

applied longitudinal analysis fitzmaurice

Applied Longitudinal Analysis: Unlocking the Fitzmaurice Method for Powerful Insights

Introduction:

Are you grappling with complex, time-dependent data? Do you need to understand how variables change over time and identify key patterns within your longitudinal datasets? Then mastering applied longitudinal analysis, particularly the methods outlined by Fitzmaurice et al., is crucial. This comprehensive guide delves into the intricacies of this powerful statistical technique, providing a practical understanding of its application and interpretation. We'll explore the core concepts, address common challenges, and equip you with the knowledge to confidently analyze your own longitudinal data using the Fitzmaurice framework. Prepare to unlock valuable insights hidden within your datasets!

Understanding Longitudinal Data and its Uniqueness:

Longitudinal data, characterized by repeated observations of the same individuals over time, presents unique analytical challenges. Unlike cross-sectional data, which captures a single snapshot in time, longitudinal data reveals dynamic relationships and individual trajectories. Analyzing this type of data requires specialized techniques that account for the correlation between repeated measurements within each individual. Ignoring this correlation can lead to inaccurate inferences and misleading conclusions. This is where the power of applied longitudinal analysis, specifically the approaches detailed by Fitzmaurice, becomes evident.

The Fitzmaurice Approach: A Foundation for Robust Analysis

The work of Fitzmaurice and colleagues provides a robust framework for analyzing longitudinal data, emphasizing the importance of correctly modeling the correlation structure inherent in repeated measurements. This framework often involves the use of mixed-effects models, which effectively account for both within-subject and between-subject variability. Key aspects of the Fitzmaurice approach include:

Modeling the Correlation Structure: Fitzmaurice emphasizes the crucial role of appropriately specifying the correlation structure among repeated measurements. Different correlation structures (e.g., compound symmetry, autoregressive, unstructured) are suited to different data characteristics and research questions. Selecting the wrong structure can lead to biased estimates and inefficient inferences.

Handling Missing Data: Longitudinal studies are often plagued by missing data. The Fitzmaurice approach incorporates methods for handling missing data, often employing techniques like multiple imputation or maximum likelihood estimation under specific missing data mechanisms (e.g., Missing Completely at Random, Missing at Random). Ignoring missing data can lead to biased results and compromised validity.

Addressing Non-Normality: Assumptions about the normality of data are often violated in practice. The Fitzmaurice approach allows for robust methods that address non-normality, potentially through transformations or the use of generalized estimating equations (GEEs).

Interpreting Results: Understanding and interpreting the output from mixed-effects models or GEEs is crucial. The Fitzmaurice approach provides a clear framework for interpreting the estimated effects, standard errors, and confidence intervals, allowing researchers to draw meaningful conclusions.

Practical Applications of Applied Longitudinal Analysis (Fitzmaurice Method):

The Fitzmaurice method finds broad applicability across diverse fields:

Clinical Trials: Evaluating the efficacy of treatments over time, assessing patient response, and modeling disease progression.

Public Health Research: Studying the impact of interventions on health outcomes, tracking disease outbreaks, and analyzing risk factors.

Educational Research: Assessing the effectiveness of educational programs, monitoring student growth, and evaluating learning trajectories.

Social Sciences: Analyzing changes in attitudes, behaviors, and social networks over time.

Environmental Science: Monitoring environmental changes, studying pollutant levels, and assessing the impact of environmental interventions.

Software and Tools for Applied Longitudinal Analysis:

Several statistical software packages support the implementation of the Fitzmaurice approach:

R: Offers extensive libraries (e.g., ``lme4``, ``nlme``, ``gee``) for mixed-effects modeling and generalized estimating equations.

SAS: Provides powerful PROC MIXED and PROC GENMOD procedures for analyzing longitudinal data.

SPSS: Offers mixed-model capabilities through its MIXED procedure.

Stata: Provides robust commands for both linear and generalized mixed models.

Challenges and Considerations:

While powerful, applied longitudinal analysis using the Fitzmaurice method presents certain challenges:

Computational Complexity: Analyzing large longitudinal datasets can be computationally intensive.

Model Selection: Choosing the appropriate correlation structure and model requires careful consideration.

Interpretation of Interactions: Interpreting interactions between time-varying and time-invariant variables can be complex.

Example: Analyzing the Effect of a Treatment on Blood Pressure Over Time

Imagine a clinical trial evaluating a new drug to lower blood pressure. Participants' blood pressure is measured at baseline and at regular intervals over six months. Using the Fitzmaurice approach, a mixed-effects model could be employed to assess the treatment's effect, accounting for the correlation between repeated blood pressure measurements within each individual. The model would estimate the treatment effect, adjusting for baseline blood pressure and other relevant covariates.

A Book Outline: Mastering Applied Longitudinal Analysis with the Fitzmaurice Method

Book Title: Unlocking Longitudinal Insights: A Practical Guide to the Fitzmaurice Method

Introduction: Defining longitudinal data, highlighting the importance of the Fitzmaurice approach, overview of the book's structure.

Chapter 1: Fundamentals of Longitudinal Data Analysis: Exploring different types of longitudinal data, introducing key concepts like within-subject correlation and time-varying covariates.

Chapter 2: Mixed-Effects Models: A detailed explanation of mixed-effects models, including random intercepts and slopes, model specification, and interpretation.

Chapter 3: Generalized Estimating Equations (GEEs): An in-depth exploration of GEEs, their advantages and disadvantages compared to mixed-effects models, and their application to different types of outcome variables.

Chapter 4: Handling Missing Data in Longitudinal Studies: Addressing missing data mechanisms, exploring imputation techniques, and discussing methods for handling missing data in mixed-effects models and GEEs.

Chapter 5: Model Selection and Diagnostics: Guidance on selecting the appropriate correlation structure, assessing model fit, and identifying potential issues.

Chapter 6: Interpreting Results and Reporting Findings: A comprehensive guide to interpreting model output, presenting results effectively, and drawing meaningful conclusions.

Chapter 7: Advanced Topics in Longitudinal Analysis: Exploring advanced techniques such as latent growth curve modeling, joint modeling of longitudinal and time-to-event data, and handling non-linear trajectories.

Conclusion: Summarizing key concepts, emphasizing the importance of the Fitzmaurice approach, and highlighting future directions in longitudinal data analysis.

Detailed Explanation of the Book Outline Points:

Each chapter of the proposed book would provide a detailed explanation of the corresponding topic, including theoretical underpinnings, practical examples using real-world datasets, and step-by-step instructions on how to implement the techniques using statistical software. For example, Chapter 2 on mixed-effects models would cover:

Different types of mixed-effects models (linear, generalized linear, nonlinear)

Specifying random effects structures

Interpreting fixed and random effects estimates

Assessing model fit using various criteria (e.g., AIC, BIC)

Presenting results using tables and graphs

Frequently Asked Questions (FAQs):

1. What is the difference between mixed-effects models and generalized estimating equations? Mixed-effects models model the correlation structure explicitly, while GEEs use a working correlation matrix. Mixed-effects models are generally preferred when the focus is on estimating individual-level effects, while GEEs are often preferred for population-average effects.
1. How do I choose the appropriate correlation structure for my data? The choice of correlation structure depends on the nature of the data and the research question. Visual inspection of the correlation matrix, along with model selection criteria (AIC, BIC), can guide this decision.
1. How do I handle missing data in my longitudinal analysis? Several methods exist, including complete case analysis (which is generally discouraged), imputation methods (e.g., multiple imputation), and maximum likelihood estimation under specified missing data mechanisms. The best approach depends on the pattern and mechanism of missing data.
1. What are the assumptions of mixed-effects models? Assumptions include the linearity of the relationship between the outcome and predictors (for linear mixed models), independence of observations within subjects, and normality of residuals. These assumptions can be checked using diagnostic plots and tests.
1. What software packages can I use for applied longitudinal analysis? R, SAS, SPSS, and Stata all offer capabilities for mixed-effects modeling and GEEs.
1. How can I interpret the results of a mixed-effects model? Interpret the fixed effects as the population-average effects, while the random effects represent the individual deviations from the population average.
1. What is the advantage of using the Fitzmaurice approach? It provides a robust and flexible framework for analyzing longitudinal data, accounting for within-subject correlation and other complexities.

1. What are latent growth curve models? These are specialized mixed-effects models used to model individual growth trajectories over time.

1. Where can I find more resources on applied longitudinal analysis? Numerous books, articles, and online courses are available. The work of Fitzmaurice et al. provides a strong starting point.

Related Articles:

1. Longitudinal Data Analysis: A Beginner's Guide: An introductory overview of longitudinal data analysis concepts.

1. Mixed-Effects Models: A Comprehensive Tutorial: A detailed tutorial on mixed-effects models, including model specification and interpretation.

1. Generalized Estimating Equations: A Practical Approach: A practical guide to using GEEs for analyzing longitudinal data.

1. Handling Missing Data in Longitudinal Studies: A Review of Methods: A review of different methods for handling missing data in longitudinal studies.

1. Model Selection in Longitudinal Data Analysis: A discussion of strategies for selecting the appropriate model for longitudinal data.

1. Interpreting Results from Longitudinal Data Analysis: Guidance on interpreting the results of longitudinal data analysis.

1. Applications of Longitudinal Data Analysis in Clinical Trials: Case studies illustrating the application of longitudinal data analysis in clinical trials.

1. Longitudinal Data Analysis using R: A tutorial on performing longitudinal data analysis using the R statistical programming language.

1. Advanced Topics in Longitudinal Data Analysis: A discussion of advanced topics in longitudinal data analysis, such as latent growth curve modeling and joint modeling.

applied longitudinal analysis fitzmaurice: Applied Longitudinal Analysis Garrett M.

Fitzmaurice, Nan M. Laird, James H. Ware, 2011-08-30 Praise for the First Edition . . . [this book] should be on the shelf of everyone interested in . . . longitudinal data analysis. —Journal of the American Statistical Association Features newly developed topics and applications of the analysis of longitudinal data Applied Longitudinal Analysis, Second Edition presents modern methods for analyzing data from longitudinal studies and now features the latest state-of-the-art techniques. The book emphasizes practical, rather than theoretical, aspects of methods for the analysis of diverse types of longitudinal data that can be applied across various fields of study, from the health and medical sciences to the social and behavioral sciences. The authors incorporate their extensive academic and research experience along with various updates that have been made in response to reader feedback. The Second Edition features six newly added chapters that explore topics currently evolving in the field, including: Fixed effects and mixed effects models Marginal models and generalized estimating equations Approximate methods for generalized linear mixed effects models Multiple imputation and inverse probability weighted methods Smoothing methods for longitudinal data Sample size and power Each chapter presents methods in the setting of applications to data sets drawn from the health sciences. New problem sets have been added to many chapters, and a related website features sample programs and computer output using SAS, Stata, and R, as well as data sets and supplemental slides to facilitate a complete understanding of the material. With its strong emphasis on multidisciplinary applications and the interpretation of results, Applied Longitudinal Analysis, Second Edition is an excellent book for courses on statistics in the health and medical sciences at the upper-undergraduate and graduate levels. The book also serves as a valuable reference for researchers and professionals in the medical, public health, and pharmaceutical fields as well as those in social and behavioral sciences who would like to learn more about analyzing longitudinal data.

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Fitzmaurice, Nan M. Laird, James H. Ware, 2012-10-23 Praise for the First Edition . . . [this book] should be on the shelf of everyone interested in . . . longitudinal data analysis. —Journal of the American Statistical Association Features newly developed topics and applications of the analysis of longitudinal data Applied Longitudinal Analysis, Second Edition presents modern methods for analyzing data from longitudinal studies and now features the latest state-of-the-art techniques. The book emphasizes practical, rather than theoretical, aspects of methods for the analysis of diverse types of longitudinal data that can be applied across various fields of study, from the health and medical sciences to the social and behavioral sciences. The authors incorporate their extensive academic and research experience along with various updates that have been made in response to reader feedback. The Second Edition features six newly added chapters that explore topics currently evolving in the field, including: Fixed effects and mixed effects models Marginal models and generalized estimating equations Approximate methods for generalized linear mixed effects models

Multiple imputation and inverse probability weighted methods Smoothing methods for longitudinal data Sample size and power Each chapter presents methods in the setting of applications to data sets drawn from the health sciences. New problem sets have been added to many chapters, and a related website features sample programs and computer output using SAS, Stata, and R, as well as data sets and supplemental slides to facilitate a complete understanding of the material. With its strong emphasis on multidisciplinary applications and the interpretation of results, *Applied Longitudinal Analysis, Second Edition* is an excellent book for courses on statistics in the health and medical sciences at the upper-undergraduate and graduate levels. The book also serves as a valuable reference for researchers and professionals in the medical, public health, and pharmaceutical fields as well as those in social and behavioral sciences who would like to learn more about analyzing longitudinal data.

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applied longitudinal analysis fitzmaurice: Linear Mixed Models for Longitudinal Data Geert Verbeke, Geert Molenberghs, 2009-05-12 This book provides a comprehensive treatment of linear mixed models for continuous longitudinal data. Next to model formulation, this edition puts major emphasis on exploratory data analysis for all aspects of the model, such as the marginal model, subject-specific profiles, and residual covariance structure. Further, model diagnostics and missing data receive extensive treatment. Sensitivity analysis for incomplete data is given a prominent place. Most analyses were done with the MIXED procedure of the SAS software package, but the data analyses are presented in a software-independent fashion.

applied longitudinal analysis fitzmaurice: Longitudinal Data Analysis Donald Hedeker, Robert D. Gibbons, 2006-05-12 Longitudinal data analysis for biomedical and behavioral sciences This innovative book sets forth and describes methods for the analysis of longitudinal data, emphasizing applications to problems in the biomedical and behavioral sciences. Reflecting the growing importance and use of longitudinal data across many areas of research, the text is designed to help users of statistics better analyze and understand this type of data. Much of the material from the book grew out of a course taught by Dr. Hedeker on longitudinal data analysis. The material is, therefore, thoroughly classroom tested and includes a number of features designed to help readers better understand and apply the material. Statistical procedures featured within the text include: * Repeated measures analysis of variance * Multivariate analysis of variance for repeated measures * Random-effects regression models (RRM) * Covariance-pattern models * Generalized-estimating equations (GEE) models * Generalizations of RRM and GEE for categorical outcomes Practical in their approach, the authors emphasize the applications of the methods, using real-world examples

for illustration. Some syntax examples are provided, although the authors do not generally focus on software in this book. Several datasets and computer syntax examples are posted on this title's companion Web site. The authors intend to keep the syntax examples current as new versions of the software programs emerge. This text is designed for both undergraduate and graduate courses in longitudinal data analysis. Instructors can take advantage of overheads and additional course materials available online for adopters. Applied statisticians in biomedicine and the social sciences can also use the book as a convenient reference.

applied longitudinal analysis fitzmaurice: Missing Data in Longitudinal Studies Michael J. Daniels, Joseph W. Hogan, 2008-03-11 Drawing from the authors' own work and from the most recent developments in the field, *Missing Data in Longitudinal Studies: Strategies for Bayesian Modeling and Sensitivity Analysis* describes a comprehensive Bayesian approach for drawing inference from incomplete data in longitudinal studies. To illustrate these methods, the authors employ

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applied longitudinal analysis fitzmaurice: **Mixed Effects Models for Complex Data** Lang Wu, 2009-11-11 Although standard mixed effects models are useful in a range of studies, other approaches must often be used in correlation with them when studying complex or incomplete data. *Mixed Effects Models for Complex Data* discusses commonly used mixed effects models and presents appropriate approaches to address dropouts, missing data, measurement errors, censoring, and outliers. For each class of mixed effects model, the author reviews the corresponding class of regression model for cross-sectional data. An overview of general models and methods, along with motivating examples After presenting real data examples and outlining general approaches to the analysis of longitudinal/clustered data and incomplete data, the book introduces linear mixed effects (LME) models, generalized linear mixed models (GLMMs), nonlinear mixed effects (NLME) models, and semiparametric and nonparametric mixed effects models. It also includes general approaches for the analysis of complex data with missing values, measurement errors, censoring, and outliers. Self-contained coverage of specific topics Subsequent chapters delve more deeply into missing data problems, covariate measurement errors, and censored responses in mixed effects models. Focusing on incomplete data, the book also covers survival and frailty models, joint models of survival and longitudinal data, robust methods for mixed effects models, marginal generalized estimating equation (GEE) models for longitudinal or clustered data, and Bayesian methods for mixed effects models. Background material In the appendix, the author provides background information, such as likelihood theory, the Gibbs sampler, rejection and importance sampling methods, numerical integration methods, optimization methods, bootstrap, and matrix algebra. Failure to properly address missing data, measurement errors, and other issues in statistical analyses can lead to severely biased or misleading results. This book explores the biases that arise when naïve methods are used and shows which approaches should be used to achieve accurate results in longitudinal data analysis.

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increase considerably in all areas of scientific inquiry mainly as a result of model-building methods available in modern statistical software packages. However, there has been minimal coverage in the available literature to guide researchers, practitioners, and students who wish to apply these methods to health-related areas of study. *Applied Survival Analysis, Second Edition* provides a comprehensive and up-to-date introduction to regression modeling for time-to-event data in medical, epidemiological, biostatistical, and other health-related research. This book places a unique emphasis on the practical and contemporary applications of regression modeling rather than the mathematical theory. It offers a clear and accessible presentation of modern modeling techniques supplemented with real-world examples and case studies. Key topics covered include: variable selection, identification of the scale of continuous covariates, the role of interactions in the model, assessment of fit and model assumptions, regression diagnostics, recurrent event models, frailty models, additive models, competing risk models, and missing data. Features of the Second Edition include: Expanded coverage of interactions and the covariate-adjusted survival functions The use of the Worcester Heart Attack Study as the main modeling data set for illustrating discussed concepts and techniques New discussion of variable selection with multivariable fractional polynomials Further exploration of time-varying covariates, complex with examples Additional treatment of the exponential, Weibull, and log-logistic parametric regression models Increased emphasis on interpreting and using results as well as utilizing multiple imputation methods to analyze data with missing values New examples and exercises at the end of each chapter Analyses throughout the text are performed using Stata® Version 9, and an accompanying FTP site contains the data sets used in the book. *Applied Survival Analysis, Second Edition* is an ideal book for graduate-level courses in biostatistics, statistics, and epidemiologic methods. It also serves as a valuable reference for practitioners and researchers in any health-related field or for professionals in insurance and government.

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applied longitudinal analysis fitzmaurice: Joint Models for Longitudinal and Time-to-Event Data Dimitris Rizopoulos, 2012-06-22 In longitudinal studies it is often of interest to investigate how a marker that is repeatedly measured in time is associated with a time to an event of interest, e.g., prostate cancer studies where longitudinal PSA level measurements are collected in conjunction with the time-to-recurrence. Joint Models for Longitudinal and Time-to-Event Data: With Applications in R provides a full treatment of random effects joint models for longitudinal and time-to-event outcomes that can be utilized to analyze such data. The content is primarily explanatory, focusing on applications of joint modeling, but sufficient mathematical details are provided to facilitate understanding of the key features of these models. All illustrations put forward can be implemented in the R programming language via the freely available package JM written by the author. All the R code used in the book is available at: <http://jmr.r-forge.r-project.org/>

applied longitudinal analysis fitzmaurice: Models for Intensive Longitudinal Data Theodore A. Walls, Joseph L. Schafer, 2006-01-19 Rapid technological advances in devices used for data collection have led to the emergence of a new class of longitudinal data: intensive longitudinal data (ILD). Behavioral scientific studies now frequently utilize handheld computers, beepers, web interfaces, and other technological tools for collecting many more data points over time than previously possible. Other protocols, such as those used in fMRI and monitoring of public safety, also produce ILD, hence the statistical models in this volume are applicable to a range of data. The volume features state-of-the-art statistical modeling strategies developed by leading statisticians and methodologists working on ILD in conjunction with behavioral scientists. Chapters present applications from across the behavioral and health sciences, including coverage of substantive topics such as stress, smoking cessation, alcohol use, traffic patterns, educational performance and intimacy. Models for Intensive Longitudinal Data (MILD) is designed for those who want to learn about advanced statistical models for intensive longitudinal data and for those with an interest in selecting and applying a given model. The chapters highlight issues of general concern in modeling these kinds of data, such as a focus on regulatory systems, issues of curve registration, variable frequency and spacing of measurements, complex multivariate patterns of change, and multiple independent series. The extraordinary breadth of coverage makes this an indispensable reference for principal investigators designing new studies that will introduce ILD, applied statisticians working on related models, and methodologists, graduate students, and applied analysts working in a range of fields. A companion Web site at www.oup.com/us/MILD contains program examples and documentation.

applied longitudinal analysis fitzmaurice: *Nonparametric Regression Methods for Longitudinal Data Analysis* Hulin Wu, Jin-Ting Zhang, 2006-05-12 Incorporates mixed-effects modeling techniques for more powerful and efficient methods This book presents current and effective nonparametric regression techniques for longitudinal data analysis and systematically investigates the incorporation of mixed-effects modeling techniques into various nonparametric regression models. The authors emphasize modeling ideas and inference methodologies, although some theoretical results for the justification of the proposed methods are presented. With its logical structure and organization, beginning with basic principles, the text develops the foundation needed to master advanced principles and applications. Following a brief overview, data examples from biomedical research studies are presented and point to the need for nonparametric regression analysis approaches. Next, the authors review mixed-effects models and nonparametric regression models, which are the two key building blocks of the proposed modeling techniques. The core section of the book consists of four chapters dedicated to the major nonparametric regression methods: local polynomial, regression spline, smoothing spline, and penalized spline. The next two chapters extend these modeling techniques to semiparametric and time varying coefficient models for longitudinal data analysis. The final chapter examines discrete longitudinal data modeling and analysis. Each chapter concludes with a summary that highlights key points and also provides bibliographic notes that point to additional sources for further study. Examples of data analysis from biomedical research are used to illustrate the methodologies contained throughout the book. Technical proofs are presented in separate appendices. With its focus on solving problems, this is an excellent textbook for upper-level undergraduate and graduate courses in longitudinal data analysis. It is also recommended as a reference for biostatisticians and other theoretical and applied research statisticians with an interest in longitudinal data analysis. Not only do readers gain an understanding of the principles of various nonparametric regression methods, but they also gain a practical understanding of how to use the methods to tackle real-world problems.

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this unique handbook reviews the breadth of current approaches for studying how people think, feel, and behave in everyday environments, rather than in the laboratory. The volume thoroughly describes experience sampling methods, diary methods, physiological measures, and other self-report and non-self-report tools that allow for repeated, real-time measurement in natural settings. Practical guidance is provided to help the reader design a high-quality study, select and implement appropriate methods, and analyze the resulting data using cutting-edge statistical techniques. Applications across a wide range of psychological subfields and research areas are discussed in detail.

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Joseph L. Fleiss, 1981-04-21 An introduction to applied probability; Assessing significance in a fourfold table; Determining sample sizes needed to detect a difference between two proportions; How to randomize; Sampling method; The analysis of data from matched samples; The comparison of proportions from several independent samples; Combining evidence from fourfold tables; The effects of misclassification errors; The control of misclassification error; The measurement of interrater agreement; The standardization of rates.

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M. Collins, Stephanie T. Lanza, 2013-05-20 A modern, comprehensive treatment of latent class and latent transition analysis for categorical data On a daily basis, researchers in the social, behavioral, and health sciences collect information and fit statistical models to the gathered empirical data with the goal of making significant advances in these fields. In many cases, it can be useful to identify latent, or unobserved, subgroups in a population, where individuals' subgroup membership is inferred from their responses on a set of observed variables. Latent Class and Latent Transition Analysis provides a comprehensive and unified introduction to this topic through one-of-a-kind, step-by-step presentations and coverage of theoretical, technical, and practical issues in categorical latent variable modeling for both cross-sectional and longitudinal data. The book begins with an introduction to latent class and latent transition analysis for categorical data. Subsequent chapters delve into more in-depth material, featuring: A complete treatment of longitudinal latent class models Focused coverage of the conceptual underpinnings of interpretation and evaluation of a latent class solution Use of parameter restrictions and detection of identification problems Advanced topics such as multi-group analysis and the modeling and interpretation of interactions between covariates The authors present the topic in a style that is accessible yet rigorous. Each method is presented with both a theoretical background and the practical information that is useful for any data analyst. Empirical examples showcase the real-world applications of the discussed concepts and models, and each chapter concludes with a Points to Remember section that contains a brief summary of key ideas. All of the analyses in the book are performed using Proc LCA and Proc LTA, the authors' own software packages that can be run within the SAS® environment. A related Web site houses information on these freely available programs and the book's data sets, encouraging readers to reproduce the analyses and also try their own variations. Latent Class and Latent Transition Analysis is an excellent book for courses on categorical data analysis and latent variable models at the upper-undergraduate and graduate levels. It is also a valuable resource for researchers and practitioners in the social, behavioral, and health sciences who conduct latent class and latent transition analysis in their everyday work.

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Molenberghs, Garrett Fitzmaurice, Michael G. Kenward, Anastasios Tsiatis, Geert Verbeke, 2014-11-06 Missing data affect nearly every discipline by complicating the statistical analysis of collected data. But since the 1990s, there have been important developments in the statistical methodology for handling missing data. Written by renowned statisticians in this area, Handbook of Missing Data Methodology presents many methodological advances and the latest applications of missing data methods in empirical research. Divided into six parts, the handbook begins by establishing notation and terminology. It reviews the general taxonomy of missing data mechanisms and their implications for analysis and offers a historical perspective on early methods for handling

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