Book Review : Best Methods for the Analysis of Change Edited by Linda M. Collins and John L. Horn Washington DC: American Psychological Association, 1991, 355 pp., approx. $40

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BOOK REVIEW

Best Methods for the Analysis of Change

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This book consists of the papers presented at an October 1989 conference at the University of Southern California (USC). In the preface, the editors state that the conference, and the book, were inspired by a similar, very influential, conference in Madison in 1962, which resulted in the book *Problems in measuring change* (Harris, 1963). In the preface, the editors state that the two conferences and books should not be compared: "We did not ask for that comparison when we designed our conference, nor do we welcome it now" (p. xvi). I did not have a detailed comparison in mind, but because both conferences were concerned with change, some global comparisons are almost inevitable.

The editors speculate on why it took almost 30 years for the next conference on change to be organized—clearly not because the Harris (1963) book answered all questions about change. I have a hypothesis. The Harris book appeared in the 1960s, when funding was plentiful and psychometrics thrived. Somewhere in the 1970s things went wrong. Psychometrics lost contact with psychology, which was devastating in terms of the number of graduate students enrolled and new research questions generated. As a result, psychometrics developed into a minor sect, except in those places in which it succeeded in making contact with interdisciplinary research efforts. Classical psychometric research, using typical psychometric terminology, has become a relatively minor research area, in which there are not very many books and/or conferences.

It is useful to define the field in terms of the data structures that are studied. In the analysis of change, the data structures studied are repeated, short, multivariate time series. Thus, there are measurements of n objects on m variables at t time points. The objects (n) are independent and identically distributed, and t is relatively small (often $t = 2$). This is obviously different from multivariate time series analysis, in which $n = 1$ and t is large; and from repeated measures analysis, in which $m = 1$. The book concentrates on situations in which n is as large as possible, m is moderate, and t is small, as well as situations in which n and t are small, and m is large. It is helpful to view these situations as three-dimensional data boxes of various types.

Global Impression

This is a very useful collection of papers. The chapters, in many respects, are technically superior to those in Harris (1963). The technical developments (driven mostly by computer packages, but also by uniform terminology and notation) are quite impressive (if you like that sort of thing). The authors are obviously experts in their field, although it is often not exactly clear what that field is. The book gives the impression that the basic questions (causal inference, confounding, slicing the data box) have not changed much.

The editors did a great job. Each of the 18 chapters has a useful introduction, references are pooled over chapters, and there is a nice introductory section outlining the organization of the book.

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There is also a decent index. In this respect, the book is greatly superior to many other proceedings volumes.

There is one general problem. The proceedings of the Madison conference were called *Problems in Measuring Change*, but the proceedings of the USC conference are called *Best Methods for the Analysis of Change*. There is a clear difference here that does not illustrate the progress in the field, but rather the difference between the 1960s and the 1980s. The authors received some "good-natured ribbing" from their colleagues about the title; I think the title is rather distasteful.

Best Methods for the Analysis of Change makes four general contributions. The first involves work in the factor analysis tradition. Factor analysis sometimes gives the impression of a hopelessly old-fashioned terminology, used only by a small number of elderly researchers. Factor analysis has been treated badly by statisticians who failed to see that it was just another data analysis technique. Psychometricians reacted by withdrawing into a factor analysis cult, also failing to see that factor analysis is just another data analysis technique.

The second contribution is in ordinal psychometrics, in the tradition of Guttman and Coombs. This is useful and interesting, but fairly limited in scope. In order to get ordinal psychometrics to work, probability must be superimposed, arriving at latent trait models.

The book also includes various types of structural equations work. For example, methods of fitting nonstandard applications into standard software are discussed. Some of the work presented requires extensions of basic computer packages. Structural equations models are developing into yet another school—with its own terminology and common assumptions that seem to be obvious to anybody working in the field, and far from obvious to anybody else.

The fourth type of contribution consists of some special purpose models. They are developed (tailor-made) for particular data-gathering situations.

The Chapters

1. *Muthén.* Chapter 1 describes techniques to incorporate simple random coefficients specifications into structural equations programs. This leads to a cross between packages such as HLM or VARCL and LISCOMP or LISREL. These extensions are both useful and convenient for readers interested in structural modeling.

2. *Cohen.* Chapter 2 deals with the design of longitudinal studies and with the difficulties of causal inference in longitudinal designs with time-varying covariates. Comments by Collins and Graham and by Little follow the chapter. Cohen introduces the amusing notion of a *premature covariate* and the biases connected with it.

3. *Cliff.* Chapter 3 discusses ordinal (tau-based) psychometrics, with some applications to repeated measures. The paper is mostly programmatic, with few concrete results.

4. *Browne and Du Toit.* This chapter is another major extension of standard structural equation methodology, designed to deal with repeated measures—in particular with learning curves. Three models (fixed curve with autoregressive errors, random parameter curve, and structured latent curve) are compared. This is a very interesting and well-written chapter. The comments by Harlow are a useful extended summary of the paper.

5. *Jones.* Cattell introduced the notion of the *data box*, which is characterized by three dimensions—persons, variables, and time points. The data box is a useful tool for visualizing the global structure of data (e.g., a long, thin box or a horizontal slice). Jones discusses time-series literature in which the number of time points is small. The chapter is a useful, but necessarily quite superficial, discussion of the enormous amount of existing literature.

6. *Nesselroade.* More data box discussion here. Chapter 6 is a useful methodological contribu-

tion that concentrates on selection along the three dimensions of the box and generalizability to nonselected elements. Given the fact that there already is a great deal of confusion and controversy over selection in just one dimension, the chapter is necessarily somewhat vague and philosophical.

7. *Cunningham.* This chapter discusses classical factorial invariance theory, with some recent LISREL-type developments. The discussion by Horn is quite a bit longer than the paper itself.

8. *Bock.* Chapter 8 provides a solid and very clear introduction to the triple logistic growth curve model, a strong and specific special-purpose model.

9. *Collins.* The concept of a Guttman scale is the key concept in ordinal psychometrics. It can be extended to the data box—reordering persons, items, and time points in such a way that each slice, plane, and tray has the triangular Guttman pattern. Collins discusses the longitudinal Guttman simplex, with some probabilistic extensions.

10. *Meredith.* Chapter 10 provides a modern and attractive treatment of the latent change and latent difference models, which combine features of linear systems models with canonical analysis. In his comments, McArdle shows how to fit the models with LISREL. He also takes the art of drawing path diagrams to new heights (p. 165).

11. *Roberts and Bengtson.* Chapter 11 discusses change over generations. Attitude change from 1971 to 1985 in a joint sample of 767 parents and their children is analyzed using LISREL. Any real statistician will probably pull his/her hair out after reading this chapter. These interesting data are pressed and mangled into approximately 20 regression coefficients.

12. *Embretson.* Somewhere between the ordinal psychometricians and the Lisraelites we find the Raschists, represented here in Chapter 12. In general, Rasch models stay closer to the data and concentrate on more specific subsets of the variables than LISREL models. The emphasis is on measurement, not so much on relationship. I think this is very healthy.

13. *Widaman.* Chapter 13 contrasts qualitative and quantitative change and psychometric versus cognitive approaches to studying change in psychology.

14. *Loehlin.* Additive models with latent variables have been used in the study of genetics for a long time, mostly to study intergenerational change. The models used in behavioral genetics are usually complicated and involve many variables. The number of simplifying assumptions made is exponential with the number of variables. In most of the models presented in this chapter the total amount of implausibility of the assumptions is overwhelming.

15. *Gollob and Reichardt.* How do we reach *causal* conclusions about change? What designs are needed to make causal inferences? This topic, unfortunately currently quite popular in statistics, is treated in Chapter 15 and in the comments by Cudeck. Because I do not understand the question in debates such as these, I am always unsatisfied with the answer. In the introduction to this chapter, the editors state that "A principal aim of research on change is to infer cause" (p. 243). I would replace "aim" by "sin."

16. *Elias and Robbins.* A problem in longitudinal research is that observations are expensive, which tends to keep n small. Moreover, frequently there is much attrition. Thus, Chapter 16 discusses the data box with small or moderate n and large m, and the problems created by small n.

17. *McArdle and Hamagami.* This chapter is related to Chapter 10 by Meredith and to Chapter 4 by Browne and DuToit. Latent growth curve models are introduced, and estimation is discussed (using LISREL) with fairly small samples and random missing data patterns. For simulated data that follow the model, a small sample and a moderate amount of missing data is no problem. This leaves the question of what happens with real data that obviously do not follow the model. In general, substituting hundreds of assumptions for hundreds of data points does have its dangers.

18. *Willett and Singer.* In the very last chapter, survival analysis is introduced. Survival analysis

and related techniques have been almost the preferred data analysis techniques for measuring change in labor economics, mathematical sociology, and medical statistics. Chapter 18 provides a good introduction and some SAS code. The material that logically falls between these two (mathematics, statistics) is missing.

Summary

This is a very useful book. Many of the individual contributions are somewhat sectarian, and there are very few attempts to link the psychometric framework to general developments in statistics and other disciplines. The commentators, such as Rubin and Little, try to bring general statistics into the picture, but they do not have enough pages to make an impact. Bock (Chapter 8), Embretson (Chapter 12), and Willet and Singer (Chapter 18) try to widen the scope, but they are fairly isolated from the mainstream.

It seems that more people working in the field now put their faith in explicit modeling, which sweeps most of the statistical and methodological problems under a rug of Greek symbols. I think this approach tends to make the data of secondary interest (econometrics and economics are good illustrations). The data are the nuisance factor in the system, and the preferred approach is to tinker with the machine until the omnibus test does not indicate significance any more. This is brilliantly represented by the contributions of Browne and DuToit (Chapter 4), Meredith (Chapter 10), and McArdle and Hamagami (Chapter 17). These chapters represent the effort to overcome the problems of measuring change, discussed extensively in Harris (1963), by the technical machinery of structural equations modeling. I am much less optimistic than they are, but I applaud their heroic efforts. Again, I compliment the editors by molding this collection of diverse papers into something that comes quite close to a textbook.

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Reference

Harris, C. W. (Ed.). 1963. *Problems in measuring change.* Madison WI: University of Wisconsin Press.