



The scope of structural equation modeling

- types of variables
- multi-sample analysis
- measurement models and structural models
- PRELIS and LISREL



The program

March 1 and 2

- Path models with manifest variables
- Models of Classical Test Theory
- Latent state-trait models
- Latent change models
- Latent growth curve models

March 3 and 4

- Individual causal effect models
- Multigroup models
- Ordinal variable models
- Multitrait-multimethod models

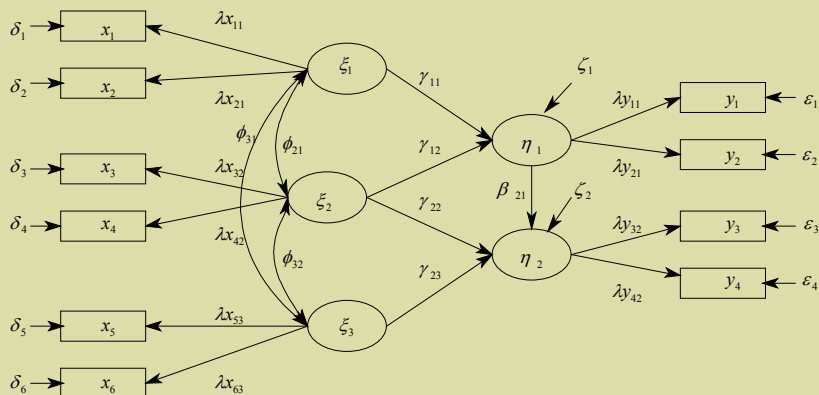


Emphasis

- Theory
- Data generation according to a model
- Analyzing data including empirical data



The scope of structural equation modeling



LISREL notation, exogenous and endogenous variables



The scope of structural equation modeling

– Model equations for structured means

- Measurement model for y : $y = \tau_y + \Lambda_y \eta + \varepsilon$
- Measurement model for x : $x = \tau_x + \Lambda_x \xi + \delta$
- Structural model: $\eta = \alpha + B \eta + \Gamma \xi + \zeta$



The scope of structural equation modeling

– Implied covariance structure

$$\Sigma = \begin{bmatrix} \mathbf{A}(\mathbf{\Gamma}\mathbf{\Phi}\mathbf{\Gamma}' + \mathbf{\Psi})\mathbf{A}' + \mathbf{\Theta}_\varepsilon & \mathbf{A}(\mathbf{\Gamma}\mathbf{\Phi}\mathbf{\Lambda}'_x) \\ \mathbf{\Lambda}_x\mathbf{\Phi}\mathbf{\Gamma}'\mathbf{A}' & \mathbf{\Lambda}_x\mathbf{\Phi}\mathbf{\Lambda}'_x + \mathbf{\Theta}_\delta \end{bmatrix}$$

– where

$$\mathbf{A} := \mathbf{\Lambda}_y(\mathbf{I} - \mathbf{B})^{-1}$$



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- Implied mean structure

$$E(\xi) =: \kappa$$

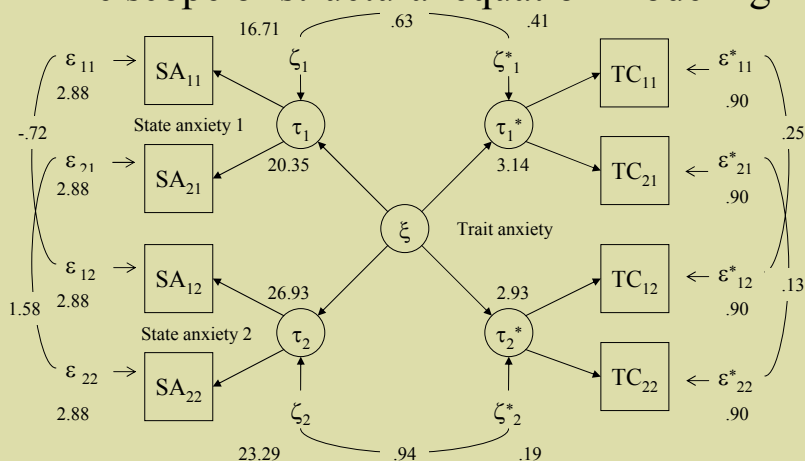
$$\mu_y = \tau_y + \Lambda_y (\mathbf{I} - \mathbf{B})^{-1} (\alpha + \Gamma \kappa)$$

$$\mu_x = \tau_x + \Lambda_x \kappa$$

$$E(\eta) = (\mathbf{I} - \mathbf{B})^{-1} (\alpha + \Gamma \kappa)$$

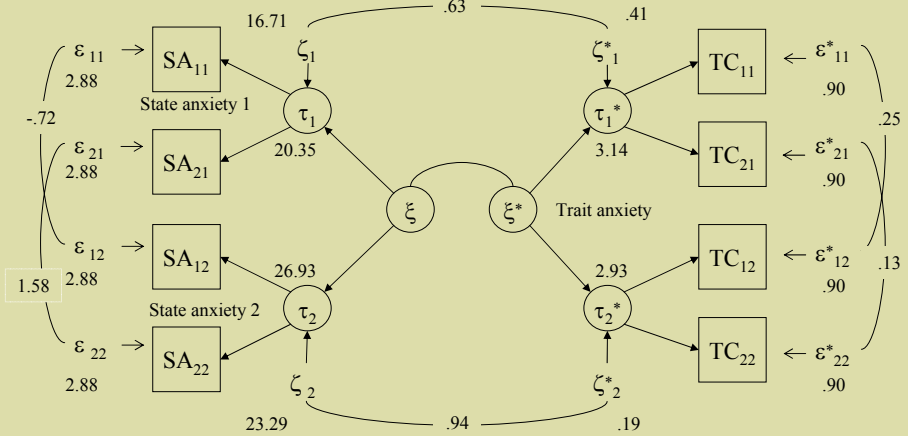


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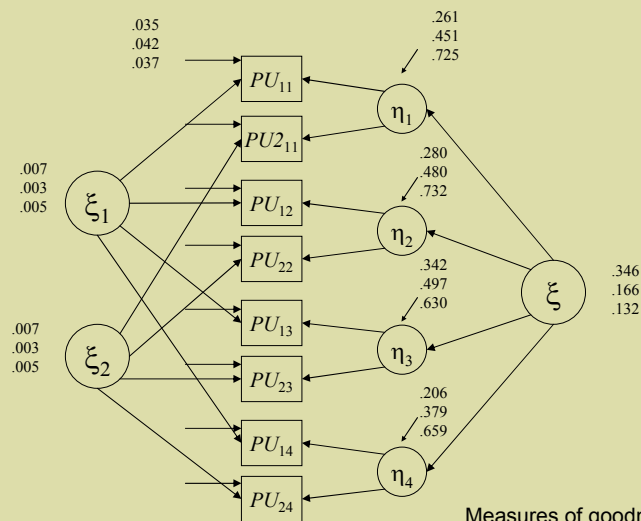




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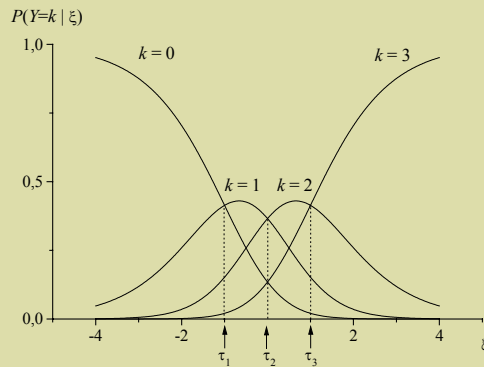
The scope of structural equation modeling



Measures of goodness-of-fit:
χ²=103.39, P=0.11



The scope of structural equation modeling



The scope of structural equation modeling

Math. notation	Θ_{δ}	Λ_x	Φ	Γ	B	Ψ	Λ_y	Θ_{ε}
Lisrel-notation	TD	LX	PH	GA	BE	PS	LY	TE
Default form	DI	FU	SY	FU	ZE	SY	FU	DI
Default mode	FR	FI	FR	FR	FI	FR	FI	FR
Order	$NX \times NX$	$NX \times NK$	$NK \times NK$	$NE \times NK$	$NE \times NE$	$NE \times NE$	$NY \times NE$	$NY \times NY$
ID Identity		*	*	*			*	*
IZ Identity / Zero		*		*			*	
ZI Zero/Identity		*		*			*	
DI diagonal	*	*	*	*		*	*	*
FU rectangular		*		*	*		*	
SD Diagonal 0, all others free					*			
SY symmetric, no diagonal		*		*			*	
ST symmetric, 1 in diagonal			*					
ZE 0	*				*	*		*



The scope of structural equation modeling

– Internet resources about SEM

- SEMnet Discussion List
 - <http://www.gsu.edu/~mkteer/semnet.html>
- Joel West's SEM page
 - <http://www.gsm.uci.edu/~joelwest/SEM/>
- Ed Rigdon's SEM faq
 - <http://www.gsu.edu/~mkteer/semfaq.html>

metheval

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und evaluationsforschung

SEMNET Information - Microsoft Internet Explorer

Adresse <http://www.gsu.edu/~mkteer/semnet.html>

SEMNET

The Structural Equation Modeling Discussion Network

Researchers who study or apply structural equation modeling methods may be interested in an electronic mail network called SEMNET. Operating over the Internet, SEMNET is an open forum for ideas and questions about the methodology that includes analysis of covariance structures, path analysis, and confirmatory factor analysis. SEMNET bridges the gaps between users, between disciplines, and between conferences. SEMNET was founded in February 1993. As of November 1998, SEMNET had more than 1,500 subscribers around the world.

SEMNET is for sharing ideas about this methodology with other interested researchers. SEMNET is also for researchers who are just learning (or re-learning) about structural equation modeling, or who are facing problems in applying these techniques to their own research.

The current postmaster/list owner for SEMNET is Dr. Carl E. Ferguson, Jr. (CFERGUSO@ALSTON.CBA.UA.EDU), professor of marketing at The University of Alabama, in Tuscaloosa. SEMNET is sponsored by the Seebeck Computer Center at The University of Alabama.

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COMMANDS VS. MESSAGES

Interacting with SEMNET
Users send **commands** to the list to be distributed to the list. The same e-mail may contain both **commands** and **messages**, providing information to the list.

ADDRESSES

SEMNET users need to refer to the following addresses:
Commands are always sent to:
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Messages are always sent to the SEMNET address:

<http://www.gsu.edu/~mkteer/semnet.html>

Hoyle SEM Home Page - Microsoft Internet Explorer

Adresse <http://www.smallwaters.com/book/s/hoyle.html>

STRUCTURAL EQUATION MODELING: Concepts, Issues and Applications

Edited by RICK H. HOYLE, *University of Kentucky*

"Rick H. Hoyle's edited collection provides readers with a largely nontechnical review of some of the major issues facing researchers who wish to use structural equation modeling. It is a timely book, not only because of the high level of interest in structural equation modeling, but because it makes accessible to a broad group of structural equation modeling users current methodological developments." *from the Foreword by Kenneth A. Bollen*

Though technically sound, the chapters are primarily an introduction to the structural equation modeling process, devoted to fundamental concepts such as estimation and the use of computer programs for applying the approach.

Contents:

Foreword *Kenneth A. Bollen*

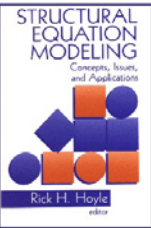
Preface *Rick H. Hoyle*

1. The Structural Equation Modeling Approach: Basic Concepts and Fundamental Issues *Rick H. Hoyle*
2. Model Specification: Procedures, Strategies, and Related Issues *Robert C. MacCallum*
3. Estimates and Tests in Structural Equation Modeling *Chih-Ping Chou & Peter M. Bentler*
4. Structural Equation Models With Nonnormal Variables: Problems and Remedies *Stephen G. West, John F. Finch, & Patrick J. Curran*
5. Evaluating Model Fit *Li-tze Hu & Peter M. Bentler*
6. Statistical Power in Structural Equation Modeling *David Kaplan*
7. Objectivity and Reasoning in Science and Structural Equation Modeling *Stanley A. Mulaik & Lawrence R. James*
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9. Writing About Structural Equation Models *Rick H. Hoyle & Abigail T. Panter*
10. Latent Variable Models of Multitrait-Multimethod Data *Herbert W. Marsh & David Grayson*
11. Sex-Race Differences in Social Support and Depression in Older Low-Income Adults *Jane A. Scott-Lennox & Richard D. Lennox*
12. Modeling the Relation of Personality Variables to Symptom Complaints: The Unique Role of Negative Affectivity *Jay G. Hull, Judith C. Tedlie, & Daniel A. Lehn*
13. Predictors of Change in Antisocial Behavior During Elementary School for Boys *Mike Stoolmiller, Terry E. Duncan, & Gerald R. Patterson*

Publisher: Sage / 1995 / 290 pages

Price: \$62.00 (hardcopy, ISBN: 0-8039-5317-8) or \$28.95 (paperback, ISBN: 0-8039-5318-6)

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- guter Einführungstext

Bollen SEWLT Home Page - Microsoft Internet Explorer

Adresse <http://www.smallwaters.com/book/s/bollen.html>

STRUCTURAL EQUATIONS WITH LATENT VARIABLES

By KENNETH A. BOLLEN, *University of North Carolina*

Structural Equations with Latent Variables is a comprehensive treatment of the general structural equation system. The book serves three purposes. First, it demonstrates the generality of this model. Rather than treating path analysis, recursive and nonrecursive models, classical econometrics, and confirmatory factor analysis as unique, they are treated as special cases of a common model. The second purpose is to emphasize the application of these techniques. Empirical examples appear throughout. Several chapters contain some of the programs the author used to obtain the results for the empirical examples. Finally, the book explores the crucial role played by substantive expertise in most stages of the modeling process.

Structural equation models can be presented two ways—from the general model to simpler models, or from simpler models to the general model. *Structural Equations with Latent Variables* develops from the latter strategy, starting with the regression/econometric and factor analysis models and presenting them from the perspective of the general model.

Structural Equations with Latent Variables fills the gap existing in the treatment of this subject between introductory texts and specialized papers. It provides social scientists, market researchers, applied statisticians, other analysts, and graduate students with a thorough examination of structural equation models. At the same time it presents new material on measurement reliability and validity, overall fit indices, model identification, and other topics.

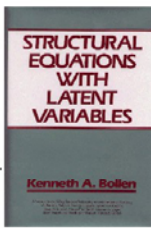
Contents:

1. Introduction
2. Model Notation, Covariances, and Path Analysis
3. Causality and Causal Models
4. Structural Equation Models with Observed Variables
5. The Consequences of Measurement Error
6. Measurement Models: The Relation Between Latent and Observed Variables
7. Confirmatory Factor Analysis
8. The General Model, Part I: Latent Variable and Measurement Models
9. The General Model, Part II: Extensions
10. Appendix A: Matrix Algebra Review
11. Appendix B: Asymptotic Distribution Theory

Publisher: Wiley / 1989 / 514 pages / hardcover / ISBN: 0-471-01171-1

Price: \$84.95

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- sehr umfassend
- Standardwerk

Marcolides and Schumacker Home Page - Microsoft Internet Explorer

Adresse http://www.smallwaters.com/books/marc_sch.html

ADVANCED STRUCTURAL EQUATION MODELING: Issues and Techniques


Edited by **GEORGE A. MARCOULIDES**, *California State University at Fullerton*, and **RANDALL E. SCHUMACKER**, *University of North Texas*

Structural equation models are used by biologists, educational and medical researchers, psychologists, social scientists, and others who traditionally deal with nonexperimental and quasi-experimental data. *Explores the most important and influential statistical resolutions to basic research encountered in the scientific arena, the development of structural equation models, and the testing of theories.*

Accepted today as a major component of applied statistics, structural equation modeling has become a standard tool in both dependent and independent variables, and is now available in commercial computer packages, the method is used for the analysis of time-dependent data, regression analysis, and path analysis.

This volume focuses on the latest issues and developments in the field. It provides a comprehensive understanding and working knowledge of advanced structural equation modeling. This approach allows readers to better understand the theory and practice of the method. The book was written for a broad audience crossing many disciplines, including those who have taken multivariate statistics courses, including introductory statistics.

Im Lesesaal Psychologie vorhanden
 - guter Einführungstext (Basics of ...)
 - Fortsetzung für Fortgeschrittene



Contents:

1. Introduction *George A. Marcoulides & Randall E. Schumacker*
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3. Nonlinear Structural Equation Models: The Kenny-Judd Model With Interaction Effects *Karl G. Joereskog & Fan Yang*
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7. Bootstrapping Techniques in Analysis of Mean and Covariance Structures *Yiu-Pai Yung & Peter Bentler*
8. A Limited-Information Estimator for LISREL Models With or Without Heteroscedastic Errors *Kenneth A. Bollen*
9. Full Information Estimation in the Presence of Incomplete Data *James L. Arbuckle*
10. Inference Problems With Equivalent Models *Larry J. Williams, Hamparsum Bozdogan, & Lynda Aiman-Smith*
11. An Evaluation of Incremental Fit Indices: A Clarification of Mathematical and Empirical Properties *Herbert W. Marsh, John R. Balla, & Kit-Tai Hau*

Publisher: Lawrence Erlbaum Associates / 1996 / 514 pages / hardcover / ISBN: 0-8058-1819-7
 Price: \$79.95

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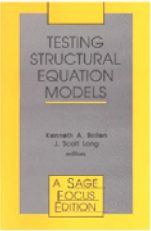
TESTING STRUCTURAL EQUATION MODELS

Edited by **KENNETH A. BOLLEN**, *University of North Carolina*, and **J. SCOTT LONG**, *Indiana University*

"This book is a valuable adjunct to the extant literature on specification, estimation, and identification. My overall impression is that this volume is indispensable for those wishing to keep current with this fast-moving field. I recommend that this book be used as a supplementary text in a graduate-level course in structural equation modeling." *Structural Equation Modeling*.

Highly integrated and valuable, this book is a must for every researcher's shelf, particularly with coverage like testing structural equation models, multifaceted conceptions of fit, Monte Carlo evaluations of goodness of fit indices, specification tests for the linear regression model, bootstrapping goodness of fit measures, Bayesian model selection, alternative ways of assessing model fit, power evaluations, goodness of fit with categorical and other non-normal variables, new covariance structure model improvement statistics, and nonpositive definite matrices.

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 - wichtiger Sammelband für spezielle Fragen



Contents:

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3. Monte Carlo Evaluations of Goodness-of-Fit Indices for Structural Equation Models *David W. Gerbing & James C. Anderson*
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