

*Springer Series in Statistics*

**Geert Molenberghs  
Geert Verbeke**

**Models for  
Discrete  
Longitudinal  
Data**



Springer

# Models For Discrete Longitudinal Data

**Sylvie Tchumtchoua**



## **Models For Discrete Longitudinal Data:**

*Models for Discrete Longitudinal Data* Geert Molenberghs, Geert Verbeke, 2006-08-30 The linear mixed model has become the main parametric tool for the analysis of continuous longitudinal data as the authors discussed in their 2000 book Without putting too much emphasis on software the book shows how the different approaches can be implemented within the SAS software package The authors received the American Statistical Association's Excellence in Continuing Education Award based on short courses on longitudinal and incomplete data at the Joint Statistical Meetings of 2002 and 2004

**Models for Discrete Longitudinal Data** Geert Molenberghs, 2005      **Longitudinal Data Analysis** Garrett Fitzmaurice, Marie Davidian, Geert Verbeke, Geert Molenberghs, 2008-08-11 Although many books currently available describe statistical models and methods for analyzing longitudinal data they do not highlight connections between various research threads in the statistical literature Responding to this void Longitudinal Data Analysis provides a clear comprehensive and unified overview of state of the art theory      Bayesian Semiparametric Models for Discrete Longitudinal Data Sylvie Tchuente, 2010

*Modeling Longitudinal Data* Robert E. Weiss, 2006-12-06 Longitudinal data are ubiquitous across Medicine Public Health Public Policy Psychology Political Science Biology Sociology and Education yet many longitudinal data sets remain improperly analyzed This book teaches the art and statistical science of modern longitudinal data analysis The author emphasizes specifying understanding and interpreting longitudinal data models He inspects the longitudinal data graphically analyzes the time trend and covariates models the covariance matrix and then draws conclusions Covariance models covered include random effects autoregressive autoregressive moving average antedependence factor analytic and completely unstructured models among others Longer expositions explore an introduction to and critique of simple non longitudinal analyses of longitudinal data missing data concepts diagnostics and simultaneous modeling of two longitudinal variables Applications and issues for random effects models cover estimation shrinkage clustered data models for binary and count data and residuals and residual plots Shorter sections include a general discussion of how computational algorithms work handling transformed data and basic design issues This book requires a solid regression course as background and is particularly intended for the final year of a Biostatistics or Statistics Masters degree curriculum The mathematical prerequisite is generally low mainly assuming familiarity with regression analysis in matrix form Doctoral students in Biostatistics or Statistics applied researchers and quantitative doctoral students in disciplines such as Medicine Public Health Public Policy Psychology Political Science Biology Sociology and Education will find this book invaluable The book has many figures and tables illustrating longitudinal data and numerous homework problems The associated web site contains many longitudinal data sets examples of computer code and labs to reinforce the material From the reviews This book is extremely well presented and it has been written in a style that makes its reading really pleasant and enjoyable I highly recommend Modeling Longitudinal Data as a good reference book for anyone interested in looking into the art and statistical

science of modern longitudinal data analysis Journal of Applied Statistics December 2005 The book is clearly written and well presented The author s accumulated experience in presenting the material comes over On balance this is one of the books which anyone about to teach a practical course in longitudinal data analysis should consider adopting as the course text Short Book Reviews of the ISI June 2006 Modeling Longitudinal Data is a welcome addition to the vast literature on longitudinal data analysis The book requires little in terms of prerequisites but offers a great deal Zhigang Zhang for the Journal of the American Statistical Association December 2006 Overall Robert Weiss s book can be used as an excellent textbook for a first master level course in longitudinal data analysis in a statistics or biostatistics program or as a self study book for applied researchers interested in this area The style is very clear concepts are explained in an engaging way and amply illustrated and the chapters on covariate selection and modeling the variance covariance matrix are definite assets Ralitza Gueorgueiva for Biostatistics September 2006 *Latent Variable Models for Discrete Longitudinal Data with Measurement Error* Keith Humphreys,1996

**Antedependence Models for Longitudinal Data** Dale L. Zimmerman,Vicente A. Núñez-Antón,2009-08-19 The First Book Dedicated to This Class of Longitudinal Models Although antedependence models are particularly useful for modeling longitudinal data that exhibit serial correlation few books adequately cover these models By gathering results scattered throughout the literature Antedependence Models for Longitudinal Data offers a convenient systematic way to learn about antedependence models Illustrated with numerous examples the book also covers some important statistical inference procedures associated with these models After describing unstructured and structured antedependence models and their properties the authors discuss informal model identification via simple summary statistics and graphical methods They then present formal likelihood based procedures for normal antedependence models including maximum likelihood and residual maximum likelihood estimation of parameters as well as likelihood ratio tests and penalized likelihood model selection criteria for the model s covariance structure and mean structure The authors also compare the performance of antedependence models to other models commonly used for longitudinal data With this book readers no longer have to search across widely scattered journal articles on the subject The book provides a thorough treatment of the properties and statistical inference procedures of various antedependence models

**Nonparametric Regression Methods for Longitudinal Data Analysis** Hulin Wu,Jin-Ting Zhang,2006-04-27 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. Dynamic Mixed Models for Familial Longitudinal Data Brajendra C.

Sutradhar, 2011-01-27 This book provides a theoretical foundation for the analysis of discrete data such as count and binary data in the longitudinal setup. Unlike the existing books, this book uses a class of auto correlation structures to model the longitudinal correlations for the repeated discrete data that accommodates all possible Gaussian type auto correlation models as special cases including the equi correlation models. This new dynamic modelling approach is utilized to develop theoretically sound inference techniques such as the generalized quasi likelihood GQL technique for consistent and efficient estimation of the underlying regression effects involved in the model, whereas the existing working correlations based GEE generalized estimating equations approach has serious theoretical limitations both for consistent and efficient estimation and the existing random effects based correlations approach is not suitable to model the longitudinal correlations. The book has exploited the random effects carefully only to model the correlations of the familial data. Subsequently, this book has modelled the correlations of the longitudinal data collected from the members of a large number of independent families by using the class of auto correlation structures conditional on the random effects. The book also provides models and inferences for discrete longitudinal data in the adaptive clinical trial set up. The book is mathematically rigorous and provides details for the development of estimation approaches under selected familial and longitudinal models. Further, while the book provides special cares for mathematics behind the correlation models, it also presents the illustrations of the statistical analysis of various real life data. This book will be of interest to the researchers including graduate students in biostatistics and econometrics among other applied statistics research areas. Brajendra Sutradhar is a University Research Professor at Memorial University in St John's Canada. He is an elected member of the International Statistical Institute and a fellow of the

American Statistical Association He has published about 110 papers in statistics journals in the area of multivariate analysis time series analysis including forecasting sampling survival analysis for correlated failure times robust inferences in generalized linear mixed models with outliers and generalized linear longitudinal mixed models with bio statistical and econometric applications He has served as an associate editor for six years for Canadian Journal of Statistics and for four years for the Journal of Environmental and Ecological Statistics He has served for 3 years as a member of the advisory committee on statistical methods in Statistics Canada Professor Sutradhar was awarded 2007 distinguished service award of Statistics Society of Canada for his many years of services to the society including his special services for society s annual meetings

Applied Longitudinal Analysis Garrett M. Fitzmaurice, Nan M. Laird, James H. Ware, 2004-07 Publisher Description *Bayesian Semiparametric Models for Discrete Longitudinal Data* Sylvie Tchumtchoua, 2010 Discrete longitudinal data are common in various disciplines and are often used to assess the change over time of one or several outcomes and or what covariates might be associated with the outcomes Existing parametric and nonparametric semiparametric models typically attribute the heterogeneity across subjects and or through time to the effects of included explanatory variables or the effect of omitted variables that do not vary across subjects and over time This dissertation focuses on developing new flexible semiparametric models for discrete longitudinal data using Dirichlet processes It consists of three parts In chapter 2 we propose a semiparametric Bayesian framework for the analysis of associations among multivariate longitudinal categorical variables in high dimensional data settings This type of data is frequent especially in the social and behavioral sciences A semiparametric hierarchical factor analysis model is developed in which the distributions of the factors are modeled nonparametrically through a dynamic Dirichlet process A Markov chain Monte Carlo algorithm is developed for fitting the model and the methodology is applied to study the dynamics of public attitudes toward science and technology in the United States over the period 1992 2001 In chapter 3 we consider the estimation of nonparametric regression for binary longitudinal data Instead of assuming a parametric link function we specify the joint distribution of the covariates and the latent variable underlying the binary outcome as a multivariate normal with subject and time specific mean vector and covariance matrix We then modeled the distribution of these parameters nonparametrically using a dynamic Dirichlet process The resulting binary regression model is a finite mixture of probit regressions and a nonlinear regression The proposed model is more flexible than the existing models in that it models the relationship between the binary response and the covariates nonparametrically while at the same time allowing the shape of the relationship to change over time The methodology is illustrated using simulated data and a real dataset the data on labor force participation of married women in the US over the period 1979 to 1992 Finally chapter 4 proposes two functional generalized linear models where the response variables are discrete functional data and one of the covariates is also functional Functional regression is combined with penalized B splines in a semiparametric Bayesian framework to jointly estimate the response model and the predictor curves

clustering curves with similar shapes The methodology is applied to study the price and bids arrivals dynamics in online auctions using data for the palm M515 Personal Digital Assistant PDA units from eBay com

**The SAGE Handbook of Multilevel Modeling** Marc A. Scott, Jeffrey S. Simonoff, Brian D. Marx, 2013-08-31 In this important new Handbook the editors have gathered together a range of leading contributors to introduce the theory and practice of multilevel modeling The Handbook establishes the connections in multilevel modeling bringing together leading experts from around the world to provide a roadmap for applied researchers linking theory and practice as well as a unique arsenal of state of the art tools It forges vital connections that cross traditional disciplinary divides and introduces best practice in the field Part I establishes the framework for estimation and inference including chapters dedicated to notation model selection fixed and random effects and causal inference Part II develops variations and extensions such as nonlinear semiparametric and latent class models Part III includes discussion of missing data and robust methods assessment of fit and software Part IV consists of exemplary modeling and data analyses written by methodologists working in specific disciplines Combining practical pieces with overviews of the field this Handbook is essential reading for any student or researcher looking to apply multilevel techniques in their own research

Correlated Data Analysis: Modeling, Analytics, and Applications Xue-Kun Song, Peter X.-K. Song, 2007-07-27 This book covers recent developments in correlated data analysis It utilizes the class of dispersion models as marginal components in the formulation of joint models for correlated data This enables the book to cover a broader range of data types than the traditional generalized linear models The reader is provided with a systematic treatment for the topic of estimating functions and both generalized estimating equations GEE and quadratic inference functions QIF are studied as special cases In addition to the discussions on marginal models and mixed effects models this book covers new topics on joint regression analysis based on Gaussian copulas

**Quasi-Least Squares Regression** Justine Shults, Joseph M. Hilbe, 2014-01-28 Drawing on the authors substantial expertise in modeling longitudinal and clustered data Quasi Least Squares Regression provides a thorough treatment of quasi least squares QLS regression a computational approach for the estimation of correlation parameters within the framework of generalized estimating equations GEEs The authors present a detailed evaluation of QLS methodology demonstrating the advantages of QLS in comparison with alternative methods They describe how QLS can be used to extend the application of the traditional GEE approach to the analysis of unequally spaced longitudinal data familial data and data with multiple sources of correlation In some settings QLS also allows for improved analysis with an unstructured correlation matrix Special focus is given to goodness of fit analysis as well as new strategies for selecting the appropriate working correlation structure for QLS and GEE A chapter on longitudinal binary data tackles recent issues raised in the statistical literature regarding the appropriateness of semi parametric methods such as GEE and QLS for the analysis of binary data this chapter includes a comparison with the first order Markov maximum likelihood MARK1ML approach for binary data Examples throughout the

book demonstrate each topic of discussion In particular a fully worked out example leads readers from model building and interpretation to the planning stages for a future study including sample size calculations The code provided enables readers to replicate many of the examples in Stata often with corresponding R SAS or MATLAB code offered in the text or on the book s website

**Encyclopedia of Environmetrics** Abdel H. El-Shaarawi, Walter W. Piegorsch, 2002 A comprehensive overview of environmetric research and its applications Environmetrics covers the development and application of quantitative methods in the environmental sciences It provides essential tools for understanding predicting and controlling the impacts of agents both man made and natural which affect the environment Basic and applied research in this area covers a broad range of topics Primary among these are the quantitative sciences such as statistics probability and applied mathematics chemometrics and econometrics Applications are also important for example in ecology and environmental biology public health atmospheric science geology engineering risk management and regulatory governmental policy amongst others Divided into 12 sections the Encyclopedia brings together over 600 detailed articles which have been carefully selected and reviewed through the collaborative efforts of the Editors in Chief and the appropriate Section Editor Presented in alphabetical order all the articles will include an explanatory introduction extensive cross referencing and an up to date bibliography providing literature references for further reading Presenting state of the art information in a readable highly accessible style the scope and coverage provided by the Encyclopedia of Environmetrics will ensure its place as the landmark reference for the many scientists educators and decision makers working across this multidisciplinary field An essential reference tool for university libraries research laboratories government institutions and consultancies concerned with the environmental sciences the Encyclopedia of Environmetrics brings together for the first time comprehensive coverage of the full range of topics techniques and applications covered by this multidisciplinary field There is currently no central reference source which addresses the needs of this multidisciplinary community This new Encyclopedia will fill this gap by providing a comprehensive source of relevant fundamental concepts in environmetric research development and applications for statisticians mathematicians economists environmentalists ecologist government officials and policy makers

Methods and Applications of Statistics in Clinical Trials, Volume 2 Narayanaswamy Balakrishnan, 2014-06-16 Methods and Applications of Statistics in Clinical Trials Volume 2 Planning Analysis and Inferential Methods includes updates of established literature from the Wiley Encyclopedia of Clinical Trials as well as original material based on the latest developments in clinical trials Prepared by a leading expert the second volume includes numerous contributions from current prominent experts in the field of medical research In addition the volume features Multiple new articles exploring emerging topics such as evaluation methods with threshold empirical likelihood methods nonparametric ROC analysis over and under dispersed models and multi armed bandit problems Up to date research on the Cox proportional hazard model frailty models trial reports intrarater reliability conditional power and the kappa index Key qualitative issues including cost effectiveness



analysis publication bias and regulatory issues which are crucial to the planning and data management of clinical trials

*Explanatory Item Response Models* Paul de Boeck, Mark Wilson, 2013-03-09 This edited volume gives a new and integrated introduction to item response models predominantly used in measurement applications in psychology education and other social science areas from the viewpoint of the statistical theory of generalized linear and nonlinear mixed models. Moreover, this new framework allows the domain of item response models to be coordinated and broadened to emphasize their explanatory uses beyond their standard descriptive uses. The basic explanatory principle is that item responses can be modeled as a function of predictors of various kinds. The predictors can be characteristics of items, of persons, and of combinations of persons and items; they can be observed or latent, of either items or persons, and they can be continuous or latent, categorical. Thus, a broad range of models can be generated, including a wide range of extant item response models as well as some new ones. Within this range, models with explanatory predictors are given special attention, but we also discuss descriptive models. Note that the item responses that we are referring to are not just the traditional test data but are broadly conceived as categorical data from a repeated observations design. Hence, data from studies with repeated observations, experimental designs, or with longitudinal designs may also be modeled. The intended audience for this volume is rather broad.

*Tutorials in Biostatistics, Statistical Methods in Clinical Studies* Ralph B. D'Agostino, 2004-11-30 The Tutorials in Biostatistics have become a very popular feature of the prestigious Wiley journal *Statistics in Medicine*. The introductory style and practical focus make them accessible to a wide audience, including medical practitioners with limited statistical knowledge. This book represents the first of two volumes presenting the best tutorials published in *SIM*, focusing on statistical methods in clinical studies. Topics include the design and analysis of clinical trials, epidemiology, survival analysis, and data monitoring. Each tutorial is focused on a medical problem, has been fully peer reviewed and edited, and is authored by leading researchers in biostatistics. Many articles include an appendix on the latest developments since publication in the journal and additional references. This will appeal to statisticians working in medical research as well as statistically minded clinicians, biologists, epidemiologists, and geneticists. It will also appeal to graduate students of biostatistics.

**Handbook of Advanced Multilevel Analysis** Joop Hox, J. Kyle Roberts, 2011-01-11 This new handbook is the definitive resource on advanced topics related to multilevel analysis. The editors assembled the top minds in the field to address the latest applications of multilevel modeling as well as the specific difficulties and methodological problems that are becoming more common as more complicated models are developed. Each chapter features examples that use actual datasets. These datasets, as well as the code to run the models, are available on the book's website: <http://www.hlm-online.com>. Each chapter includes an introduction that sets the stage for the material to come and a conclusion. Divided into five sections, the first provides a broad introduction to the field that serves as a framework for understanding the latter chapters. Part 2 focuses on multilevel latent variable modeling, including item response theory and mixture modeling. Section 3 addresses

models used for longitudinal data including growth curve and structural equation modeling Special estimation problems are examined in section 4 including the difficulties involved in estimating survival analysis Bayesian estimation bootstrapping multiple imputation and complicated models including generalized linear models optimal design in multilevel models and more The book s concluding section focuses on statistical design issues encountered when doing multilevel modeling including nested designs analyzing cross classified models and dyadic data analysis Intended for methodologists statisticians and researchers in a variety of fields including psychology education and the social and health sciences this handbook also serves as an excellent text for graduate and PhD level courses in multilevel modeling A basic knowledge of multilevel modeling is assumed

**The Use of Routine Health Data in Low- and Middle-Income Countries** Jim Todd, Michael Johnson Mahande, 2020-12-11 This eBook is a collection of articles from a Frontiers Research Topic Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series they are collections of at least ten articles all centered on a particular subject With their unique mix of varied contributions from Original Research to Review Articles Frontiers Research Topics unify the most influential researchers the latest key findings and historical advances in a hot research area Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office [frontiersin.org](mailto:frontiersin.org) about contact

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