BOOK REVIEW


This book presents a novel approach to the teaching of structural equation modeling from one of the primary figures in the area. It is primarily addressed to quantitative methodologists and their graduate students but will be useful to the wider audience of individuals interested in more extended and contemporary presentations of structural equation modeling. Particular strengths of the book include: 1) an extended philosophical review of various notions of causality and how these are implicated in the specification, evaluation and interpretation of structural models; 2) a broad contextualization of inquiry in structural models, including such topics as graph theory; 3) systematic presentations of the basics of structural modeling in graphic, equation, and matrix form; and 4) an extended examination and review of model evaluation in structural equation models. Topic extensions of structural models, such as longitudinal, nonrecursive, or multilevel models, reference the primary literature in the area and refer the reader to extended discussions of contemporary developments. Taken together, the book is a systematic presentation of structural modeling which is a useful foundation for those interested in the philosophical and conceptual fundamentals of structural modeling.

Outline

The book begins with a presentation of the necessary preliminaries of linear and vector algebra and, in a welcome addition, also discusses basics of multivariate calculus useful in understanding aspects of the estimation and statistical significance of structural solutions.

The book then turns to an extended discussion of the philosophical underpinnings of structural equation modeling with specific focus on notions of causality, reviewing works from contemporary cognitive psychology, standard philosophy of science and more contemporary approaches to the description of causality. This latter section leads nicely to a discussion of graph theory as introduced by Spirtes, Glymour, and Scheines (1993), and Pearl (2000). Some of the fundamental conclusions from this work, such as the d-separation and faithfulness conditions associated with
graphs, are applied later on in the book. A presentation of the basics of structural equation estimation follows, outlining these forms first in equation form, then by path diagram, and finally in their matrix form. As such, these presentations survey the usual descriptions of structural equations in the research literature as well as software interfaces for structural modeling. An entire chapter is dedicated to identification conditions for structural models. Although this presentation is systematic and works through some examples, a brief discussion of models which are not empirically identified (due to particular characteristics of the data) would have been helpful as well. Methods using the information matrix of second order derivatives of the fit function are described, but the reader would probably benefit from an example analysis here as well, given that this approach is a common default in many structural equation modeling programs.

A technical presentation of the estimation and minimization procedures follows in the next chapter and the book does a good job of presenting these technical topics, particularly the minimization routines, with helpful figures and examples. It is at this point in the book that the differential calculus introduced in the introductory math section, receives the most application.

After this, the book embarks on chapters which take up individual topics within structural modeling. For example, in the confirmatory factor analysis chapter, after introducing the standard confirmatory model, a more extended discussion follows of faceted, multi-rater/multi-occasion, and multi-trait multi-method models. While some of this presentation is necessarily brief, given time constraints, the book points the interested reader to the more recent and extended presentations of these topics which have recently enjoyed renewed interest in the literature.

The book is particularly noteworthy for its inclusion of topics which do not often find their way into treatments of structural equations. One example is the chapter dedicated to the design of structural equation models, reviewing arguments surrounding the use of single indicators, the four-step procedure for testing parameter nested models proposed by Mulaik and Millsap (2000), tetrad-approaches to model identification and modification, as well as multigroup invariance. Although these topics often are individually mentioned in example analyses in other texts, their inclusion under the general topic of design makes it a particularly useful reference for those designing and/or doing a preliminary evaluation of candidate structural models.

As mentioned above, other chapters dedicated to particular topics present and highlight the primary literature on the topic in addition to example analyses. For example, chapters on model equivalency and longitudinal models highlight Stelzl’s (1986) equivalence rules and Meredith and Tisak’s (1990) presentation of growth curve models, respectively. The
chapter on nonrecursive models recalls Heise’s sometimes overlooked 1975 treatment of such models.

Use as a Textbook

Two comments come to mind when considering use of the text in the graduate classroom. First, the organization of the book, in which the mathematical fundamentals are presented systematically before moving to the more applied considerations of experimental design, estimation, and interpretation may prompt some instructors to employ a parallel approach to presentation of the material. The chapters on math could be presented in tandem with the chapters formally introducing the structural model, for example. Given that students are eager to understand the benefits of structural models such an opportunity to “see the algebra in action” might help motivate students. Similarly, the sections on philosophy of science and graph theory require digestion at a slower pace than the more applied material and I found myself rereading the philosophical survey after reading references made in later chapters.

Second, the book does not attempt an encyclopedic coverage (nor would this be appropriate for a first graduate course in the area). The following few topics might provide additional interesting reading, for example: In addition to the skeptical moments suggested in the chapter on longitudinal data, I would also direct readers to consider Molenaar’s (2003) rewriting of moving average models (such as growth curve models) as autoregressive models. In addition to the general discussions of group-level invariance, I would have also included a discussion how ergodic theory can inform the relationship between inter- and intra-individual level change (e.g., Molenaar 2008). Although the expression of multilevel models as structural models is brief and elegant, a survey of recent developments in this area (as was done in the multi-trait multi-method chapter) would give the reader an appreciation for the applicability of this area to applied research questions. Generalized models would further contextualize how these novel approaches also may be viewed as related structural models via link functions. Additional readings on the topics of missing data, power analyses, behavior genetic models, and latent variable interactions could also be helpful additions.

Summary

In conclusion, students of this text will receive a formal introduction to structural equation modeling with its implied philosophical underpinnings in the larger literature on causality. The decision to include both common subspecies of structural models such as instrumental variables as
well as more generally related literatures such as graph theory provide the reader with a springboard to “next steps” in the study of this exciting field. The text should be on the shelf of everyone with a serious interest in structural modeling.

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References