BOOK REVIEW

Generalized Latent Variable Modeling. Multilevel, Longitudinal, and Structural Equation Models. Anders Skrondal and Sophia Rabe-Hesketh. Boca Raton, FL: Chapman & Hall/CRC, 2004, 508 pages (hardcover).

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Modeling has come a long way. Terms such as structural equation models, hierarchical linear models, latent class models, linear factor models, dynamical models, logit models, log-linear models, survival analysis, and many more are commonplace in the empirical sciences. The statistical methods labeled by these terms are at the brink of replacing classical statistical testing. Despite their general and increasing acceptance, these models have been developed both separately from each other and in different disciplines. Camps of freaks have emerged, often with little or no cross-fertilization but considerable unobserved heterogeneity.

In this situation, but even more so from the perspective of developing the field, the volume by Skrondal and Rabe-Hesketh is more than welcome. The volume was written with the goal to provide a unifying framework for the previously mentioned models and many other models, all seen from the perspective of the generalized linear model. Fittingly, this volume appeared in the *Interdisciplinary Statistics* series, published by Chapman & Hall.

To present my general conclusion upfront, the authors did reach the goals under which this volume was written. The authors demonstrate that it is possible to formulate an umbrella framework. Seemingly discrepant models such as structural equations models and log-linear models can be cast in the terms of such an overarching model. As a consequence, models can be specified that include different types of response data, including, for instance, dichotomous, continuous, and ordinal data in one model. This demonstrates how massive the progress is that has been made.

BOOK OVERVIEW

The book includes three parts (in the list of contents, only two parts are specified; when reading the book, three parts become obvious). The first part sets the tone, specifies notation, and provides the substantive and statistical backgrounds needed for understanding the second and third parts. This first part includes chapters 1 to

3. These chapters discuss latent variable concepts and generalized linear models and their extensions and give examples of latent variable models. These chapters are encyclopedic in nature. Concepts are introduced matter of factly rather than derived or explained for the unsuspecting reader.

The second part of the book begins with chapter 4. Here is where the text becomes more interesting, and the unifying framework is developed, with reference mostly to the work of the two authors of this book. The general framework is based on the specification of hierarchical conditional relations. There is a response model, which is a more flexible and more general version of what is otherwise known as the measurement model and the structural model. One of the most important contributions made here is that formulations are general enough to allow simultaneous analysis of variables of various types, both at the factor and the manifest variable levels. Some of the material covered in this chapter was covered already in earlier yet recent publications of the authors. Other aspects, for instance the incorporation of multilevel latent class models, are new in this context.

The following chapters cover identification and equivalence (chap. 5), estimation (chap. 6), assigning values to latent variables (chap. 7), and model specification and inference (chap. 8). Each of these chapters is worth reading. However, these chapters differ in level of exposition and depth. For example, chapter 5 is rather cursory (e.g., the important work by Raykov and Penev on model equivalence is mentioned only in passing). In contrast, chapter 6 is more detailed (with the exception of the section on Generalized Estimating Equations methods).

An interesting characteristic of this book is that not only material from a number of different fields and disciplines is covered but also bridges are built between camps in statistics. For example, Bayesian methods are discussed as interesting options instead of representatives of a parallel and incompatible universe.

The third part of this book presents sample applications. The six chapters in this part are grouped based on response types and data types. Dichotomous responses, ordinal responses, and counts are exemplified followed by durations and survival, comparative responses, and in the last chapter multiple processes and mixed responses. Many of the examples present applications that go beyond the material covered in the earlier chapters. This makes the third part both interesting and hard to read. Most interesting and, from my perspective, most important is the last chapter, in which the flexibility of the new umbrella framework is convincingly illustrated. Data are analyzed in which multiple processes and mixed responses, that is, response variables of different characteristics, are included.

THE AUDIENCE

One asks, who can benefit from this book? In the preface, the authors do not indicate the readership they are trying to reach with this text. Considering that materials are covered from such fields as statistics, biometrics, psychometrics, and econometrics,

one would assume that readers from all these fields are invited to read the book. The general notation used in the book is close to what is known as the LISREL notation. It is known to most researchers in all these and other fields and disciplines.

The level of exposition is not for the faint of heart. Solid background knowledge is needed to follow both the conceptual and, even more so, the technical presenta tion. The authors are aware of this and recommend repeatedly in the text that cer tain sections and chapters can be skipped at first reading. My recommendation would be to resist the temptation of not reading these chapters. They are somewhat hard to read. However, they present material in some depth that otherwise is spread over many articles in the technical literature.[1]

This book excels when it covers methods for the analysis of longitudinal data and when it comes to taking into account the clustered nature of data sets. In psychology, a new paradigm is emerging, the paradigm of person-oriented research (Bergman & Magnusson, 1997; Molenaar, 2004; von Eye & Bergman, 2003). This line of research explicitly assumes that functioning and development differs across individuals. The methods presented here can help person-oriented researchers make such differences explicit.

Thus, the number of readers who are able to benefit from this text is rather large. These must be readers with solid statistical background, from a large number of empirical disciplines. However, readers with particular research agendas can benefit also because this book provides plentiful material, putting researchers in a position to answer even very specific questions.

Therefore, I recommend this book to all methodologists, biometricians, and statisticians who are in contact with real data. This book is enlightening to read.

REFERENCES

Bergman, L. R., & Magnusson, D. (1997). A person-oriented approach in research on developmental psychopathology. *Development and Psychopathology, 9,* 291–319.

Cattell, R. B. (1949). The dimensions of culture patterns by factorization of national characters. *Journal of Abnormal and Social Psychology, 44,* 443–469.

Molenaar, P. C. M. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology—This time forever. *Measurement: Interdisciplinary Research and Perspectives, 2,* 201–218.

von Eye, A., & Bergman, L. R. (2003). Research strategies in developmental psychopathology: Dimensional identity and the person-oriented approach. *Development and Psychopathology, 15,* 553–580.

[1]However, I would recommend that the psychological readership either be thick-skinned or skip section 1.3. In this section, interesting illustrations of concepts of validity are presented. In addition, psychology as a science is criticized based on an article by R.B. Cattell from 1949 (!). This article is actually worth reading. In this article, Cattell attempts an application of his goal of introducing a new terminology in psychology. This was apparently a goal that is not easily understood by readers not trained in the science and history of psychology.