

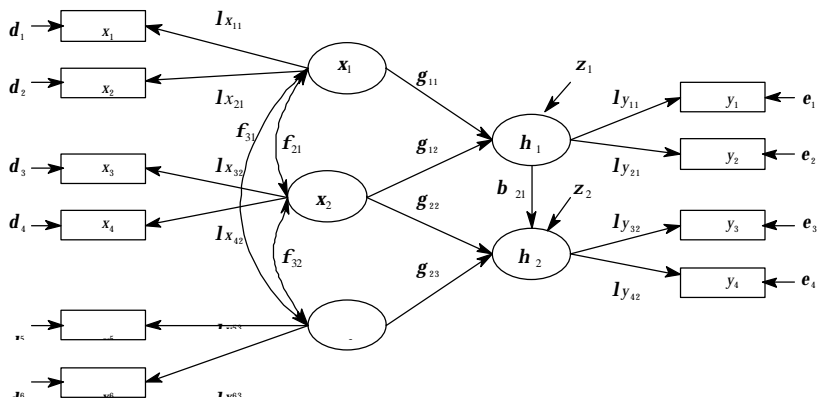


Einführung und Überblick

- Meßmodelle und Strukturmodelle
- Implizierte Kovarianzstruktur
- Implizierte Mittelwertstruktur
- PRELIS und LISREL
- Arten von Variablen
- Multi-sample Analysen



Einführung und Überblick



LISREL-Notation, exogene und endogene Variablen



Einführung und Überblick

Modellgleichungen

- Meßmodell für y : $y = \tau_y + \Lambda_y \eta + \varepsilon$
- Meßmodell für x : $x = \tau_x + \Lambda_x \xi + \delta$
- Strukturmodell: $\eta = \alpha + B \eta + \Gamma \xi + \zeta$



Einführung und Überblick

Implizierte Kovarianzstruktur

$$\Sigma = \begin{bmatrix} \mathbf{A}(\Gamma\Phi\Gamma' + \Psi)\mathbf{A}' + \Theta_e & \mathbf{A}(\Gamma\Phi\Lambda'_x) \\ \Lambda_x\Phi\Gamma'\mathbf{A}' & \Lambda_x\Phi\Lambda'_x + \Theta_d \end{bmatrix}$$

wobei

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



Einführung und Überblick

Implizierte Mittelwertstruktur

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

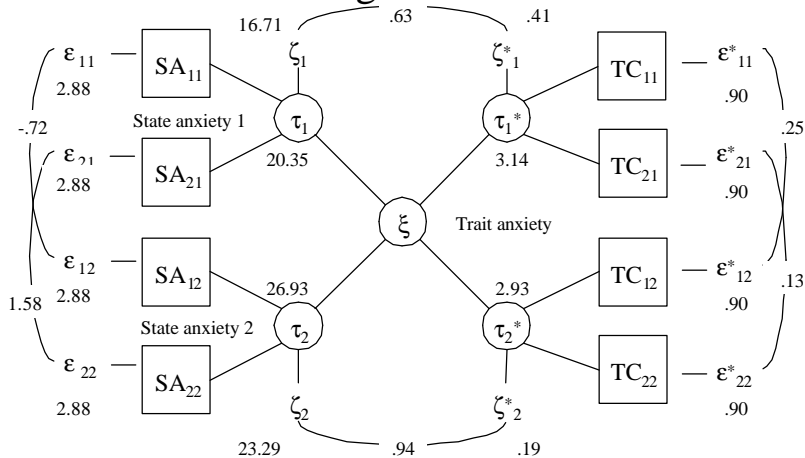
$$\mu_y = \tau_y + \Lambda_y (I-B)^{-1} (\alpha + \Gamma \kappa)$$

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

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

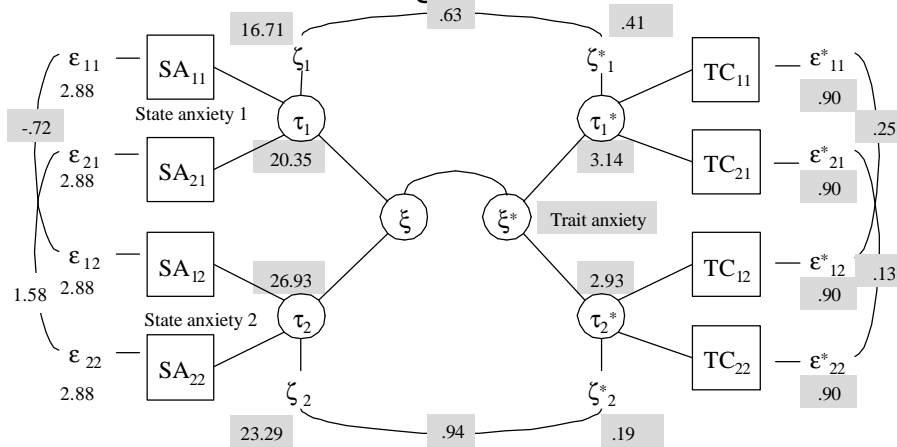


Einführung und Überblick

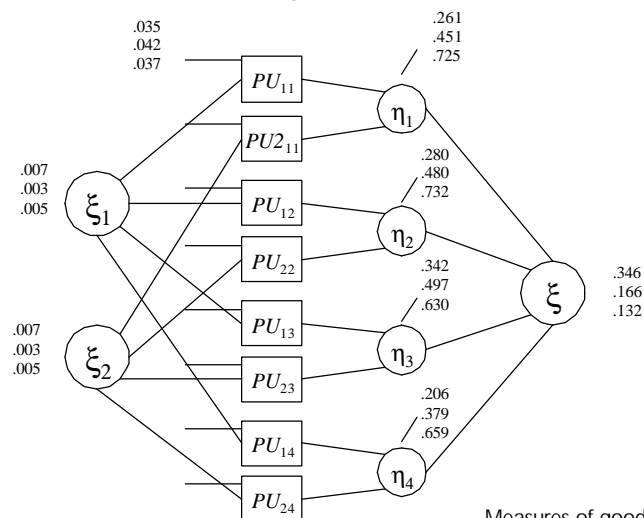




Einführung und Überblick



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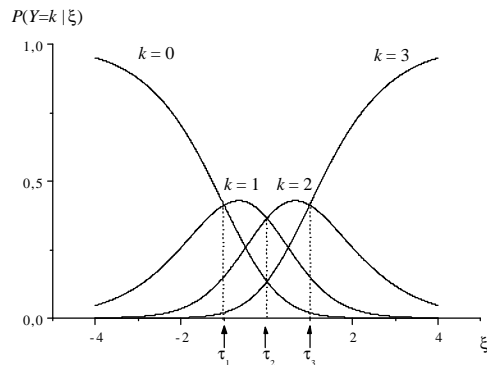


Measures of goodness-of-fit:
 $\chi^2=103.39, P=0.11$



Einführung und Überblick

Ordinale Variablen (Kategorienwahrscheinlichkeiten)



Einführung und Überblick

Math. notation	Θ_δ	Λ_γ	Φ	Γ	B	Ψ	Λ_η	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	*				*	*		*



Einführung und Überblick

– Internet resources about SEM

- SEMnet Diskussionsliste
 - <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

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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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*

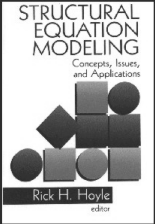
Preface *Rick H. Hoyle*

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 & Laurence R. James*
8. One Application of Structural Equation Modeling From Two Perspectives: Exploring the BQS and LISREL Strategies *Barbara M. Byrne*
9. Writing About Structural Equation Models *Rick H. Hoyle & Abigail T. Panter*
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13. Predictors of Change in Antisocial Behavior During Elementary School for Boys *Mike Stoolmiller, Terry B. 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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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.

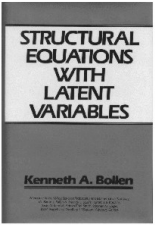
Contents:

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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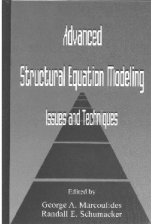
ADVANCED STRUCTURAL EQUATION MODELING: Issues and Techniques

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. Perhaps the most important and influential statistical revolution to have recently occurred in the scientific arena, the development of structural equation modeling has revolutionized the way in which researchers analyze and test theories.

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

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



Contents:

1. Introduction *George A. Marcoulides & Randall E. Schumacker*
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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, Haniye Arslanoglu, & 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
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TESTING STRUCTURAL EQUATION MODELS

Edited by **KENNETH A. BOLLEN**, *University of North Carolina*, and **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.

Contents:

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