PSY 9555A – SEM: Sep 18 – Building Blocks (Multiple Regression & Factor Analysis)

Fundamental Concepts

$$cov_{xy} = r_{xy} SD_x SD_y$$

$$r_{TxTy} = \frac{r_{xy}}{\sqrt{r_{xx}}\sqrt{r_{yy}}}$$

$$\beta_1 = \frac{r_{y1} - r_{y2} r_{12}}{1 - r_{12}^2} \qquad \beta_2 = \frac{r_{y2} - r_{y1} r_{12}}{1 - r_{12}^2}$$

$$R_{y_{12}}^2 = {\beta_1}^2 + {\beta_2}^2 + 2 r_{12} \beta_1 \beta_2$$

$$R_{y_{12}}^2 = \beta_1 r_{y_1} + \beta_2 r_{y_2}$$

Fundamental Concepts

- Assumptions in multiple regression
  - see http://publish.uwo.ca/~ptrembla/resources/Assumptions-Multiple-Regression.pdf
- Suppression
- Partial and part (semi-partial correlations)
- Spuriousness and specification error
- Different types of correlation coefficients
- Censored variables

Fundamental Concepts

- Statistical tests
- Critical ratio
- Power, effect size, sample size
- Standard error of measurement estimates in SEM
- Bootstrapping

Data preparation (Chapter 3 – Kline)

- Raw data vs. summary (correlations/covariance matrix)
- Positive definiteness
- Missing data (ask yourself why data are missing)
    - Alternative procedures (see next slide)
- Normality and dealing with non-normality

Missing Data

- use multiple imputation or maximum likelihood
- not perfect but much better than conventional procedures
- Mplus
- See also http://www.ats.ucla.edu/stat/mplus/faq/fiml_counts.htm

Baraldi, A. N. & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology*, *48*, 5-37.

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology*, *60*, 549-576.

Missing Data: Mplus

In the second use, the AUXILIARY option is used in conjunction with TYPE=GENERAL with continuous dependent variables and maximum likelihood estimation to identify a set of variables that will be used as missing data correlates in addition to the analysis variables (Collins, Schafer, & Kam, 2001; Graham, 2003; Asparouhov & Muthén, 2008b; Enders, 2010). This use is not available with MODINDICES, BOOTSTRAP, and models with a set of exploratory factor analysis (EFA) factors in the MODEL command. The setting M in parentheses is placed behind the variables on the AUXILIARY statement that will be used as missing data correlates. Following is an example of how to specify the M setting:

AUXILIARY = z1-z4 (M);

where z1, z2, z3, and z4 are variables that will be used as missing data correlates in addition to the analysis variables.

From Mplus version 7 p. 552.

Dichotomous (Binary), Categorical-Ordinal, and Count Outcomes

Continuous

- continuous ordinal
- interval
- ratio

Discrete

- dichotomous, binary
- nominal (can have more than two unordered categories)
- ordinal

In Mplus after "variable: names are…" include

categorical are …..

- For dichotomous variables
  - 1 and 2 will be automatically recoded as 0 and 1
- For ordinal variables
  - no more than 10 categories
  - integer values only
  - categories automatically recoded as 0, 1, 2, …

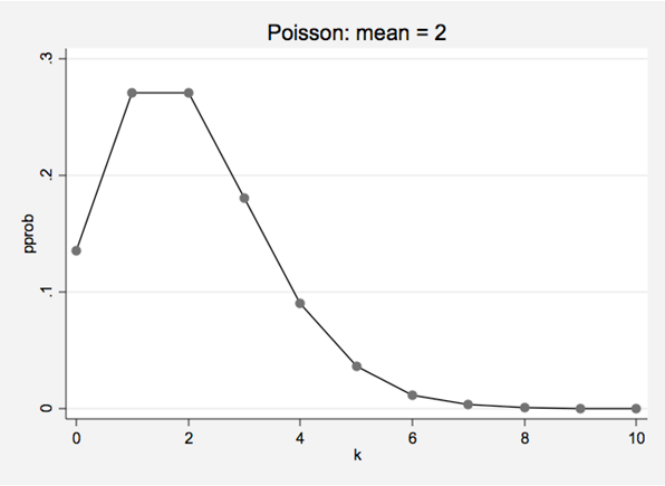
nominal are …..

- categories automatically recoded as 0, 1, 2, …
- last category is reference

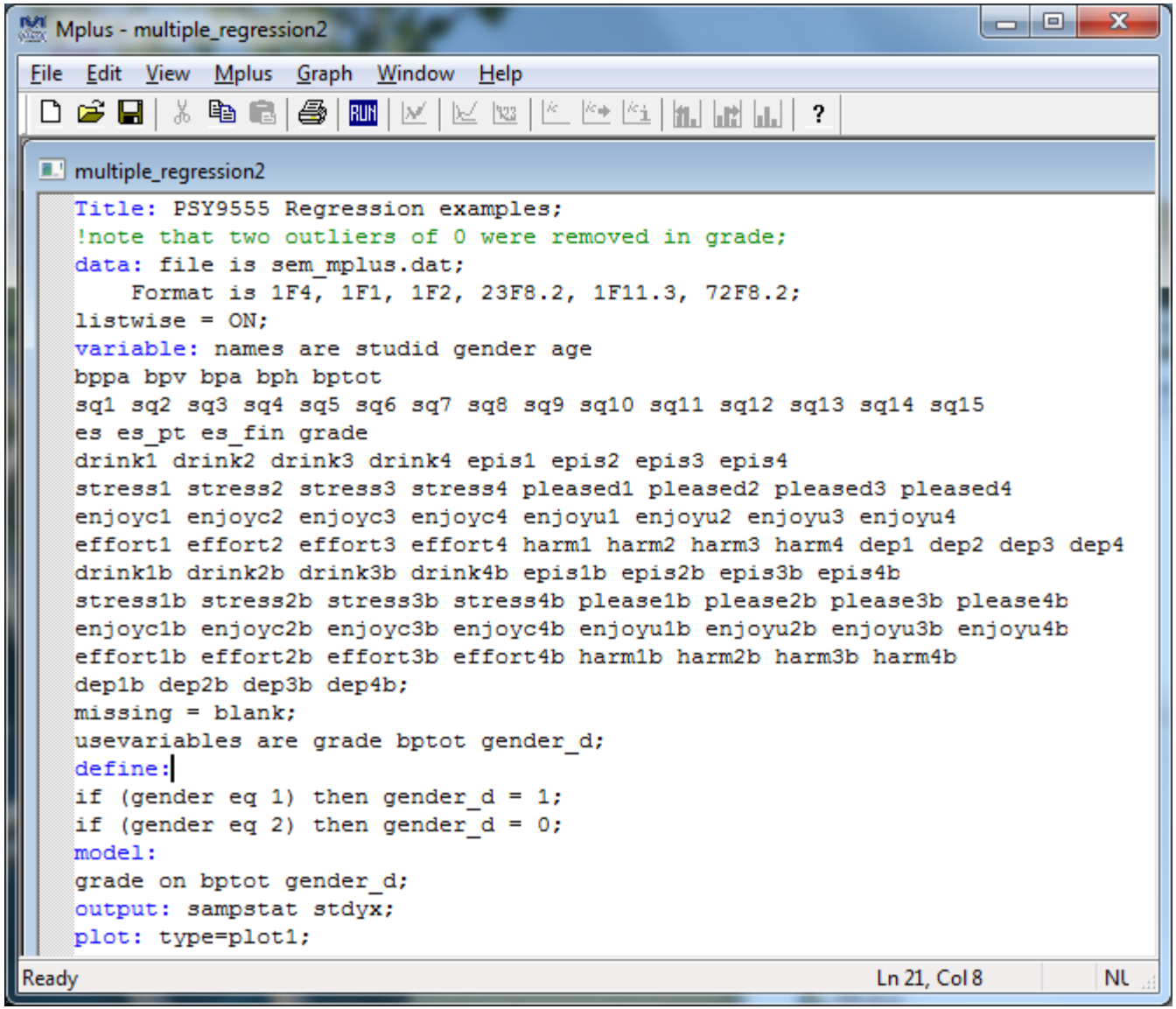
Dichotomous (Binary), Categorical-Ordinal, and Count Outcomes

Count Variables

- e.g., number of accidents at a particular highway
- Number of aggressive acts in the previous month
- Poisson distribution
  - To model count data that varies randomly over time
  - Often used when probability is small
  - Discrete values (positive integers)



Mplus: Regression – Two Predictors



Mplus: Multiple Regression – Two Predictors

Means

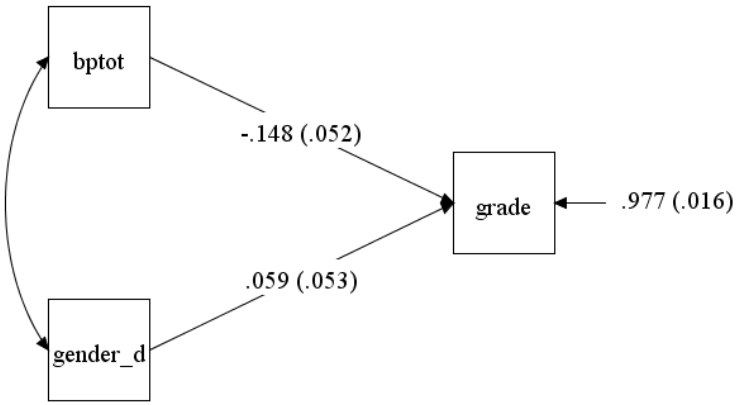
	GRADE	BPTOT	GENDER_D
1	74.698	59.829	0.355

Covariances

	GRADE	BPTOT	GENDER_D
GRADE	94.201		
BPTOT	-23.893	304.857	
GENDER_D	0.193	0.978	0.229

Correlations

	GRADE	BPTOT	GENDER_D
GRADE	1.000		
BPTOT	-0.141	1.000	
GENDER_D	0.041	0.117	1.000



MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GRADE ON				
BPTOT	-0.082	0.029	-2.788	0.005
GENDER_D	1.192	1.076	1.108	0.268
Intercepts				
GRADE	79.193	1.833	43.195	0.000
Residual Variances				
GRADE	92.007	6.935	13.267	0.000

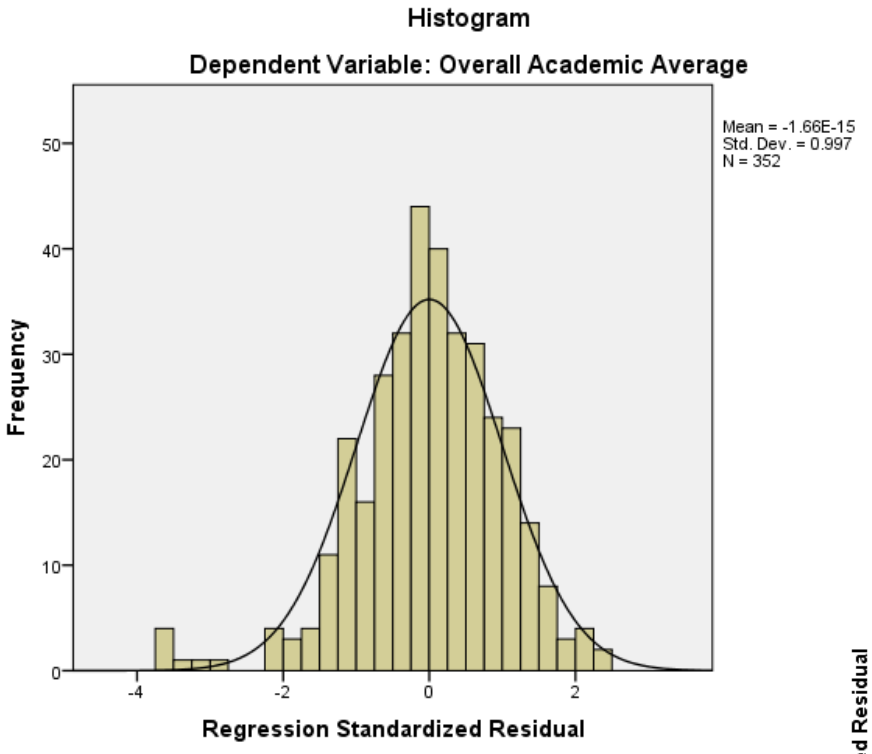
STDYX Standardization

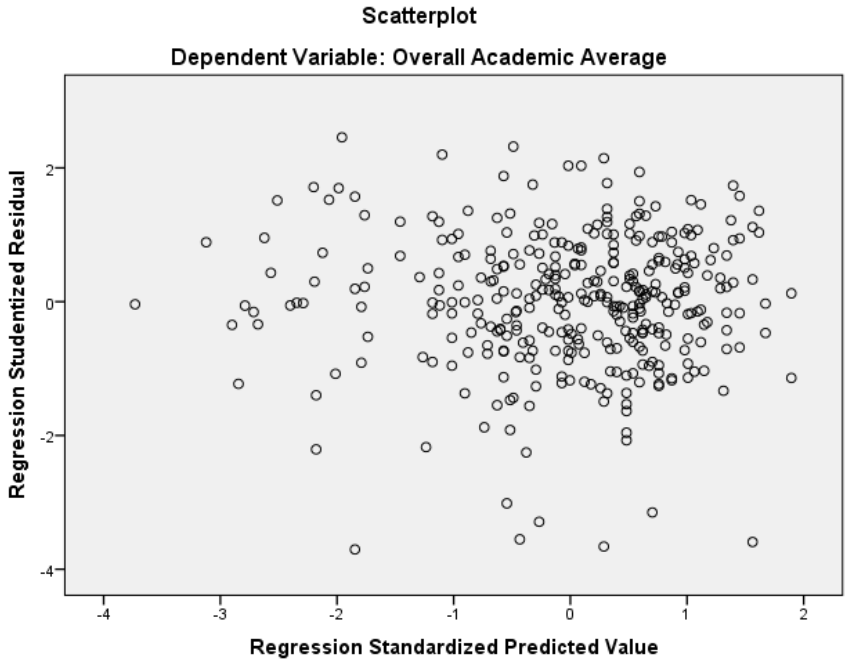
	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GRADE ON				
BPTOT	-0.148	0.052	-2.818	0.005
GENDER_D	0.059	0.053	1.110	0.267
Intercepts				
GRADE	8.159	0.331	24.682	0.000
Residual Variances				
GRADE	0.977	0.016	61.478	0.000

R-SQUARE

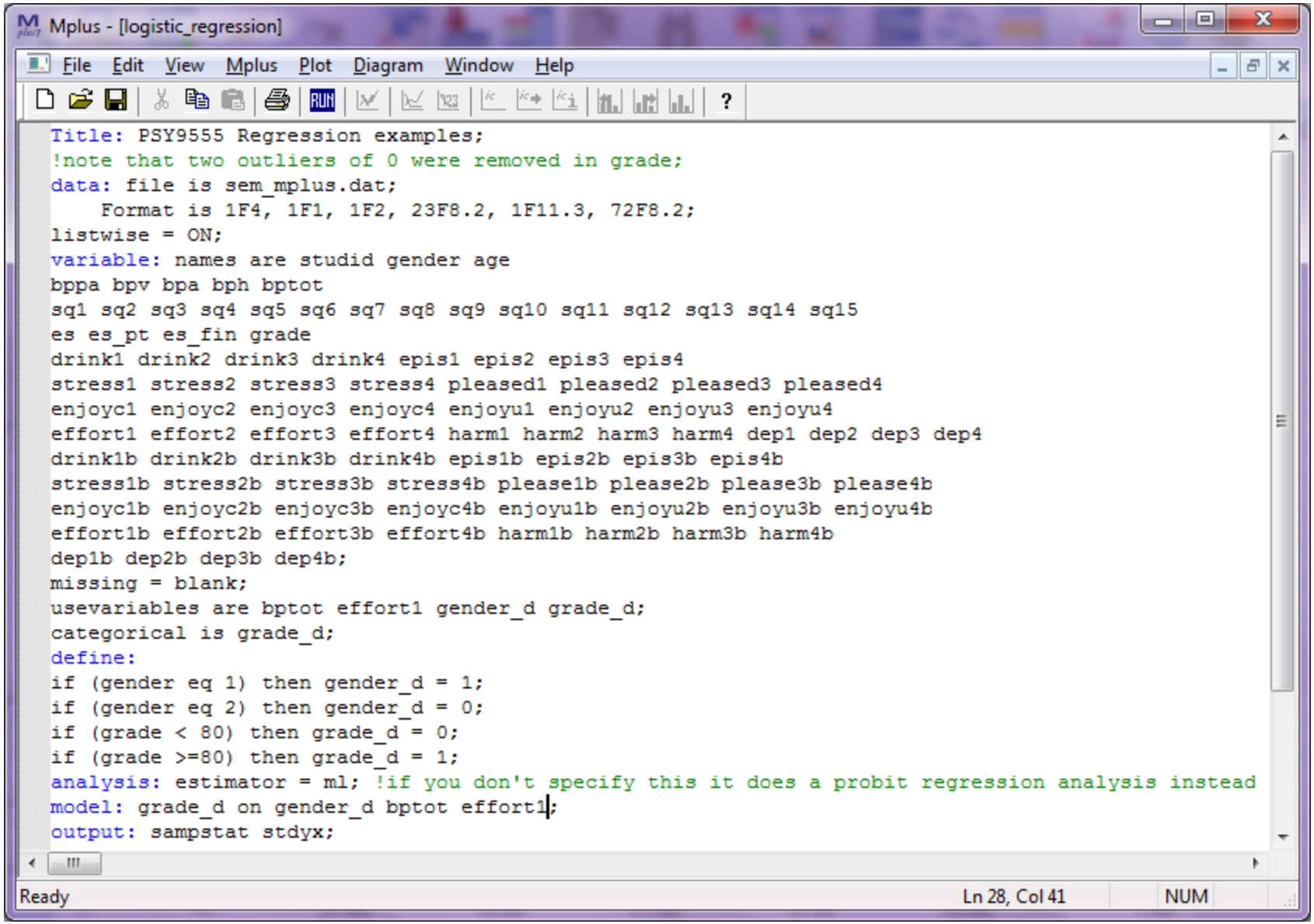
Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
GRADE	0.023	0.016	1.466	0.143

Multiple Regression – Two Predictors





Mplus: Logistic Regression



Mplus: Logistic Regression

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UNIVARIATE PROPORTIONS AND COUNTS FOR CATEGORICAL VARIABLES

    GRADE_D
      Category 1    0.705       248.000
      Category 2    0.295       104.000


SAMPLE STATISTICS


     SAMPLE STATISTICS


           Means
              BPTOT         EFFORT1       GENDER_D
              ________      ________      ________
 1             59.829         6.671         0.355


           Covariances
              BPTOT         EFFORT1       GENDER_D
              ________      ________      ________
 BPTOT        305.726
 EFFORT1       -8.854         2.841
 GENDER_D       0.981        -0.018         0.230
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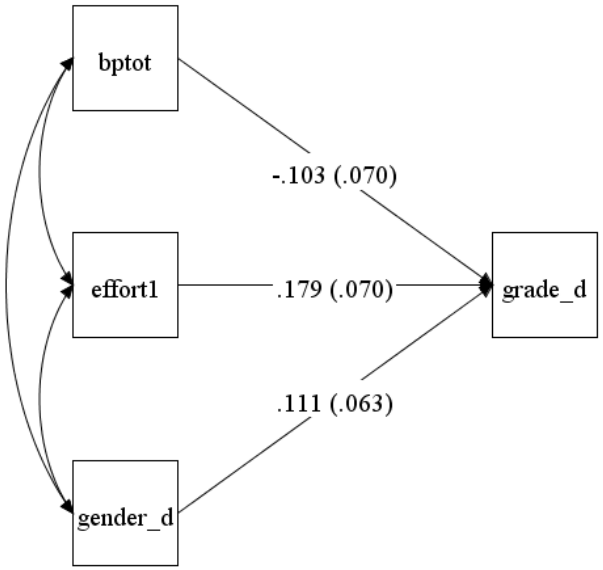


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MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

 GRADE_D    ON
    GENDER_D         0.435      0.248      1.751      0.080
    BPTOT           -0.011      0.008     -1.453      0.146
    EFFORT1          0.199      0.080      2.480      0.013

 Thresholds
    GRADE_D$1        1.735      0.801      2.166      0.030


LOGISTIC REGRESSION ODDS RATIO RESULTS

 GRADE_D    ON
    GENDER_D         1.545
    BPTOT            0.989
    EFFORT1          1.221


STANDARDIZED MODEL RESULTS


STDYX Standardization

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

 GRADE_D    ON
    GENDER_D         0.111      0.063      1.771      0.077
    BPTOT           -0.103      0.070     -1.467      0.142
    EFFORT1          0.179      0.070      2.546      0.011

 Thresholds
    GRADE_D$1        0.926      0.423      2.191      0.028


R-SQUARE

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    GRADE_D          0.063      0.033      1.887      0.059
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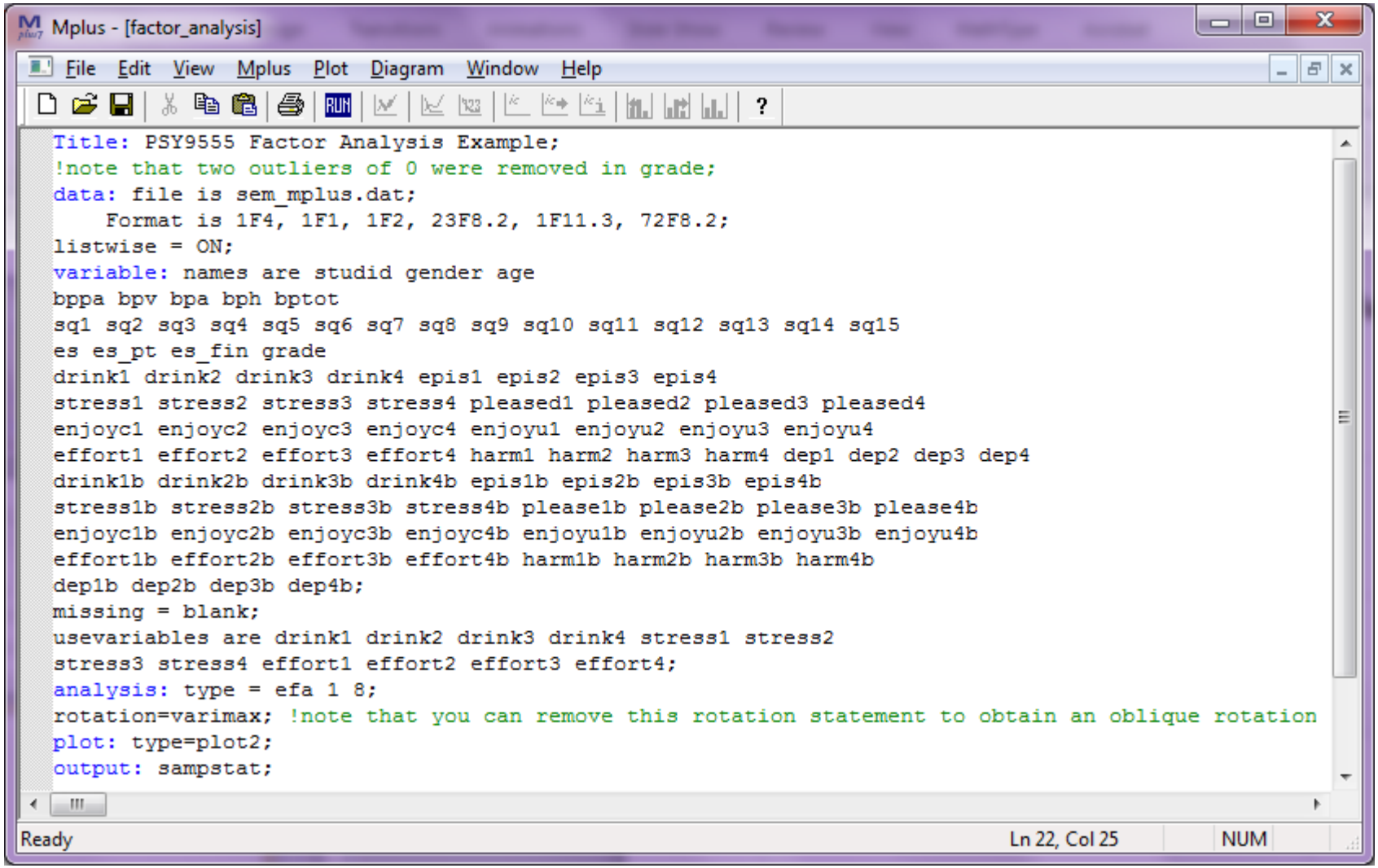
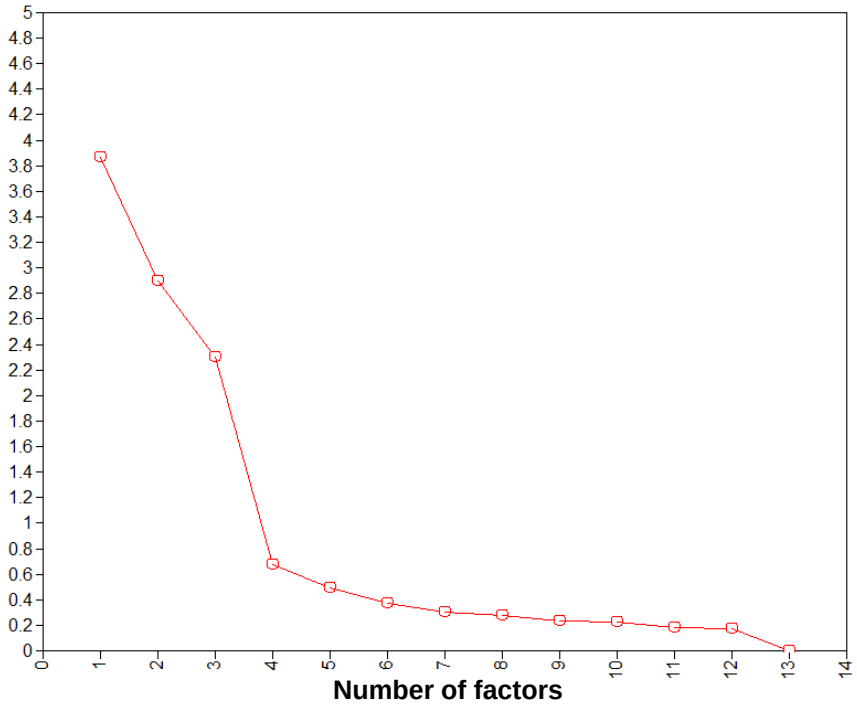
Mplus: Exploratory Factor Analysis



Mplus: Exploratory Factor Analysis

PROBLEM OCCURRED IN EXPLORATORY FACTOR ANALYSIS WITH 7 FACTOR(S).

Eigenvalues



Scree Plot

SUMMARY OF MODEL FIT INFORMATION

Model	Chi-Square	Degrees of Freedom	P-Value
1-factor	1713.208	54	0.0000
2-factor	841.598	43	0.0000
3-factor	214.815	33	0.0000
4-factor	106.778	24	0.0000
5-factor	42.427	16	0.0003
6-factor	18.150	9	0.0335
7-factor	N/A		

Models Compared	Chi-Square	Degrees of Freedom	P-Value
1-factor against 2-factor	871.610	11	0.0000
2-factor against 3-factor	626.783	10	0.0000
3-factor against 4-factor	108.037	9	0.0000
4-factor against 5-factor	64.352	8	0.0000
5-factor against 6-factor	24.276	7	0.0010

Mplus: Exploratory Factor Analysis

VARIMAX ROTATED LOADINGS

	1	2	3
DRINK1	0.847	0.047	0.062
DRINK2	0.845	0.018	0.045
DRINK3	0.907	0.069	0.024
DRINK4	0.872	0.038	0.086
STRESS1	0.048	-0.748	0.003
STRESS2	-0.042	-0.788	-0.079
STRESS3	-0.123	-0.858	-0.127
STRESS4	-0.065	-0.817	-0.167
EFFORT1	-0.074	-0.057	-0.696
EFFORT2	-0.020	-0.088	-0.706
EFFORT3	-0.072	-0.064	-0.837
EFFORT4	-0.028	-0.120	-0.815

GEOMIN ROTATED LOADINGS (* significant at 5% level)

	1	2	3
DRINK1	0.849*	-0.004	-0.009
DRINK2	0.849*	0.023	0.006
DRINK3	0.910*	-0.028	0.036
DRINK4	0.874*	0.009	-0.032
STRESS1	0.088	0.769*	-0.089
STRESS2	0.004	0.797*	-0.015
STRESS3	-0.072	0.860*	0.021
STRESS4	-0.013	0.816*	0.069
EFFORT1	-0.031	-0.015	0.700*
EFFORT2	0.026	0.017	0.711*
EFFORT3	-0.020	-0.022	0.844*
EFFORT4	0.026	0.039	0.818*

GEOMIN FACTOR CORRELATIONS (* significant at 5% level)

	1	2	3
1	1.000		
2	-0.115	1.000	
3	-0.130*	0.222*	1.000

FACTOR STRUCTURE

	1	2	3
DRINK1	0.851	-0.104	-0.120
DRINK2	0.846	-0.073	-0.100
DRINK3	0.909	-0.124	-0.088
DRINK4	0.877	-0.099	-0.144
STRESS1	0.011	0.739	0.070
STRESS2	-0.085	0.793	0.161
STRESS3	-0.173	0.873	0.221
STRESS4	-0.116	0.833	0.252
EFFORT1	-0.120	0.144	0.701
EFFORT2	-0.068	0.172	0.711
EFFORT3	-0.128	0.167	0.842
EFFORT4	-0.085	0.218	0.823