

## Statistical Approaches To Measurement Invariance

*This introductory text describes the principles of invariant measurement, how invariant measurement can be achieved with Rasch models, and how to use invariant measurement to solve measurement problems in the social, behavioral, and health sciences. Rasch models are used throughout but a comparison of Rasch models to other item response theory (IRT) models is also provided. Written with students in mind, the manuscript was class tested to help maximize accessibility. Chapters open with an introduction and close with a summary and discussion. Numerous examples and exercises demonstrate the main issues addressed in each chapter. Key terms are defined when first introduced and in an end-of-text glossary. All of the book's analyses were conducted with the Facets program. The data sets used in the book, sample syntax files for running the Facets program, Excel files for creating item and person response functions, links to related websites, and other material are available at [www.GeorgeEngelhard.com](http://www.GeorgeEngelhard.com). Highlights include: A strong philosophical and methodological approach to measurement in the human sciences Demonstrations of how measurement problems can be addressed using invariant measurement Practical illustrations of how to create and evaluate scales using invariant measurement A history of measurement based on test-score and scaling traditions Previously unpublished work in analyzing rating data, the detection and measurement of rater errors, and the evaluation of rater accuracy A review of estimation methods, model-data fit, indices used to evaluate the quality of rater-mediated assessments, rater error and bias, and rater accuracy. Intended as a supplementary text for graduate or advanced undergraduate courses on measurement or test theory, item response theory, scaling theory, psychometrics, advanced measurement techniques, research methods, or evaluation research taught in education, psychology, and the social and health sciences, the book also appeals to practitioners and researchers in these fields who develop or use scales and instruments. Only a basic mathematical level is required including a basic course in statistic.*

*'I often... wonder to myself whether the field needs another book, handbook, or encyclopedia on this topic. In this case I think that the answer is truly yes. The handbook is well focused on important issues in the field, and the chapters are written by recognized authorities in their fields. The book should appeal to anyone who wants an understanding of important topics that frequently go uncovered in graduate education in psychology' - David C Howell, Professor Emeritus, University of Vermont* Quantitative psychology is arguably one of the oldest disciplines within the field of psychology and nearly all psychologists are exposed to quantitative psychology in some form. While textbooks in statistics, research methods and psychological measurement exist, none offer a unified treatment of quantitative psychology. The SAGE Handbook of Quantitative Methods in Psychology does just that. Each chapter covers a methodological topic with equal attention paid to established theory and the challenges facing methodologists as they address new research questions using that particular methodology. The reader will come away from each chapter with a greater understanding of the methodology being addressed as well as an understanding of the directions for future developments within that methodological area. Drawing on a global scholarship, the Handbook is divided into seven parts: Part One: Design and Inference: addresses issues in the inference of causal relations from experimental and non-experimental research, along with the design of true experiments and quasi-experiments, and the problem of missing data due to various influences such as attrition or non-compliance. Part Two: Measurement Theory: begins with a chapter on classical test theory, followed by the common factor analysis model as a model for psychological measurement. The models for continuous latent variables in item-response theory are covered next, followed by a chapter on discrete latent variable models as represented in latent class analysis. Part Three: Scaling Methods: covers metric and non-metric scaling methods as developed in multidimensional scaling, followed by consideration of the scaling of discrete measures as found in dual scaling and correspondence analysis. Models for preference data such as those found in random utility theory are covered next. Part Four: Data Analysis: includes chapters on regression models, categorical data analysis, multilevel or hierarchical models, resampling methods, robust data analysis, meta-analysis, Bayesian data analysis, and cluster analysis. Part Five: Structural Equation Models: addresses topics in general structural equation modeling, nonlinear structural equation models, mixture models, and multilevel structural equation models. Part Six: Longitudinal Models: covers the analysis of longitudinal data via mixed modeling, time series analysis and event history analysis. Part Seven: Specialized Models: covers specific topics including the analysis of neuro-imaging data and functional data-analysis. This book focuses on the practical application of statistical techniques for assessing measurement invariance with less emphasis on theoretical development or exposition. Instead, it describes the methods using a pedagogical framework followed by extensive illustrations that demonstrate how to use software to analyze real data. The chapters illustrate the practical methods to assess measurement invariance and shows how to apply them to a range of data. The computer syntax and data sets used in this book are available for download here: [people.umass.edu/cswells](http://people.umass.edu/cswells).

*Sponsored by the American Educational Research Association's Special Interest Group for Educational Statisticians This volume is the second edition of Hancock and Mueller's highly-successful 2006 volume, with all of the original chapters updated as well as four new chapters. The second edition, like the first, is intended to serve as a didactically-oriented resource for graduate students and research professionals, covering a broad range of advanced topics often not discussed in introductory courses on structural equation modeling (SEM). Such topics are important in furthering the understanding of foundations and assumptions underlying SEM as well as in exploring SEM, as a potential tool to address new types of research questions that might not have arisen during a first course. Chapters focus on the clear explanation and application of topics, rather than on analytical derivations, and contain materials from popular SEM software.*

*A Step-by-Step Guide*

**Basic Themes and Methods**

**MEASUREMENT INVARIANCE OF BURNOUT INVENTORIES ACROSS SEX**

**Methods and Applications**

**Measurement Error in Longitudinal Data**

**Longitudinal Structural Equation Modeling**

Appropriate for use in developmental research methods or analysis of change courses, this is the first methods handbook specifically designed to meet the needs of those studying development. Leading developmental methodologists present cutting-edge analytic tools and describe how and when to use them, in accessible, nontechnical language. They also provide valuable guidance for strengthening developmental research with designs that anticipate potential sources of bias. Throughout the chapters, research examples demonstrate the procedures in action and give readers a better understanding of how to match research questions to developmental methods. The companion website ([www.guilford.com/laursen-materials](http://www.guilford.com/laursen-materials)) supplies data and program syntax files for many of the chapter examples.

This volume explores the scientific frontiers and leading edges of research across the fields of anthropology, economics, political science, psychology, sociology, history, business, education, geography, law, and psychiatry, as well as the newer, more specialized areas of artificial intelligence, child development, cognitive science, communications, demography, linguistics, and management and decision science. It includes recommendations concerning new resources, facilities, and programs that may be needed over the next several years to ensure rapid progress and provide a high level of returns to basic research.

This proceedings volume highlights the latest research and developments in psychometrics and statistics. This book compiles and expands on selected and peer reviewed presentations given at the 83rd Annual International Meeting of the Psychometric Society (IMPS), organized by Columbia University and held in New York, USA July 9th to 13th, 2018. The IMPS is one of the largest international meetings on quantitative measurement in education, psychology and the social sciences. The last couple of years it has attracted more than 500 participants and more than 250 paper presentations from researchers around the world. Leading experts in the world and promising young researchers have written the 38 chapters. The chapters address a large variety of topics including but not limited to item response theory, multistage adaptive testing, and cognitive diagnostic models. This volume is the 7th in a series of recent volumes to cover research presented at the IMPS.

This book demonstrates how to conduct latent variable modeling (LVM) in R by highlighting the features of each model, their specialized uses, examples, sample code and output, and an interpretation of the results. Each chapter features a detailed example including the analysis of the data using R, the relevant theory, the assumptions underlying the model, and other statistical details to help readers better understand the models and interpret the results. Every R command necessary for conducting the analyses is described along with the resulting output which provides readers with a template to follow when they apply the methods to their own data. The basic information pertinent to each model, the newest developments in these areas, and the relevant R code to use them are reviewed. Each chapter also features an introduction, summary, and suggested readings. A glossary of the text's boldfaced key terms and key R commands serve as helpful resources. The book is accompanied by a website with exercises, an answer key, and the in-text example data sets. Latent Variable Modeling with R: -Provides some examples that use messy data providing a more realistic situation readers will encounter with their own data. -Reviews a wide range of LVMS including factor analysis, structural equation modeling, item response theory, and mixture models and advanced topics such as fitting nonlinear structural equation models, nonparametric item response theory models, and mixture regression models. -Demonstrates how data simulation can help researchers better understand statistical methods and assist in selecting the necessary sample size prior to collecting data. -[www.routledge.com/9780415832458](http://www.routledge.com/9780415832458) provides exercises that apply the models along with annotated R output answer keys and the data that corresponds to the in-text examples so readers can replicate the results and check their work. The book opens with basic instructions in how to use R to read data, download functions, and conduct basic analyses. From there, each chapter is dedicated to a different latent variable model including exploratory and confirmatory factor analysis (CFA), structural equation modeling (SEM), multiple groups CFA/SEM, least squares estimation, growth curve models, mixture models, item response theory (both dichotomous and polytomous items), differential item functioning (DIF), and correspondance analysis. The book concludes with a discussion of how data simulation can be used to better understand the workings of a statistical method and assist researchers in deciding on the necessary sample size prior to collecting data. A mixture of independently developed R code along with available libraries for simulating latent models in R are provided so readers can use these simulations to analyze data using the methods introduced in the previous chapters. Intended for use in graduate or advanced undergraduate courses in latent variable modeling, factor analysis, structural equation modeling, item response theory, measurement, or multivariate statistics taught in psychology, education, human development, and social and health sciences, researchers in these fields also appreciate this book's practical approach. The book provides sufficient conceptual background information to serve as a standalone text. Familiarity with basic statistical concepts is assumed but basic knowledge of R is not.

The Science of Prevention

Statistical Models for Test Equating, Scaling, and Linking

Handbook of Item Response Theory Modeling

Confirmatory Factor Analysis

The SAGE Encyclopedia of Psychology and Gender

A Multidisciplinary Reference on Survey, Scale and Test Development

Measurement invariance exists when a scale functions equivalently across people and is therefore essential for making meaningful group comparisons. Often, measurement is examined with independent and identically distributed data; however, there are times when the participants are clustered within units, creating dependency in the data. We have taken different approaches to address this dependency when studying measurement invariance (e.g., Kim, Kwok, & Yoon, 2012; Ryu, 2014; Kim, Yoon, Wen, Luo, & Yoon, 2015), but there are no comparisons of the various approaches. The purpose of this master's thesis was to investigate measurement invariance in multilevel data where the dependent variable was a level-1 variable using five different approaches. Publicly available data from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) was used as an illustrative example. The construct of early behavior, which was made up of four teacher-rated behavior scales, was evaluated for measurement invariance in relation to the specific case of this illustrative example, the statistical conclusions of the five approaches were in agreement (i.e., the loading of the externalizing item and the intercept of the internalizing approaches to learning item were not invariant). Simulation work should be done to investigate in which situations the conclusions of these approaches diverge.

This book offers researchers a systematic and accessible introduction to using a Bayesian framework in structural equation modeling (SEM). Stand-alone chapters on each clearly explain the Bayesian form of the model and walk the reader through implementation. Engaging worked-through examples from diverse social science subfields illustrate various modeling techniques, highlighting statistical or estimation problems that are likely to arise and describing potential solutions. For each model, instructions are provided for writing up findings for publication, including annotated sample data analysis plans and results sections. Other user-friendly features in every chapter include "Major Take-Home Points," notation glossaries, annotated suggestions for further reading, and sample code in both Mplus and R. The companion website ([www.guilford.com/depaoli-mate](http://www.guilford.com/depaoli-mate)) provides datasets; annotated code for implementation in both Mplus and R, so that users can work within their preferred platform; and output for all of the book's examples.

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'; the implication that psychometrics as a field is confined to psychology is highly misleading. Scientists and practitioners from virtually every conceivable discipline now use 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 specific 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. Through 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 implement the analyses discussed

This study investigated potential causes of extant group mean differences of self-reported levels of burnout across sex. Based on the origins of burnout as an interpersonal conflict combined with research showing differences in how men and women perceive and resolve interpersonal conflict and stress, it was hypothesized that statistical artifacts, such as violations of the measurement invariance assumption, were present. It was further hypothesized that these artifacts were causing differences in the prevalence of self-reported burnout and that removing them would reduce the size of such differences. Participants (n = 579) completed three separate measures of burnout: the Copenhagen Burnout Inventory, the Oldenburg Burnout Inventory, and the Maslach Burnout Inventory, as well as several measures of nomological correlates of burnout. The data were analyzed using confirmatory factor analysis and item response theory approaches to measurement invariance. Results indicated that no violations of measurement invariance were present. Implications for research and practice are discussed.

The Wiley Handbook of Psychometric Testing

Assessing Measurement Invariance for Applied Research

Forms, Issues, and Methods of Analysis

The SAGE Handbook of Quantitative Methods in Psychology

Achievements and Opportunities

Using Rasch Models in the Social, Behavioral, and Health Sciences

This accessible book has established itself as the go-to resource on confirmatory factor analysis (CFA) for its emphasis on practical and conceptual aspects rather than mathematics or formulas. Detailed, worked-through examples drawn from psychology, management, and sociology studies illustrate the procedures, pitfalls, and extensions of CFA methodology. The text shows how to formulate, program, and interpret CFA models using popular latent variable software packages (LISREL, Mplus, EQS,

SAS/CALIS); understand the similarities ...

The seminal reference for the latest research in developmental psychopathology *Developmental Psychopathology* is a four-volume compendium of the most complete and current research on every aspect of the field. Volume One: Theory and Method focuses on the theoretical and empirical work that has contributed to dramatic advancements in understanding of child and adult development, including findings in the areas of genetics and neurobiology, as well as social and contextual factors. Now in its third edition, this comprehensive reference has been fully updated to reflect the current state of the field and its increasingly multilevel and interdisciplinary nature and the increasing importance of translational research. Contributions from expert researchers and clinicians provide insight into how multiple levels of analysis may influence individual differences, the continuity or discontinuity of patterns, and the pathways by which the same developmental outcomes may be achieved. Advances in developmental psychopathology have burgeoned since the 2006 publication of the second edition ten years ago, and keeping up on the latest findings in multiple avenues of investigation can be burdensome to the busy professional and researcher from psychology and related fields. This reference solves the problem by collecting the best of the best, as edited by Dante Cicchetti, a recognized leader in the field, into one place, with a logical organization designed for easy reference. Get up to date on the latest research from the field Explore new models, emerging theory, and innovative approaches Learn new technical analysis and research design methods Understand the impact of life stage on mental health The complexity of a field as diverse as developmental psychopathology deepens with each emerging theory and new area of study, as made obvious by the exciting findings coming out of institutions and clinics around the world. *Developmental Psychopathology Volume One: Theory and Method* brings these findings together into a cohesive, broad-reaching reference.

This text describes a variety of methodological advances that increase the integrity of research results in the area of prevention. Although the focus of this volume is on alcohol and substance abuse, most of the methods described can be applied to the full range of areas in prevention research, including smoking, risky sex, health problems, poor school performance, criminal behaviour and a variety of other areas in which research occurs in field settings. The editors have brought together a array of researchers who describe and analyze new directions and provide direct examples of methodological problems and solutions from their own specific research.

“ Dr. Dimitrov has constructed a masterpiece—a classic resource that should adorn the shelf of every counseling researcher and graduate student serious about the construction and validation of high quality research instruments. —Bradley T. Erford, PhD Loyola University Maryland Past President, American Counseling Association

“ This book offers a comprehensive treatment of the statistical models and methods needed to properly examine the psychometric properties of assessment scale data. It is certain to become a definitive reference for both novice and experienced researchers alike. ” —George A. Marcoulides, PhD University of California, Riverside This instructive book presents statistical methods and procedures for the validation of assessment scale data used in counseling, psychology, education, and related fields. In Part I, measurement scales, reliability, and the unified construct-based model of validity are discussed, along with key steps in instrument development. Part II describes factor analyses in construct validation, including exploratory factor analysis, confirmatory factor analysis, and models of multitrait-multimethod data analysis. Traditional and Rasch-based analyses of binary and rating scales are examined in Part III. Dr. Dimitrov offers students, researchers, and clinicians step-by-step guidance on contemporary methodological principles, statistical methods, and psychometric procedures that are useful in the development or validation of assessment scale data. Numerous examples, tables, and figures provided throughout the text illustrate the underlying principles of measurement in a clear and concise manner for practical application. \*Requests for digital versions from ACA can be found on [www.wiley.com](http://www.wiley.com). \*To purchase print copies, please visit the ACA website here. \*Reproduction requests for material from books published by ACA should be directed to [permissions@counseling.org](mailto:permissions@counseling.org).

Cross-Cultural Analysis

Methodological Advances from Alcohol and Substance Abuse Research

Testing Measurement Invariance in Multilevel Data with Unequal Cross-level Factor Structures

Principles and Practice of Structural Equation Modeling, Fourth Edition

A Comprehensive Introduction

Handbook of Developmental Research Methods

*This open access thematic report identifies factors and conditions that can help schools and education systems promote tolerance in a globalized world. The IEA's International Civic and Citizenship Study (ICCS) is a comparative research program designed to investigate the ways in which young people are prepared to undertake their roles as citizens, and provides a wealth of data permitting not only comparison between countries but also comparisons between schools within countries, and students within countries. Advanced analytical methods provide insights into relationships between students' attitudes towards cultural diversity and the characteristics of the students themselves, their families, their teachers and school principals. The rich diversity of educational and cultural contexts in the 38 countries who participated in ICCS 2009 are also acknowledged and addressed. Readers interested in civic education and adolescents' attitudes towards cultural diversity will find the theoretical perspectives explored engaging. For readers interested in methodology, the advanced analytical methods employed present textbook examples of how to address cross-cultural comparability of measurement instruments and multilevel data structures in international large-scale assessments (ILSA). Meanwhile, those interested in educational policy should find the identification and comparison*

of malleable factors across education systems that contribute to positive student attitudes towards cultural diversity a useful and thought-provoking resource.

By focusing on underlying themes, this book helps readers better understand the connections between multivariate methods. For each method the author highlights: the similarities and differences between the methods, when they are used and the questions they address, the key assumptions and equations, and how to interpret the results. The concepts take center stage while formulas are kept to a minimum. Examples using the same data set give readers continuity so they can more easily apply the concepts. Each method is also accompanied by a worked out example, SPSS and SAS input, and an example of how to write up the results. EQS code is used for the book's SEM applications. This extensively revised edition features: New SEM chapters including an introduction (ch.10), path analysis (ch.11), confirmatory factor analysis (ch.12), and latent variable modeling (ch.13) the last three with an EQS application. A new chapter on multilevel modeling (ch. 8) that is now used more frequently in the social sciences. More emphasis on significance tests, effect sizes, and confidence intervals to encourage readers to adopt a thorough approach to assessing the magnitude of their findings. A new data set that explores the work environment. More discussion about the basic assumptions and equations for each method for a more accessible approach. New examples that help clarify the distinctions between methods. A new website at <https://sites.google.com/site/multivariatesecondedition/> that features the datasets for all of the examples in the book for use in both SPSS and SAS and in EQS for the SEM chapters. The first two chapters review the core themes that run through most multivariate methods. The author shows how understanding multivariate methods is much more achievable when we notice the themes that underlie these statistical techniques. This multiple level approach also provides greater reliability and validity in our research. After providing insight into the core themes, the author illustrates them as they apply to the most popular multivariate methods used in the social, and behavioral sciences. First, two intermediate methods are explored - multiple regression and analysis of covariance. Next the multivariate grouping variable methods of multivariate analysis of variance, discriminant function analysis, and logistic regression are explored. Next the themes are applied to multivariate modeling methods including multilevel modeling, path analysis, confirmatory factor analysis, and latent variable models that include exploratory structural methods of principal component and factor analysis. The book concludes with a summary of the common themes and how they pertain to each method discussed in this book. Intended for advanced undergraduate and/or graduate courses in multivariate statistics taught in psychology, education, human development, business, nursing, and other social and life sciences, researchers also appreciate this book's applied approach. Knowledge of basic statistics, research methods, basic algebra, and finite mathematics is recommended.

This step-by-step guide is written for R and latent variable model (LVM) novices. Utilizing a path model approach and focusing on the lavaan package, this book is designed to help readers quickly understand LVMs and their analysis in R. The author reviews the reasoning behind the syntax selected and provides examples that demonstrate how to analyze data for a variety of LVMs. Featuring examples applicable to psychology, education, business, and other social and health sciences, minimal text is devoted to theoretical underpinnings. The material is presented without the use of matrix algebra. As a whole the book prepares readers to write about and interpret LVM results they obtain in R. Each chapter features background information, boldfaced key terms defined in the glossary, detailed interpretations of R output, descriptions of how to write the analysis of results for publication, a summary, R based practice exercises (with solutions included in the back of the book), and references and related readings. Margin notes help readers better understand LVMs and write their own R syntax. Examples using data from published work across a variety of disciplines demonstrate how to use R syntax for analyzing and interpreting results. R functions, syntax, and the corresponding results appear in gray boxes to help readers quickly locate this material. A unique index helps readers quickly locate R functions, packages, and datasets. The book and accompanying website at <http://blogs.baylor.edu/rlatentvariable/> provides all of the data for the book's examples and exercises as well as R syntax so readers can replicate the analyses. The book reviews how to enter the data into R, specify the LVMs, and obtain and interpret the estimated parameter values. The book opens with the fundamentals of using R including how to download the program, use functions, and enter and manipulate data. Chapters 2 and 3 introduce and then extend path models to include latent variables. Chapter 4 shows readers how to analyze a latent variable model with data from more than one group, while Chapter 5 shows how to analyze a latent variable model with data from more than one time period. Chapter 6 demonstrates the analysis of dichotomous variables, while Chapter 7 demonstrates how to analyze LVMs with missing data. Chapter 8 focuses on sample size determination using Monte Carlo methods, which can be used with a wide range of statistical models and account for missing data. The final chapter examines hierarchical LVMs, demonstrating both higher-order and bi-factor approaches. The book concludes with three Appendices: a review of common measures of model fit including their formulae and interpretation; syntax for other R latent variable models packages; and solutions for each chapter's exercises. Intended as a supplementary text for graduate and/or advanced undergraduate courses on latent variable modeling, factor

*analysis, structural equation modeling, item response theory, measurement, or multivariate statistics taught in psychology, education, human development, business, economics, and social and health sciences, this book also appeals to researchers in these fields. Prerequisites include familiarity with basic statistical concepts, but knowledge of R is not assumed.*

*The SAGE Encyclopedia of Psychology and Gender is an innovative exploration of the intersection of gender and psychology—topics that resonate across disciplines and inform our everyday lives. This encyclopedia looks at issues of gender, identity, and psychological processes at the individual as well as the societal level, exploring topics such as how gender intersects with developmental processes both in infancy and childhood and throughout later life stages; the evolution of feminism and the men's movement; the ways in which gender can affect psychological outcomes and influence behavior; and more. With articles written by experts across a variety of disciplines, this encyclopedia delivers insights on the psychology of gender through the lens of developmental science, social science, clinical and counseling psychology, sociology, and more. This encyclopedia will provide librarians, students, and professionals with ready access to up-to-date information that informs some of today's key contemporary issues and debates. These are the sorts of questions we plan for this encyclopedia to address: What is gender nonconformity? What are some of the evolutionary sex differences between men and women? How does gender-based workplace harassment affect health outcomes? How are gender roles viewed in different cultures? What is third-wave feminism?*

*Constructing Measures*

*Latent Variable Modeling Using R*

*Measurement Invariance*

*A Second Course (2nd ed.)*

*Developmental Psychopathology, Theory and Method*

*Structural Equation Modeling*

Structural equation modeling (SEM) is becoming the central and one of the most popular analytical tools in the social sciences. Many classical and modern statistical techniques such as regression analysis, path analysis, confirmatory factor analysis, and models with both measurement and structural components have been shown to fall under the umbrella of SEM. Thus, the flexibility of SEM makes it applicable to many research designs, including experimental and non-experimental data, cross-sectional and longitudinal data, and multiple-group and multilevel data. In this eBook, you will find 19 cutting-edge papers from the Research Topic: Recent Advancements in Structural Equation Modeling (SEM). These 19 papers cover a wide variety of topics related to SEM, including: (a) analysis of different types of data (from cross-sectional data with floor effects to complex survey data and longitudinal data); (b) measurement-related issues (from the development of new scale to the evaluation of person fit and new ways to test measurement invariance); and (c) technical advancement and software development. We hope that the readers will gain new perspectives and be able to apply some of the new techniques and models discussed in these 19 papers.

The first comprehensive structural equation modeling (SEM) handbook, this accessible volume presents both the mechanics of SEM and specific SEM strategies and applications. The editor, contributors, and editorial advisory board are leading methodologists who have organized the book to move from simpler material to more statistically complex modeling approaches. Sections cover the foundations of SEM; statistical underpinnings, from assumptions to model modifications; steps in implementation, from data preparation through writing the SEM report; and basic and advanced applications, including new and emerging topics in SEM. Each chapter provides conceptually oriented descriptions, fully explicated analyses, and engaging examples that reveal modeling possibilities for use with readers' data. Many of the chapters also include access to data and syntax files at the companion website, allowing readers to try their hands at reproducing the authors' results.

"This handbook offers comprehensive coverage of structural equation modeling (SEM), beginning with background issues, continuing through statistical underpinnings and steps in implementation, then moving into basic and advanced applications of SEM. In a single volume, it offers virtually complete coverage of SEM and its use"--

Intended to bridge the gap between the latest methodological developments and cross-cultural research, this interdisciplinary resource presents the latest strategies for analyzing cross-cultural data. Techniques are demonstrated through the use of applications that employ cross national data sets such as the latest European Social Survey. With an emphasis on the generalized latent variable approach, internationally – prominent researchers from a variety of fields explain how the methods work, how to apply them, and how they relate to other methods presented in the book. Syntax and graphical and verbal explanations of the techniques are included. A website features some of the data sets and syntax commands used in the book. Applications from the behavioral and social sciences that use real data-sets demonstrate: The use of samples from 17 countries to validate the resistance to change scale across these nations How to test the cross-national invariance properties of social trust The interplay between social structure, religiosity, values, and social attitudes A comparison of anti-immigrant attitudes and patterns of religious orientations across European countries. The book is divided into techniques for analyzing cross-cultural data within the generalized-latent-variable approach: multiple-group confirmatory factor analysis and multiple-group structural equation modeling; multi-level analysis; latent class analysis; and item-response theory. Since researchers from various disciplines often use different methodological approaches, a consistent framework for describing and applying each method is used so as to cross 'methodological borders' between disciplines. Some chapters describe the basic strategy and how it relates to other techniques presented in the book, others apply the techniques and address specific research questions, and a few combine the two. A table in the preface highlights for each chapter: a description of the contents, the statistical methods used, the goal(s) of the analysis, and the data set employed. This book is intended for researchers, practitioners, and advanced students interested in cross-cultural research. Because the applications span a variety of disciplines, the book will appeal to researchers and students in:

psychology, political science, sociology, education, marketing and economics, geography, criminology, psychometrics, epidemiology, and public health, as well as those interested in methodology. It is also appropriate for an advanced methods course in cross-cultural analysis.

Latent Variable Modeling with R

The Behavioral and Social Sciences

The Essence of Multivariate Thinking

Modeling Contextual Effects in Longitudinal Studies

Applications to Typical Performance Assessment

Handbook of Structural Equation Modeling

*Measurement connects theoretical concepts to what is observable in the empirical world, and is fundamental to all social and behavioral research. In this volume, J. Micah Roos and Shawn Bauldry introduce a popular approach to measurement: confirmatory factor analysis, with examples in every chapter draw from national survey data. Data to replicate the examples are available on a companion website, along with code in R, Stata, and Mplus.*

*This user-friendly guide illustrates how to assess measurement invariance using computer programs, statistical methods, and real data. This book reflects the current thinking and research on how consumers' perception of product risks and benefits affects their behavior. It provides the scientific, regulatory and industrial research community with a conceptual and methodological reference point for studies on consumer behavior and marketing. The contributions address various aspects of consumer psychology and behavior, risk perception and communication, marketing research strategies, as well as consumer product regulation. The book is divided into 4 parts: Product risks; Perception of product risks and benefits; Consumer behavior; Regulation and responsibility.*

*The goal of this book is to emphasize the formal statistical features of the practice of equating, linking, and scaling. The book encourages the view and discusses the quality of the equating results from the statistical perspective (new models, robustness, fit, testing hypotheses, statistical monitoring) as opposed to placing the focus on the policy and the implications, which although very important, represent a different side of the equating practice. The book contributes to establishing "equating" as a theoretical field, a view that has not been offered often before. The tradition in the practice of equating has been to present the knowledge and skills needed as a craft, which implies that only with years of experience under the guidance of a knowledgeable practitioner could one acquire the required skills. This book challenges this view by indicating how a good equating framework, a sound understanding of the assumptions that underlie the psychometric models, and the use of statistical tests and statistical process control tools can help the practitioner navigate the difficult decisions in choosing the final equating function. This book provides a valuable reference for several groups: (a) statisticians and psychometricians interested in the theory behind equating methods, in the use of model-based statistical methods for data smoothing, and in the evaluation of the equating results in applied work; (b) practitioners who need to equate tests, including those with these responsibilities in testing companies, state testing agencies, and school districts; and (c) instructors in psychometric, measurement, and psychology programs.*

*Consumer Perception of Product Risks and Benefits*

*Approaches to Studying Measurement Invariance in Multilevel Data with a Level-1 Grouping Variable*

*83rd Annual Meeting of the Psychometric Society, New York, NY 2018*

*Invariant Measurement*

*Quantitative Psychology*

*An Item Response Modeling Approach*

This book reviews the statistical procedures used to detect measurement bias. Measurement bias is examined from a general latent variable perspective so as to accommodate different forms of testing in a variety of contexts including cognitive or clinical variables, attitudes, personality dimensions, or emotional states. Measurement models that underlie psychometric practice are described, including their strengths and limitations. Practical strategies and examples for dealing with bias detection are provided throughout.

This volume reviews the challenges and alternative approaches to modeling how individuals change across time and provides methodologies and data analytic strategies for behavioral and social science researchers. This accessible guide provides concrete, clear examples of how contextual factors can be included in most research studies. Each chapter c

Emphasizing concepts and rationale over mathematical minutiae, this is the most widely used, complete, and accessible structural equation modeling (SEM) text. Continuing the tradition of using real data examples from a variety of disciplines, the significantly revised fourth edition incorporates recent developments such as Pearl's graphing theory and the structural causal model (SCM), measurement invariance, and more. Readers gain a comprehensive understanding of all phases of SEM, from data collection and screening to the interpretation and reporting of the results. Learning is enhanced by exercises with answers, rules to remember, and topic boxes. The companion website supplies data, syntax, and output for the book's examples--now including files for Amos, EQS, LISREL, Mplus, Stata, and R (lavaan). New to This Edition \*Extensively revised to cover important new topics: Pearl's graphing theory and the SCM, causal

inference frameworks, conditional process modeling, path models for longitudinal data, item response theory, and more. \*Chapters on best practices in all stages of SEM, measurement invariance in confirmatory factor analysis, and significance testing issues and bootstrapping. \*Expanded coverage of psychometrics. \*Additional computer tools: online files for all detailed examples, previously provided in EQS, LISREL, and Mplus, are now also given in Amos, Stata, and R (lavaan). \*Reorganized to cover the specification, identification, and analysis of observed variable models separately from latent variable models. Pedagogical Features \*Exercises with answers, plus end-of-chapter annotated lists of further reading. \*Real examples of troublesome data, demonstrating how to handle typical problems in analyses. \*Topic boxes on specialized issues, such as causes of nonpositive definite correlations. \*Boxed rules to remember. \*Website promoting a learn-by-doing approach, including syntax and data files for six widely used SEM computer tools.

Currently there are many introductory textbooks on educational measurement and psychometrics as well as R. However, there is no single book that covers important topics in measurement and psychometrics as well as their applications in R. The Handbook of Educational Measurement and Psychometrics Using R covers a variety of topics, including classical test theory; generalizability theory; the factor analytic approach in measurement; unidimensional, multidimensional, and explanatory item response modeling; test equating; visualizing measurement models; measurement invariance; and differential item functioning. This handbook is intended for undergraduate and graduate students, researchers, and practitioners as a complementary book to a theory-based introductory or advanced textbook in measurement. Practitioners and researchers who are familiar with the measurement models but need to refresh their memory and learn how to apply the measurement models in R, would find this handbook quite fulfilling. Students taking a course on measurement and psychometrics will find this handbook helpful in applying the methods they are learning in class. In addition, instructors teaching educational measurement and psychometrics will find our handbook as a useful supplement for their course.

Statistical Methods for Validation of Assessment Scale Data in Counseling and Related Fields

Confirmatory Factor Analysis for Applied Research, Second Edition

Teaching Tolerance in a Globalized World

Statistical Approaches to Measurement Invariance

Handbook of Educational Measurement and Psychometrics Using R

***Multi-item surveys are frequently used to study scores on latent factors, like human values, attitudes and behavior. Such studies often include a comparison, between specific groups of individuals, either at one or multiple points in time. If such latent factor means are to be meaningfully compared, the measurement structures including the latent factor and their survey items should be stable across groups and/or over time, that is 'invariant'. Recent developments in statistics have provided new analytical tools for assessing measurement invariance (MI). The aim of this special issue is to provide a forum for a discussion of MI, covering some crucial 'themes': (1) ways to assess and deal with measurement non-invariance; (2) Bayesian and IRT methods employing the concept of approximate measurement invariance; and (3) new or adjusted approaches for testing MI to fit increasingly complex statistical models and specific characteristics of survey data. The special issue started with a kick-off meeting where all potential contributors shared ideas on potential papers. This expert workshop was organized at Utrecht University in The Netherlands and was funded by the Netherlands Organization for Scientific Research (NWO-VENI-451-11-008). After the kick-off meeting the authors submitted their papers, all of which were reviewed by experts in the field. The papers in the eBook are listed in alphabetical order, but in the editorial the papers are introduced thematically. Although it is impossible to cover all areas of relevant research in the field of MI, papers in this eBook provide insight on important aspects of measurement invariance. We hope that the discussions included in this special issue will stimulate further research on MI and facilitate further discussions to support the understanding of the role of MI in multi-item surveys.***

***Measurement Error in Longitudinal Data tackles the important issue of how to understand and estimate change in the context of imperfect data. 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 a 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 test of measurement invariance (MI) investigates whether observed items measure a construct in the same way across different groups or over times. Examining MI is a prerequisite for multiple group comparisons in psychological tests (Schmitt & Kuljanin, 2008). With the prevalence of multilevel data in educational research (e.g., students nested within schools), establishing MI across multiple groups or waves of nested data has brought increasing attention. Two popular techniques for the test of multilevel MI include the multiple-group multilevel confirmatory factor analysis (MMCFA) and the design-based approaches. The MMCFA approach estimates sample covariance matrices at different levels separately. The design-based approach treats nested data as single-level and accounts for data dependency by adjusting the test statistics and standard errors of parameter estimates. Both approaches have been examined in previous studies assuming equal within- and between-level factor structures (e.g., Kim, Kwok & Yoon, 2012), yet the performance of these two approaches on models with unequal cross-level factor structures has not been examined thoroughly. The purpose of this study is to compare the MMCFA and the design-based approaches for evaluating the between-level MI when factor structures differ across levels. Two simulation studies were designed to evaluate the statistical power and Type I error rates of the two estimation approaches. The manipulated conditions included the factor structure, between-level factor variance, number of clusters, cluster size, size of noninvariance, and location of noninvariance. Model comparisons were conducted based on the scaled log-likelihood ratio tests. Results showed that power rates in the MMCFA approach were generally higher than those in the design-based approach across conditions, especially when the cross-level factor structures were different. The between-level factor variance, number of clusters and cluster size were three major factors that impacted the statistical power and Type I error rates with these two approaches. The strengths and limitations of each approach in multilevel MI evaluations as well as the practical implications were discussed at the end.**

**Dependent Data in Social Sciences Research**

**Bayesian Structural Equation Modeling**

**Recent Advancements in Structural Equation Modeling (SEM): From Both Methodological and Application Perspectives**

Constructing Measures introduces a way to understand the advantages and disadvantages of measurement instruments, how to use such instruments, and how to apply these methods to develop new instruments or adapt old ones. The book is organized around the steps taken while constructing an instrument. It opens with a summary of the constructive steps involved. Each step is then expanded on in the next four chapters. These chapters develop the "building blocks" that make up an instrument--the construct map, the design plan for the items, the outcome space, and the statistical measurement model. The next three chapters focus on quality control. They rely heavily on the calibrated construct map and review how to check if scores are operating consistently and how to evaluate the reliability and validity evidence. The book introduces a variety of item formats, including multiple-choice, open-ended, and performance items; projects; portfolios; Likert and Guttman items; behavioral observations; and interview protocols. Each chapter includes an overview of the key concepts, related resources for further investigation and exercises and activities. Some chapters feature appendices that describe parts of the instrument development process in more detail, numerical manipulations used in the text, and/or data results. A variety of examples from the behavioral and social sciences and education including achievement and performance testing; attitude measures; health measures, and general sociological scales, demonstrate the application of the material. An accompanying downloadable resources feature control files, output, and a data set to allow readers to compute the text's exercises and create new analyses and case archives based on the book's examples so the reader can work through the entire development of an instrument. Constructing Measures is an ideal text or supplement in courses on item, test, or instrument development, measurement, item response theory, or rasch analysis taught in a variety of departments including education and psychology. The book also appeals to those who develop instruments, including industrial/organizational, educational, and school psychologists, health outcomes researchers, program evaluators, and sociological measurers. Knowledge of basic descriptive statistics and elementary regression is recommended.

This comprehensive resource reviews structural equation modeling (SEM) strategies for longitudinal data to help readers see which modeling options are available for which hypotheses. The author demonstrates how SEM is related to other longitudinal data techniques throughout. By exploring connections between models, readers gain a better understanding of when to choose one analysis over another. The book explores basic models to sophisticated ones including the statistical and conceptual underpinnings that are the building blocks of the analyses. Accessibly written, research examples from the behavioral and social sciences and results interpretations are provided throughout. The emphasis is on concepts and practical guidance for applied research rather than on mathematical proofs. New terms are highlighted and defined in the glossary. Figures are included for every model along with detailed discussions of model specification and implementation issues. Each chapter also includes examples of each model type, comment sections that provide practical guidance, model extensions, and recommended readings. Highlights include: Covers the major SEM approaches to longitudinal analysis in one resource. Explores connections between longitudinal SEM models to enhance integration. Numerous examples that help readers match research questions to appropriate analyses and interpret results. Reviews practical issues related to model specification and estimation to reinforce connections. Analyzes continuous and discrete (binary and ordinal) variables throughout for breadth not found in other sources. Reviews key SEM concepts for those who need a refresher (Ch. 1). Emphasizes how to apply and interpret each model through realistic data examples. Provides the book's data sets at [www.longitudinalsem.com](http://www.longitudinalsem.com) along with the Mplus and R-lavaan syntax used to generate the results. Introduces the LISREL notation system used throughout (Appendix A). The chapters can be read out of order but it is best to read chapters 1 - 4 first because most of the later chapters refer back to them. The book opens with a review of latent variables and analysis of binary and ordinal variables. Chapter 2 applies this information to assessing longitudinal measurement invariance. SEM tests of dependent means and proportions over time points are explored in Chapter 3, and stability and change, difference scores, and lagged regression are covered in Chapter 4. The remaining chapters are each devoted to one major type of longitudinal SEM -- repeated measures analysis models, full cross-lagged panel models and simplex models, modeling stability with state-trait models, linear and nonlinear growth curve models, latent difference score models, latent transition analysis, time series analysis, survival analysis, and attrition. Missing data is discussed in the context of many of the preceding models in Chapter 13. Ideal for graduate courses on longitudinal (data) analysis, advanced SEM, longitudinal SEM, and/or advanced data (quantitative) analysis taught in the behavioral, social, and health sciences, this text also appeals to researchers in these fields. Intended for those without an extensive math background, prerequisites include familiarity with basic SEM. Matrix algebra is avoided in all but a few places.

This volume presents contributions on handling data in which the postulate of independence in the data matrix is violated. When this postulate is violated and when the methods assuming independence are still applied, the estimated parameters are likely to be biased, and statistical decisions are very likely to be incorrect. Problems associated with dependence in data have been known for a long time, and led to the development of tailored methods for the analysis of dependent data in various areas of statistical analysis. These methods include, for example, methods for the analysis of longitudinal data, corrections for dependency, and corrections for degrees of freedom. This volume contains the following five sections: growth curve modeling, directional dependence, dyadic data modeling, item response modeling (IRT), and other methods for the analysis of dependent data (e.g., approaches for modeling cross-section dependence, multidimensional scaling techniques, and mixed models). Researchers and graduate students in the social and behavioral sciences, education, econometrics, and medicine will find this up-to-date overview of modern statistical approaches for dealing with problems related to dependent data particularly useful.