navigation of the program Modeling syntax is provided in the appendix Examples of various types of categorical outcomes demonstrate how to set up each model and interpret the output Extended examples illustrate the logic of model development interpretation of output the context of the research questions and the steps around which the analyses are structured Readers can replicate examples in each chapter by using the corresponding data and syntax files available at [www.psypress.com](http://www.psypress.com) 9781848729568 The book opens with a review of multilevel with categorical outcomes followed by a chapter on IBM SPSS data management techniques to facilitate working with multilevel and longitudinal data sets Chapters 3 and 4 detail the basics of the single level and multilevel generalized linear model for various types of categorical outcomes These chapters review underlying concepts to assist with trouble shooting common programming and modeling problems Next population average and unit specific longitudinal models for investigating individual or organizational developmental processes are developed Chapter 6 focuses on single and multilevel models using multinomial and ordinal data followed by a chapter on models for count data The book concludes with additional trouble shooting techniques and tips for expanding on the modeling techniques introduced Ideal as a supplement for graduate level courses and or professional workshops on multilevel longitudinal latent variable modeling multivariate statistics and or advanced quantitative techniques taught in psychology business education health and sociology this practical workbook also appeals to researchers in these fields An excellent follow up to the authors highly successful Multilevel and Longitudinal Modeling with IBM SPSS and Introduction to Multilevel Modeling Techniques 2nd Edition this book can also be used with any multilevel and or longitudinal book or as a stand alone text introducing multilevel modeling with categorical outcomes [Multilevel and Longitudinal Modeling with IBM SPSS](#) Ronald H. Heck, Scott L. Thomas, Lynn Naomi Tabata, 2021 Multilevel and Longitudinal Modeling with IBM SPSS Third Edition demonstrates how to use the multilevel and longitudinal modeling techniques available in IBM SPSS Versions 25 27 Annotated screenshots with all relevant output provide readers with a step by step understanding of each technique as they are shown how to navigate the program Throughout diagnostic tools data management issues and related graphics are introduced SPSS commands show the flow of the menu structure and how to facilitate model building while annotated syntax is also available for those who prefer this approach Extended examples illustrating the logic of model development and

evaluation are included throughout the book demonstrating the context and rationale of the research questions and the steps around which the analyses are structured The book opens with the conceptual and methodological issues associated with multilevel and longitudinal modeling followed by a discussion of SPSS data management techniques that facilitate working with multilevel longitudinal or cross classified data sets The next few chapters introduce the basics of multilevel modeling developing a multilevel model extensions of the basic two level model e g three level models models for binary and ordinal outcomes and troubleshooting techniques for everyday use programming and modeling problems along with potential solutions Models for investigating individual and organizational change are next developed followed by models with multivariate outcomes and finally models with cross classified and multiple membership data structures The book concludes with thoughts about ways to expand on the various multilevel and longitudinal modeling techniques introduced and issues e g missing data sample weights to keep in mind in conducting multilevel analyses Key features of the third edition Thoroughly updated throughout to reflect IBM SPSS Versions 26 27 Introduction to fixed effects regression for examining change over time where random effects modeling may not be an optimal choice Additional treatment of key topics specifically aligned with multilevel modeling e g models with binary and ordinal outcomes Expanded coverage of models with cross classified and multiple membership data structures Added discussion on model checking for improvement e g examining residuals locating outliers Further discussion of alternatives for dealing with missing data and the use of sample weights within multilevel data structures Supported by online data sets the book s practical approach makes it an essential text for graduate level courses on multilevel longitudinal latent variable modeling multivariate statistics or advanced quantitative techniques taught in departments of business education health psychology and sociology The book will also prove appealing to researchers in these fields The book is designed to provide an excellent supplement to Heck and Thomas s *An Introduction to Multilevel Modeling Techniques* Fourth Edition however it can also be used with any multilevel or longitudinal modeling book or as a stand alone text

**Multilevel Analysis** Joop J. Hox, Mirjam Moerbeek, Rens van de Schoot, 2010-09-13 This practical introduction helps readers apply multilevel techniques to their research Noted as an accessible introduction the book also includes advanced extensions making it useful as both an introduction and as a reference to students researchers and methodologists Basic models and examples are discussed in non technical terms with an emphasis on understanding the methodological and statistical issues involved in using these models The estimation and interpretation of multilevel models is demonstrated using realistic examples from various disciplines For example readers will find data sets on stress in hospitals GPA scores survey responses street safety epilepsy divorce and sociometric scores to name a few The data sets are available on the website in SPSS HLM MLwiN LISREL and or Mplus files Readers are introduced to both the multilevel regression model and multilevel structural models Highlights of the second edition include Two new chapters one on multilevel models for ordinal and count data Ch 7 and another on multilevel survival analysis Ch 8 Thoroughly updated chapters on multilevel

structural equation modeling that reflect the enormous technical progress of the last few years The addition of some simpler examples to help the novice whilst the more complex examples that combine more than one problem have been retained A new section on multivariate meta analysis Ch 11 Expanded discussions of covariance structures across time and analyzing longitudinal data where no trend is expected Expanded chapter on the logistic model for dichotomous data and proportions with new estimation methods An updated website at <http://www.joophox.net> with data sets for all the text examples and up to date screen shots and PowerPoint slides for instructors Ideal for introductory courses on multilevel modeling and or ones that introduce this topic in some detail taught in a variety of disciplines including psychology education sociology the health sciences and business The advanced extensions also make this a favorite resource for researchers and methodologists in these disciplines A basic understanding of ANOVA and multiple regression is assumed The section on multilevel structural equation models assumes a basic understanding of SEM

*A Step-by-Step Guide to Applying the Rasch Model Using R* Iasonas Lamprianou, 2024-12-17 This new edition provides a step by step guide to applying the Rasch model in R a probabilistic model used by researchers across the social sciences to measure unobservable latent variables Although the focus is on simple R code the book provides updated guidance through the point and click menus of BlueSky Statistics software The book covers all Rasch models frequently used in social sciences from the Simple Rasch model to the Rating Scale Partial Credit and Many Facets Rasch models Using a pragmatic approach to model data fit this book offers helpful practical examples to investigate Rasch model assumptions In addition to traditional Rasch model approaches it introduces the Rasch model as a special case of a Generalized Mixed Effects Model Readers will also benefit from the online support material which includes all the code used in the book in downloadable and useable files It also provides a comprehensive guide to R programming and practical guidance on using BlueSky Statistics software s point and click menus This dual approach enables readers to experiment with data analysis using the provided data sets enhancing their understanding and application of statistical concepts It will be a valuable resource for both students and researchers who want to use Rasch models in their research

**D-scoring Method of Measurement** Dimiter Dimitrov, 2023-07-18 D scoring Method of Measurement presents a unified framework of classical and latent measurement referred to as D scoring method of measurement DSM Provided are detailed descriptions of DSM procedures and illustrative examples of how to apply the DSM in various scenarios of measurement The DSM is designed to combine merits of the traditional CTT and IRT for the purpose of transparency ease of interpretations computational simplicity of test scoring and scaling and practical efficiency particularly in large scale assessments Through detailed descriptions of DSM procedures this book shows how practical applications of such procedures are facilitated by the inclusion of operationalized guidance for their execution using the computer program DELTA for DSM based scoring equating and item analysis of test data In doing so the book shows how DSM procedures can be readily translated into computer source codes for other popular software packages such as R D



scoring Method of Measurement equips researchers and practitioners in the field of educational and psychological measurement with a comprehensive understanding of the DSM as a unified framework of classical and latent scoring equating and psychometric analysis      Multilevel Analysis J. J. Hox, 2002 This volume provides an introduction to multilevel analysis for applied researchers The book presents two types of multilevel models the multilevel regression model and a model for multilevel covariance structures      *Applying the Rasch Model in Social Sciences Using R* Iasonas

Lamprianou, 2019-12-12 This unique text provides a step by step beginner's guide to applying the Rasch model in R a probabilistic model used by researchers across the social sciences to measure unobservable latent variables Each chapter is devoted to one popular Rasch model ranging from the least to the most complex Through a freely available and user friendly package BlueSky Statistics Lamprianou offers a range of options for presenting results critically examines the strengths and weaknesses of applying the Rasch model in each instance and suggests more effective methodologies where applicable With a focus on simple software code which does not assume extensive mathematical knowledge the reader is initially introduced to the so called simple Rasch Model to construct a political activism variable out of a group of dichotomously scored questions In subsequent chapters the book covers everything from the Rating Scale to the Many facets Rasch model The final chapter even showcases a complete mock manuscript demonstrating how a Rasch based paper on the identification of online hate speech should look like Combining theoretical rigor and real world examples with empirical datasets from published papers this book is essential reading for students and researchers alike who aspire to use Rasch models in their research

Applying Generalizability Theory using EduG Jean Cardinet, Sandra Johnson, Gianreto Pini, 2011-03-04 Intended to help improve measurement and data collection methods in the behavioral social and medical sciences this book demonstrates an expanded and accessible use of Generalizability Theory G theory G theory conceptually models the way in which the reliability of measurement is ascertained Sources of score variation are identified as potential contributors to measurement error and taken into account accordingly The authors demonstrate the powerful potential of G theory by showing how to improve the quality of any kind of measurement regardless of the discipline Readers will appreciate the conversational style used to present a comprehensive review of G theory and its application using the freeware EduG To maximize understanding the authors illustrate all fundamental principles with concrete examples from different fields and contexts Annotated applications lead students through the main concepts of G theory while illustrating both the use of EduG and interpretation of its output Formulas are avoided wherever possible Exercises with data sets available on the Psychology Press website allow readers to carry out their own analyses to reinforce understanding Brief overviews of analysis of variance estimation and the statistical error model are provided for review The procedures involved in carrying out a generalizability study using EduG follow as well as guidance in the interpretation of results Real world applications of G theory to the assessment of depression managerial ability attitudes and writing and mathematical skills are then presented Next annotated exercises

provide an opportunity for readers to use EduG and interpret its results The book concludes with a review of the development of G theory and possible new directions of application Finally for those with a strong statistical background the appendixes provide the formulas used by EduG Ideal as a supplement for courses on measurement theory and or generalizability theory taught in departments of psychology education medicine and the social sciences this text will also appeal to researchers from a variety of fields interested in learning how to apply G theory to their studies **New**

**Developments in Categorical Data Analysis for the Social and Behavioral Sciences** L. Andries van der Ark, Marcel A. Croon, Klaas Sijtsma, 2005-01-15 Categorical data are quantified as either nominal variables distinguishing different groups for example based on socio economic status education and political persuasion or ordinal variables distinguishing levels of interest such as the preferred politician or the preferred type of punishment for committing burglary This new book is a collection of up to date studies on modern categorical data analysis methods emphasizing their application to relevant and interesting data sets This volume concentrates on latent class analysis and item response theory These methods use latent variables to explain the relationships among observed categorical variables Latent class analysis yields the classification of a group of respondents according to their pattern of scores on the categorical variables This provides insight into the mechanisms producing the data and allows the estimation of factor structures and regression models conditional on the latent class structure Item response theory leads to the identification of one or more ordinal or interval scales In psychological and educational testing these scales are used for individual measurement of abilities and personality traits The focus of this volume is applied After a method is explained the potential of the method for analyzing categorical data is illustrated by means of a real data example to show how it can be used effectively for solving a real data problem These methods are accessible to researchers not trained explicitly in applied statistics This volume appeals to researchers and advanced students in the social and behavioral sciences including social developmental organizational clinical and health psychologists sociologists educational and marketing researchers and political scientists In addition it is of interest to those who collect data on categorical variables and are faced with the problem of how to analyze such variables among themselves or in relation to metric variables **Latent Variable and Latent Structure Models** George A. Marcoulides, Irini

Moustaki, 2014-04-04 This edited volume features cutting edge topics from the leading researchers in the areas of latent variable modeling Content highlights include coverage of approaches dealing with missing values semi parametric estimation robust analysis hierarchical data factor scores multi group analysis and model testing New methodological topics are illustrated with real applications The material presented brings together two traditions psychometrics and structural equation modeling Latent Variable and Latent Structure Models thought provoking chapters from the leading researchers in the area will help to stimulate ideas for further research for many years to come This volume will be of interest to researchers and practitioners from a wide variety of disciplines including biology business economics education medicine

psychology sociology and other social and behavioral sciences A working knowledge of basic multivariate statistics and measurement theory is assumed American Book Publishing Record ,2007 **Bibliographic Guide to Education** ,2001 lists publications cataloged by Teachers College Columbia University supplemented by The Research Libraries of The New York Public Library **Multilevel Modeling** Douglas A. Luke,2019-12-13 Multilevel Modeling is a concise practical guide to building models for multilevel and longitudinal data Author Douglas A Luke begins by providing a rationale for multilevel models outlines the basic approach to estimating and evaluating a two level model discusses the major extensions to mixed effects models and provides advice for where to go for instruction in more advanced techniques Rich with examples the Second Edition expands coverage of longitudinal methods diagnostic procedures models of counts Poisson power analysis cross classified models and adds a new section added on presenting modeling results A website for the book includes the data and the statistical code both R and Stata used for all of the presented analyses **The Leadership Quarterly** ,2002

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