


# Intro to Mx

HGEN619 class 2005



## General Comments

- case insensitive, except for filenames under Unix
- comments: anything following a !
- blank lines
- commands: identified by first 2 letters, BUT recommended to use full words

## Job Structure

- three types of groups:
  - Data, Calculation, Constraint
- number of groups indicated by
  - #NGroups 3
  - at the beginning of job
- jobs can be stacked in one run

## Group Structure

- Title
- Group type: data, calculation, constraint
  - [Read observed data, Select, Labels]
- Matrices declaration
  - [Specify numbers, parameters, etc.]
- Algebra section and/or Model statement
  - [Options]
- End

## Read Observed Data

- Data NInputvars=2 [NObservations=123]
- CMatrix/ Means/ CTable/
  - summary statistics
  - read from script / file (File=filename)
- Rectangular/ Ordinal / VLength
  - raw data
  - read from script / file (File=filename)
- Select variables ; [by number/label]
- Labels variables

## Matrix Declaration

- Group 1
- Begin Matrices;
  - C Full 2 3 Free ! [name type rows columns free]
  - ! more matrices ! default element is fixed at 0
- End Matrices;
  
- Group 2
- Begin Matrices = Group 1;
  - ! copies all matrices from group 1
  - D Full 2 3 = C1 ! equates D to C of group 1

## Matrix Types (Mx manual p.56)

Type	Structure	Shape	Free
Zero	Null (zeros)	Any	0
Unit	Unit (ones)	Any	0
Iden	Identity	Square	0
Diag	Diagonal	Square	r
S Diag	Subdiagonal	Square	$r(r-1)/2$
Stand	Standardized	Square	$r(r-1)/2$
Symm	Symmetric	Square	$r(r+1)/2$
Lower	Lower triangular	Square	$r(r+1)/2$
Full	Full	Any	r x c
Computed	Equated to	Any	0

## Matrices

Example Command	Specification Matrix	Values
A Zero 2 3 Free	0 0 0 0 0 0	0 0 0 0 0 0
B Unit 2 3 Free	0 0 0 0 0 0	1 1 1 1 1 1
C Iden 3 3 Free	0 0 0 0 0 0 0 0 0	1 0 0 0 1 0 0 0 1
D Izero 2 5 Free	0 0 0 0 0 0 0 0 0 0	1 0 0 0 0 0 1 0 0 0
E Ziden 2 5 Free	0 0 0 0 0 0 0 0 0 0	0 0 0 1 0 0 0 0 0 1

## Matrices II

Example Command	Specification Matrix	Values
F Diag 3 3 Free	1 0 0 0 2 0 0 0 3	? 0 0 0 ? 0 0 0 ?
G SDiag 3 3 Free	0 0 0 1 0 0 2 3 0	0 0 0 ? 0 0 ? ? 0
H Stand 3 3 Free	0 1 2 1 0 3 2 3 0	1 ? ? ? 1 ? ? ? 1

## Matrices III

Example Command	Specification Matrix	Values
I Symm 3 3 Free	1 2 4 2 3 5 4 5 6	? ? ? ? ? ? ? ? ?
J Lower 3 3 Free	1 0 0 2 3 0 4 5 6	? 0 0 ? ? 0 ? ? ?
K Full 2 4 Free	1 2 3 4 5 6 7 8	? ? ? ? ? ? ? ?

## Constrained Matrices \*

Syntax	Matrix Quantity	Dimensions
%On	Observed covariance matrix	NI x NI
%En	Expected covariance matrix	NI x NI
%Mn	Expected mean vector	1 x NI
%Pn	Expected proportions	NR x NC
%Fn	Function value	1 x 1

\* to special quantities in previous groups

## Matrix Algebra / Model

- Begin Algebra;
  - $B = A \cdot A'$ ;
  - $C = B + B$ ;
  - ...
- End Algebra;
  
- Means [continuous] / Thresholds [categorical] X;
- Covariances X;
- Weight / Frequency X;

X: matrix or matrix formula

## Unary Matrix Operations

Symbol	Name	Function	Example	Priority
~	Inverse	Inversion	$A^{-1}$	1
'	Transpose	Transposition	$A^T$	1

## Binary Matrix Operations

Symbol	Name	Function	Example	Priority
^	Power	Element powering	$A^B$	2
*	Star	Multiplication	$A * B$	3
.	Dot	Dot multiplication	$A . B$	3
@	Kronecker	Kronecker product	$A @ B$	3
&	Quadratic	Quadratic product	$A \& B$	3
%	Eldiv	Element division	$A \% B$	3
+	Plus	Addition	$A + B$	4
-	Minus	Subtraction	$A - B$	4
	Bar	Horizontal adhesion	$A   B$	4
_	Underscore	Vertical adhesion	$A _ B$	4

## Matrix Operations (Mx p.59)

Symbol	Name	Function	Example	Priority
$\sim$	Inverse	Inversion	$A^{-1}$	1
$'$	Transpose	Transposition	$A'$	1
$\wedge$	Power	Element powering	$A^B$	2
$*$	Star	Multiplication	$A*B$	3
$.$	Dot	Dot multiplication	$A.B$	3
$@$	Kronecker	Kronecker product	$A@B$	3
$\&$	Quadratic	Quadratic product	$A\&B$	3
$\%$	Eldiv	Element division	$A\%B$	3
$+$	Plus	Addition	$A+B$	4
$-$	Minus	Subtraction	$A-B$	4
$ $	Bar	Horizontal adhesion	$A B$	4
$_$	Underscore	Vertical adhesion	$A_B$	4

## Matrix Functions (Mx p. 64)

Keyword	Function	Restrictions	Dimensions
$\backslash\text{tr}()$	Trace	$r=c$	$1 \times 1$
$\backslash\text{det}()$	Determinant	$r=c$	$1 \times 1$
$\backslash\text{sum}()$	Sum	None	$1 \times 1$
$\backslash\text{prod}()$	Product	None	$1 \times 1$
$\backslash\text{max}()$	Maximum	None	$1 \times 1$
$\backslash\text{min}()$	Minimum	None	$1 \times 1$
$\backslash\text{abs}()$	Absolute value	None	$r \times c$
$\backslash\text{exp}()$	Exponent	None	$r \times c$
$\backslash\text{ln}()$	Natural logarithm	None	$r \times c$
$\backslash\text{sqrt}()$	Square root	None	$r \times c$

## Matrix Functions II

Keyword	Function	Restrictions	Dimensions
\stand()	Standardize	$r=c$	$r \times c$
\mean()	Mean of columns	None	$1 \times c$
\cov()	Covariance of cols	None	$c \times c$
\pdfnor()	Mv normal density	$r=c+2$	$1 \times 1$
\mnor()	Mv normal integral	$r=c+3$	$1 \times 1$
\pchisq()	Probability of $\chi^2$	$r=1 \ c=2$	$1 \times 2$
\d2v()	Diagonal to vector	None	$\text{Min}(r,c) \times 1$
\m2v()	Matrix to vector	None	$rc \times 1$
\part()	Extract part of vector	None	variable

## Specify Numbers/ Parameters

- Numbers
  - Matrix <name> <number list>
  - Start/Value <name> <value> <element list>
- Parameters
  - Fix/Free <value> <element list>
  - Equate <name GRC> <name GRC>
  - Specify <name> <integer list>
  - Bound low high <parameter list/element list>
- Label Matrices
  - Label Row/Column <name> <label list>

## Options

- Statistical Output
  - Suppressing output: No\_Output
  - Appearance: NDecimals=n
  - Residuals: RSiduals
  - Adjusting Degrees of Freedom: DFreedom=n
- Power Calculations
  - Power = alpha,df
- Confidence Intervals
  - Interval {@value} <matrix element list>

## Options

- Optimization options
  - Bootstrap Estimates
  - Randomizing Starting Values: THard=n
  - Automatic Cold Restart: THard=-n
  - Jiggling Parameter Starting Values: Jiggle
  - Confidence Intervals on Fit Statistics
  - Comparative Fit Indices: Null
  - Likelihood-Ratio Statistics of Submodels: Issat/ Sat
  - Check Identification of Model: Check

## Fitting Submodels

- Multiple Fit
  - Option Multiple: Matrix/ Value/ Start/ Equate/ Fix/ Free/ Options
- Drop {@value} <parlist> <element list>
- Binary Save/Get <filename>
- Writing Matrices to Files
  - MXn = <filename>
- Writing Individual Likelihood Stats to Files:
  - MXnP = <filename>

## Mx

- Graphical Interface
- Language
  
- [www.vcu.edu/mx](http://www.vcu.edu/mx)