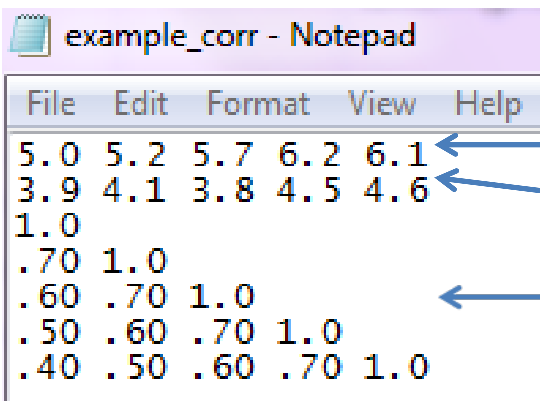
PSY 9556B (Jan8) Design Issues and Missing Data Continued
Examples of Simulations for Projects

- Let's create a data for a variable measured repeatedly over five occasions
- We could create raw data (for each subject) or summary data for the sample
- Here's an example of summary data


example_corr - Notepad

File Edit Format View Help

```
5.0 5.2 5.7 6.2 6.1
3.9 4.1 3.8 4.5 4.6
1.0
.70 1.0
.60 .70 1.0
.50 .60 .70 1.0
.40 .50 .60 .70 1.0
```

Means
Standard deviations
Correlations

- Notice that I have simulated a growth pattern
- with increasing variation over time
- and fairly substantial stability in rank ordering (correlations) across time
- But with higher correlations for time points in closer proximity

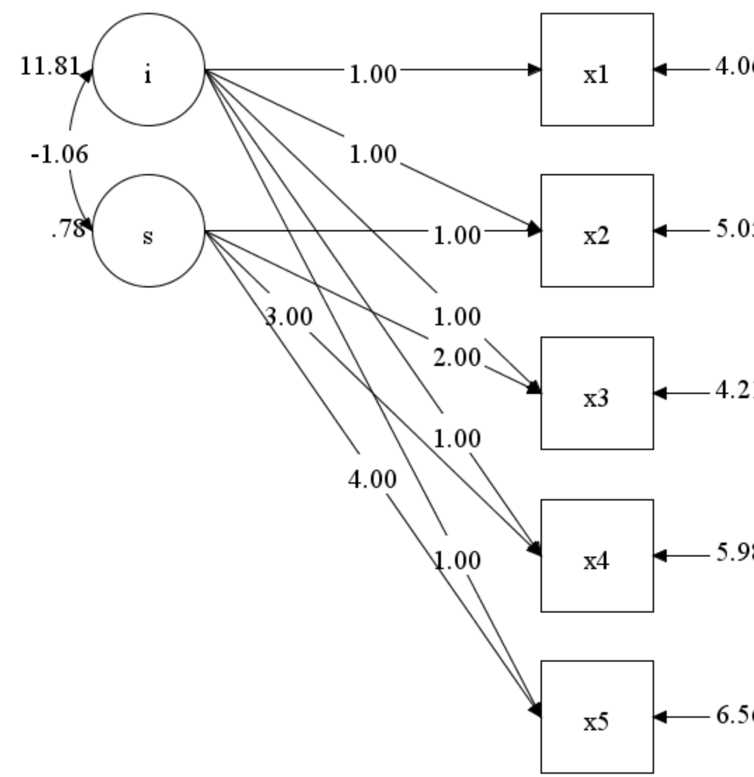
Simulated Data Example: Syntax (Mplus) of a Latent Growth Model

I can analyze a LGM model with summary data

```
Title: Example of a latent-growth-modeling study with summary data;
data:
file is example_corr.txt;
nobservations = 200;
type=correlation means stdeviations;
variable:
names are x1 x2 x3 x4 x5;
usevariables are x1 x2 x3 x4 x5;
analysis:
estimator = ml; !note summary data such as correlation matrix cannot use mlr
model:
I S | x1@0 x2@1 x3@2 x4@3 x5@4;
plot:
type is plot3; !note this function does not work with summary data
series = x1(0) x2(1) x3(2) x4(3) x5(4);
output: sampstat residual stdyx tech4 modindices;
!to make your own plot of the linear trend use the mean intercept as the
!starting point (on the y axis) and add the amount of the mean slope at
!each time unit.
```

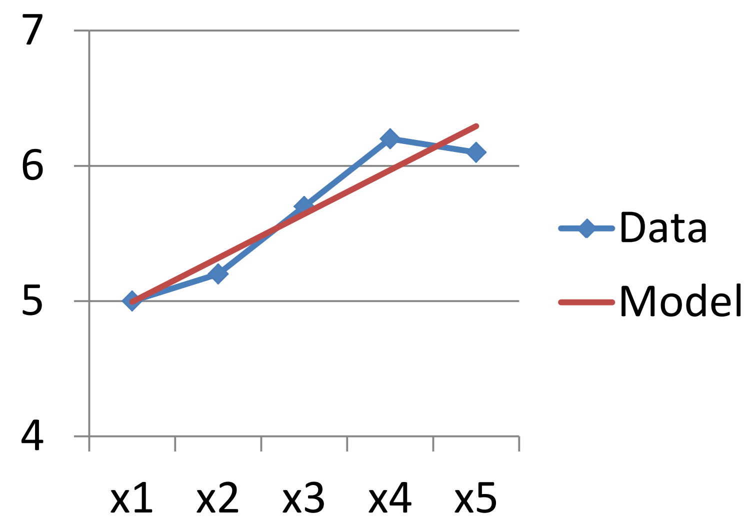
Simulated Data Example: LGM Model and Results

```
Chi-Square Test of Model Fit

          Value                           14.650
          Degrees of Freedom                  10
          P-Value                         0.1454

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                         0.048
          90 Percent C.I.                  0.000   0.098
          Probability RMSEA <= .05         0.469

CFI/TLI

          CFI                              0.992
          TLI                              0.992

Chi-Square Test of Model Fit for the Baseline Model

          Value                          568.088
          Degrees of Freedom                  10
          P-Value                         0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                            0.047
```



Simulated Data Example: Results

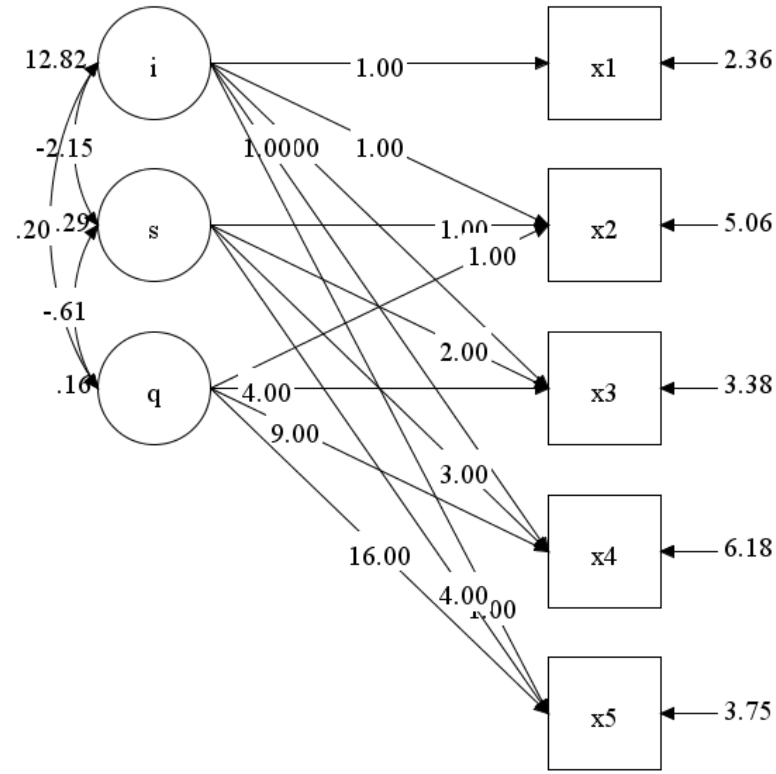
S WITH				
I	-1.057	0.362	-2.923	0.003
Means				
I	4.994	0.269	18.569	0.000
S	0.325	0.081	4.021	0.000
Intercepts				
X1	0.000	0.000	999.000	999.000
X2	0.000	0.000	999.000	999.000
X3	0.000	0.000	999.000	999.000
X4	0.000	0.000	999.000	999.000
X5	0.000	0.000	999.000	999.000
Variances				
I	11.810	1.488	7.937	0.000
S	0.784	0.143	5.504	0.000
Residual Variances				
X1	4.056	0.823	4.926	0.000
X2	5.046	0.657	7.685	0.000
X3	4.213	0.547	7.704	0.000
X4	5.979	0.795	7.518	0.000
X5	6.558	1.119	5.861	0.000



Simulated Data Example: Adding a Quadratic Component

```
model:
I S Q| x1@0 x2@1 x3@2 x4@3 x5@4;
```

```
Chi-Square Test of Model Fit

          Value                              6.228
          Degrees of Freedom                     6
          P-Value                           0.3982

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.014
          90 Percent C.I.                    0.000  0.094
          Probability RMSEA <= .05           0.674

CFI/TLI

          CFI                                1.000
          TLI                                0.999

Chi-Square Test of Model Fit for the Baseline Model

          Value                            568.088
          Degrees of Freedom                    10
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.030
```

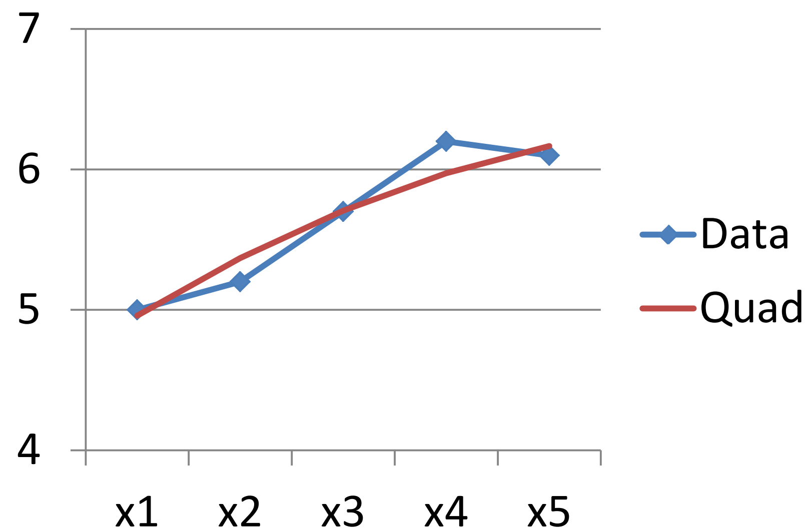


Simulated Data Example: Adding a Quadratic Component

S WITH				
I	-2.152	1.345	-1.600	0.110
Q WITH				
I	0.196	0.268	0.731	0.465
S	-0.614	0.262	-2.349	0.019
Means				
I	4.959	0.274	18.085	0.000
S	0.446	0.190	2.347	0.019
Q	-0.036	0.045	-0.801	0.423
Intercepts				
X1	0.000	0.000	999.000	999.000
X2	0.000	0.000	999.000	999.000
X3	0.000	0.000	999.000	999.000
X4	0.000	0.000	999.000	999.000
X5	0.000	0.000	999.000	999.000
Variances				
I	12.815	1.961	6.536	0.000
S	3.294	1.243	2.651	0.008
Q	0.162	0.064	2.539	0.011
Residual Variances				
X1	2.362	1.420	1.663	0.096
X2	5.062	0.696	7.278	0.000
X3	3.380	0.594	5.693	0.000
X4	6.180	0.826	7.484	0.000
X5	3.754	1.759	2.134	0.033

Quadratic not significant

Chisquare diff test (4 df) = 14.650 – 6.228 = 8.422 n.s. (crit value at .05 = 9.488)



*Tested a cubic component; n.s.

Simulated Data Example: SPSS MANOVA (matrix data)

```
matrix data variables = rowtype_ d1 d2 d3 d4 d5.
begin data
mean 5.0 5.2 5.7 6.2 6.1
stddev 3.9 4.1 3.8 4.5 4.6
n 200 200 200 200 200
corr 1
corr .7 1
corr .6 .7 1
corr .5 .6 .7 1
corr .4 .5 .6 .7 1
end data.
manova d1 to d5
/transform (d1 d2 d3 d4 d5) = polynomial
/print= cellinfo (all) error transform param(all) signif (efsize) signif (multiv univ)
/ matrix=in(*)
/ design.
```

Note that to get equivalent results in LGM residuals are set to 0 and you
Would need some codes for polynomials instead of the 0, 1, 2, 3, 4

Simulated Data Example: Using Montecarlo in Mplus

- In my previous example, the simulated data was a sample
- It would be possible to create a population instead with the same parameters
- Once we have a population, we can obtain random samples and study properties such as sample size and power.
- Let's try an example using the Montecarlo procedure in Mplus
- Using the previous LGM analysis syntax, I add a line at the end "savedata:" to save the parameters describing the model for further analysis with Montecarlo.

```
Title: Example of a latent-growth-modeling study with summary data;
data:
file is example_corr.txt;
nobservations = 200;
type=correlation means stdeviations;
variable:
names are x1 x2 x3 x4 x5;
usevariables are x1 x2 x3 x4 x5;
analysis:
estimator = ml; !note summary data such as correlation matrix cannot use mlr
model:
I S Q| x1@0 x2@1 x3@2 x4@3 x5@4;
plot:
series = x1(0) x2(1) x3(2) x4(3) x5(4);
output: sampstat residual stdyx tech4 modindices;
savedata: estimates = lgmestimates.dat;
```

Simulated Data Example: Using Montecarlo in Mplus

```
montecarlo:
names are x1 x2 x3 x4 x5;
nobservations = 200;
nreps = 1000;
seed = 45335;
save = rep1.dat;
population = lgmestimates.dat;
coverage = lgmestimates.dat;
model population:
I S Q| x1@0 x2@1 x3@2 x4@3 x5@4;
model:
I S Q| x1@0 x2@1 x3@2 x4@3 x5@4;
output: tech9;
```

MODEL RESULTS

	ESTIMATES Population	ESTIMATES Average	Std. Dev.	S. E. Average	M. S. E.	95% Cover	% Sig Coeff
S WITH							
I	-2.152	-2.1136	1.2862	1.3420	1.6541	0.952	0.325
Q WITH							
I	0.196	0.1882	0.2584	0.2670	0.0668	0.951	0.082
S	-0.614	-0.6059	0.2686	0.2614	0.0722	0.945	0.659
Means							
I	4.959	4.9385	0.2677	0.2732	0.0720	0.956	1.000
S	0.446	0.4485	0.2013	0.1894	0.0405	0.933	0.643
Q	-0.036	-0.0367	0.0481	0.0449	0.0023	0.933	0.161
Intercepts							
X1	0.000	0.0000	0.0000	0.0000	0.0000	1.000	0.000
X2	0.000	0.0000	0.0000	0.0000	0.0000	1.000	0.000
X3	0.000	0.0000	0.0000	0.0000	0.0000	1.000	0.000
X4	0.000	0.0000	0.0000	0.0000	0.0000	1.000	0.000
X5	0.000	0.0000	0.0000	0.0000	0.0000	1.000	0.000
Variances							
I	12.815	12.7244	1.9484	1.9555	3.8007	0.947	1.000
S	3.294	3.2574	1.2526	1.2424	1.5688	0.940	0.758
Q	0.162	0.1595	0.0662	0.0638	0.0044	0.941	0.715
Residual Variances							
X1	2.362	2.3705	1.3434	1.4213	1.8029	0.964	0.380
X2	5.062	5.0790	0.6574	0.6967	0.4320	0.965	1.000
X3	3.380	3.3683	0.6097	0.5931	0.3715	0.941	1.000
X4	6.180	6.1958	0.8643	0.8268	0.7465	0.935	1.000
X5	3.754	3.7529	1.8003	1.7551	3.2379	0.945	0.574

Simulated Data Example: Using Montecarlo in Mplus

```
TITLE: growth1.inp normal, no covariate, no missing
MONTECARLO:
NAMES ARE x1-x5;
NOBSERVATIONS = 200;
NREPS = 1000;
SEED = 53487;
SAVE = growth1.sav;
ANALYSIS:
MODEL POPULATION:
i s q | x1@0 x2@1 x3@2 x4@3 x5@4;
[x1-x5@0];
[i*4.959 s*0.446 q*-0.036];
i*12.815;
s*3.294;
q*0.162;
i WITH s*-2.152;
i WITH q*0.196;
s WITH q*-.614;
x1*2.362;
x2*5.062;
x3*3.380;
x4*6.180;
x5*3.754;
MODEL:
i s q | x1@0 x2@1 x3@2 x4@3 x5@4;
[x1-x5@0];
[i*4.959 s*0.446 q*-0.036];
i*12.815;
s*3.294;
q*0.162;
i WITH s*-2.152;
i WITH q*0.196;
s WITH q*-.614;
x1*2.362;
x2*5.062;
x3*3.380;
x4*6.180;
x5*3.754;
OUTPUT: TECH9;
```

Alternatively, you could specify the parameters yourself. In this example, you would specify the mean intercept and slope, the variance of the intercepts and slopes, the correlation between the slopes and intercepts, and the residuals.

STRUCTURAL EQUATION MODELING, *9*(4), 599–620

TEACHER'S CORNER

How to Use a Monte Carlo Study to Decide on Sample Size and Determine Power

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Understanding the Three Mechanisms of Missing Data

RISK	Reading Score	MCAR	MAR	NMAR
Disadv	174	174	174	.
Disadv	179	.	.	.
Disadv	194	194	194	.
Disadv	194	194	194	.
Disadv	203	203	.	.
Disadv	206	.	.	206
Disadv	209	209	.	209
Disadv	213	213	213	213
Disadv	233	233	233	233
Disadv	248	.	.	248
Adv	208	208	208	208
Adv	217	217	217	217
Adv	219	219	219	219
Adv	221	221	221	221
Adv	225	.	225	225
Adv	228	.	228	228
Adv	234	234	234	234
Adv	236	236	236	236
Adv	236	236	236	236
Adv	243	243	243	243

From Long, J. D. (2012). *Longitudinal data analysis for the behavioral sciences using R*. Thousand Oaks Sage, California: Sage. (p. 91)

Simulation Example of Missing Data

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

	x1	x2	x3	x4	x5	new1	new2
1	4.664270	.532908	1.093350	-.088013	-7.890250	-7.89	999.00
2	.077985	.220060	.817038	-3.586656	-4.809571	-4.81	999.00
3	1.620843	.985304	4.112497	1.413266	-4.304725	-4.30	999.00
4	4.204337	4.618360	2.314004	-.964795	-3.037667	-3.04	999.00
5	7.918704	.731640	1.249133	-.493786	-2.953642	-2.95	999.00
6	-2.666700	-2.295355	-4.158282	-2.220752	-2.916542	-2.92	999.00
7	.535243	1.373632	-4.169932	1.833149	-2.684271	-2.68	999.00
8	-.277904	-1.049819	-.643203	-.503458	-2.381333	-2.38	999.00
9	1.082189	6.667872	7.732547	-.349096	-2.357714	-2.36	999.00
10	1.089092	4.720787	.029987	-.325337	-2.190490	-2.19	999.00
11	2.028279	4.427999	5.199293	4.125208	-1.365259	-1.37	-1.37
12	.590648	-.149356	5.137088	3.811625	-1.160693	-1.16	-1.16
13	-4.613561	-.443791	.751505	-3.472063	-1.019762	-1.02	-1.02
14	.546872	-1.053835	1.869084	-1.048805	-1.018047	-1.02	-1.02
15	-1.328994	2.811242	2.084779	2.368853	-.990130	-.99	-.99
16	1.538687	.448791	-1.362049	1.386721	-.969791	-.97	-.97
17	1.195198	-1.130505	.936015	-2.308565	-.841942	-.84	-.84
18	-.999140	2.314413	2.610304	1.905061	-.807042	-.81	-.81
19	4.491838	3.073584	1.752912	-.049674	-.696999	-.70	-.70
20	5.890434	7.076167	9.228248	6.462100	-.568524	-.57	-.57
21	2.290458	2.489073	5.752497	3.977106	.209326	.21	.21
22	10.049971	9.525242	1.538150	6.319548	.486037	.49	.49
23	5.323121	7.264900	3.657205	9.248732	.538043	.54	.54
24	-1.097981	.489432	.088079	3.808075	.651980	.65	.65
25	-2.076057	-2.582060	3.244246	.974815	.749493	.75	.75
26	2.052521	6.715822	4.975799	3.186590	.778931	.78	.78
27	7.790298	3.480114	10.860715	10.358933	.849868	.85	.85
28	6.572593	4.117977	3.012412	6.617684	1.231090	999.00	1.23
29	3.800202	3.017381	3.473497	-3.425224	1.307617	1.31	1.31

Data derived from previous LGM model with 200 cases

New1 is a duplicate of X5 with 10 cases MCAR

New2 is a duplicate of X5 with 10 cases MNAR

Simulation Example of Missing Data

Lets see what happens to the descriptive statistics when we use a listwise deletion.

Descriptive Statistics

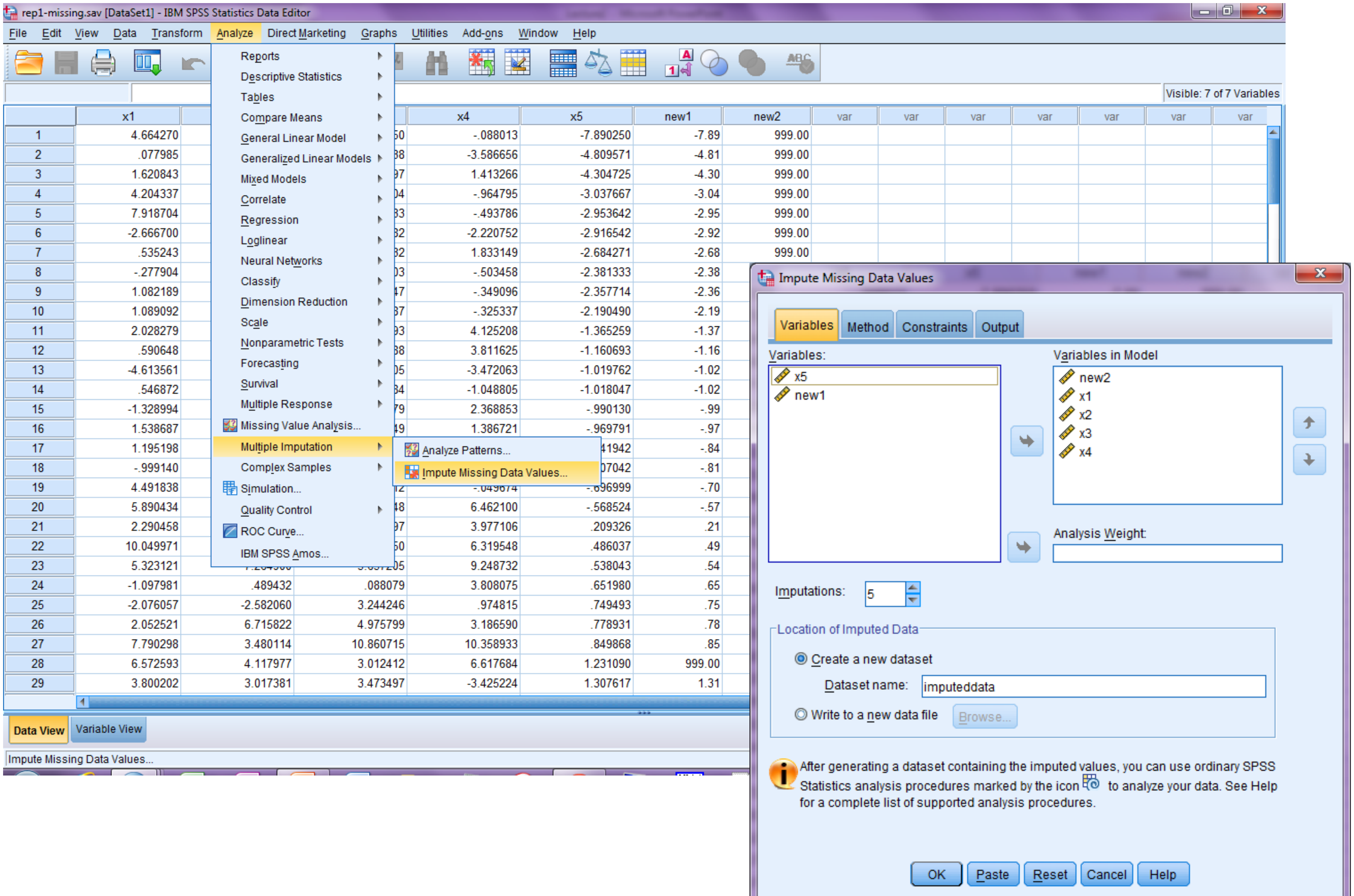
	N	Minimum	Maximum	Mean	Std. Deviation
x5	200	-7.890250	18.340545	5.92731016	4.438446019
new1	190	-7.89	18.34	5.9426	4.47728
new2	190	-1.37	18.34	6.4263	3.94866
Valid N (listwise)	180				

Correlations

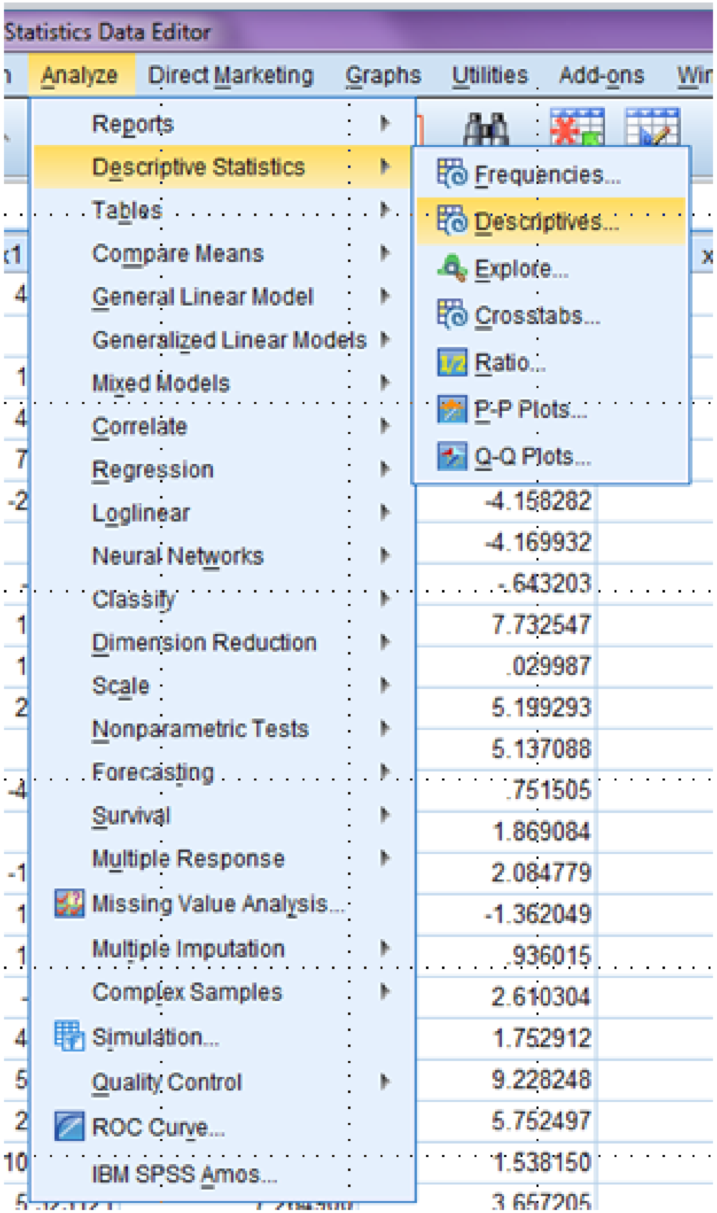
		x5	new1	new2
x1	Pearson Correlation	.492	.505	.476
	Sig. (2-tailed)	.000	.000	.000
	N	200	190	190
x2	Pearson Correlation	.556	.555	.525
	Sig. (2-tailed)	.000	.000	.000
	N	200	190	190
x3	Pearson Correlation	.687	.691	.666
	Sig. (2-tailed)	.000	.000	.000
	N	200	190	190
x4	Pearson Correlation	.708	.713	.663
	Sig. (2-tailed)	.000	.000	.000
	N	200	190	190

- The true mean value is 5.927 (variable x5)
- New1 has a similar mean of 5.943 because it was MCAR
- New2 has a biased mean of 6.426 because it was MNAR
- See also standard deviation and correlation differences

Multiple Imputation of new2



Multiple Imputation of new2



Descriptive Statistics

Imputation	Imputation Number	N	Minimum	Maximum	Mean	Std. Deviation
Original data	new2	190	-1.37	18.34	6.4263	3.94866
	Valid N (listwise)	190				
1	new2	200	-1.37	18.34	6.2683	3.95366
	Valid N (listwise)	200				
2	new2	200	-3.92	18.34	6.2139	4.04366
	Valid N (listwise)	200				
3	new2	200	-1.40	18.34	6.2341	3.97070
	Valid N (listwise)	200				
4	new2	200	-3.36	18.34	6.1913	4.03663
	Valid N (listwise)	200				
5	new2	200	-5.65	18.34	6.1542	4.11310
	Valid N (listwise)	200				
Pooled	new2	200			6.2123	
	Valid N (listwise)	200				

Note that the pooled mean of 6.21 is better than the listwise value of 6.43 in approximating the correct value of 5.93 but there is still some bias due to the fact that it was missing not at random (MNAR)

Missing Data Estimation with FIML in Mplus

- Continuing with our example, I specify a simple basic analysis in Mplus.
- I start with a LISTWISE deletion.
- As can be seen below, 10 cases are deleted (200 -10 = 190)

```
DATA:
  FILE IS C:\Users\ptrembla\Documents\Longitudinal course\LGM examples\rep1-missing.dat;
LISTWISE=ON;
VARIABLE:
  MISSING ARE ALL (999);
  NAMES ARE x1 x2 x3 x4 x5 new1 new2;
  USEVARIABLES ARE x1 x2 x3 x4 new2;
ANALYSIS:
type = basic;
OUTPUT: sampstat;
```

```
SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                         190

Number of dependent variables                                    5
Number of independent variables                                  0
Number of continuous latent variables                            0

Observed dependent variables

  Continuous
   X1          X2          X3          X4          NEW2


Estimator                                                       ML
```

Missing Data Estimation in Mplus: Listwise Deletion

```
SAMPLE STATISTICS

     Means
        X1            X2            X3            X4            NEW2
        ________      ________      ________      ________      ________
 1         5.211         5.798         6.202         6.202         6.426

     Covariances
        X1            X2            X3            X4            NEW2
        ________      ________      ________      ________      ________
X1        13.320
X2         9.709        14.095
X3         7.256         9.392        13.196
X4         6.727         9.003         9.925        16.521
NEW2       6.853         7.777         9.549        10.640        15.592

     Correlations
        X1            X2            X3            X4            NEW2
        ________      ________      ________      ________      ________
X1         1.000
X2         0.709         1.000
X3         0.547         0.689         1.000
X4         0.453         0.590         0.672         1.000
NEW2       0.476         0.525         0.666         0.663         1.000
```

- As can be seen all means are biased (compare to SPSS) but New2 has the same value in both analyses as expected

Descriptive Statistics

	N	Maximum	Mean	Std. Deviation
x1	200	16.505708	5.04160956	3.688753275
x2	200	19.249330	5.59053005	3.816377768
x3	200	14.869597	5.93351681	3.804905237
x4	200	17.939640	5.86592636	4.238476275
new2	190	18.34	6.4263	3.94866
x5	200	18.340545	5.92731016	4.438446019
Valid N (listwise)	190			

From SPSS

Maximum Likelihood Estimation of Missing Data:???

- In this example I use the default ML missing data estimation.
- However, I have only one variable in my model: New2
- There is no other information for estimating missing data
- Therefore the results remain the same (i.e., mean = 6.426)

```
DATA:
  FILE IS C:\Users\ptrembla\Documents\Longitudinal course\LGM examples\rep1-missing.dat;
VARIABLE:
  MISSING ARE ALL (999);
  NAMES ARE x1 x2 x3 x4 x5 new1 new2;
  USEVARIABLES new2;
ANALYSIS:
type = basic;
OUTPUT: sampstat;
```

```
SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                         190

Number of dependent variables                                    1
Number of independent variables                                  0
Number of continuous latent variables                            0

Observed dependent variables

  Continuous
   NEW2


Estimator                                                       ML
```

```
ESTIMATED SAMPLE STATISTICS


     Means
        NEW2
        ________
 1         6.426
```

Maximum Likelihood Estimation of Missing Data

- Now we have x1 x2 x3 x4 in the model that will perhaps help in the estimation
- Note that we have 200 cases (not 190)

```
DATA:
  FILE IS C:\Users\ptrembla\Documents\Longitudinal course\LGM examples\rep1-missing.dat;
VARIABLE:
  MISSING ARE ALL (999);
  NAMES ARE x1 x2 x3 x4 x5 new1 new2;
  USEVARIABLES x1 x2 x3 x4 new2;
ANALYSIS:
type = basic;
OUTPUT: sampstat;
```

```
SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                         200

Number of dependent variables                                    5
Number of independent variables                                  0
Number of continuous latent variables                            0

Observed dependent variables

  Continuous
   X1          X2          X3          X4          NEW2


Estimator                                                       ML
```

Maximum Likelihood Estimation of Missing Data

```
SUMMARY OF DATA

     Number of missing data patterns            2

SUMMARY OF MISSING DATA PATTERNS


     MISSING DATA PATTERNS (x = not missing)

           1  2
 X1        x  x
 X2        x  x
 X3        x  x
 X4        x  x
 NEW2      x


     MISSING DATA PATTERN FREQUENCIES

    Pattern   Frequency     Pattern   Frequency
          1         190           2          10


COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value   0.100


     PROPORTION OF DATA PRESENT


           Covariance Coverage
              X1            X2            X3            X4            NEW2
              ________      ________      ________      ________      ________
 X1             1.000
 X2             1.000         1.000
 X3             1.000         1.000         1.000
 X4             1.000         1.000         1.000         1.000
 NEW2           0.950         0.950         0.950         0.950         0.950
```

Two patterns of missing data:

1. No values missing
2. Values missing on New2

Maximum Likelihood Estimation of Missing Data

- Note that the mean for New2 is now 6.180. This value is comparable to the multiple imputed value of 6.21 on the SPSS analysis
- Due the MNAR mechanism it was impossible to eliminate all the bias

ESTIMATED SAMPLE STATISTICS

Means

	X1	X2	X3	X4	NEW2
1	5.042	5.591	5.934	5.866	6.180

Covariances

	X1	X2	X3	X4	NEW2
X1	13.539				
X2	9.936	14.492			
X3	7.888	10.226	14.405		
X4	7.488	9.878	11.112	17.875	
NEW2	7.410	8.450	10.524	11.685	16.380

Correlations

	X1	X2	X3	X4	NEW2
X1	1.000				
X2	0.709	1.000			
X3	0.565	0.708	1.000		
X4	0.481	0.614	0.692	1.000	
NEW2	0.498	0.548	0.685	0.683	1.000

Sd = sqr(16.38) = 4.05

Descriptive Statistics

	N	Maximum	Mean	Std. Deviation
x1	200	16.505708	5.04160956	3.688753275
x2	200	19.249330	5.59053005	3.816377768
x3	200	14.869597	5.93351681	3.804905237
x4	200	17.939640	5.86592636	4.238476275
new2	190	18.34	6.4263	3.94866
x5	200	18.340545	5.92731016	4.438446019
Valid N (listwise)	190			

Mplus Examples: Maximum Likelihood Estimation
Auxiliary Variables

The analysis below is similar to the previous one with the exception that x1, x2, x3, x4 are not brought into the model but are used to estimate missing data in New2. (Produces identical estimates)

```
DATA:
  FILE IS C:\Users\ptrembla\Documents\Longitudinal course\LGM examples\rep1-missing.dat;
VARIABLE:
  MISSING ARE ALL (999);
  NAMES ARE x1 x2 x3 x4 x5 new1 new2;
  USEVARIABLES new2;
  AUXILIARY = (m) x1 x2 x3 x4;
ANALYSIS:
MODEL:
new2;
OUTPUT: sampstat;
```

Specification of auxiliary variables in missing analysis (m)

```
SUMMARY OF ANALYSIS

Number of groups                                   1
Number of observations                           200

Number of dependent variables                      1
Number of independent variables                    0
Number of continuous latent variables              0

Observed dependent variables

  Continuous
   NEW2

Observed auxiliary variables
   X1          X2          X3          X4


Estimator                                         ML
```

```
     ESTIMATED SAMPLE STATISTICS


           Means
              NEW2
              ________
 1              6.180


           Covariances
              NEW2
              ________
 NEW2          16.380


           Correlations
              NEW2
              ________
 NEW2           1.000
```

Imputation in Mplus

EXAMPLE 11.6: MULTIPLE IMPUTATION FOLLOWED BY THE ESTIMATION OF A GROWTH MODEL USING MAXIMUM LIKELIHOOD

```
TITLE:     this is an example of multiple imputation
           followed by the estimation of a growth
           model using maximum likelihood
DATA:      FILE = ex11.6.dat;
VARIABLE:  NAMES = x1 y1-y4 z x2;
           USEVARIABLES = y1-y4 x1 x2;
           MISSING = ALL(999);
DATA IMPUTATION:
           IMPUTE = y1-y4 x1 (c) x2;
           NDATASETS = 10;
ANALYSIS:  ESTIMATOR = ML;
MODEL:     i s | y1@0 y2@1 y3@2 y4@3;
           i s ON x1 x2;
OUTPUT:    TECH1 TECH8;
```

See p. 398-399 Mplus manual Version 7