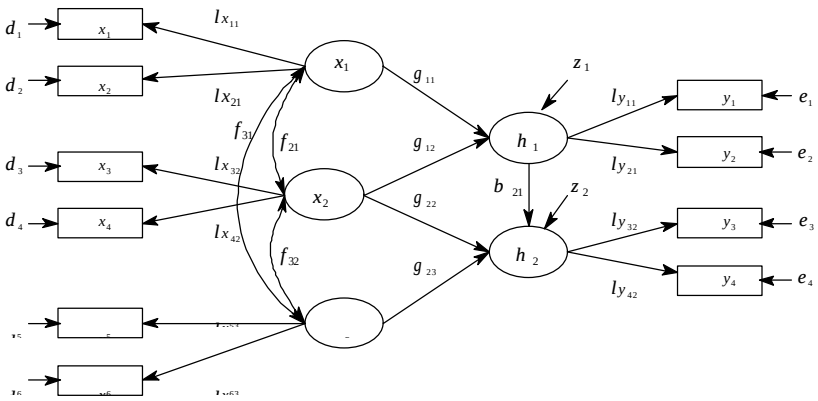
The scope of structural equation modeling

- measurement models and structural models
- implied covariance structure
- implied mean structure
- PRELIS and LISREL
- types of variables
- multi-sample analysis

The scope of structural equation modeling



LISREL notation, exogeneous 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: $\eta = \alpha + \mathrm{B}\,\eta + \Gamma\,\xi + \zeta$

The scope of structural equation modeling

– Implied covariance structure

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

– where

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

The scope of structural equation modeling

– Implied mean structure

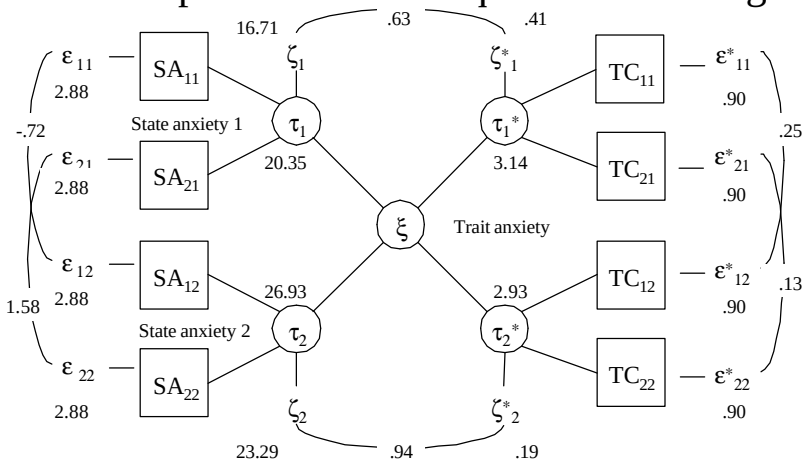
$$\mathrm{E}(\xi) =: \kappa$$

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

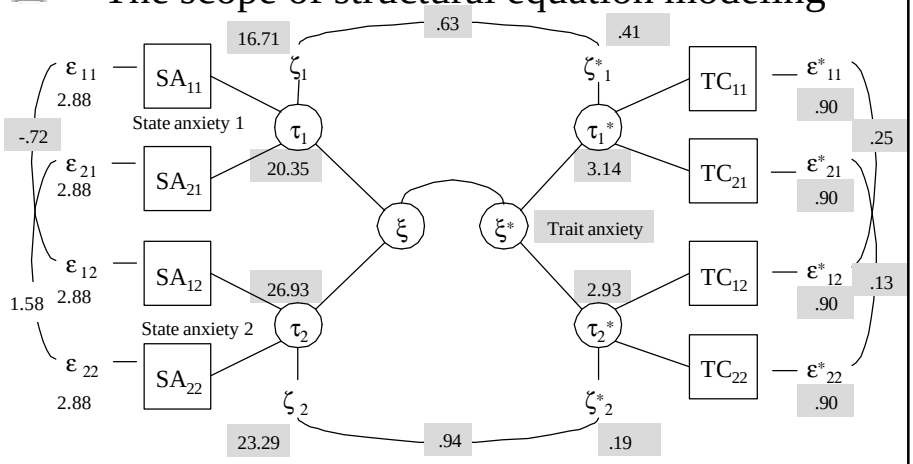
$$\mu_x = \tau_x + \Lambda_x \, \kappa$$

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

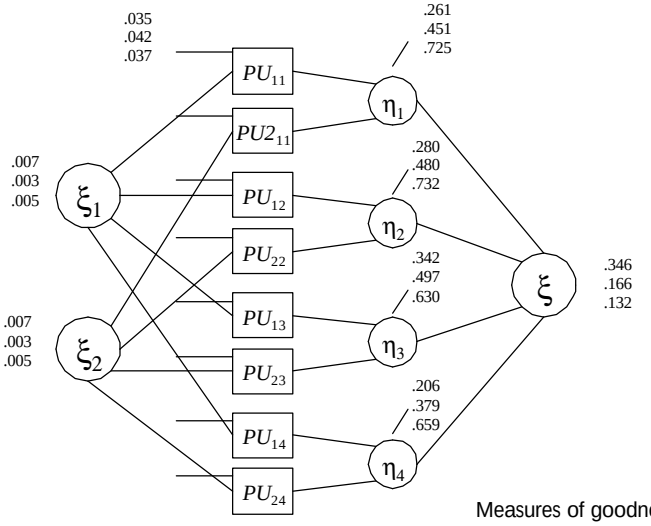
The scope of structural equation modeling



The scope of structural equation modeling

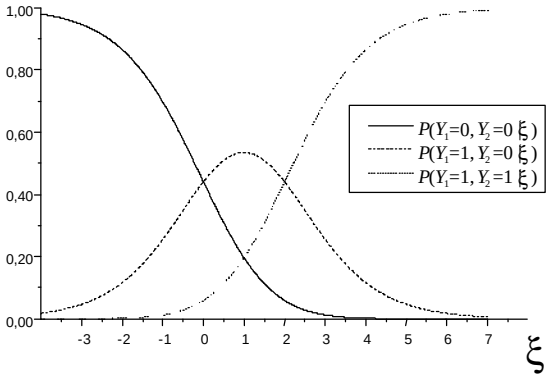


The scope of structural equation modeling

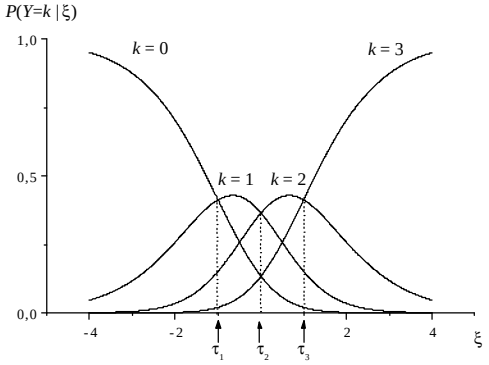


Measures of goodness-of-fit:
$\chi^2 = 103.39$, $P = 0.11$

The scope of structural equation modeling



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×NX	NX×NK	NK×NK	NE×NK	NE×NE	NE×NE	NY×NE	NY×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

The scope of structural equation modeling

- Books and papers on SEM