Book Reviews

Jacques A. Hagenaars and Allan L. McCutcheon (eds). *Applied Latent Class Analysis*. New York: Cambridge University Press, 2002. ISBN 978-0-521-10405-0. 454 pp, $58.00.

If one has data on individuals, it may be that there are unobserved (and unobservable) categorical variables that "explain" the data. This situation is modeled by a *latent class model* (LCM) and analyzed with *latent class analysis* (LCA). LCA is used principally in the social and behavioral sciences where it provides a richer explanation of a phenomenon than can be obtained from direct summarization of the data. The corresponding technique when the unobserved variables are modeled as continuous is the better known *factor analysis*.

The book under review is a collection of fifteen "essays" (constituting the chapters) by eminent LCA authorities. It is a 2009 paperback re-issue of the original book. The first two chapters are introductory. The chapters after that introduce an innovation to the basic latent class model and show how it is useful in one or more areas of application. The editors have done a good job of keeping the notation consistent as one goes from chapter to chapter, always a concern in books with chapters written by different authors. (Appendix A provides further help).

The first introductory chapter, by the distinguished pioneer Leo A. Goodman, is a wonderful explanation of the intuitive ideas behind LCA. This chapter is well worth reading and rereading.

The second introductory chapter (Chapter 2) by Allan L. McCutcheon is valuable in its own right and important preparation for later chapters. It discusses the parameterizations of the basic LCM (probabilistic and loglinear), model estimation, model evaluation, restricted LCM (putting restrictions on the LCM parameters), and multi-sample LCM.

The next five chapters form a part on classification and measurement. Chapter 3, by Jeroen K. Vermunt and Jay Magidson, is on latent class cluster analysis. It includes two real-data worked examples, one using diabetes data and the other one using prostate cancer

data. The next chapter discusses examples of latent budget analysis and extensions. The first example the authors, Peter G. M. van der Heijden, L. Andries van der Ark, and Ab Mooijaart, take up is a fascinating analysis of the order in which the 45 books of Plato were written. The next example is a 1998 analysis of the trades entered into by the ethnic groups within the Netherlands in two major Dutch cities: Amsterdam and Rotterdam. The final example studies the transition of students in the Netherlands from primary to secondary school in the context of the social milieu. Chapter 5 by Marcel Croon treats the ordering of the latent classes. Ordering is important in certain applications. The author discusses both the history of this topic and modern methods. Several illustrative applications from the European Values 90 study of the European Value Systems Study Group are given. Chapter 6 by Ulf Böckenholt is on discrete choice models; that is, models in which each of many individuals must make a choice among a set of items. Party preference in Germany is one example used. Chapter 7 by Anton K. Formann and Thomas Kohlmann treats three-parameter linear logistic LCA. This topic may seem highly technical but it turns out to be just the right extension of LCA to handle the Rasch model and similar models widely used in education assessment and other fields.

The next part of the book is four chapters on causal analysis and dynamic models. Chapter 8 by C. Mitchell Dayton and George B. Macready is on covariates in LCA, both continuous and categorical. Analogous to the analysis of variance, covariates may be either blocking variables or continuous covariates. With blocking variables, an example is given using a data set comprising four items on role conflict. The Second International Mathematics Study provides an example with continuous covariates. Chapter 9 by Jacques A. Hagenaars (one of the editors) treats directed loglinear models with latent variables. This topic encompasses certain causal models. The example data are the United States data from the Political Action Study. These data are analyzed in great detail and numerous models are compared and contrasted. Chapters 10 and 11 both deal with longitudinal data but use different frameworks. Chapter 10, by Linda M. Collins and Brian P. Flaherty, employs a method called latent transition analysis. The authors apply the method to a sample of middle school students with data on substance use (tobacco, alcohol, marijuana) over time. Chapter 11, by Rolf Langeheine and Frank van de Pol, uses Markov chains. The authors apply the method to general life satisfaction over time from the German Socio-Economic Panel.

The last part of the book is on unobserved heterogeneity and nonresponse. Because of the methodological implications, this part may be of particular interest to *Journal of Official Statistics* readers. In Chapter 12, author Tamás Rudas discusses the measurement of the fit of a statistical model based on a latent class approach. A measure called the mixture index of fit is developed and advantages over traditional chi-squared goodness of fit tests are discussed. Mixture regression models is the topic of Chapter 13 by Michel Wedel and Wayne S. DeSarbo. In mixture models, the data come from two or more classes, each class having its own specific probability distribution. The class of any particular data point is unknown, as is the proportion of the sample in any class. The mixture regression model problem is to both classify the data into classes and to, at the same time, fit a regression model within each class. The authors apply their methods to a trade show performance study. Managers in classes 1 and 2 evaluate the trade show on nonselling factors and selling factors respectively. In another example, consumers'

preferences for banking services were studied. The data are best modeled by dividing the consumers into four classes. Chapter 14, by Jeroen K. Vermunt, concerns unobserved heterogeneity in event history data. A common reason for such heterogeneity is the inability to include a pertinent explanatory variable in the analysis. A general random-effects approach is developed and illustrated on two examples: First inter-firm job change based on the 1975 Social Stratification and Mobility Survey in Japan and Dutch adolescents' first experience with relationships based on a small-scale two-wave panel survey. The last chapter, Chapter 15, treats LCMs for contingency tables with missing data. Authors Christopher Winship, Robert D. Mare, and John Robert Warren base their approach on two ideas: "(1) Latent class models can be adapted to contingency tables with missing data by defining variables that are latent (missing) for some cases and are manifest (observed) for others; and (2) latent class models can be viewed as loglinear models for tables in which some cells are unobserved or partially observed." Two examples are analyzed in detail. One is on prenatal care and infant mortality; the other concerns intergenerational educational mobility based on data from the 1994 General Social Survey and the Survey of American Families.

One topic *not* covered in the book is the adaptation of LCMs to complex sample survey data. See Patterson et al. (2002) for a very helpful discussion.

The book under review is not organized as a textbook so the very recent book of Collins and Lanza (2010) would likely be a better choice for that purpose. The latter book also has more recent information on software.

By the time this review appears the new book by Biemer (2011) that applies LCA to survey error will be out. I am sure Biemer's book will be of great interest to many *Journal of Official Statistics* readers.

I highly recommend the book under review to anyone who may need to work with LCMs, or who would like to find out if they could help with a particular research question. The key strength of the book is the level of expertise that the chapter authors bring to their subjects. One should certainly read the first two chapters. After that, the chapters are rather independent so one can pick and choose.

References

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Steven G. Heeringa, Brady T. West, and Patricia A. Berglund. *Applied Survey Data Analysis*. Boca Raton, FL CRC Press, 2010. ISBN 978-1-4200-8066-7. 414 pp, $79.95.

Many survey data analysts have a good general understanding of the theory and application of statistical analysis to basic behavioral science data. However, many analysts do not receive specialized training in the specific aspects of complex survey design and its implications for the statistical analysis of survey data. *Applied Survey Data Analysis* is a great remedy to fill this gap. This text is the result of teaching and analysis experience gained at the Joint Program in Survey Methodology at University of Maryland, and the University of Michigan's Program in Survey Methodology and Summer Institute in Survey Research Techniques, all programs with a fantastic reputation and history of quality survey data production and analysis.

This text is aimed at neither the beginner nor the advanced data analyst. A basic background in probability, survey methodology, and statistical modeling and inference is necessary because the authors often skip over theoretical explanations of more basic concepts. On the other end of the spectrum the book also covers many more complicated subjects quickly and does not go into the level of depth that one might hope for. This book is aimed more at the reader interested in practical analytical advice and guidance. Understandably, this is a fine line to walk and the authors do an admirable job of striking a balance between statistical theory and practical advice and analysis.

The authors provide excellent coverage of each aspect of the survey analysis process: from understanding the sample design, design variables, underlying constructs, and missing data, to analyzing the data, to interpreting and evaluating the results, and lastly reporting estimates and inferences from the survey data. Of course, as analysts they concentrate on statistical estimation and interpretation, but they are aware of the importance of the earlier stages of survey design and larger research considerations to the eventual quality of the data analysis and treat these topics accordingly. This book is an excellent general resource and if the reader is left wanting on a topic the authors never fail to provide an ample set of citations and references to a wide variety of notable texts on the topic in question.

Chapter 1 provides an overview of the approach of the authors and a general introduction to the history of the analysis of complex survey data. Chapter 2 is an introduction to complex survey sample design, which provides the reader with many of the basics regarding probability sampling and covers important topics of survey sample design and analysis such as clustering, stratification, weighting, and nonresponse.

Chapter 3 presents an introduction to estimation and inference with complex sample designs. This chapter follows the general pattern of most of the book, first presenting the general theory and application of statistical estimation and inference, and secondly demonstrating how these generalities must be adjusted to take into account the special nature of survey designs (e.g., clustering, stratification, weighting).

Chapter 4 covers recommendations for preparing both the survey data and the researcher for statistical analysis. This chapter focuses mainly on practical considerations for survey analysts and provides a helpful "final checklist" that every analyst should go through before proceeding on to the analysis stage. These types of tips are a welcome sight given how many analysts, especially experienced ones, ignore very basic data preparation procedures

(e.g., identifying the correct selection and post-stratification weights in a dataset created by a third party).

Chapter 5 provides an overview of common descriptive analyses for continuous variables and Chapter 6 does the same for categorical variables. Although these sections are straightforward and simple for seasoned data analysts, they are a very important part of the general product survey analysts provide for clients and more general media reports. Simple descriptive analyses and graphical expositions are underappreciated and give the analyst an important initial grounding in the nature of the data and allow for an effective presentation of the data to general audiences.

Chapter 7 gives a general introduction to linear regression models and the specific adjustments that must be made by survey analysts to account for the special nature of complex survey data. Chapter 8 provides an especially important discussion of logistic regression and the binary dependent variables and dichotomous response options that are so often the subject of statistical analysis of survey questions. Survey data rarely provides the opportunity to analyze a true continuous dependent variable. It would have been helpful had the authors explored the topic in greater depth given the importance and prevalence of binary (or at least noncontinuous) dependent variables in survey data. Chapter 9 is an extension of the basic models presented in Chapters 7 and 8, covering general linear models for multinomial, ordinal, and count variables. Chapter 10 covers survival analysis of event history survey data, which is a very important data format and analysis tool for the health sciences.

Chapter 11 deals with the problem of item-missing data in surveys, the problems it poses for analysis, and methods of imputation for dealing with missing data at this level. The authors provide a helpful introduction to the most common methods of imputing missing data and offer many practical tips regarding the necessity of imputation in the first place and the pros and cons of various imputation methods.

The final chapter (Chapter 12) provides a very quick overview of more advanced topics in survey data analysis, including Bayesian analysis, structural equation models such as factor analysis, general linear mixed models (e.g., hierarchical), and small area estimation. This chapter is one of the few areas of the book I found lacking. Bayesian analysis of survey data is one of the leading cutting-edge fields in data analysis, which requires more attention. Similarly, structural equation modeling is very popular in survey data analysis and only receives a cursory introduction here. Exploratory and confirmatory factor analysis are two of the most popular statistical tools for constructing models of attitudinal relationships, belief systems, and possible "psychological maps" of these beliefs and attitudes.

The text also provides a helpful appendix on the major statistical software packages. Throughout the book, the authors work through examples with Stata commands and analysis outputs. Stata is certainly one of the most popular and effective software packages for analyzing survey data and therefore is a good choice in this regard. The open software platform provided by Stata encourages the development of innovative programming to deal with the intricacies of data analysis and the realm of survey analysis is well represented. If you are more familiar with another software package such as SPSS, SAS, or SUDAAN, the Appendix offers a useful description of the specific survey analysis options available for each package and the advantages and disadvantages of each.

Other important current topics in survey design and analysis not addressed by this text are Internet samples and the "cell-phone-only" population. The challenges of including cell-phone-only citizens in surveys and research on the possible effects of under-representation of this subpopulation in our samples are a topic of intense debate and research. It would have also been helpful to enter into a greater discussion of unit nonresponse and the effects of nonresponse on bias and analysis.

Overall, Heeringa, West, and Berglund provide a very useful intermediate text for practicing survey data analysts and students with a general knowledge of social science statistics. The strengths of the book – warnings about common missteps, practical tips, step-by-step worked examples and exercises, and direction with regard to the appropriate steps in the analysis process – arise from the authors' considerable experience as practicing analysts, researchers, and teachers. This text would make an excellent and helpful addition to the desk of any analyst, researcher, or student with a general background in statistics who is dealing with the special challenges and demands of complex survey data.

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Dr. Enders has written a masterpiece of missing data literature for the veteran researcher looking to boost her skills or the novice data analyst who has just received her first incomplete data set. His background in educational psychology fueling the book ignites the reader's mind and illuminates "state of the art" methods in a familiar glow. Consistent with its title, this text is APPLIED. It develops rationale, describes methods, reveals strengths and weaknesses of each method, and then guides the reader in selecting and implementing appropriate methods. Examples contained within each chapter provide a seamless demonstration of the purpose and utility of methods described across the chapters.

The first chapter lays out an overview of mechanisms of missing data, tests for the mechanisms of missing data and problems arising from each of them when ignoring the missing values and doing analysis with only the complete cases. Identifying whether the data are Missing Completely At Random (MCAR), Missing At Random (MAR), or Missing Not At Random (MNAR) plays a critical role in the decision to use one method versus another. Most of the book is dedicated to methods that are appropriate for MCAR data or MAR data, which means that values are haphazardly missing (MCAR) or that the missing values can be explained by other variables in the data set (MAR). The second chapter is a survey of traditional handling methods and their potential for bias and other

shortcomings. Chapter 3 and 4 begin the journey through the modern methods by covering Maximum Likelihood Estimation (MLE). The author does an excellent job developing the statistical concepts of MLE and then adapting them for cases where data are not complete.

Travel through the contemporary period continues in Chapters 7, 8, and 9 with Multiple Imputation (MI) after a short primer on Bayesian statistics in Chapter 6. The three over-arching stages of the MI methodology (Imputation-Analysis-Pooling) are outlined over the course of two chapters. Chapter 7 describes the Imputation Stage of the methodology through the use of Data Augmentation. The iterative two-step process of Data Augmentation (Imputation, Posterior) used to create several fully imputed data sets is outlined in moderate detail. Diagnostics for the Imputation Stage are described and illustrated here as well. The next chapter, Chapter 8, describes the Analysis Stage and Pooling Stage for the multiple data sets created in the Imputation Stage. Here, Dr. Enders necessarily uses a more mathematically rigorous approach (although not extensively) than in all of the other chapters in the book. Finally, Chapter 9 provides guidance in handling issues arising from the use of MI such as convergence problems and binary data, and a brief note on alternative methods to Data Augmentation to create imputed values in the Imputation Stage.

Handling data that are MNAR requires special attention beyond the previously described modern methods that are appropriate for MCAR and MAR data. With data that are MNAR, the mechanism for missingness is not completely random, and it cannot be explained by other variables within the dataset being analyzed. Chapter 10 discusses options to improve analysis with MNAR data including a Selection Model or Pattern Mixture Model. Both of these methods incorporate additional information external to the data being used. For the analyst, this requires knowledge about the predictors of missingness which are external to the model that she would like to estimate.

The remainder of the book, Chapter 11, lists software options and advice for implementing the modern missing data methods developed in previous chapters. Capabilities of common software such as SAS, SPSS, Mplus, LISREL, NORM, AMOS, and EQS are described.

Overall, I recommend Dr. Ender's *Applied Missing Data Analysis* as a foundation for researchers designing experiments or surveys and analyzing not only these data but also any dataset of interest. The readability and utility of the book make it an option for almost any audience, but particular attention to analyses done in the social sciences establishes this text as a great introduction to missing data analysis for data users in this discipline.

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David L. Streiner and Souraya Sidani (eds). *When Research Goes Off the Rails: Why It Happens and What You Can Do About It*. New York: The Guilford Press, 2010. ISBN 978-1-60623-410-5. 398 pp, $35.

As I read this book, I was reminded frequently of the times when my projects have not gone quite as anticipated, for one reason or another. Perhaps, if I had read this book several years ago, I would have known what to look for when I was planning my various research activities, and how to prepare for the inevitable bumps in the road to completion. The whole point of the book is to demonstrate that research is not always "clean," easy, or even successful. Research can be a messy business, and sometimes the train runs off the track that has been laid for it.

The editors have recruited many authors to write more than forty chapters addressing the pitfalls they have encountered in the various stages of research. Part I focuses on getting the approval from institutional review boards and other similar entities. Part II highlights problems encountered with gaining access to the participants. It transitions nicely into Part III, where the authors turn their attention to issues regarding the recruitment and retention of research participants. Parts IV and V discuss various aspects of study implementation and data collection. Part VI then talks about data analysis. Part VII contains chapters that describe issues regarding collaboration (with research sponsors, gatekeepers, participants, and others); there is some degree of overlap with earlier chapters, though it ties the material together nicely. The last part (Part VIII) of the book provides some final thoughts, shared by the editors and others.

All of the chapters share a similar structure. First, the authors provide some background to the research question they were addressing or the context of the study environment in which they were working. Next, the authors discuss the challenges they encountered during the research process (examples: an overwhelming amount of qualitative data, time or resource constraints, lack of adequate communication regarding research objectives, technological difficulties), and how they overcame them. The authors then discuss what lessons they learned, and how they might be applicable to the reader. Finally, they provide a couple of references where the reader might learn more, along with a sentence or two explaining why those particular works are recommended. Each chapter is fairly short, providing enough information to adequately explain the issues at hand and hold the reader's interest without overwhelming him or her with minutiae.

The general tone throughout the book is engaging, approachable, and conversational. The authors are remarkable in their vulnerability. They have candid discussions about what went as planned and what did not. I read the book over the course of several weeks, in fits and spurts. Because each chapter is written by a different author or authors, the amount of carryover from one to the next is minimal, making it easy to pick up again after a break. One of the most helpful parts of the book is "A Guide to the Contents of Each Chapter," presented in table form immediately following the table of contents. Here, the editors have categorized each chapter by setting (e.g., university, industry, and community), method, ethics issues, treatment, and other issues. It indicates, for example, that there are a total of twenty chapters that address some aspect of participant recruitment, though only nine are located within Part III. I believe this table will prove particularly useful to readers who are interested in focusing on certain topics.

As a methodologist who works on surveys of businesses, governments, and organizations, most of the book was not directly applicable, since a substantial portion of the authors are American and Canadian university researchers in the fields of psychology, sociology, epidemiology, and health sciences. Even so, I enjoyed reading about the trials and tribulations researchers have encountered elsewhere and was delighted and surprised when I found that we had similar experiences. For instance, in Chapter 28, Brian D. Carpenter and Steve Balsis discuss elements of observing intergenerational interactions among family members in a home environment. Their discussion about clarifying instructions for entering an apartment building, confirming who the participants will be, balancing the schedules of the participants and the researchers, obtaining participants' consent, and recording the interaction is similar to what I encounter when I conduct cognitive interviews, usability tests, or respondent debriefings with people who represent businesses and governments.

Of the forty-two chapters in this book, two stand out in my mind, for different reasons. Chapter 9, for instance, compares the environment of Statistics Canada's research data centers (RDCs) to the Soviet gulag archipelago. The authors of this entry articulate the inherent difficulties in working within the constraints of the RDC environment, and its effect on their projects: "Although we have not been involved in any true catastrophes, akin to running off the rails into the side of a mountain and detonating, there have been projects that have simply run late, broken down, stopped at every village along the line for no good reason, or hit bumps that have caused us to spill coffee on ourselves and swear loudly in front of a carriage full of elderly nuns" (pp. 89–90). This single comment encapsulates much of the nature of the material found in the book: many authors describe research projects that had late starts, shifting or conflicting priorities, evolving research questions and/or methods, and encounters with difficult or misunderstood participants, gatekeepers, community leaders, and research partners. All of these factors created environments that did not meet the authors' expectations, but in the end, most of the research was completed in a way that was amenable to most parties. The authors of Chapter 9 were not the only ones to play with the analogy selected by the editors, and suggested by the book's title. Clearly, Streiner and Sidani chose an image that resonated with the authors.

Later, in "Where Did All the Bodies Go?" (Chapter 31), Harry S. Shannon talks about his difficulties in building a historical panel of company employees as a means of comparing that group's death rate to the rate of the general population. The initial data analysis yielded figures that did not make sense. Upon consulting with company managers and union leadership, he realizes that his data set is missing a substantial portion of employee records. Shannon and his colleagues put on their old clothes and enter the company's dusty record vaults, searching for the historical records needed to complete the cohort needed for the research. Shannon's description of events echoed Season 4 of one of my favorite television shows – HBO's critically acclaimed series, "The Wire." In that season, a detective observed that a drug lord had succeeded in taking over a significant portion of the city turf, without the increase in violence and corpses typically associated with such an event. Eventually, by searching parks, playgrounds, and sewers, and by putting together information gleaned from criminals and citizens, the detectives discover that the bodies they are looking for are to be found in the city's vacant houses. In each case,

the researcher/detective recognized that the data did not add up, and engaged in a systematic process to identify the missing pieces.

This book falls short in a couple of ways, although I think this may be more of a reflection on my expertise, which differs from that of the authors. More specifically, as a survey methodologist, I was surprised at the authors' apparent lack of knowledge about what I consider to be basic survey methods literature. This literature would have proven useful in their research endeavors, especially with regard to questionnaire design and data collection. Perhaps this lack of knowledge is because survey methodology is a fairly new field, and its findings and relevance have not yet worked their way back to the interdisciplinary fields that represent its origins. It also seems that some basic project management, planning, and risk analysis techniques could have identified the source of some of the difficulties the researchers encountered, or at least have provided an indication of the effect on research schedules resulting from a train derailment or cattle on the track. Perhaps graduate degree programs need to add project management courses to their curricula. Regardless of whether students are pursuing careers in "pure" or "applied" research, learning how to manage a project, identify its dependencies and critical path, and mitigate schedule delays or reductions in funding will no doubt prove to be marketable skills.

Overall, I enjoyed reading this book and think it will be helpful for survey researchers in a number of areas. The explicit and implicit messages about project planning, scalable approaches to research and analysis (e.g., Chapter 41), the amount and type of information to include when writing a methods section (Chapter 43), and various ways of obtaining buy-in from gatekeepers, stakeholders, sponsors, and other interested parties have the potential to be incredibly useful for readers. It will also be helpful to students who are pursuing their own research for theses or dissertations. Streiner and Sidani were successful in turning a potentially dry subject – the study of research – into a book that is both entertaining and enlightening. If nothing else, the openness of the authors in sharing their experiences should encourage others to do the same, so we can all learn from each other. I would encourage conference committees to build sessions into their programs where researchers can share what they wish they had known before getting their project underway, or what nearly caused their project to derail. Such openness requires a willingness to display some vulnerability, but could result in a greater appreciation for projects that run smoothly and an increase in awareness of factors that influence success.

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[1] This review is released to inform parties of research and to encourage discussion. The views expressed on statistical, methodological, technical, or operational issues are those of the author and not necessarily those of the U.S. Census Bureau.