

Multiple Regression With Categorical Data

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Learn How to Properly Analyze Categorical Data Analysis of Categorical Data with R presents a modern account of categorical data analysis using the popular R software. It covers recent techniques of model building and assessment for binary, multicategory, and count response variables and discusses fundamentals, such as odds ratio and probability estimation. The authors give detailed advice and guidelines on which procedures to use and why to use them. The Use of R as Both a Data Analysis Method and a Learning Tool Requiring no prior experience with R, the text offers an introduction to the essential features and functions of R. It incorporates numerous examples from medicine, psychology, sports, ecology, and other areas, along with extensive R code and output. The authors use data simulation in R to help readers understand the underlying assumptions of a procedure and then to evaluate the procedure's performance. They also present many graphical demonstrations of the features and properties of various analysis methods.

Web Resource The data sets and R programs from each example are available at www.chrisbilder.com/categorical. The programs include code used to create every plot and piece of output. Many of these programs contain code to demonstrate additional features or to perform more detailed analyses than what is in the text. Designed to be used in tandem with the book, the website also uniquely provides videos of the authors teaching a course on the subject. These videos include live, in-class recordings, which instructors may find useful in a blended or flipped classroom setting. The videos are also suitable as a substitute for a short course.

This successful book, now available in paperback, provides academics and researchers with a clear set of prescriptions for estimating, testing and probing interactions in regression models. Including the latest research in the area, such as Fuller's work on the corrected/constrained estimator, the book is appropriate for anyone who uses multiple regression to estimate models, or for those enrolled in courses on multivariate statistics.

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Statistical Methods for Categorical Data Analysis is designed as an accessible reference work and textbook about categorical data (that is, data arising from counts instead of measurement. Examples include data about birth, death, marriage, and so forth). It integrates statistical and econometric approaches to the analysis of limited and categorical dependent variables, thereby offering a practical, mathematically uncomplicated approach to the topics of modern data analysis. The volume offers a comprehensive presentation of many different models in a one-volume format (with website). Two features distinguish this book from other analyses of categorical data. First, the authors present both the transformational and latent variable approaches and so synthesize similar methods in statistical and econometric literatures. Second, the book has an applied orientation and features actual examples from social science research. The authors keep discussions of theory to a minimum. Key Features * Exercises and examples utilize popular data already familiar to many social scientists * Examples of the use of various popular software packages * Includes non-standard applications of existing software for estimating models which cannot be handled directly using existing pre-programmed software

Accessible, up-to-date coverage of a broad range of modern and traditional methods. The ability to understand and analyze categorical, or count, data is crucial to the success of statisticians in a wide variety of fields, including biomedicine, ecology, the social sciences, marketing, and many more. Statistical Analysis of Categorical Data provides thorough, clear, up-to-date explanations of all important methods of categorical data analysis at a level accessible to anyone with a solid undergraduate knowledge of statistics. Featuring a liberal use of real-world examples as well as a regression-based approach familiar to most students, this book reviews pertinent statistical theory, including advanced topics such as Score statistics and the transformed central limit theorem. It presents the distribution theory of Poisson as well as multinomial variables, and it points out the connections between them. Complete with numerous illustrations and exercises, this book covers the full range of topics necessary to develop a well-rounded understanding of modern categorical data analysis, including: * Logistic regression and log-linear models. * Exact conditional methods. * Generalized linear and additive models. * Smoothing count data with practical implementations in S-plus software. * Thorough description and analysis of five important computer packages. Supported by an ftp site, which describes the facilities important to a statistician wanting to analyze and report on categorical data, Statistical Analysis of Categorical Data is an excellent resource for students, practicing statisticians, and researchers with a special interest in count data. An updated treatment of categorical data analysis in the biomedical sciences that now explores applications to translational research Thoroughly updated with the latest advances in the field, Applied Categorical Data Analysis and Translational Research, Second Edition maintains the accessible style of its predecessor while also exploring the importance of translational research as it relates to basic scientific findings within clinical practice. With its easy-to-follow style, updated coverage of major methodologies, and broadened scope of coverage, this new edition provides an accessible guide to statistical methods involving categorical data and the steps to their application in problem solving in the biomedical sciences. Delving even further into the applied direction, this update offers many real-world examples from biomedicine, epidemiology, and public health along with detailed case studies taken straight from modern research in these fields. Additional features of the Second Edition include: A new chapter on the relationship between translational research and categorical data, focusing on design study, bioassay, and Phase I and Phase II clinical trials A new chapter on categorical data and diagnostic medicine, with coverage of the diagnostic process, prevalence surveys, the ROC function and ROC curve, and important statistical considerations A revised chapter on logistic regression models featuring an updated treatment of simple and multiple regression analysis An added section on quantal bioassays Each chapter features updated and new exercise sets along with numerous graphs that demonstrate the highly visual nature of the topic. A related Web site features the book's examples as well as additional data sets that can be worked with using SAS® software. The only book of its kind to provide balanced coverage of methods for both categorical data and translational research, Applied Categorical Data Analysis and Translational Research, Second Edition is an excellent book for courses on applied statistics and biostatistics at the upper-undergraduate and graduate levels. It is also a valuable reference for researchers and practitioners in the biomedical and public health fields.

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This book introduces basic and advanced concepts of categorical regression with a focus on the structuring constituents of regression, including regularization techniques to structure predictors. In addition to standard methods such as the logit and probit model and extensions to multivariate settings, the author presents more recent developments in flexible and high-dimensional regression, which allow weakening of assumptions on the structuring of the predictor and yield fits that are closer to the data. A generalized linear model is used as a unifying framework whenever possible in particular parametric models that are treated within this framework. Many topics not normally included in books on categorical data analysis are treated here, such as nonparametric regression; selection of predictors by regularized estimation procedures; alternative models like the hurdle model and zero-inflated regression models for count data; and non-standard tree-based ensemble methods. The book is accompanied by an R package that contains data sets and code for all the examples.

Taking a practical approach that draws on the authors' extensive teaching, consulting, and research experiences, *Applied Survey Data Analysis* provides an intermediate-level statistical overview of the analysis of complex sample survey data. It emphasizes methods and worked examples using available software procedures while reinforcing the principles and theory that underlie those methods. After introducing a step-by-step process for approaching a survey analysis problem, the book presents the fundamental features of complex sample designs and shows how to integrate design characteristics into the statistical methods and software for survey estimation and inference. The authors then focus on the methods and models used in analyzing continuous, categorical, and count-dependent variables; event history; and missing data problems. Some of the techniques discussed include univariate descriptive and simple bivariate analyses, the linear regression model, generalized linear regression modeling methods, the Cox proportional hazards model, discrete time models, and the multiple imputation analysis method. The final chapter covers new developments in survey applications of advanced statistical techniques, including model-based analysis approaches. Designed for readers working in a wide array of disciplines who use survey data in their work, this book also provides a useful framework for integrating more in-depth studies of the theory and methods of survey data analysis. A guide to the applied statistical analysis and interpretation of survey data, it contains many examples and practical exercises based on major real-world survey data sets. Although the authors use Stata for most examples in the text, they offer SAS, SPSS, SUDAAN, R, WesVar, IVEware, and Mplus software code for replicating the examples on the book's website:

<http://www.isr.umich.edu/src/smp/asda/>

The linear regression model is the most commonly used statistical method in the social sciences. This book considers regression models that are appropriate when the dependent variable is censored, truncated, binary, ordinal, nominal, or count. I refer to these variables as categorical and limited dependent variables (hereafter CLDVs). Until recently, the greatest obstacle in using models for CLDVs was the lack of software that was flexible, stable, and easy to use. This limitation no longer applies since these models can be estimated routinely with standard software. Now, the greatest impediment is the complexity of the models and the difficulty in interpreting the results. The difficulties arise because most models for CLDVs are nonlinear.

Statistical science's first coordinated manual of methods for analyzing ordered categorical data, now fully revised and updated, continues to present applications and case studies in fields as diverse as sociology, public health, ecology, marketing, and pharmacy. *Analysis of Ordinal Categorical Data, Second Edition* provides an introduction to basic descriptive and inferential methods for categorical data, giving thorough coverage of new developments and recent methods. Special emphasis is placed on interpretation and application of methods including an integrated comparison of the available strategies for analyzing ordinal data. Practitioners of statistics in government, industry (particularly pharmaceutical), and academia will want this new edition.

Because of the sophistication of statistical software packages, many social and behavioural science students are exposed to complex multivariate statistical techniques without having to learn the maths needed to acquire the data output. This book covers multivariate topics using a conceptual, not mathematical approach.

Praise for the Second Edition "A must-have book for anyone expecting to do research and/or applications in categorical data analysis." —*Statistics in Medicine* "It is a total delight reading this book." —*Pharmaceutical Research* "If you do any analysis of categorical data, this is an essential desktop reference." —*Technometrics* The use of statistical methods for analyzing categorical data has increased dramatically, particularly in the biomedical, social sciences, and financial industries. Responding to new developments, this book offers a comprehensive treatment of the most important methods for categorical data analysis. *Categorical Data Analysis, Third Edition* summarizes the latest methods for univariate and correlated multivariate categorical responses. Readers will find a unified generalized linear models approach that connects logistic regression and Poisson and negative binomial loglinear models for discrete data with normal regression for continuous data. This edition also features: An emphasis on logistic and probit regression methods for binary, ordinal, and nominal responses for independent observations and for clustered data with marginal models and random effects models Two new chapters on alternative methods for binary response data, including smoothing and regularization methods, classification methods such as linear discriminant analysis and classification trees, and cluster analysis New sections introducing the Bayesian approach for methods in that chapter More than 100 analyses of data sets and over 600 exercises Notes at the end of each chapter that provide references to recent research and topics not covered in the text, linked to a bibliography of more than 1,200 sources A supplementary website showing how to use R and SAS; for all examples in the text, with information also about SPSS and Stata and with exercise solutions *Categorical Data Analysis, Third Edition* is an invaluable tool for statisticians and methodologists, such as biostatisticians and researchers in the social and behavioral sciences, medicine and public health, marketing, education, finance, biological and agricultural sciences, and industrial quality control. This SAGE Research Methods Dataset example introduces readers to interaction effects in multiple regression. Multiple regression techniques allow researchers to evaluate whether a continuous dependent variable is a linear function of two or more independent variables. This example demonstrates how to compute and interpret product-term interactions between two

categorical variables in Ordinary Least Squares (OLS) regression using a subset of data from the 2007--2008 British Crime Survey. Specifically, we test whether confidence in the police is related to the relative deprivation of one's neighbourhood and whether or not respondents have been a victim of crime. In this example, readers are introduced to the basic theory and assumptions underlying this technique, the type of question this technique can be used to answer, and how to produce and report results. The dataset file is accompanied by a Teaching Guide, a Student Guide, and a How-to Guide for R.

Categorical data arise often in many fields, including biometrics, economics, management, manufacturing, marketing, psychology, and sociology. This book provides an introduction to the analysis of such data. The coverage is broad, using the loglinear Poisson regression model and logistic binomial regression models as the primary engines for methodology. Topics covered include count regression models, such as Poisson, negative binomial, zero-inflated, and zero-truncated models; loglinear models for two-dimensional and multidimensional contingency tables, including for square tables and tables with ordered categories; and regression models for two-category (binary) and multiple-category target variables, such as logistic and proportional odds models. All methods are illustrated with analyses of real data examples, many from recent subject area journal articles. These analyses are highlighted in the text, and are more detailed than is typical, providing discussion of the context and background of the problem, model checking, and scientific implications. More than 200 exercises are provided, many also based on recent subject area literature. Data sets and computer code are available at a web site devoted to the text. Adopters of this book may request a solutions manual from: textbook@springer-ny.com. From the reviews: "Jeff Simonoff's book is at the top of the heap of categorical data analysis textbooks...The examples are superb. Student reactions in a class I taught from this text were uniformly positive, particularly because of the examples and exercises. Additional materials related to the book, particularly code for S-Plus, SAS, and R, useful for analysis of examples, can be found at the author's Web site at New York University. I liked this book for this reason, and recommend it to you for pedagogical purposes." (Stanley Wasserman, *The American Statistician*, August 2006, Vol. 60, No. 3) "The book has various noteworthy features. The examples used are from a variety of topics, including medicine, economics, sports, mining, weather, as well as social aspects like needle-exchange programs. The examples motivate the theory and also illustrate nuances of data analytical procedures. The book also incorporates several newer methods for analyzing categorical data, including zero-inflated Poisson models, robust analysis of binomial and poisson models, sandwich estimators, multinomial smoothing, ordinal agreement tables...this is definitely a good reference book for any researcher working with categorical data." *Technometrics*, May 2004 "This guide provides a practical approach to the appropriate analysis of categorical data and would be a suitable purchase for individuals with varying levels of statistical understanding." *Paediatric and Perinatal Epidemiology*, 2004, 18 "This book gives a fresh approach to the topic of categorical data analysis. The presentation of the statistical methods exploits the connection to regression modeling with a focus on practical features rather than formal theory...There is much to learn from this book. Aside from the ordinary materials such as association diagrams, Mantel-Haenszel estimators, or overdispersion, the reader will also find some less-often presented but interesting and stimulating topics...[T]his is an excellent book, giving an up-to-date introduction to the wide field of analyzing categorical data." *Biometrics*, September 2004 "...It is of great help to data analysts, practitioners and researchers who deal with categorical data and need to get a necessary insight into the methods of analysis as well as practical guidelines for solving problems." *International Journal of General Systems*, August 2004 "The author has succeeded in writing a useful and readable textbook combining most of general theory and practice of count data." *Kwantitatieve Methoden* "The book especially stresses how to analyze and interpret data...In fact, the highly detailed multi-page descriptions of analysis and interpretation make the book stand out." *Mathematical Geology*, February 2005 "Overall, this is a competent and detailed text that I would recommend to anyone dealing with the analysis of categorical data." *Journal of the Royal Statistical Society* "This important work allows for clear analogies between the well-known linear models for Gaussian data and categorical data problems. ... Jeffrey Simonoff's *Analyzing Categorical Data* provides an introduction to many of the important ideas and methods for understanding counted data and tables of counts. ... Some readers will find Simonoff's style very much to their liking due to reliance on extended real data examples to illuminate ideas. ... I think the extensive examples will appeal to most students." (Sanford Weisberg, *SIAM Review*, Vol. 47 (4), 2005) "It is clear that the focus of Simonoff's book is different from other books on categorical data analysis. ... As an introductory textbook, the book is comprehensive enough since all basic topics in categorical data analysis are discussed. ... I think Simonoff's book is a valuable addition to the literature because it discusses important models for counts" (Jeroen K. Vermunt, *Statistics in Medicine*, Vol. 24, 2005) "The author based this book on his notes for a class with a very diverse pool of students. The material is presented in such a way that a very heterogeneous group of students could grasp it. All methods are illustrated with analyses of real data examples. The author provides a detailed discussion of the context and background of the problem. ... The book is very interesting and can be warmly recommended to people working with categorical data." (*EMS - European Mathematical Society Newsletter*, December, 2004) "Categorical data arise often in many fields This book provides an introduction to the analysis of such data. ... All methods are illustrated with analyses of real data examples, many from recent subject-area journal articles. These analyses are highlighted in the text and are more detailed than is typical More than 200 exercises are provided, including many based on recent subject-area literature. Data sets and computer code are available at a Web site devoted to this text." (T. Postelnicu, *Zentralblatt MATH*, Vol. 1028, 2003) "This book grew out of notes prepared by the author for classes in categorical data analysis. The presentation is fresh and compelling to read. Regression ideas are used to motivate the modelling presented. The book focuses on applying methods to real problems; many of these will be novel to readers of statistics texts All chapters end with a section providing references to books or articles for the inquiring reader." (C.M. O'Brien, *Short Book Reviews*, Vol. 23 (3), 2003) This comprehensive but low-cost textbook is intended for use in an undergraduate level regression course, as well as for use by practitioners. The authors have included some statistical details throughout the book but focus on interpreting results for real applications of regression analysis. Chapters are devoted to data collection and cleaning; data visualization; model fitting and inference; model prediction and inference; model diagnostics; remedial measures; model selection techniques; model validation; and a case study demonstrating the techniques outlined throughout the book. The examples throughout each chapter are illustrated using the software packages R and JMP. At the end of each chapter, there is a tutorial section demonstrating the use of both R and JMP. The R tutorial contains source code and the JMP tutorial contains a step by step guide. Each chapter also includes exercises for further study and learning.

This book deals with the analysis of categorical data. Statistical models, especially log-linear models for contingency

tables and logistic regression, are described and applied to real life data. Special emphasis is given to the use of graphical methods. The book is intended as a text for both undergraduate and graduate courses for statisticians, applied statisticians, social scientists, economists and epidemiologists. Many examples and exercises with solutions should help the reader to understand the material.

Featuring a practical approach with numerous examples, this book focuses on helping the reader develop a conceptual, rather than technical, understanding of categorical methods, making it a much more accessible text than others on the market. The authors cover common categorical analyses and emphasize specific research questions that can be addressed by each analytic procedure so that readers are able to address the research questions they wish to answer. To achieve this goal, the authors: Review the theoretical implications and assumptions underlying each of the procedures Present each concept in general terms and illustrate each with a practical example Demonstrate the analyses using SPSS and SAS and show the interpretation of the results provided by these programs. A "Look Ahead" section at the beginning of each chapter provides an overview of the material covered so that the reader knows what to expect. This is followed by one or more research questions that can be addressed using the procedure(s) covered in the chapter. A theoretical presentation of the material is provided and illustrated using realistic examples from the behavioral and social sciences. To further enhance accessibility, the new procedures introduced in the book are explicitly related to analytic procedures covered in earlier statistics courses, such as ANOVA and linear regression. Throughout each chapter the authors use practical examples to demonstrate how to obtain and interpret statistical output in both SPSS and SAS. Their emphasis on the relationship between the initial research question, the use of the software to carry out the analysis, and the interpretation of the output as it relates to the initial research question, allows readers to easily apply the material to their own research. The data sets for executing chapter examples using SAS Version 9.1.3 and/or IBM SPSS Version 18 are available on a book specific web site. These data sets and syntax allow readers to quickly run the programs and obtain the appropriate output. The book also includes both conceptual and analytic end-of-chapter exercises to assist instructors and students in evaluating the understanding of the material covered in each chapter. This book covers the most commonly used categorical data analysis procedures. It is written for those without an extensive mathematical background, and is ideal for graduate courses in categorical data analysis or cross-classified data analysis taught in departments of psychology, human development & family studies, sociology, education, and business. Researchers in these disciplines interested in applying these procedures to their own research will appreciate this book's accessible approach.

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The use of Bayesian methods for the analysis of data has grown substantially in areas as diverse as applied statistics, psychology, economics and medical science. Bayesian Methods for Categorical Data sets out to demystify modern Bayesian methods, making them accessible to students and researchers alike. Emphasizing the use of statistical computing and applied data analysis, this book provides a comprehensive introduction to Bayesian methods of categorical outcomes. * Reviews recent Bayesian methodology for categorical outcomes (binary, count and multinomial data). * Considers missing data models techniques and non-standard models (ZIP and negative binomial). * Evaluates time series and spatio-temporal models for discrete data. * Features discussion of univariate and multivariate techniques. * Provides a set of downloadable worked examples with documented WinBUGS code, available from an ftp site. The author's previous 2 bestselling titles provided a comprehensive introduction to the theory and application of Bayesian models. Bayesian Models for Categorical Data continues to build upon this foundation by developing their application to categorical, or discrete data - one of the most common types of data available. The author's clear and logical approach makes the book accessible to a wide range of students and practitioners, including those dealing with categorical data in medicine, sociology, psychology and epidemiology.

A valuable new edition of a standard reference The use of statistical methods for categorical data has increased dramatically, particularly for applications in the biomedical and social sciences. An Introduction to Categorical Data Analysis, Third Edition summarizes these methods and shows readers how to use them using software. Readers will find a unified generalized linear models approach that connects logistic regression and loglinear models for discrete data with

normal regression for continuous data. Adding to the value in the new edition is: • Illustrations of the use of R software to perform all the analyses in the book • A new chapter on alternative methods for categorical data, including smoothing and regularization methods (such as the lasso), classification methods such as linear discriminant analysis and classification trees, and cluster analysis • New sections in many chapters introducing the Bayesian approach for the methods of that chapter • More than 70 analyses of data sets to illustrate application of the methods, and about 200 exercises, many containing other data sets • An appendix showing how to use SAS, Stata, and SPSS, and an appendix with short solutions to most odd-numbered exercises Written in an applied, nontechnical style, this book illustrates the methods using a wide variety of real data, including medical clinical trials, environmental questions, drug use by teenagers, horseshoe crab mating, basketball shooting, correlates of happiness, and much more. An Introduction to Categorical Data Analysis, Third Edition is an invaluable tool for statisticians and biostatisticians as well as methodologists in the social and behavioral sciences, medicine and public health, marketing, education, and the biological and agricultural sciences.

This book provides a comprehensive introduction to methods and models for categorical data analysis and their applications in social science research. Companion website also available, at <https://webpace.utexas.edu/dpowers/www/>

These four volumes provide a collection of key publications on categorical data analysis, carefully put together so that the reader can easily navigate, understand and put in context the major concepts and methods of analysing categorical data. The major work opens with a series of papers that address general issues in CDA, and progresses with publications which follow a logical movement from the statistics for analysing a single categorical variable, to those for studying the relationships between two and more categorical variables, and to categorical variables in some of more advanced methods, such as latent class analysis. Edited and introduced by a leading voice in the field, this collection helpfully includes both theoretical and applied items on its theme, in order to help the reader understand the methods and use them in empirical research. Volume 1: Basic Concepts and Principles Volume 2: Statistical Methods for Analysing Associations Volume 3: Log-Linear and Logistic Regression Models Volume 4: Advanced and Graphical Statistical Methods

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Regression Models for Categorical Dependent Variables Using Stata, Third Edition shows how to use Stata to fit and interpret regression models for categorical data. The third edition is a complete rewrite of the book. Factor variables and the margins command changed how the effects of variables can be estimated and interpreted. In addition, the authors' views on interpretation have evolved. The changes to Stata and to the authors' views inspired the authors to completely rewrite their popular SPost commands to take advantage of the power of the margins command and the flexibility of factor-variable notation. The new edition will interest readers of a previous edition as well as new readers. Even though about 150 pages of appendixes were removed, the third edition is about 60 pages longer than the second. Although regression models for categorical dependent variables are common, few texts explain how to interpret such models; this text fills the void. With the book, Long and Freese provide a suite of commands for model interpretation, hypothesis testing, and model diagnostics. The new commands that accompany the third edition make it easy to include powers or interactions of covariates in regression models and work seamlessly with models estimated with complex survey data. The authors' new commands greatly simplify the use of margins, in the same way that the marginsplot command harnesses the power of margins for plotting predictions. The authors discuss how to use margins and their new mchange, mtable, and mgen commands to compute tables and to plot predictions. They also discuss how to use these commands to estimate marginal effects, averaged either over the sample or at fixed values of the regressors. The authors introduce and advocate a variety of new methods that use predictions to interpret the effect of variables in regression models. The third edition begins with an excellent introduction to Stata and follows with general treatments of the estimation, testing, fit, and interpretation of this class of models. New to the third edition is an entire chapter about how to interpret regression models using predictions—a chapter that is expanded upon in later chapters that focus on models for binary, ordinal, nominal, and count outcomes. Long and Freese use many concrete examples in their third edition. All the examples, datasets, and author-written commands are available on the authors' website, so readers can easily replicate the examples with Stata. This book is ideal for students or applied researchers who want to learn how to fit and interpret models for categorical data.

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