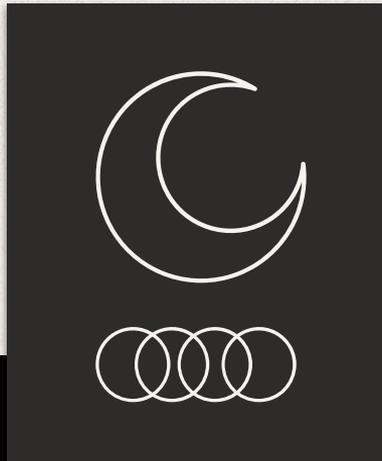


Introduction to Mplus



Brittany Wheeler and Bailey Braunstein

- **01**

What is Mplus?

An introduction

- **02**

Code Components

What is needed to perform an analysis?

- **03**

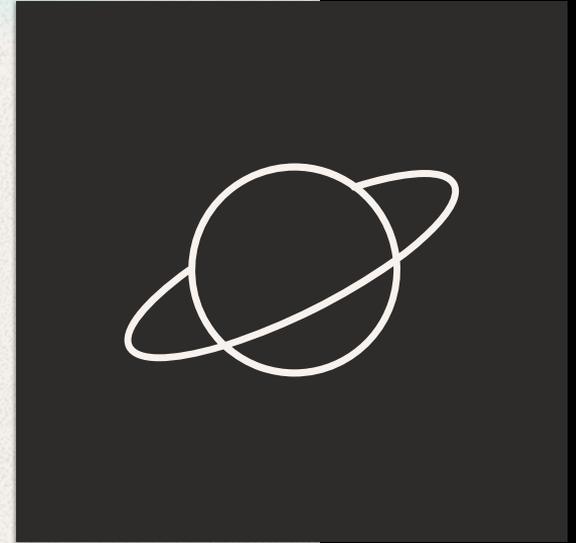
Importing your Data

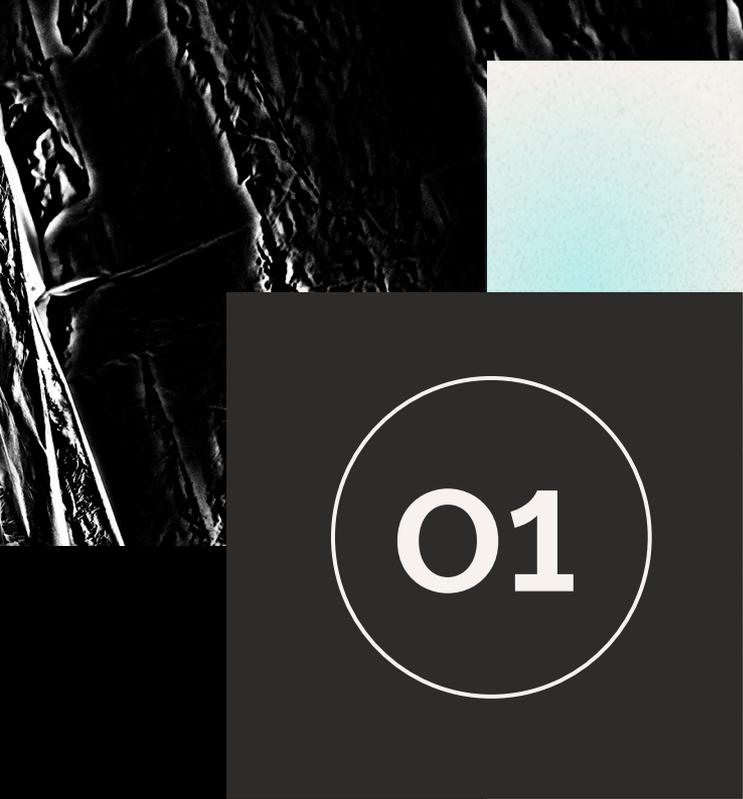
From SPSS to Mplus

- **04**

Examples

Descriptives, Linear Regression, Mediation, and Factor Analysis



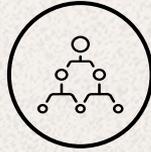


01

What is Mplus

...and why would I need it?





Mplus is a statistical modeling program that is primarily used for its ability to handle multiple types of variables and data.



Compared to similar modeling programs, Mplus is very flexible allowing you to test many different variations of models.



Popular analyses performed using Mplus are factor analysis and structural equation modeling since it can model latent variables.

The screenshot shows the Mplus software interface. The main window is titled "Mplus - Mptest2.inp". Below the menu bar (File, Edit, View, Mplus, Graph, Window, Help) is a toolbar with various icons. A text editor window titled "Mptest2.inp" is open, displaying the following code:

```
TITLE: "Wohin-steuert"-Datei, lineare Regression
DATA: FILE IS "C:\Eigene Dateien\Gul\Wohin steuert\del.csv";
VARIABLE: NAMES ARE cw144yf1 cw144yf2 leink1 leink2 bildg1 bildg2 eigschl eigsch2
          kkz gewi; WEIGHT IS gewi; ! CLUSTER IS kkz;
USEVARIABLES ARE cw144yf1 cw144yf2 leink1 leink2 bildg1 bildg2 eigschl eigsch2
          gewi;
! CATEGORICAL IS eigschl eigsch2;
ANALYSIS: ESTIMATOR=MLR;
! TYPE = COMPLEX; ! (nur für Cluster Option!)
MODEL: cw144yf1 cw144yf2 ON leink1 leink2 bildg1 bildg2 eigschl eigsch2 ;
```

The status bar at the bottom left shows "Ready" and the bottom right shows "Ln 11, Col 1".



02

Code Components

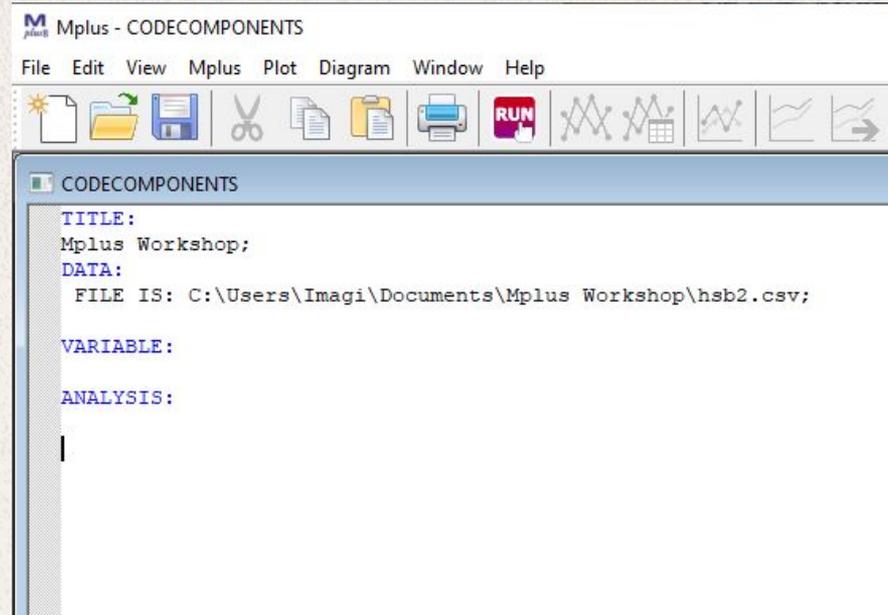
What do I need to include to perform an analysis?



● Key Components of Code

- **TITLE** - It should be something that helps you understand the analyses you ran.
- **DATA** - The data section of the code tells the program where in your computer your data file is located.

These statements end with a semicolon.



The screenshot shows the Mplus software interface. The title bar reads "Mplus - CODECOMPONENTS". The menu bar includes "File", "Edit", "View", "Mplus", "Plot", "Diagram", "Window", and "Help". The toolbar contains icons for file operations (new, open, save, delete, copy, paste, print) and analysis functions (run, model fit, plot, etc.). The main window displays the following code:

```
CODECOMPONENTS
TITLE:
Mplus Workshop;
DATA:
FILE IS: C:\Users\Imagi\Documents\Mplus Workshop\hsb2.csv;
VARIABLE:
ANALYSIS:
|
```

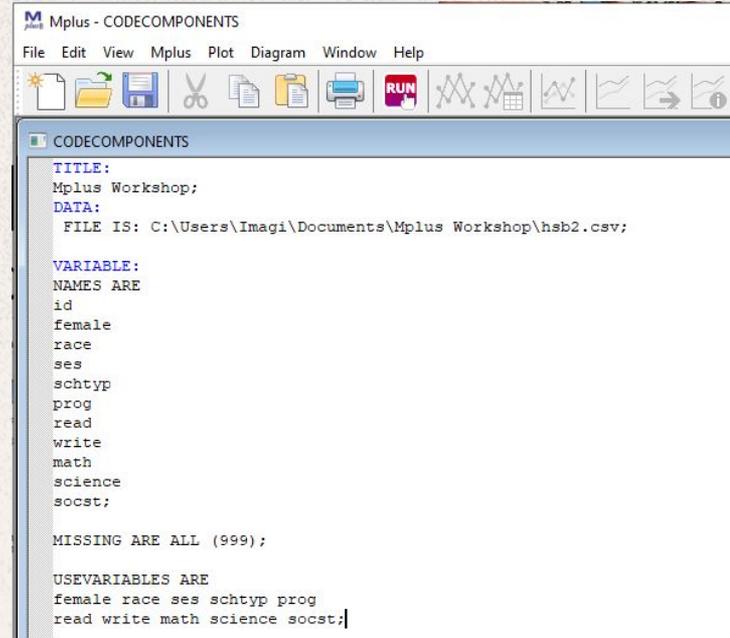
● Key Components of Code

● **VARIABLE: NAMES ARE** - This section tells the program what your variables are.

- You want to list them in the same order as your dataset.
- Mplus likes short variable names.

● **MISSING ARE ALL** - Tells the program what value you are using to identify missing observations.

● **USEVARIABLES ARE** - Tells the program what variables you want to use.



```
Mplus - CODECOMPONENTS
File Edit View Mplus Plot Diagram Window Help
CODECOMPONENTS
TITLE:
Mplus Workshop;
DATA:
FILE IS: C:\Users\Imagi\Documents\Mplus Workshop\hsb2.csv;

VARIABLE:
NAMES ARE
id
female
race
ses
schtyp
prog
read
write
math
science
socst;

MISSING ARE ALL (999);

USEVARIABLES ARE
female race ses schtyp prog
read write math science socst;
```

● Key Components of Code

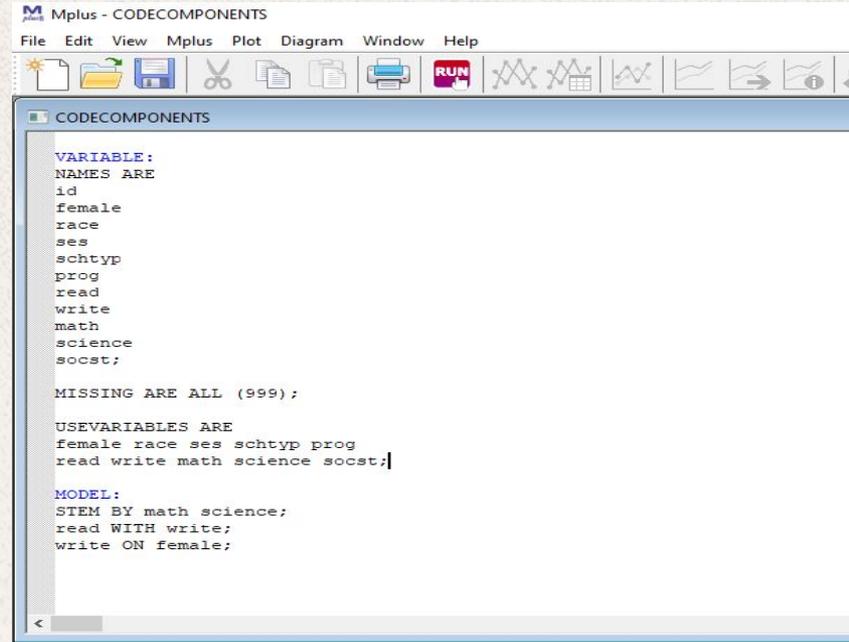
● **MODEL** - This is where you state which variables influence other variables.

- Dependent variables are written before the independent variables.

● **ON** - Used to define regression relationships.

● **BY** - Used to indicate indicators of latent factors.

● **WITH** - Correlated variables.



```
Mplus - CODECOMPONENTS
File Edit View Mplus Plot Diagram Window Help
CODECOMPONENTS
VARIABLE:
NAMES ARE
id
female
race
ses
schtyp
prog
read
write
math
science
socst;

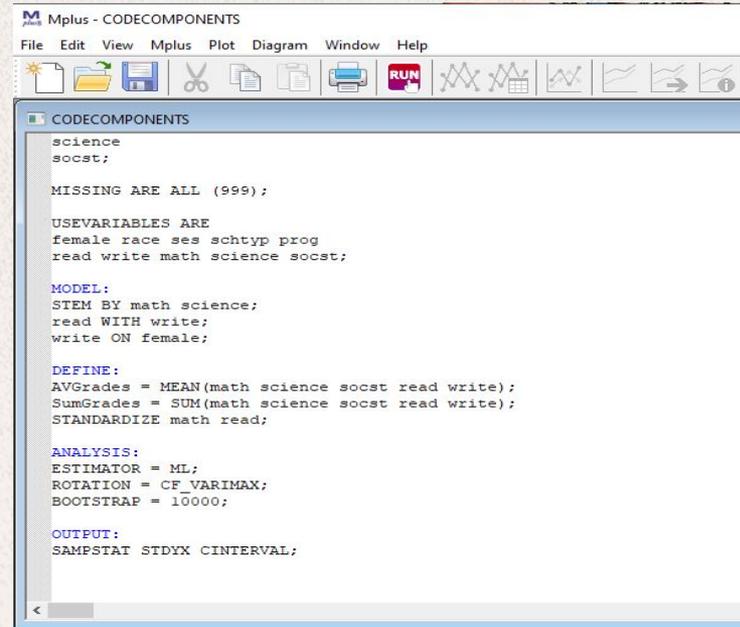
MISSING ARE ALL (999);

USEVARIABLES ARE
female race ses schtyp prog
read write math science socst;

MODEL:
STEM BY math science;
read WITH write;
write ON female;
```

• Additional Components of Code

- These bits of code are not required, but are generally added.
- **DEFINE** - Transform or manipulate variables.
- **ANALYSIS** - Can specify estimation method or request bootstrapping.
- **OUTPUT** - Request standardized results, sample statistics, and confidence intervals.
- **!** - Can be used to comment code and doesn't need to end in a semicolon.



```
Mplus - CODECOMPONENTS
File Edit View Mplus Plot Diagram Window Help
[Icons: Open, Save, Print, Run, etc.]

CODECOMPONENTS
science
socst;

MISSING ARE ALL (999);

USEVARIABLES ARE
female race ses schtyp prog
read write math science socst;

MODEL:
STEM BY math science;
read WITH write;
write ON female;

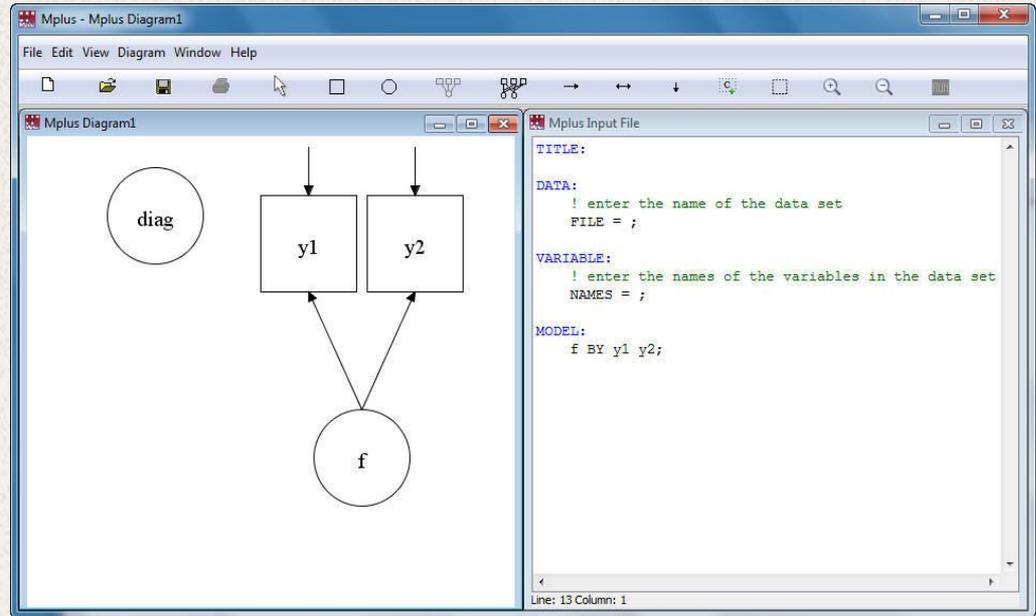
DEFINE:
AVGrades = MEAN(math science socst read write);
SumGrades = SUM(math science socst read write);
STANDARDIZE math read;

ANALYSIS:
ESTIMATOR = ML;
ROTATION = CF_VARIMAX;
BOOTSTRAP = 10000;

OUTPUT:
SAMPSTAT STDYX CINTERVAL;
```

● Additional Notes

- Commands must begin on a new line.
- Lines of code cannot be more than 90 characters long.
- Unlike R or STATA, Mplus runs **all** the code in your input file.
- Mplus will force you to save your input code before running.
- You can also use the diagrammer to write the code.
 - It only will write part of the code for you.



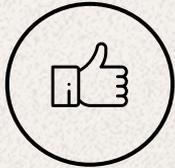


Importing Data

Moving data from SPSS to Mplus



Steps to Import Your Data



Step 1: Run descriptives in SPSS

This can be useful to check if you imported your data correctly.



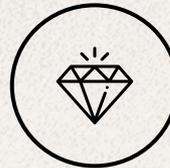
Step 4: Deal with missing values

Recode all of the system missing to a number (e.g., 999).
RECODE var1 TO var10 (SYSMIS=999)
(ELSE=COPY).



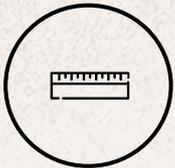
Step 2: Remove or convert non-numeric variables

Mplus cannot read character data.



Step 5: Export as .CSV

Make sure you unselect “write variable names to file”. Remember the order of your variables.



Step 3: Shorten variable names

Mplus will shorten variable names longer than 8 characters.



Step 6: Run descriptives in Mplus

This is to double check your data was imported correctly.

hsb2.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

New Open Import Data Close Save Save As... Save All Data Export Mark File Read Only Revert to Saved File Rename Dataset... Display Data File Information Cache Data... Collect Variable Information Stop Processor Switch Server... Repository Print Preview Print... Welcome Dialog... Recently Used Data Recently Used Files Exit

Data Syntax Output Script

	Label	Values	Missing	Columns	Align	Measure	Role
		{00, male}...	None	8	Right	Scale	Input
2		{1.00, hispa...	None	8	Right	Ordinal	Input
2		{1.00, low}...	None	8	Right	Ordinal	Input
2	type of school	{1.00, public...	None	8	Right	Ordinal	Input
2	type of program	{1.00, gener...	None	8	Right	Ordinal	Input
2	reading score	None	None	8	Right	Scale	Input
2	writing score	None	None	8	Right	Scale	Input
2	math score	None	None	8	Right	Scale	Input
2	science score	None	None	8	Right	Scale	Input
2	social studies s...	None	None	8	Right	Ordinal	Input

Data View Variable View

Syntax

IBM SPSS Statistics Processor is ready Unicode: ON

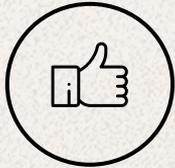
*Syntax1 - IBM SPSS Statistics Syntax Editor

File Edit View Data Transform Analyze Graphs Utilities Run Tools Extensions Window Help

RECODE

```
1 RECODE var1 TO var10 (SYSMIS=999) (ELSE=COPY),
2
```

Steps to Import Your Data



Step 1: Run descriptives in SPSS

This can be useful to check if you imported your data correctly.



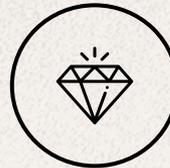
Step 4: Deal with missing values

Recode all of the system missing to a number (e.g., 999).
`RECODE var1 TO var10 (SYSMIS=999) (ELSE=COPY).`



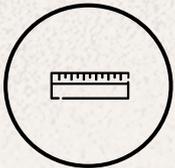
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Step 3: Shorten variable names

Mplus will shorten variable names longer than 8 characters.



Step 6: Run descriptives in Mplus

This is to double check your data was imported correctly.

- New
- Open
- Import Data
- Close Ctrl+F4
- Save Ctrl+S
- Save As...
- Save All Data
- Export**
- Mark File Read Only
- Revert to Saved File
- Rename Dataset...
- Display Data File Information
- Cache Data...
- Collect Variable Information
- Stop Processor Ctrl+Period
- Switch Server...
- Repository
- Print Preview
- Print... Ctrl+P
- Welcome Dialog...
- Recently Used Data
- Recently Used Files
- Exit

Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
2			None	None	8	Right	Scale	Input
2			{.00, male}...	None	8	Right	Ordinal	Input
2			{1.00, hispa...	None	8	Right	Ordinal	Input
2			{1.00, low}...	None	8	Right	Ordinal	Input
2		type of school	{1.00, public...	None	8	Right	Ordinal	Input
2			{1.00, gener...	None	8	Right	Ordinal	Input
2			score	None	8	Right	Scale	Input
2			score	None	8	Right	Scale	Input
2			score	None	8	Right	Scale	Input
2			e score	None	8	Right	Scale	Input
2			studies s...	None	8	Right	Scale	Input

- Database...
- Excel
- CSV Data...**
- Tab-delimited...
- Fixed Text...
- SAS...
- Stata...
- dBase...
- Lotus...
- Cognos TM1...
- SYLK...

Save Data As

Look in: Downloads

- processv35
- spss_26_home_usage_win64
- insurance.csv
- smileannotationsfinal.csv

Keeping 6 of 6 variables.

File name: sample.csv

Save as type: Comma delimited (*.csv)

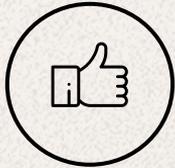
Encoding:

Write variable names to file

Save value labels where defined instead of data values

Buttons: Variables..., Save, Paste, Cancel, Help, Store File To Repository...

Steps to Import Your Data



Step 1: Run descriptives in SPSS

This can be useful to check if you imported your data correctly.



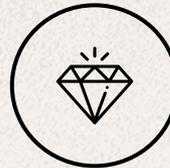
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Recode all of the system missing to a number (e.g., 999).
`RECODE var1 TO var10 (SYSMIS=999) (ELSE=COPY).`



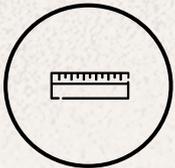
Step 2: Remove or convert non-numeric variables

Mplus cannot read character data.



Step 5: Export as .CSV

Make sure you unselect “write variable names to file”. Remember the order of your variables.



Step 3: Shorten variable names

Mplus will shorten variable names longer than 8 characters.



Step 6: Run descriptives in Mplus

This is to double check your data was imported correctly.

ImportingData

```
Title:
  Entering data from .csv file
Data:
  File is "C:\Users\Imagi\Documents\Mplus Workshop\hsb2.csv";

Variable:
  NAMES ARE
  id
  female
  race
  ses
  schtyp
  prog
  read
  write
  math
  science
  scost;

MISSING ARE ALL (999);

analysis:
type=basic;
```

importingdata

RESULTS FOR BASIC ANALYSIS

ESTIMATED SAMPLE STATISTICS

Means	FEMALE	RACE	SES	SCHTYP
ID	0.545	3.430	2.055	1.160

Means	READ	WRITE	MATH	SCIENCE
PROG	52.230	52.775	52.645	51.850

Means	SCOST
	52.405

Covariances	FEMALE	RACE	SES	SCHTYP
ID	3333.250			
FEMALE	-2.507	0.248		
RACE	44.825	0.001	1.075	
SES	8.798	-0.045	0.146	0.522
SCHTYP	10.210	0.003	0.041	0.036
PROG	-2.307	0.001	-0.036	0.009
READ	87.755	-0.270	2.581	2.167



03

Examples

Let's look at the program!



Common Errors

*** WARNING in VARIABLE command Note that only the first 8 characters of variable names are used in the output. Shorten variable names to avoid any confusion.

*** WARNING Input line exceeded 90 characters. Some input may be truncated.

*** WARNING in MODEL command All variables are uncorrelated with all other variables in the model.

**THE MODEL ESTIMATION TERMINATED
NORMALLY**

The Model Will Not Run...

Check the following:

- Semicolons at the end of each line.
- The correct variables are specified in “usevariables” command.
- The location of your data is specified correctly.
- Check your spelling.
- Make sure your variable names are in the correct order.
- Missing data is coded correctly.

Resources

General Resources

- www.statmodel.com - Created by the developers of Mplus and contains multiple examples to walkthrough and a support forum to ask questions.
- stats.idre.ucla.edu/ - Contains annotated Mplus output for various analyses.

Video Walkthroughs

- Importing data - <https://www.youtube.com/>
- SEM in Mplus - <https://www.youtube.com/playlist>

Code Resources

- <https://www.statmodel.com/language.html> - Detailed guide of all possible segments of code.
- https://offbeat.group.shef.ac.uk/FIO/models_and_index.pdf - Code for performing mediation and moderation analyses by Figure It Out Statistical Consulting.
- <https://global.oup.com/us/companion.websites/9780195367621/pdf/MplusQuickGuide2015.pdf> - A quick guide to Mplus code by Dr. Bowen of Ohio State.



STATISTICS AND METHODS

SAM LAB

ARIZONA STATE UNIVERSITY

Thank You!

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