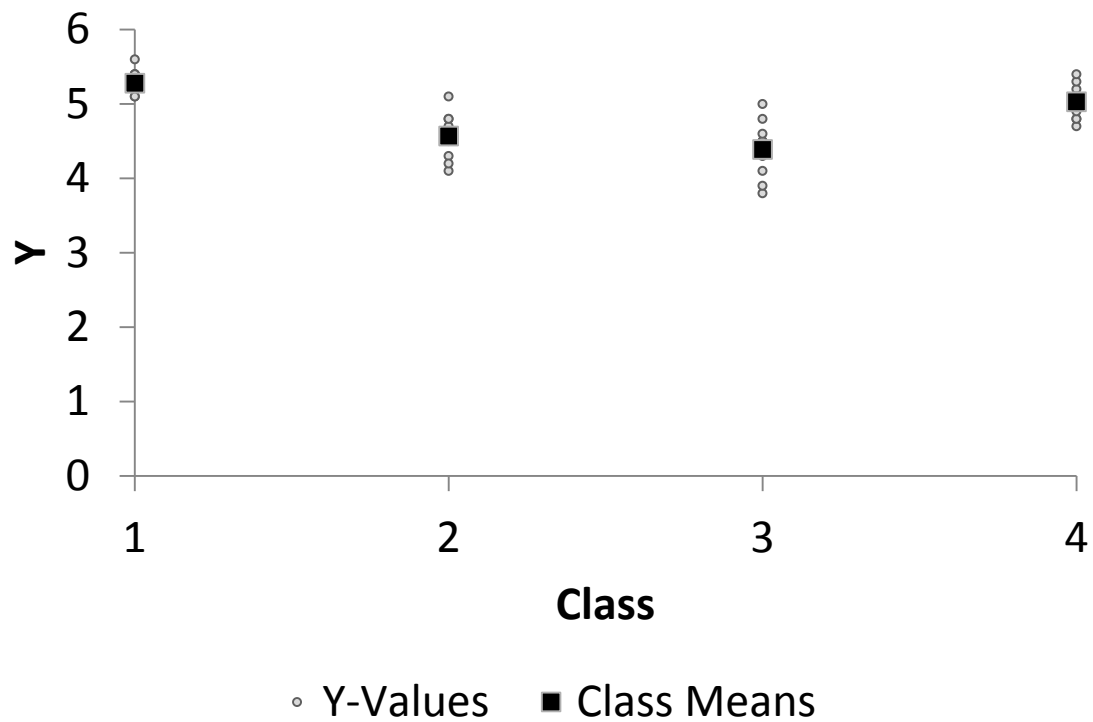
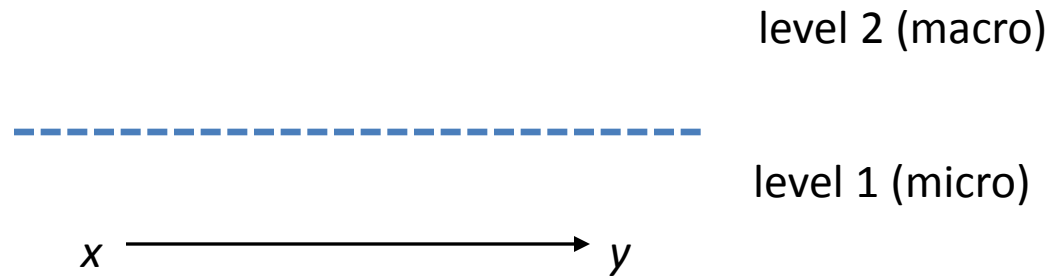


Multilevel Modeling: Introduction



Macro-level, micro-level, and cross-level relations (Snijders & Bosker, 2012)

Micro-level propositions



Macro-level, micro-level, and cross-level relations (Snijders & Bosker, 2012)

Macro-level propositions

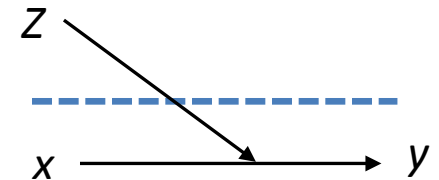
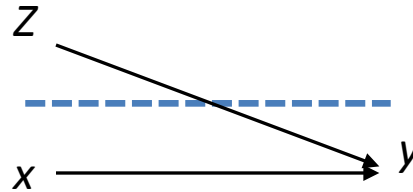
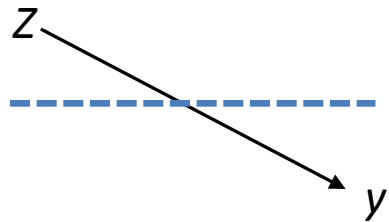
$Z \longrightarrow Y$

level 2 (macro)

level 1 (micro)

Macro-level, micro-level, and cross-level relations (Snijders & Bosker, 2012)

Macro-micro propositions

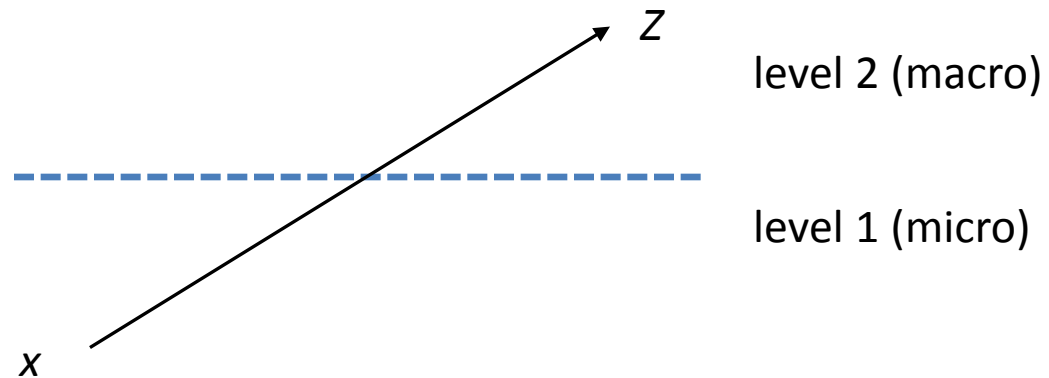


level 2 (macro)


level 1 (micro)

Macro-level, micro-level, and cross-level relations (Snijders & Bosker, 2012)

Micro-macro propositions



Mplus Website

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<div> ANALYSES/RESEARCH Mplus Examples Papers References </div>	<div> Student Pricing for Mplus Version 7.11 <p>Special student pricing is available for Mplus. The student version of the program is identical to the regular version. Click here for more information.</p> </div>
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HLM Website

← → ↻ www.ssicentral.com/hlm/index.html



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H HLM - Hierarchical Linear and Nonlinear Modeling (HLM)

In social research and other fields, research data often have a hierarchical structure. That is, the individual subjects of study may be classified or arranged in groups which themselves have qualities that influence the study. In this case, the individuals can be seen as level-1 units of study, and the groups into which they are arranged are level-2 units. This may be extended further, with level-2 units organized into yet another set of units at a third level and with level-3 units organized into another set of units at a fourth level. Examples of this abound in areas such as education (students at level 1, teachers at level 2, schools at level 3, and school districts at level 4) and sociology (individuals at level 1, neighborhoods at level 2). It is clear that the analysis of such data requires specialized software. Hierarchical linear and nonlinear models (also called multilevel models) have been developed to allow for the study of relationships at any level in a single analysis, while not ignoring the variability associated with each level of the hierarchy.



The HLM program can fit models to outcome variables that generate a linear model with explanatory variables that account for variations at each level, utilizing variables specified at each level. HLM not only estimates model coefficients at each level, but it also predicts the random effects associated with each sampling unit at every level. While commonly used in education research due to the prevalence of hierarchical structures in data from this field, it is suitable for use with data from any research field that have a hierarchical structure. This includes longitudinal analysis, in which an individual's repeated measurements can be nested within the individuals being studied. In addition, although the examples above implies that members of this hierarchy at any of the levels are nested exclusively within a member at a higher level, HLM can also provide for a situation where membership is not necessarily "nested", but "crossed", as is the case when a student may have been a member of various classrooms during the duration of a study period.

The HLM program allows for continuous, count, ordinal, and nominal outcome variables and assumes a functional relationship between the expectation of the outcome and a linear combination of a set of explanatory variables. This relationship is defined by a suitable link function, for example, the identity link (continuous outcomes) or logit link (binary outcomes).

HLM Website

← → ↻ www.ssicentral.com/hlm/student.html



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S Student edition

The student edition of HLM 7 can be downloaded from this page.

Please print this page before downloading the student edition, as the restrictions and other useful information concerning the program are given here. Also note that no technical support is provided for the student edition and that no serial number is required during installation.

The student edition of HLM 7 is available as a single, self-extracting executable **HLM7StudentSetup.exe**.

- Save **HLM7StudentSetup.exe** to the desktop or a USB flash drive.
- Run **HLM7StudentSetup.exe** from the **Windows Start Menu**.
- Default installation will be to a new folder "C:\Program Files\HLM7Student". You may change the name and location of this folder.
- After successful installation the downloaded file **HLM7StudentSetup.exe** may be deleted.

The student edition includes the following:

- All the examples distributed with the full HLM 7 edition. These examples may be run with the student edition.
- The HLM 7 help file.
- A PDF copy of the HLM 7 manual.

The student edition can run all the analyses the full edition can in terms of models selected, statistical options and output. Restrictions are, however, placed on the data used and the size of the model selected. The following restrictions apply in this edition:

- The STAT/Transfer utility used for the importation of data is not included. The student edition will only accept ASCII, SYSTAT, SPSS for Windows or SAS transport data files. **Note that SPSS data files created with SPSS 21 or earlier can be used with the student edition.**
- For a level-3 model, the maximum number of observations that may be used at levels 1, 2 and 3 is approximately 8000, 1700 and 60, respectively. Note that the restriction applies to observations in the case of the level-2 file, for example, and not to the actual number of level-2 units to be included in the analysis.
- For a level-2 model, the maximum number of observations at the two levels is 8000 at level-1 and 350 at level-2 of the hierarchy.
- No more than 5 effects may be included in any HLM equation at any level of the model, and the grand total of effects can not be 25 or higher.

When these limitations are exceeded, an appropriate error message will automatically be displayed.

For more information on how to set up these models and how to interpret the output, please see the Help file that comes with the program and the [basic examples](#).



[Download HLM 7 \(Student Edition\) \(29,905 KB\)](#)

Mplus Basic Syntax

Ten basic commands (with sub-commands)

Most common:

TITLE:

DATA:

VARIABLE:

MODEL:

Others:

DEFINE:

ANALYSIS:

OUTPUT:

SAVEDATA:

PLOT:

MONTECARLO:

Free Format Data File Specification in Mplus

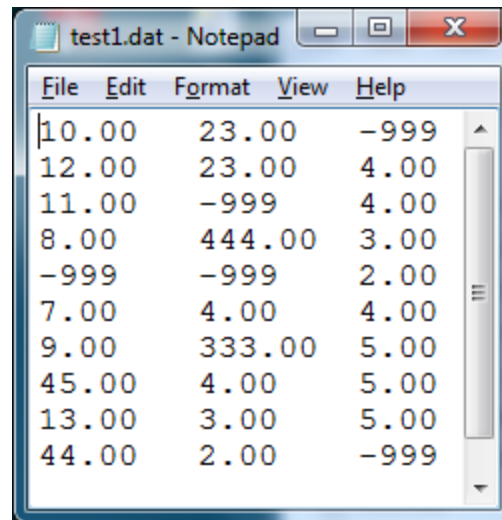
DATA:

file is test1.dat;

VARIABLE:

names are v1 v2 v3;

missing all (-999);



The screenshot shows a Notepad window titled "test1.dat - Notepad". The window contains a data file with 12 rows and 3 columns of values. The values are as follows:

v1	v2	v3
10.00	23.00	-999
12.00	23.00	4.00
11.00	-999	4.00
8.00	444.00	3.00
-999	-999	2.00
7.00	4.00	4.00
9.00	333.00	5.00
45.00	4.00	5.00
13.00	3.00	5.00
44.00	2.00	-999

Fixed Format Data File Specification in Mplus

data: File is vignette.dat;

Format is 21F8.2;

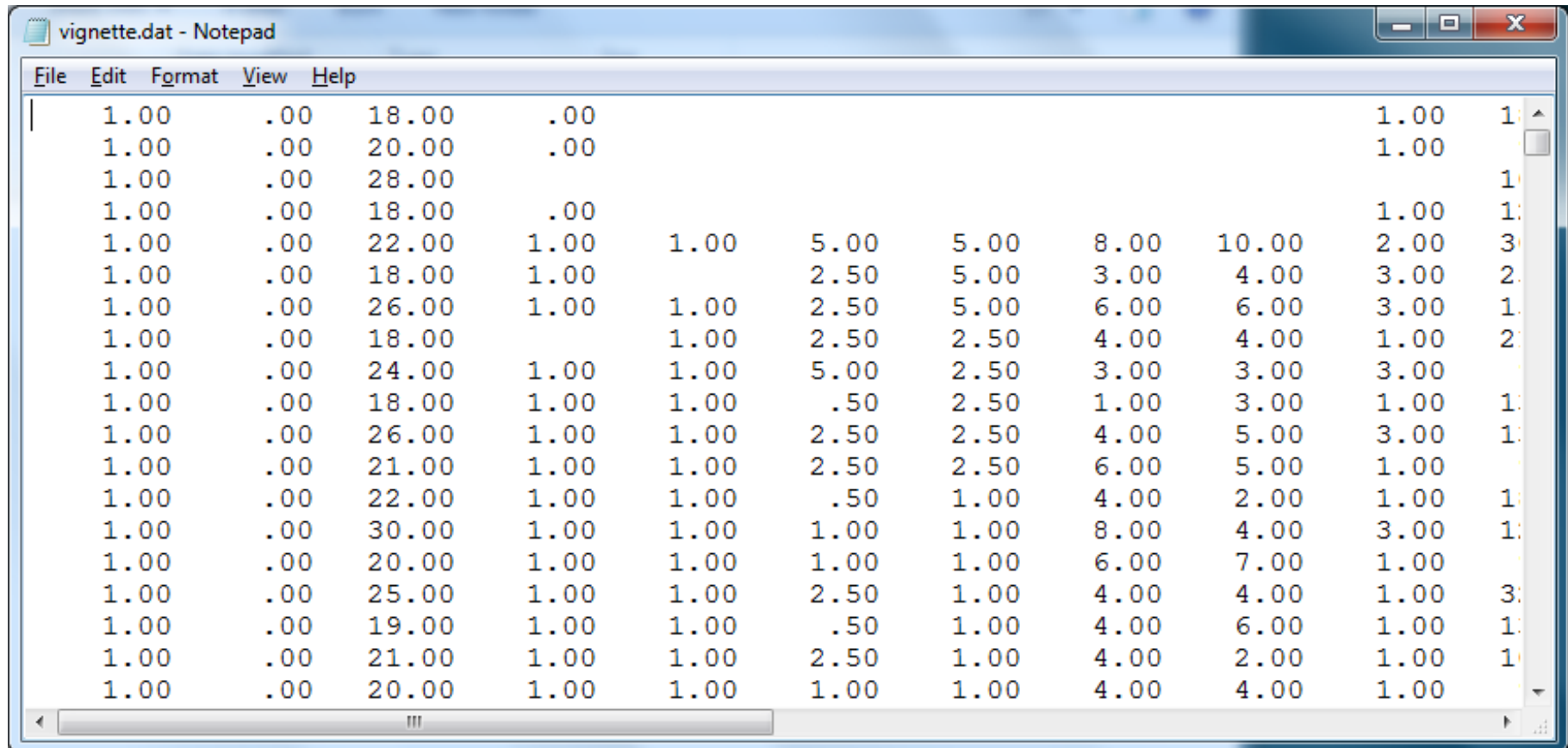
variable: names are clust gender age

everdr intox daysl2 daysse avgdr12 avgdrse smoke

bp_PA bp_V bp_A bp_H bp_tot AE_TR AE_LC AE_CB AE_RA

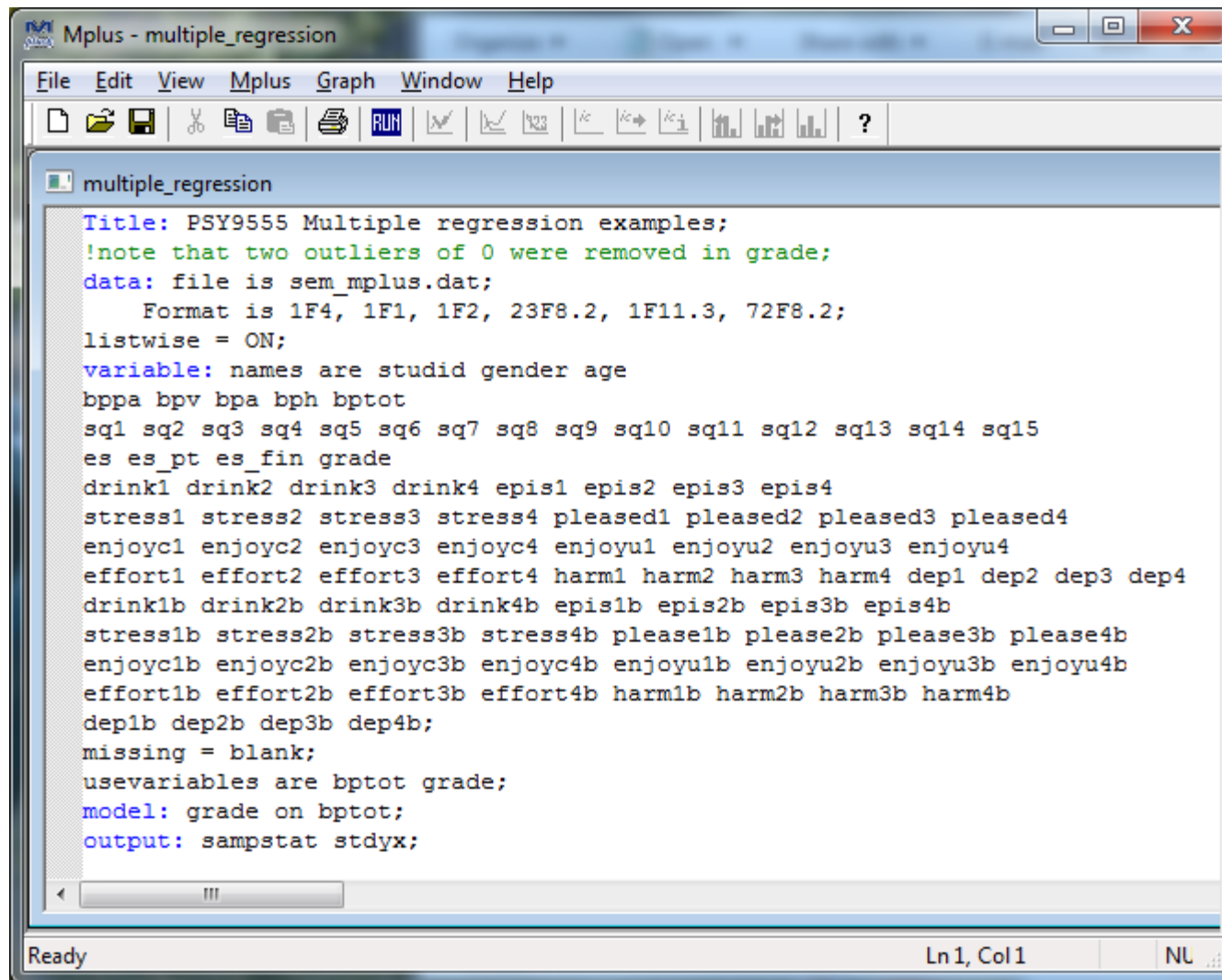
uni_num program2;

missing = blank;



1.00	.00	18.00	.00							1.00	1
1.00	.00	20.00	.00							1.00	
1.00	.00	28.00									1
1.00	.00	18.00	.00							1.00	1
1.00	.00	22.00	1.00	1.00	5.00	5.00	8.00	10.00	2.00	3.00	3
1.00	.00	18.00	1.00		2.50	5.00	3.00	4.00	3.00	2.00	2
1.00	.00	26.00	1.00	1.00	2.50	5.00	6.00	6.00	3.00	1.00	1
1.00	.00	18.00		1.00	2.50	2.50	4.00	4.00	1.00	2.00	2
1.00	.00	24.00	1.00	1.00	5.00	2.50	3.00	3.00	3.00		
1.00	.00	18.00	1.00	1.00	.50	2.50	1.00	3.00	1.00	1.00	1
1.00	.00	26.00	1.00	1.00	2.50	2.50	4.00	5.00	3.00	1.00	1
1.00	.00	21.00	1.00	1.00	2.50	2.50	6.00	5.00	1.00		
1.00	.00	22.00	1.00	1.00	.50	1.00	4.00	2.00	1.00	1.00	1
1.00	.00	30.00	1.00	1.00	1.00	1.00	8.00	4.00	3.00	1.00	1
1.00	.00	20.00	1.00	1.00	1.00	1.00	6.00	7.00	1.00		
1.00	.00	25.00	1.00	1.00	2.50	1.00	4.00	4.00	1.00	3.00	3
1.00	.00	19.00	1.00	1.00	.50	1.00	4.00	6.00	1.00	1.00	1
1.00	.00	21.00	1.00	1.00	2.50	1.00	4.00	2.00	1.00	1.00	1
1.00	.00	20.00	1.00	1.00	1.00	1.00	4.00	4.00	1.00		

Mplus: Regression – One Predictor



The screenshot shows the Mplus software window titled "Mplus - multiple_regression". The window has a menu bar with "File", "Edit", "View", "Mplus", "Graph", "Window", and "Help". Below the menu bar is a toolbar with various icons for file operations, editing, and running the model. The main text area contains the following Mplus input code:

```
multiple_regression

Title: PSY9555 Multiple regression examples;
!note that two outliers of 0 were removed in grade;
data: file is sem_mplus.dat;
      Format is 1F4, 1F1, 1F2, 23F8.2, 1F11.3, 72F8.2;
listwise = ON;
variable: names are studid gender age
bppa bpv bpa bph bptot
sq1 sq2 sq3 sq4 sq5 sq6 sq7 sq8 sq9 sq10 sq11 sq12 sq13 sq14 sq15
es es_pt es_fin grade
drink1 drink2 drink3 drink4 epis1 epis2 epis3 epis4
stress1 stress2 stress3 stress4 pleased1 pleased2 pleased3 pleased4
enjoyc1 enjoyc2 enjoyc3 enjoyc4 enjoyu1 enjoyu2 enjoyu3 enjoyu4
effort1 effort2 effort3 effort4 harm1 harm2 harm3 harm4 dep1 dep2 dep3 dep4
drink1b drink2b drink3b drink4b epis1b epis2b epis3b epis4b
stress1b stress2b stress3b stress4b please1b please2b please3b please4b
enjoyc1b enjoyc2b enjoyc3b enjoyc4b enjoyu1b enjoyu2b enjoyu3b enjoyu4b
effort1b effort2b effort3b effort4b harm1b harm2b harm3b harm4b
dep1b dep2b dep3b dep4b;
missing = blank;
usevariables are bptot grade;
model: grade on bptot;
output: sampstat stdyx;
```

At the bottom of the window, the status bar shows "Ready", "Ln 1, Col 1", and "NL".

Mplus: Regression – One Predictor

SAMPLE STATISTICS			MODEL RESULTS				
			Estimate	S.E.	Est./S.E.	Two-Tailed P-Value	
Means			GRADE ON				
	GRADE	BPTOT	BPTOT	-0.078	0.029	-2.672	0.008
1	74.698	59.829	Intercepts				
			GRADE	79.387	1.828	43.425	0.000
Covariances			Residual Variances				
	GRADE	BPTOT	GRADE	92.330	6.960	13.266	0.000
GRADE	94.201		STANDARDIZED MODEL RESULTS				
BPTOT	-23.893	304.857	STDYX Standardization				
Correlations							
	GRADE	BPTOT	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value	
GRADE	1.000						
BPTOT	-0.141	1.000	GRADE ON				
			BPTOT	-0.141	0.052	-2.699	0.007
			Intercepts				
			GRADE	8.179	0.329	24.831	0.000
			Residual Variances				
			GRADE	0.980	0.015	66.535	0.000

Mplus: Regression – One Predictor MLR (Maximum Likelihood Robust)

```
usevariables are bptot grade;
analysis:
estimator = mlr;
model: grade on bptot;
output: sampstat stdyx;
```

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GRADE ON BPTOT	-0.078	0.032	-2.476	0.013
Intercepts GRADE	79.387	1.865	42.556	0.000
Residual Variances GRADE	92.330	9.062	10.189	0.000

STANDARDIZED MODEL RESULTS

STDYX Standardization

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GRADE ON BPTOT	-0.141	0.056	-2.522	0.012
Intercepts GRADE	8.179	0.421	19.444	0.000
Residual Variances GRADE	0.980	0.016	62.179	0.000

Mplus: Logistic Regression

```

usevariables are grade bptot gender_d;
categorical is gender_d;
define:
if (gender eq 1) then gender_d = 1;
if (gender eq 2) then gender_d = 0;
analysis: estimator = ml; !if you don't specify this it does a probit regression analysis instead
model: gender_d on grade bptot;
output: sampstat standardized;
!plot: type=plot1;

```

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GENDER_D ON				
GRADE	0.013	0.012	1.092	0.275
BPTOT	0.015	0.006	2.308	0.021
Thresholds				
GENDER_D\$1	2.456	1.025	2.397	0.017

LOGISTIC REGRESSION ODDS RATIO RESULTS

GENDER_D ON	
GRADE	1.013
BPTOT	1.015

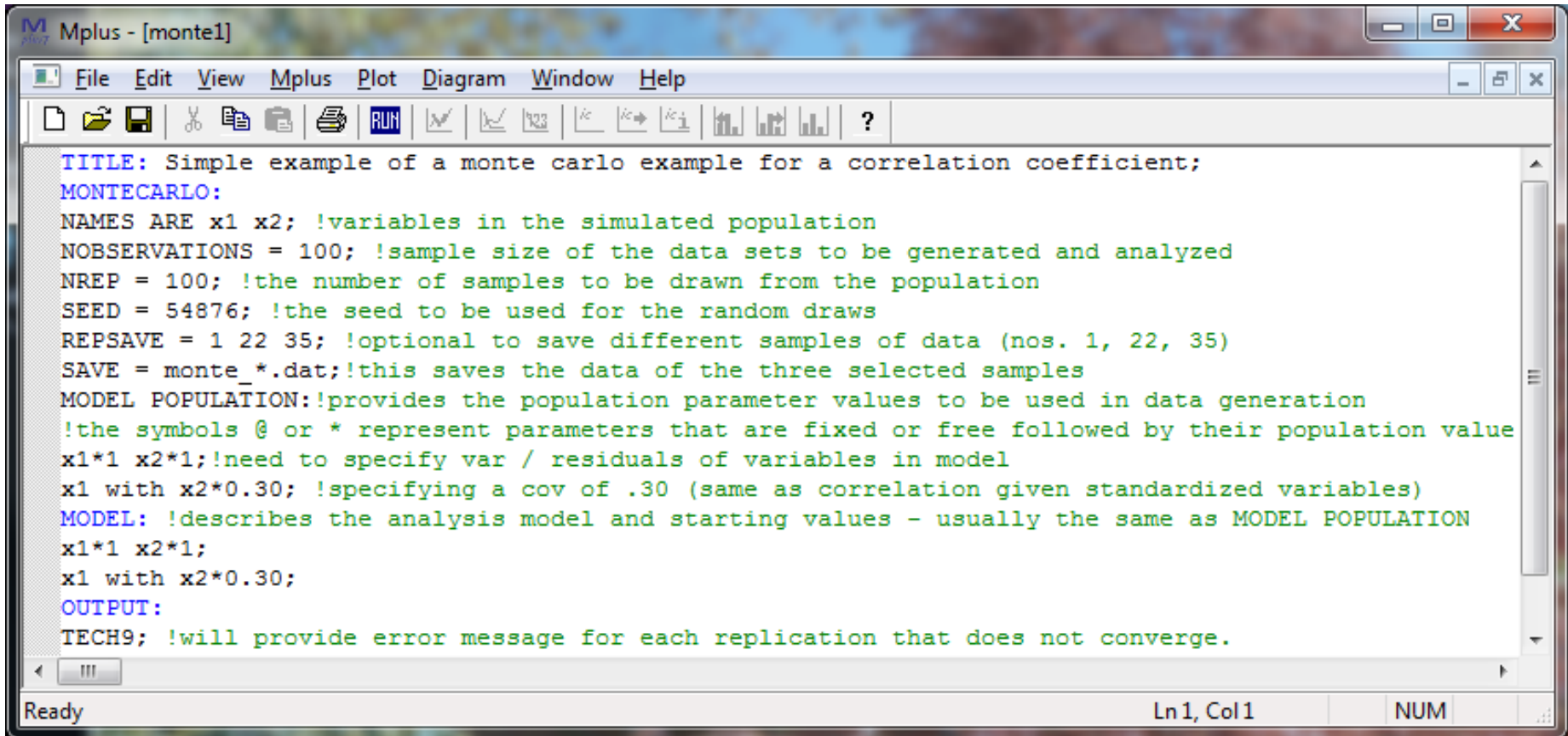
STANDARDIZED MODEL RESULTS

STDYX Standardization

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GENDER_D ON				
GRADE	0.068	0.062	1.096	0.273
BPTOT	0.141	0.060	2.346	0.019
Thresholds				
GENDER_D\$1	1.339	0.550	2.437	0.015

MONTECARLO in Mplus and Power

Example : A Correlation between two variables



The screenshot shows the Mplus software window titled "Mplus - [monte1]". The menu bar includes File, Edit, View, Mplus, Plot, Diagram, Window, and Help. The toolbar contains icons for file operations, running, and plotting. The main text area contains the following code:

```
TITLE: Simple example of a monte carlo example for a correlation coefficient;
MONTECARLO:
NAMES ARE x1 x2; !variables in the simulated population
NOBSERVATIONS = 100; !sample size of the data sets to be generated and analyzed
NREP = 100; !the number of samples to be drawn from the population
SEED = 54876; !the seed to be used for the random draws
REPSAVE = 1 22 35; !optional to save different samples of data (nos. 1, 22, 35)
SAVE = monte_*.dat; !this saves the data of the three selected samples
MODEL POPULATION: !provides the population parameter values to be used in data generation
!the symbols @ or * represent parameters that are fixed or free followed by their population value
x1*1 x2*1; !need to specify var / residuals of variables in model
x1 with x2*0.30; !specifying a cov of .30 (same as correlation given standardized variables)
MODEL: !describes the analysis model and starting values - usually the same as MODEL POPULATION
x1*1 x2*1;
x1 with x2*0.30;
OUTPUT:
TECH9; !will provide error message for each replication that does not converge.
```

The status bar at the bottom shows "Ready", "Ln1, Col1", and "NUM".

MONTECARLO in Mplus and Power

Example: A Correlation between two variables

MODEL RESULTS

		Population	ESTIMATES Average	Std. Dev.	S. E. Average	M. S. E.	95% Cover	% Sig Coeff
X1	WITH							
X2		0.300	0.2850	0.1194	0.1143	0.0143	0.950	0.720
Means								
X1		0.000	0.0091	0.1133	0.1109	0.0128	0.920	0.080
X2		0.000	0.0271	0.1131	0.1101	0.0134	0.950	0.050
Variances								
X1		1.000	0.9903	0.1613	0.1566	0.0259	0.950	1.000
X2		1.000	0.9762	0.1578	0.1543	0.0252	0.910	1.000