B Syntax overview

This appendix provides a convenient reference to LISREL 8. The commands are arranged in logical order. The diagram is constructed according to the following conventions:

- Square brackets [] enclose optional specifications. The brackets themselves should not be coded.
- Boxes enclose alternative specifications. Only one element of the list may be entered. A **boldface** element indicates the default specification.
- Parentheses () must be entered exactly as shown.
- Equals signs = are required.
- Uppercase elements are commands, keywords, keyword values, or options. They must be entered as they appear, or they may be lengthened (LABELS instead of LA, for example). Thus, except for the ALL option on the VA and ST commands and the PATH DIAGRAM command (though PD may be used instead), everything has *two* significant characters.
- Lowercase elements describe information to be filled in by the user.
- Use blanks to separate command names, keywords, and options.
- An exclamation mark (!) or the slash-asterisk combination (/*) may be used to indicate that everything that follows on this line is to be regarded as comments. Blank (empty) lines are accepted without the ! or /*.
- Command order is important, see the section *Order of commands* on page 43.

- For format statements, see the section *FORTRAN format statements in the command file* on page 38. No format statement means free format: the data are separated by a space, comma, and/or return character.
- A parameter matrix element should be written as a parameter matrix name (LY, LX, BE, GA, PH, PS, TE, TD, TH, TY, TX, AL, or KA), followed by row and column indexes (or linear indexes) of the specific element. Row and column indexes may be separated by a comma and enclosed in parentheses, like LY(3,2), LX(4,1), or separated from the matrix name and each other by spaces, like LY 3 2 LX 4 1.
- The order of the form and mode values for the parameter matrices on the MO command line is optional, but if both are given, a comma in between is required.
- An *italic* element indicates a new feature of LISREL 8

The maximum line length in a command file is 127 columns. Commands may be continued over several lines by adding a space followed by a C (for 'continue') on the current line. A keyword and its specified value should appear on the same line: start a keyword on a new line if its specified value would extend past column 127. Note that this requirement has not been followed in the syntax diagram below.

B.1 LISREL syntax diagram

["title line"]
[...]

Input specification commands

DA NI=k NO=number of cases [NG= **1** / number of groups] [MA= **CM** / AM / KM / MM / OM / PM / *RM* / *TM*]

[XM=global missing value] [*RP*=no. of repetitions]

[LA [[FI]=filename [FO] [RE]]]
[(character variable format statement)]
[y and x labels]

[RA [[FI]=filename [FO] [RE]]]
[(variable format statement)]
[data records]

[CM / KM / MM / OM / PM / *RM* / *TM*] [[FI]=filename [FO] [RE] [**SY** / FU]]]
[(variable format statement)]
[data records]

[ME [[FI]=filename [FO] [RE]]]
[(variable format statement)]
[data records]

[SD [[FI]=filename [FO] [RE]]]
[(variable format statement)]
[data records]

[AC / *WM* [FI]=filename]

[AV / DM [FI]=filename]

[SE [[FI]=filename]]
[variable names]

Model specification commands

MO [NY= **0** / no. of y-variables] [NX= **0** / no. of x-variables]

[NE= **0** / no. of eta-variables] [NK= **0** / no. of ksi-variables] [FI]

[LY= **FU** / DI / ID / IZ / ZI , **FI** / FR / PS / SP / SS / IN] [LX= **FU** / DI / ID / IZ / ZI , **FI** / FR / PS / SP / SS / IN] [BE= **ZE** / SD / FU , **FI** / FR / PS / SP / SS / IN] [GA= **FU** / DI / ID / IZ / ZI , **FR** / FI / PS / SP / SS / IN]

[PH= **SY** / DI / ID / ST , **FR** / FI / PS / SP / SS / IN] [PS= **SY** / DI / ZE , **FR** / FI / PS / SP / SS / IN]

[TE= **DI** / SY / ZE , **FR** / FI / PS / SP / SS / IN] [TD= **DI** / SY / ZE , **FR** / FI / PS / SP / SS / IN] [*TH*= **ZE** / DI / SY , **FI** / PS / SP / SS / IN]

[TY= **FI** | FR | IN | PS | SP | SS] [TX= **FI** | FR | IN | PS | SP | SS] [AL= **FI** | FR | IN | PS | SP | SS] [KA= **FI** | FR | IN | PS | SP | SS]

[*AP*= **0** | number of additional independent free parameters]

[LK [[FI]=filename [FO] [RE]]]
[(character variable format statement)]
[ksi labels]

[LE [[FI]=filename [FO] [RE]]]
[(character variable format statement)]
[eta labels]

[FR list of parameter matrix elements]

[FI list of parameter matrix elements]

[EQ list of parameter matrix elements]

[*CO* parameter matrix element=expression with other parameters]

[*IR* list of parameter matrix elements [>number] [<number]]

[PA [[FI]=filename [FO] [RE]] matrix name]
[(integer format statement)]
[pattern records]

[VA numerical value | list of parameter matrix elements | ALL]

[ST numerical value | list of parameter matrix elements | ALL]

[MA [[FI]=filename [FO] [RE]] matrix name]
[(variable format statement)]
[records of matrix values]

[PL list of parameter matrix elements [FROM a TO b]]

[NF list of parameter matrix elements]

Output specification commands

[*PD* / *PATH DIAGRAM*]

OU [ME= **ML** / DW / GL / IV / TS / UL / WL] [RC= **0.001** / value] [SL= **1** / integer] [NS] [RO] [AM] [SO]

[SE] [TV] [PC] [PT] [RS] [EF] [MR] [MI] [FS] [SS] [SC] [ALL]

[*XM*] [*XI*] [**TO** / WP] [ND= **2** / number of decimals]

[BE=filename] [GA=filename] [LX=filename] [LY=filename]

[PH=filename] [PS=filename] [TD=filename] [TE=filename]

[EC=filename] [MA=filename] [RM=filename] [SI=filename]

[AL=filename] [KA=filename] [TX=filename] [TY=filename]

[*TH*=filename]

[*GF*=filename] [*PV*=filename] [*SV*=filename] [*TV*=filename]

[TM= **172800** / maximum seconds] [IT= **three times all free parameters** / maximum iterations]

[AD= **20** / integer / OFF] [EP= **0.000001** / convergence criterion]

B.2 Notation

The Greek Alphabet		
α	A	alpha
β	B	beta
γ	Γ	gamma
δ	Δ	delta
ϵ	E	epsilon
ζ	Z	zeta
η	H	eta
θ	Θ	theta
ι	I	iota
κ	K	kappa
λ	Λ	lambda
μ	M	mu
ν	N	nu
ξ	Ξ	xi, ksi
o	O	omicron
π	Π	pi
ρ	P	rho
σ	Σ	sigma
τ	T	tau
υ	Υ	upsilon
ϕ	Φ	phi
χ	X	chi
ψ	Ψ	psi
ω	Ω	omega

Typical LISREL Notation	
x, y	observed variables
ξ, η	latent variables
ζ, δ, ϵ	error variables
$\mathbf{\Lambda}_x, \mathbf{\Lambda}_y$	factor loadings
$\mathbf{B}, \mathbf{\Gamma}$	structural parameters
$\mathbf{\Phi}, \mathbf{\Psi}$	covariance matrices
$\mathbf{\Theta}_\delta, \mathbf{\Theta}_\epsilon, \mathbf{\Theta}_{\delta\epsilon}$	error covariance matrices
$\hat{\mathbf{\Lambda}}_x$	estimate of $\mathbf{\Lambda}_x$

Other Notation	
$\mathbf{x}$	column vector
$\mathbf{x}'$	row vector
$\mathbf{X}$	matrix
$\mathbf{X}'$	matrix transpose
$\mathbf{X}^{-1}$	matrix inverse
$[x_{ij}]$	matrix element
$\|\|\mathbf{X}\|\|$	determinant of a square matrix $\mathbf{X}$
tr($\mathbf{X}$)	trace of $\mathbf{X}$ (sum of diagonal elements of a square matrix)
Greek letters	population parameters, latent random variables
Roman letters	observed random variables

TABLE 4.1
Summary of the Covariance Structure Model

Matrix	*Dimension*	*Mean*	*Covariance*	*Dimension*	*Description*
$\boldsymbol{\eta}$	$(r \times 1)$	**0**	$COV(\boldsymbol{\eta}) = E(\boldsymbol{\eta}\boldsymbol{\eta}')$	$(r \times r)$	latent endogenous variables
$\boldsymbol{\xi}$	$(s \times 1)$	**0**	$\boldsymbol{\Phi} = E(\boldsymbol{\xi}\boldsymbol{\xi}')$	$(s \times s)$	latent exogenous variables
$\boldsymbol{\zeta}$	$(r \times 1)$	**0**	$\boldsymbol{\Psi} = E(\boldsymbol{\zeta}\boldsymbol{\zeta}')$	$(r \times r)$	errors in equations
$\mathbf{B}$	$(r \times r)$	—	—	—	direct effects of $\boldsymbol{\eta}$ on $\boldsymbol{\eta}$
$\ddot{\mathbf{B}}$	$(r \times r)$	—	—	—	defined as $(\mathbf{I} - \mathbf{B})$
$\boldsymbol{\Gamma}$	$(r \times s)$	—	—	—	direct effects of $\boldsymbol{\xi}$ on $\boldsymbol{\eta}$
$\mathbf{x}$	$(q \times 1)$	**0**	$\boldsymbol{\Sigma}_{xx} = E(\mathbf{x}\mathbf{x}')$	$(q \times q)$	observed exogenous variables
$\boldsymbol{\Lambda}_x$	$(q \times s)$	—	—	—	loadings of $\mathbf{x}$ on $\boldsymbol{\xi}$
$\boldsymbol{\delta}$	$(q \times 1)$	**0**	$\boldsymbol{\Theta}_\delta = E(\boldsymbol{\delta}\boldsymbol{\delta}')$	$(q \times q)$	unique factors for $\mathbf{x}$
$\mathbf{y}$	$(p \times 1)$	**0**	$\boldsymbol{\Sigma}_{yy} = E(\mathbf{y}\mathbf{y}')$	$(p \times p)$	observed endogenous variables
$\boldsymbol{\Lambda}_y$	$(p \times r)$	—	—	—	loadings of $\mathbf{y}$ on $\boldsymbol{\eta}$
$\boldsymbol{\epsilon}$	$(p \times 1)$	**0**	$\boldsymbol{\Theta}_\epsilon = E(\boldsymbol{\epsilon}\boldsymbol{\epsilon}')$	$(p \times p)$	unique factors for $\mathbf{y}$

Structural Equations:

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \boldsymbol{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta} \qquad [4.1]$$

$$\ddot{\mathbf{B}}\boldsymbol{\eta} = \boldsymbol{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta}$$

Factor Equations:

$$\mathbf{x} = \boldsymbol{\Lambda}_x\boldsymbol{\xi} + \boldsymbol{\delta} \qquad [4.2]$$

$$\mathbf{y} = \boldsymbol{\Lambda}_y\boldsymbol{\eta} + \boldsymbol{\epsilon} \qquad [4.3]$$

Covariance Equation:

$$\boldsymbol{\Sigma} = \left[\begin{array}{c|c} \boldsymbol{\Lambda}_y\ddot{\mathbf{B}}^{-1}(\boldsymbol{\Gamma}\boldsymbol{\Phi}\boldsymbol{\Gamma}' + \boldsymbol{\Psi})\ddot{\mathbf{B}}'^{-1}\boldsymbol{\Lambda}_y' + \boldsymbol{\Theta}_\epsilon & \boldsymbol{\Lambda}_y\ddot{\mathbf{B}}^{-1}\boldsymbol{\Gamma}\boldsymbol{\Phi}\boldsymbol{\Lambda}_x' \\ \hline \boldsymbol{\Lambda}_x\boldsymbol{\Phi}\boldsymbol{\Gamma}'\ddot{\mathbf{B}}'^{-1}\boldsymbol{\Lambda}_y' & \boldsymbol{\Lambda}_x\boldsymbol{\Phi}\boldsymbol{\Lambda}_x' + \boldsymbol{\Theta}_\delta \end{array}\right] \qquad [4.4]$$

Assumptions:

a. Variables are measured from their means: $E(\boldsymbol{\eta}) = E(\boldsymbol{\zeta}) = \mathbf{0}$; $E(\boldsymbol{\xi}) = \mathbf{0}$; $E(\mathbf{x}) = E(\boldsymbol{\delta}) = \mathbf{0}$; $E(\mathbf{y}) = E(\boldsymbol{\epsilon}) = \mathbf{0}$.

b. Common and unique factors are uncorrelated: $E(\boldsymbol{\xi}\boldsymbol{\delta}') = \mathbf{0}$ or $E(\boldsymbol{\delta}\boldsymbol{\xi}') = \mathbf{0}$; $E(\boldsymbol{\eta}\boldsymbol{\epsilon}') = \mathbf{0}$ or $E(\boldsymbol{\epsilon}\boldsymbol{\eta}') = \mathbf{0}$; $E(\boldsymbol{\xi}\boldsymbol{\epsilon}') = \mathbf{0}$ or $E(\boldsymbol{\epsilon}\boldsymbol{\xi}') = \mathbf{0}$; $E(\boldsymbol{\eta}\boldsymbol{\delta}') = \mathbf{0}$ or $E(\boldsymbol{\delta}\boldsymbol{\eta}') = \mathbf{0}$.

c. Unique factors and errors in equations are uncorrelated across equations: $E(\boldsymbol{\delta}\boldsymbol{\epsilon}') = \mathbf{0}$ or $E(\boldsymbol{\epsilon}\boldsymbol{\delta}') = \mathbf{0}$; $E(\boldsymbol{\zeta}\boldsymbol{\delta}') = \mathbf{0}$ or $E(\boldsymbol{\delta}\boldsymbol{\zeta}') = \mathbf{0}$; $E(\boldsymbol{\zeta}\boldsymbol{\epsilon}') = \mathbf{0}$ or $E(\boldsymbol{\epsilon}\boldsymbol{\zeta}') = \mathbf{0}$.

d. Exogenous variables and errors in equations are uncorrelated: $E(\boldsymbol{\xi}\boldsymbol{\zeta}') = \mathbf{0}$ or $E(\boldsymbol{\zeta}\boldsymbol{\xi}') = \mathbf{0}$.

e. None of the structural equations is redundant: $\ddot{\mathbf{B}}^{-1} = (\mathbf{I} - \mathbf{B})^{-1}$ exits.