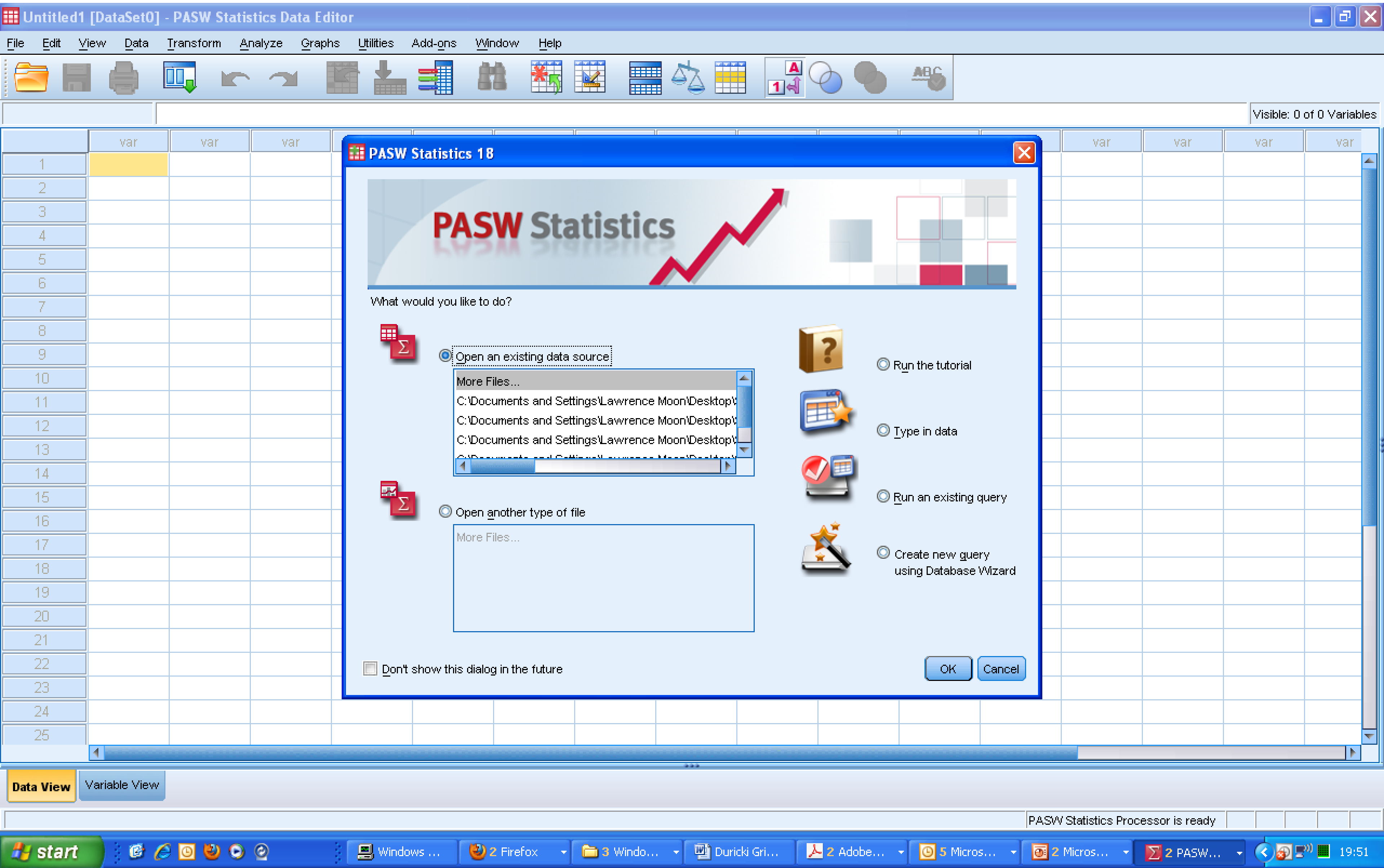
Supplementary Tutorial

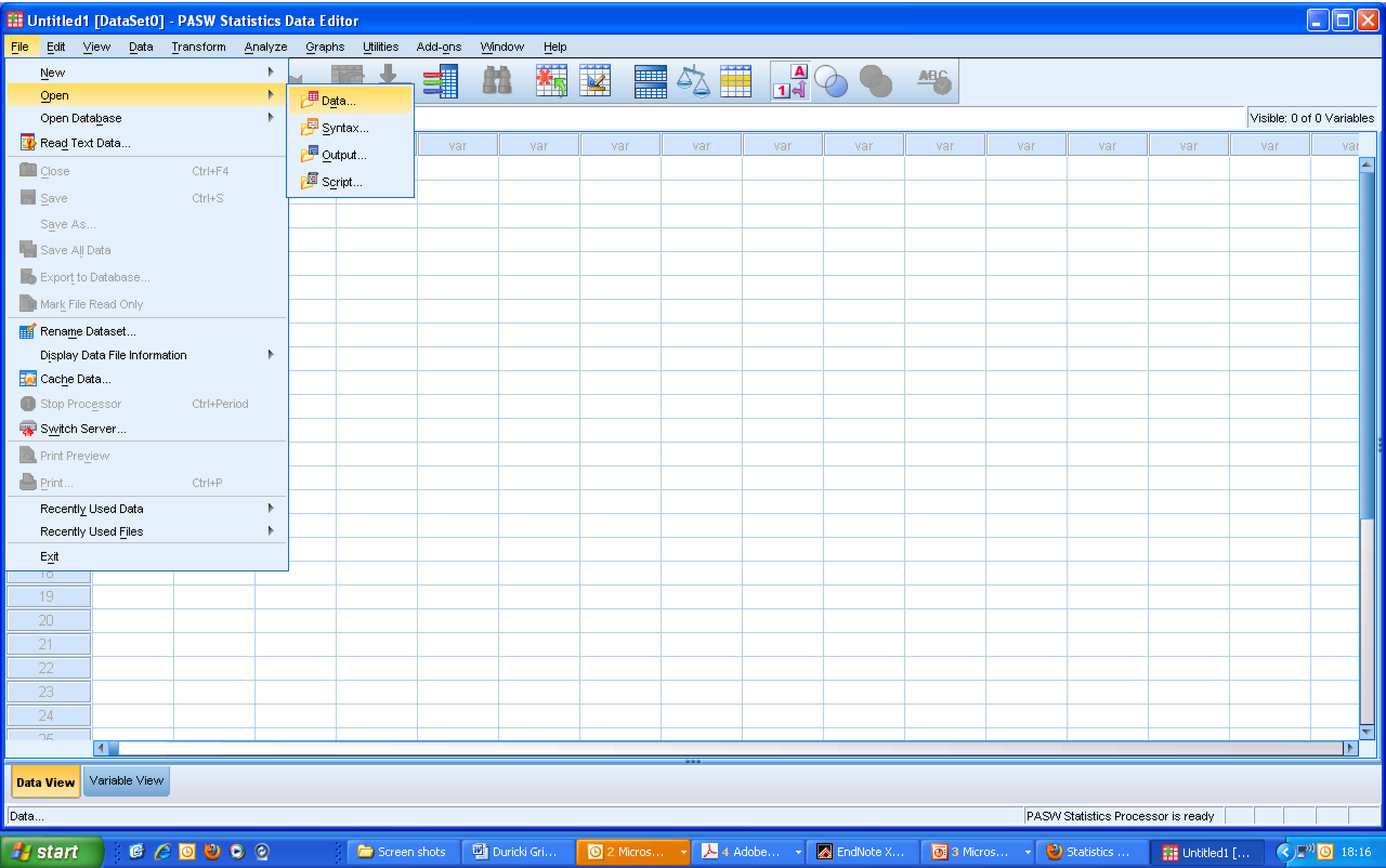
Duricki, Soleman and Moon (2016)

A click-by-click guide to analysing longitudinal data from animals where some data are missing.

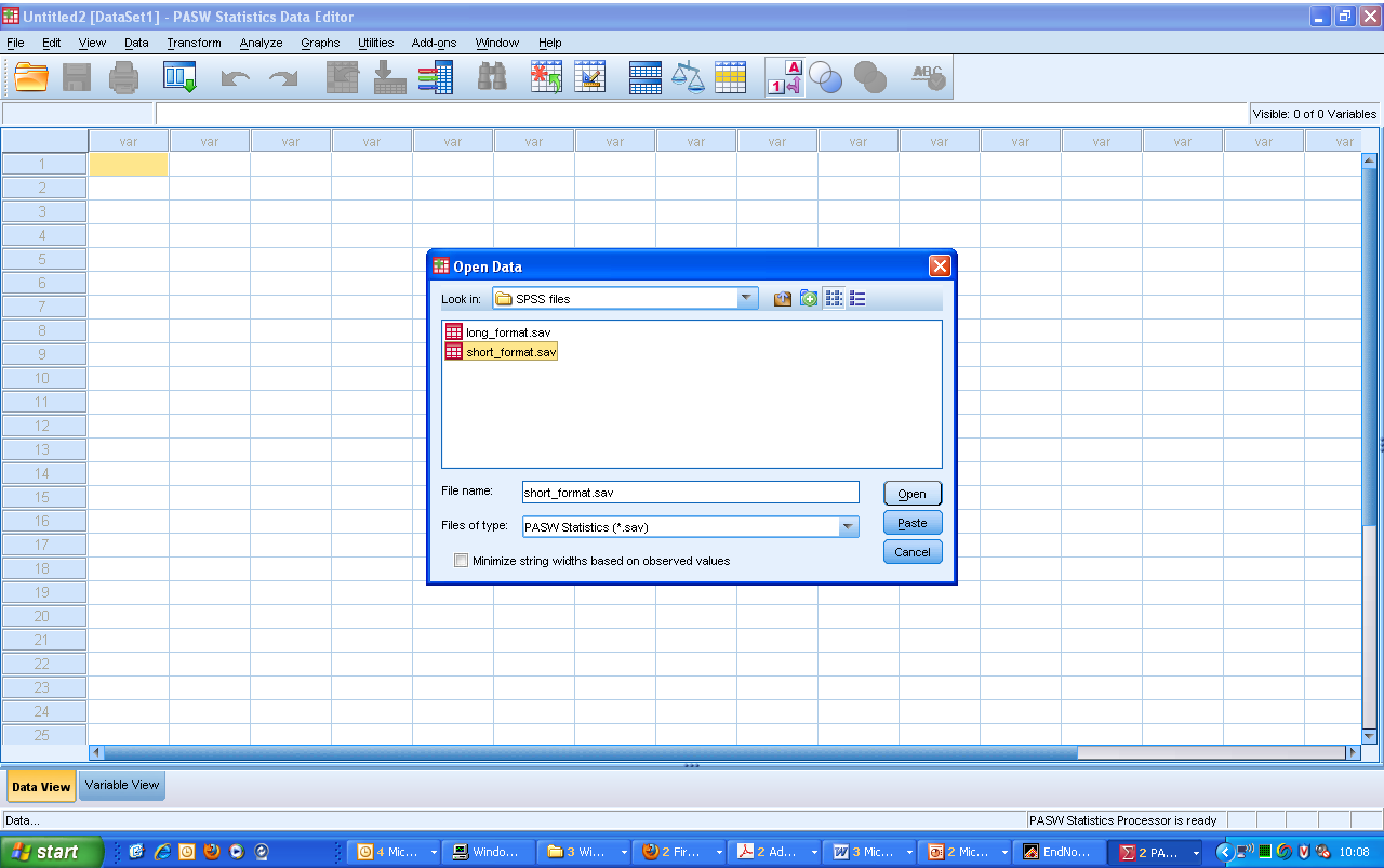
Supplementary Tutorial, Slide 1: Loading data. Click “Cancel”.



Supplementary Tutorial, Slide 2: Loading data. Click File>Open>Data.

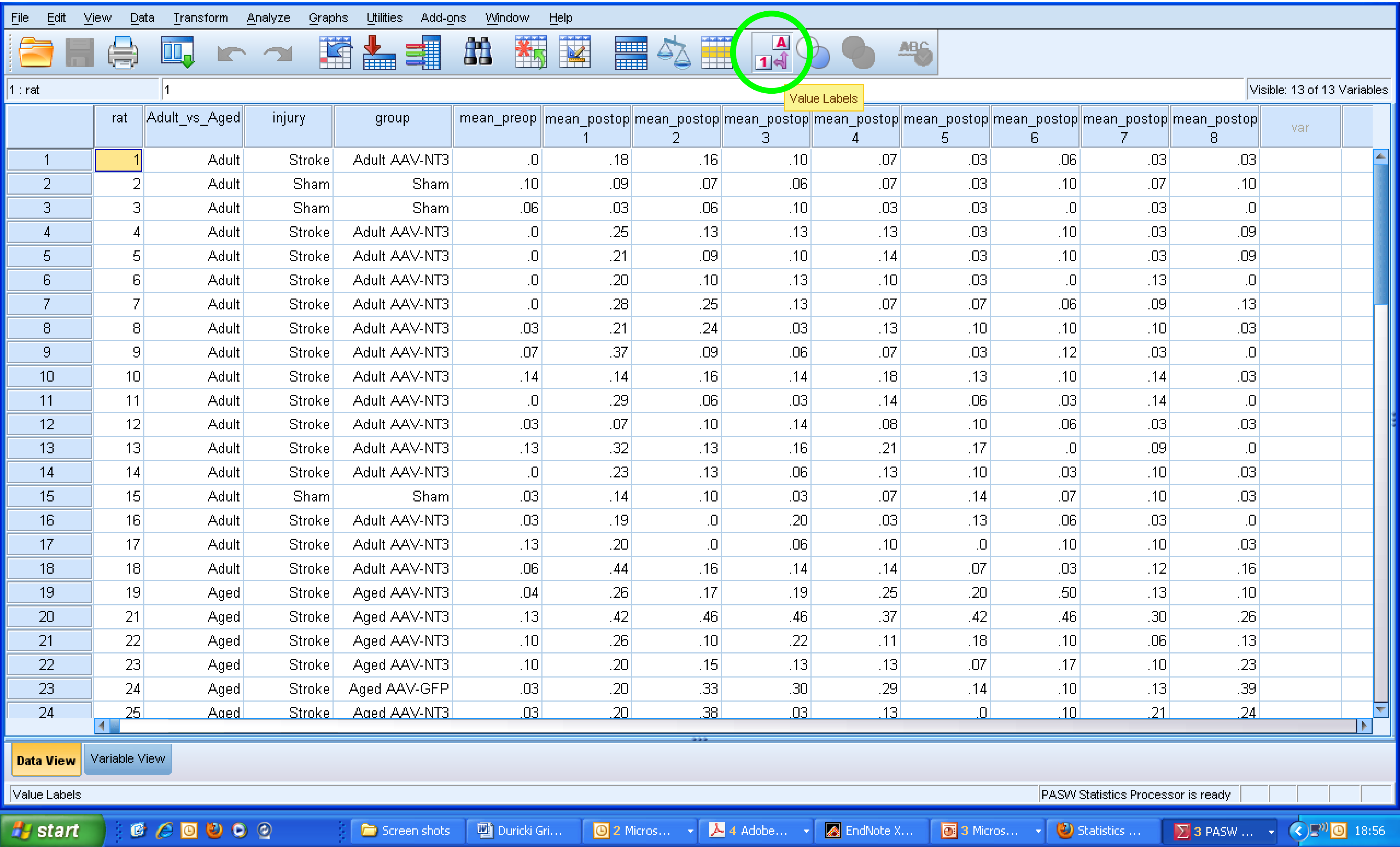


Supplementary Tutorial, Slide 3: Navigate to “short_format” data file.
You need to have downloaded this from the Nature Protocols website (Supplementary Data 1) or from www.lawrencemoon.co.uk/resources/linearmodels.asp



Supplementary Tutorial, Slide 4: Data View

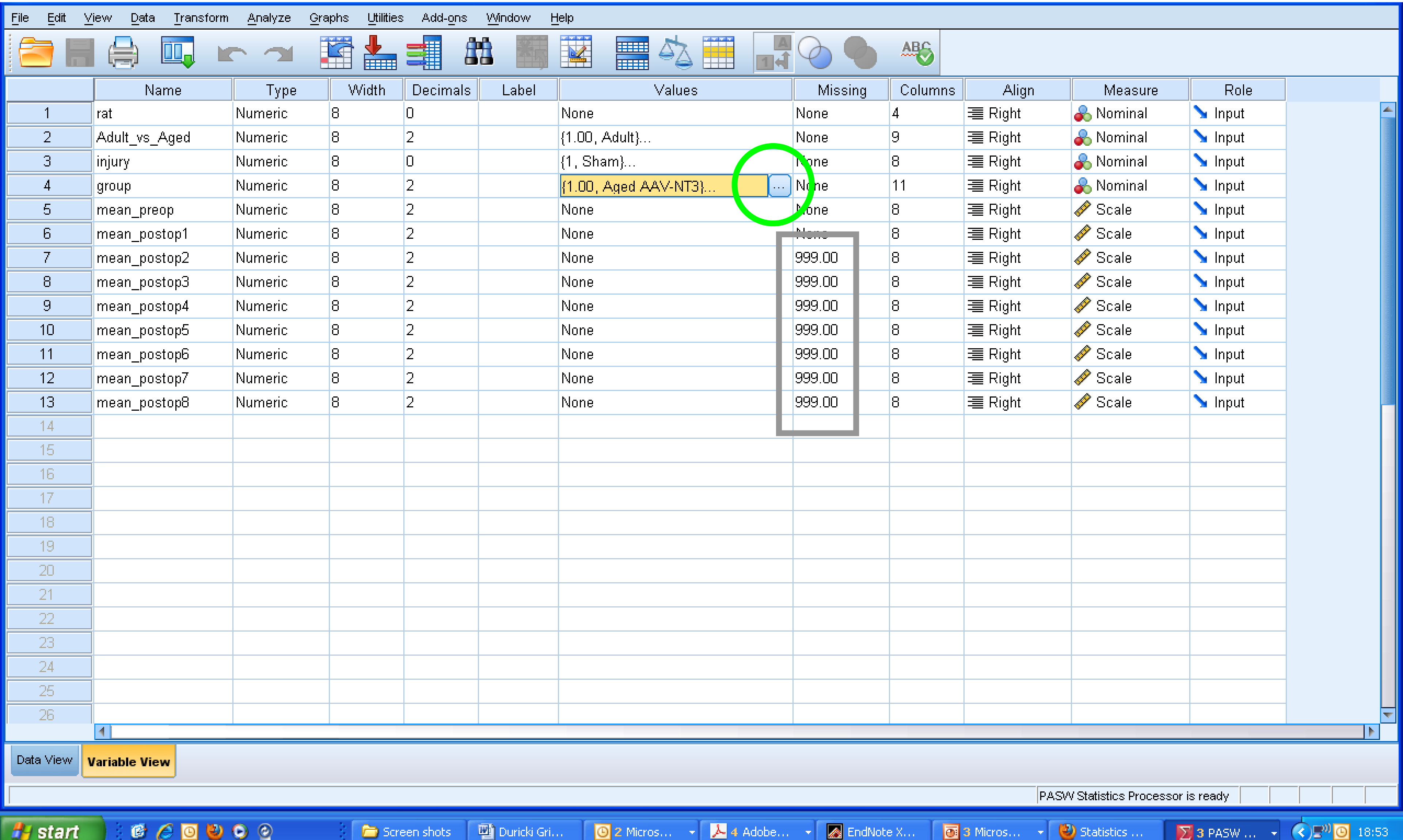
Click on the “A1” icon (green circle) to toggle between label names and label numbers.



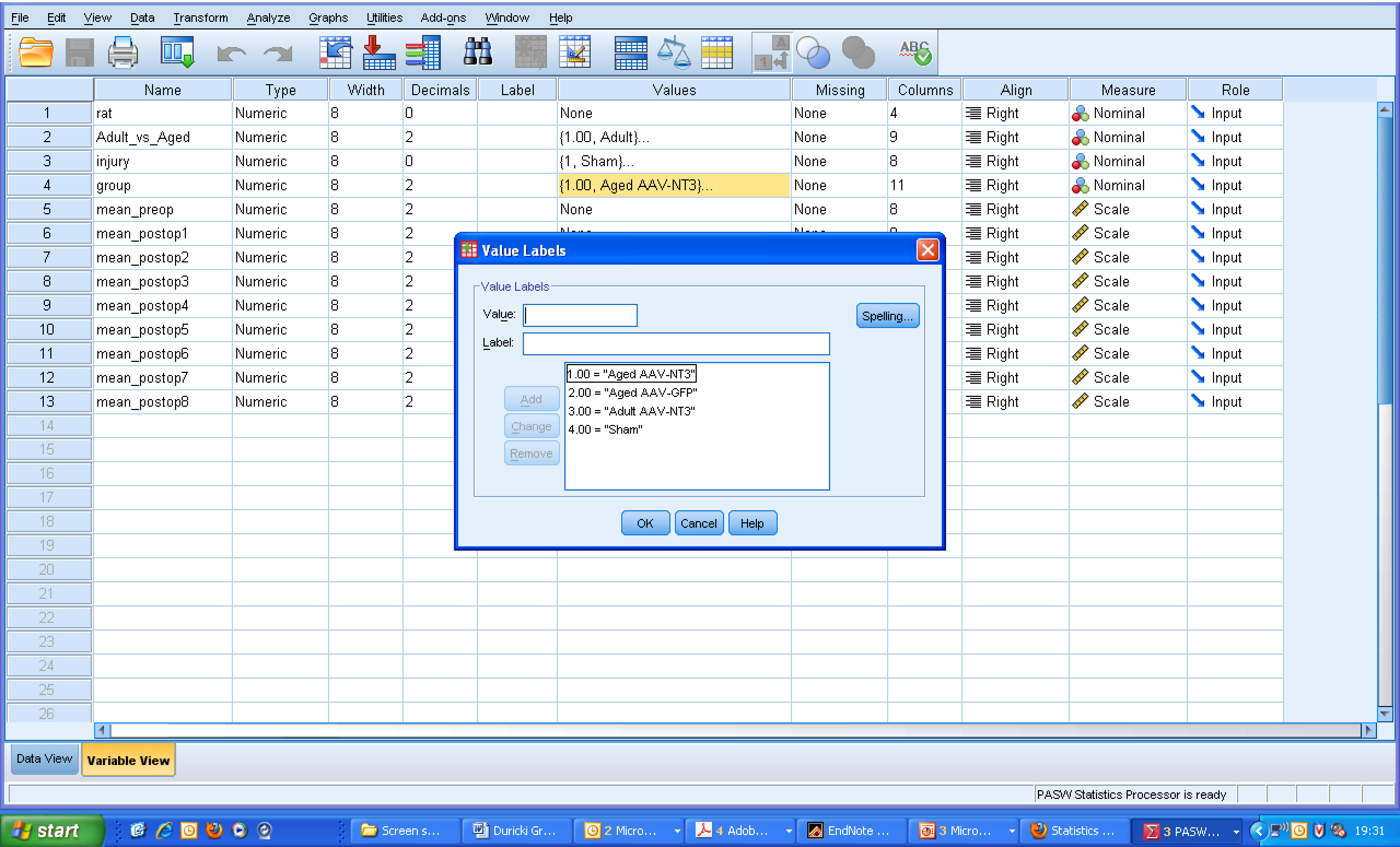
	rat	Adult_vs_Aged	injury	group	mean_preop	mean_postop 1	mean_postop 2	mean_postop 3	mean_postop 4	mean_postop 5	mean_postop 6	mean_postop 7	mean_postop 8	var
1	1	Adult	Stroke	Adult AAV-NT3	.0	.18	.16	.10	.07	.03	.06	.03	.03	
2	2	Adult	Sham	Sham	.10	.09	.07	.06	.07	.03	.10	.07	.10	
3	3	Adult	Sham	Sham	.06	.03	.06	.10	.03	.03	.0	.03	.0	
4	4	Adult	Stroke	Adult AAV-NT3	.0	.25	.13	.13	.13	.03	.10	.03	.09	
5	5	Adult	Stroke	Adult AAV-NT3	.0	.21	.09	.10	.14	.03	.10	.03	.09	
6	6	Adult	Stroke	Adult AAV-NT3	.0	.20	.10	.13	.10	.03	.0	.13	.0	
7	7	Adult	Stroke	Adult AAV-NT3	.0	.28	.25	.13	.07	.07	.06	.09	.13	
8	8	Adult	Stroke	Adult AAV-NT3	.03	.21	.24	.03	.13	.10	.10	.10	.03	
9	9	Adult	Stroke	Adult AAV-NT3	.07	.37	.09	.06	.07	.03	.12	.03	.0	
10	10	Adult	Stroke	Adult AAV-NT3	.14	.14	.16	.14	.18	.13	.10	.14	.03	
11	11	Adult	Stroke	Adult AAV-NT3	.0	.29	.06	.03	.14	.06	.03	.14	.0	
12	12	Adult	Stroke	Adult AAV-NT3	.03	.07	.10	.14	.08	.10	.06	.03	.03	
13	13	Adult	Stroke	Adult AAV-NT3	.13	.32	.13	.16	.21	.17	.0	.09	.0	
14	14	Adult	Stroke	Adult AAV-NT3	.0	.23	.13	.06	.13	.10	.03	.10	.03	
15	15	Adult	Sham	Sham	.03	.14	.10	.03	.07	.14	.07	.10	.03	
16	16	Adult	Stroke	Adult AAV-NT3	.03	.19	.0	.20	.03	.13	.06	.03	.0	
17	17	Adult	Stroke	Adult AAV-NT3	.13	.20	.0	.06	.10	.0	.10	.10	.03	
18	18	Adult	Stroke	Adult AAV-NT3	.06	.44	.16	.14	.14	.07	.03	.12	.16	
19	19	Aged	Stroke	Aged AAV-NT3	.04	.26	.17	.19	.25	.20	.50	.13	.10	
20	21	Aged	Stroke	Aged AAV-NT3	.13	.42	.46	.46	.37	.42	.46	.30	.26	
21	22	Aged	Stroke	Aged AAV-NT3	.10	.26	.10	.22	.11	.18	.10	.06	.13	
22	23	Aged	Stroke	Aged AAV-NT3	.10	.20	.15	.13	.13	.07	.17	.10	.23	
23	24	Aged	Stroke	Aged AAV-GFP	.03	.20	.33	.30	.29	.14	.10	.13	.39	
24	25	Aged	Stroke	Aged AAV-NT3	.03	.20	.38	.03	.13	.0	.10	.21	.24	

Supplementary Tutorial, Slide 5

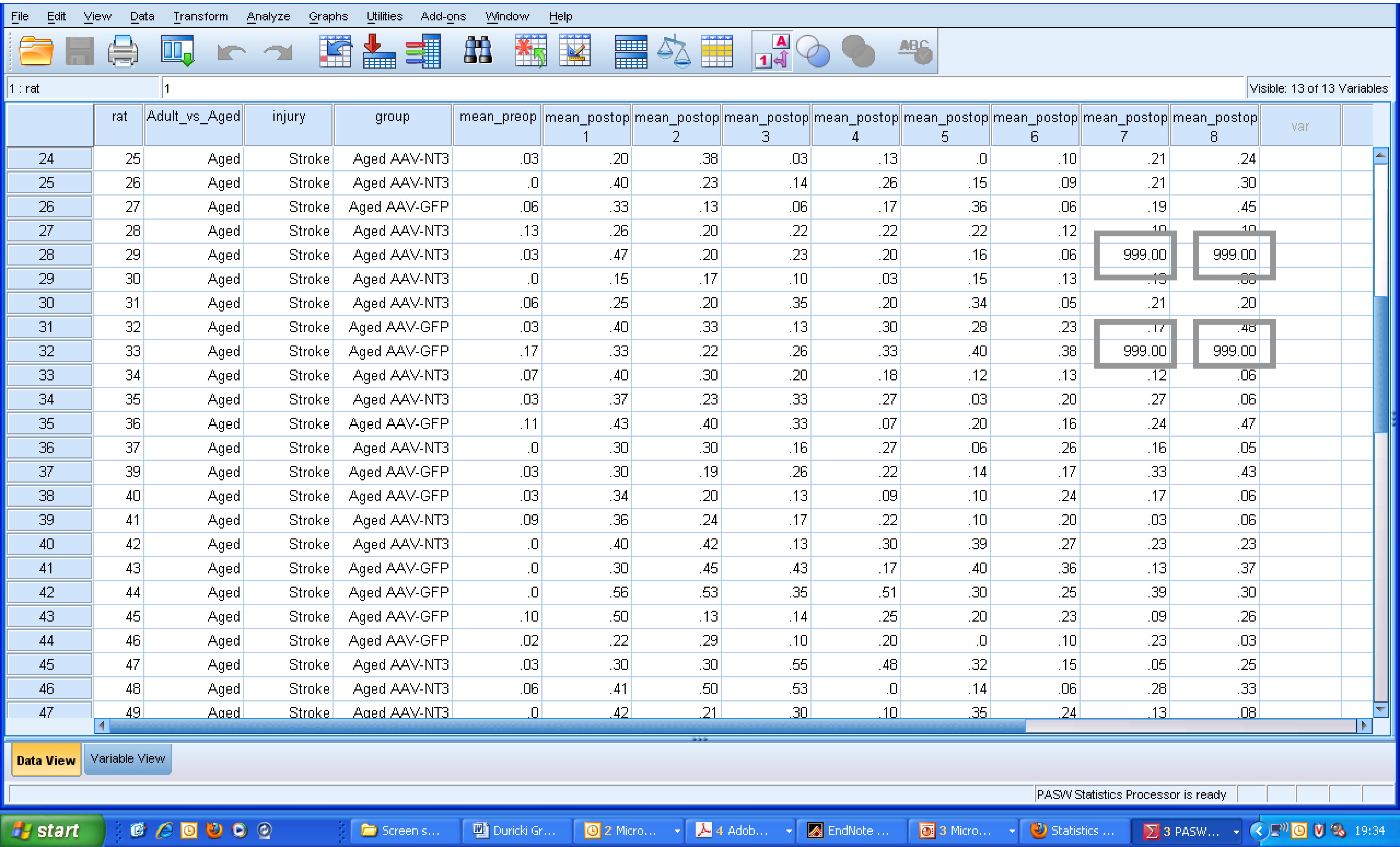
In Variable View, click on Blue icon ("…" in green circle) to discover the names of the Levels for the Factor "group". Missing values have been coded "999.00"



Supplementary Tutorial, Slide 6:
Variable View showing four Levels for “group” Factor

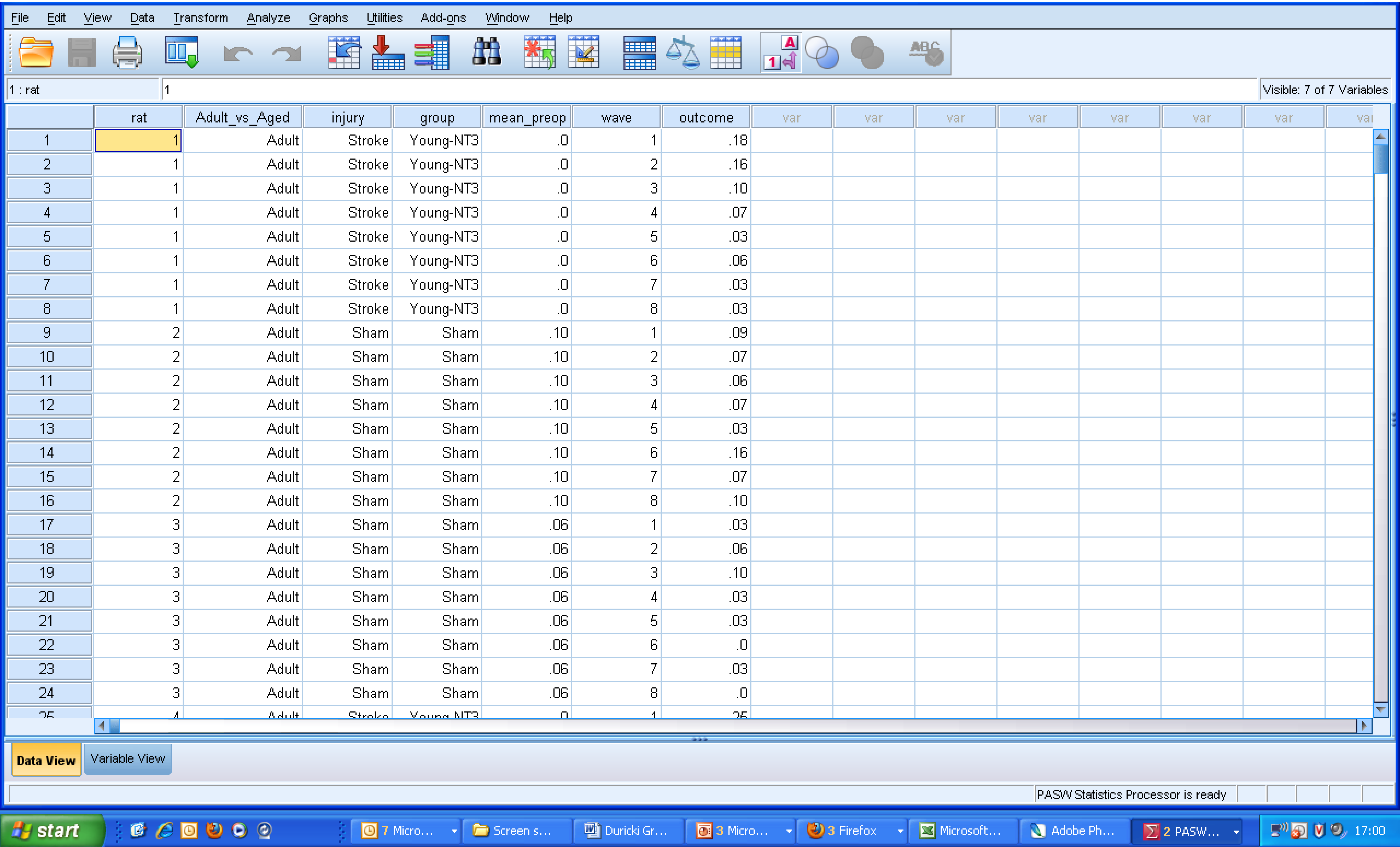


Supplementary Tutorial, Slide 7 and Figure 2: Data View



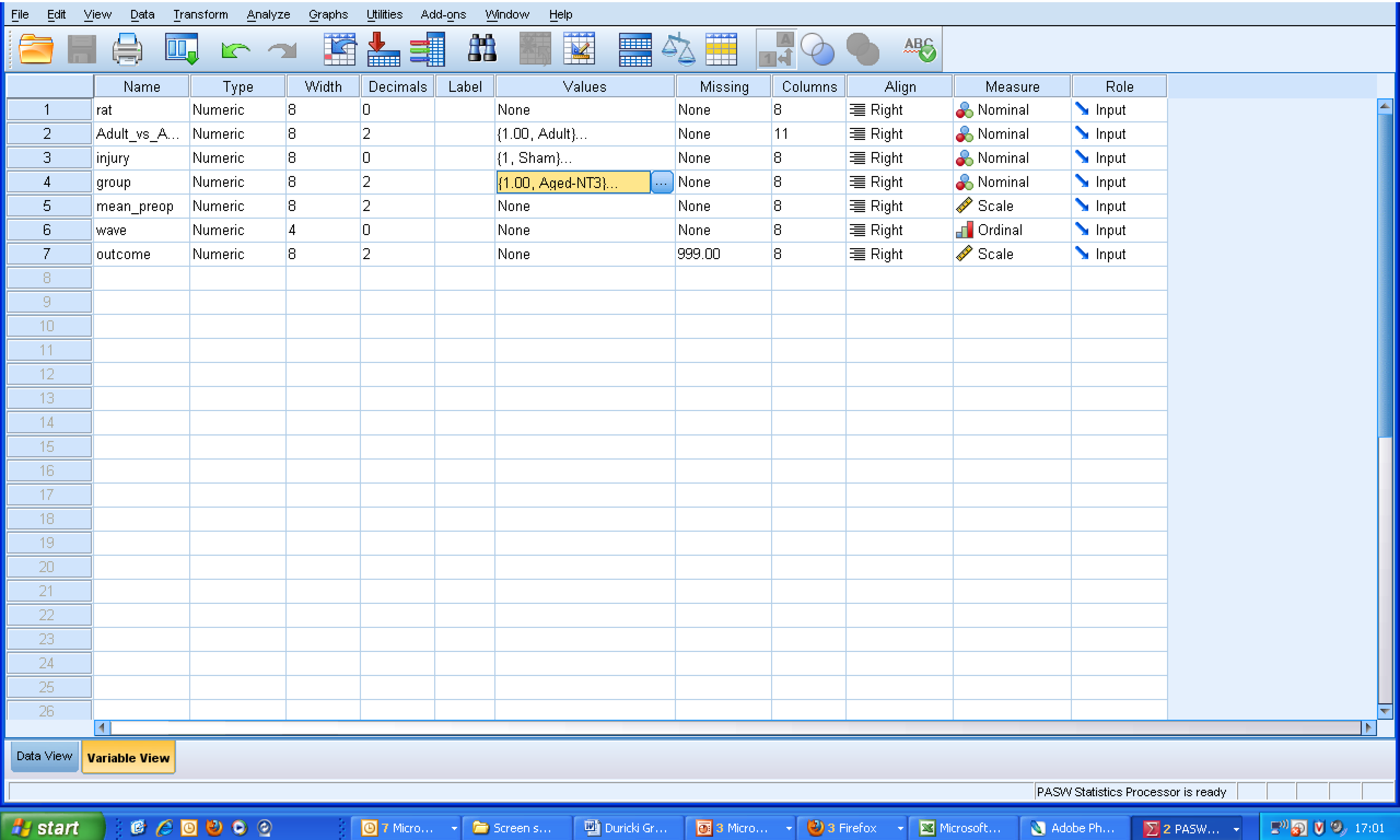
	rat	Adult_vs_Aged	injury	group	mean_preop	mean_postop 1	mean_postop 2	mean_postop 3	mean_postop 4	mean_postop 5	mean_postop 6	mean_postop 7	mean_postop 8	var
24	25	Aged	Stroke	Aged AAV-NT3	.03	.20	.38	.03	.13	.0	.10	.21	.24	
25	26	Aged	Stroke	Aged AAV-NT3	.0	.40	.23	.14	.26	.15	.09	.21	.30	
26	27	Aged	Stroke	Aged AAV-GFP	.06	.33	.13	.06	.17	.36	.06	.19	.45	
27	28	Aged	Stroke	Aged AAV-NT3	.13	.26	.20	.22	.22	.22	.12	[illegible]	[illegible]	
28	29	Aged	Stroke	Aged AAV-NT3	.03	.47	.20	.23	.20	.16	.06	999.00	999.00	
29	30	Aged	Stroke	Aged AAV-NT3	.0	.15	.17	.10	.03	.15	.13	[illegible]	[illegible]	
30	31	Aged	Stroke	Aged AAV-NT3	.06	.25	.20	.35	.20	.34	.05	.21	.20	
31	32	Aged	Stroke	Aged AAV-GFP	.03	.40	.33	.13	.30	.28	.23	.17	.48	
32	33	Aged	Stroke	Aged AAV-GFP	.17	.33	.22	.26	.33	.40	.38	999.00	999.00	
33	34	Aged	Stroke	Aged AAV-NT3	.07	.40	.30	.20	.18	.12	.13	.12	.06	
34	35	Aged	Stroke	Aged AAV-NT3	.03	.37	.23	.33	.27	.03	.20	.27	.06	
35	36	Aged	Stroke	Aged AAV-GFP	.11	.43	.40	.33	.07	.20	.16	.24	.47	
36	37	Aged	Stroke	Aged AAV-NT3	.0	.30	.30	.16	.27	.06	.26	.16	.05	
37	39	Aged	Stroke	Aged AAV-GFP	.03	.30	.19	.26	.22	.14	.17	.33	.43	
38	40	Aged	Stroke	Aged AAV-GFP	.03	.34	.20	.13	.09	.10	.24	.17	.06	
39	41	Aged	Stroke	Aged AAV-NT3	.09	.36	.24	.17	.22	.10	.20	.03	.06	
40	42	Aged	Stroke	Aged AAV-NT3	.0	.40	.42	.13	.30	.39	.27	.23	.23	
41	43	Aged	Stroke	Aged AAV-GFP	.0	.30	.45	.43	.17	.40	.36	.13	.37	
42	44	Aged	Stroke	Aged AAV-GFP	.0	.56	.53	.35	.51	.30	.25	.39	.30	
43	45	Aged	Stroke	Aged AAV-GFP	.10	.50	.13	.14	.25	.20	.23	.09	.26	
44	46	Aged	Stroke	Aged AAV-GFP	.02	.22	.29	.10	.20	.0	.10	.23	.03	
45	47	Aged	Stroke	Aged AAV-NT3	.03	.30	.30	.55	.48	.32	.15	.05	.25	
46	48	Aged	Stroke	Aged AAV-NT3	.06	.41	.50	.53	.0	.14	.06	.28	.33	
47	49	Aged	Stroke	Aged AAV-NT3	.0	.42	.21	.30	.10	.35	.24	.13	.08	

Supplementary Tutorial, Slide 8 and Figure 3: Data View of “long_format” data (“long_format.sav” data file from Supplementary Data 1) suitable for analysis using the Mixed Model>Linear procedure



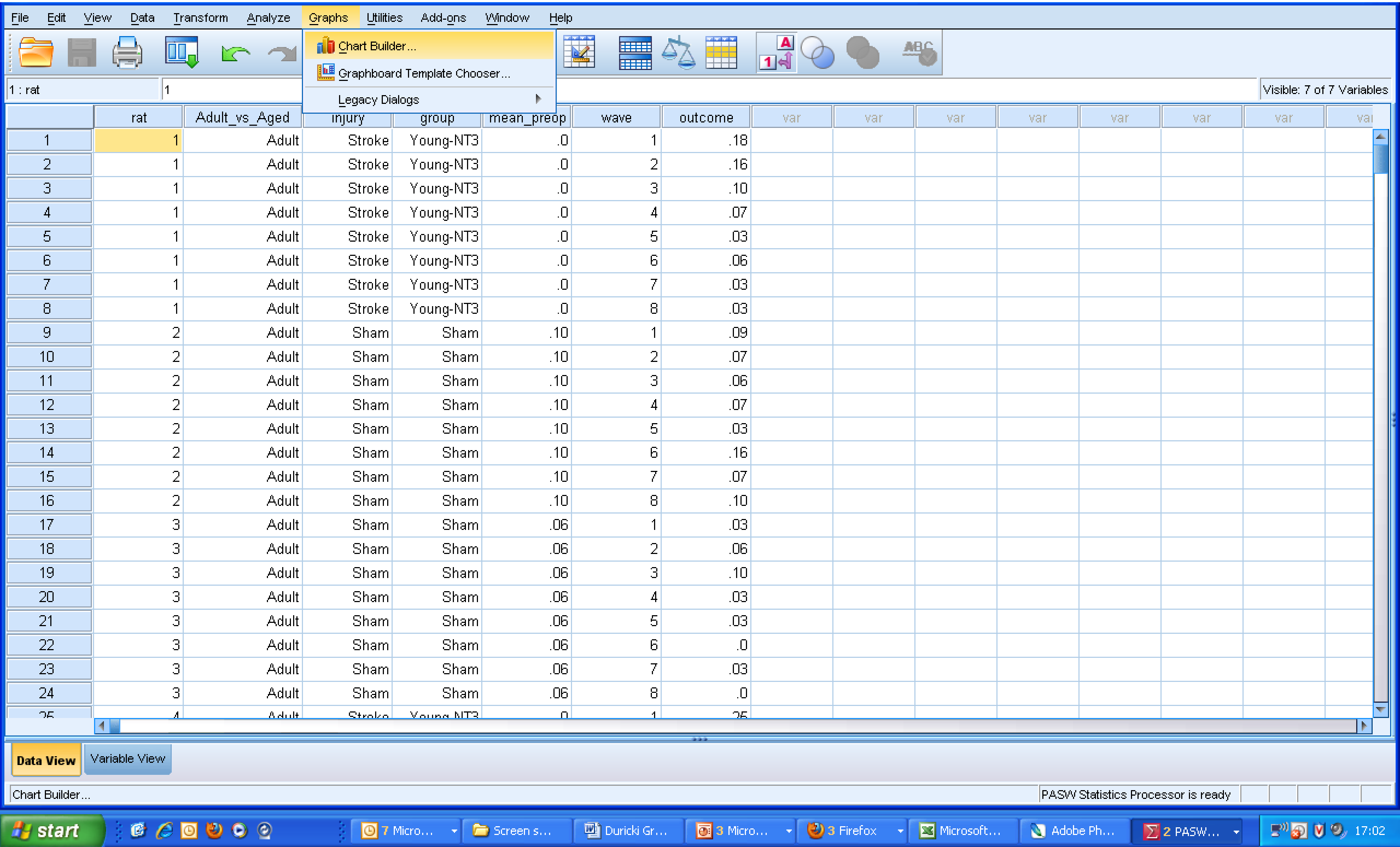
	rat	Adult_vs_Aged	injury	group	mean_preop	wave	outcome
1	1	Adult	Stroke	Young-NT3	.0	1	.18
2	1	Adult	Stroke	Young-NT3	.0	2	.16
3	1	Adult	Stroke	Young-NT3	.0	3	.10
4	1	Adult	Stroke	Young-NT3	.0	4	.07
5	1	Adult	Stroke	Young-NT3	.0	5	.03
6	1	Adult	Stroke	Young-NT3	.0	6	.06
7	1	Adult	Stroke	Young-NT3	.0	7	.03
8	1	Adult	Stroke	Young-NT3	.0	8	.03
9	2	Adult	Sham	Sham	.10	1	.09
10	2	Adult	Sham	Sham	.10	2	.07
11	2	Adult	Sham	Sham	.10	3	.06
12	2	Adult	Sham	Sham	.10	4	.07
13	2	Adult	Sham	Sham	.10	5	.03
14	2	Adult	Sham	Sham	.10	6	.16
15	2	Adult	Sham	Sham	.10	7	.07
16	2	Adult	Sham	Sham	.10	8	.10
17	3	Adult	Sham	Sham	.06	1	.03
18	3	Adult	Sham	Sham	.06	2	.06
19	3	Adult	Sham	Sham	.06	3	.10
20	3	Adult	Sham	Sham	.06	4	.03
21	3	Adult	Sham	Sham	.06	5	.03
22	3	Adult	Sham	Sham	.06	6	.0
23	3	Adult	Sham	Sham	.06	7	.03
24	3	Adult	Sham	Sham	.06	8	.0
25	4	Adult	Stroke	Young-NT3	.0	1	.25

Supplementary Tutorial, Slide 9: Variable View for “long format” data

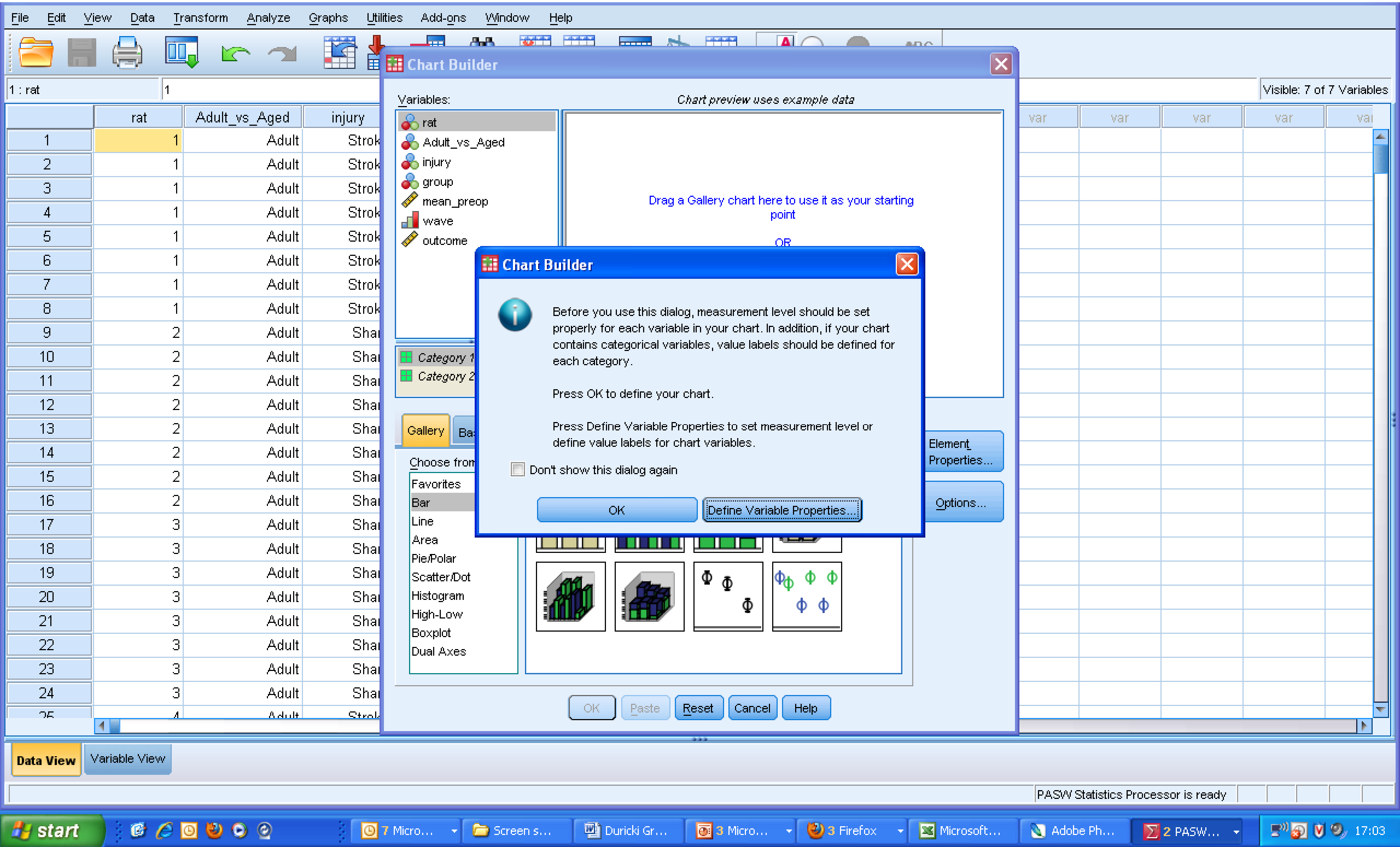


	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	rat	Numeric	8	0		None	None	8	Right	Nominal	Input
2	Adult_vs_A...	Numeric	8	2		{1.00, Adult}...	None	11	Right	Nominal	Input
3	injury	Numeric	8	0		{1, Sham}...	None	8	Right	Nominal	Input
4	group	Numeric	8	2		{1.00, Aged-NT3}...	None	8	Right	Nominal	Input
5	mean_preop	Numeric	8	2		None	None	8	Right	Scale	Input
6	wave	Numeric	4	0		None	None	8	Right	Ordinal	Input
7	outcome	Numeric	8	2		None	999.00	8	Right	Scale	Input

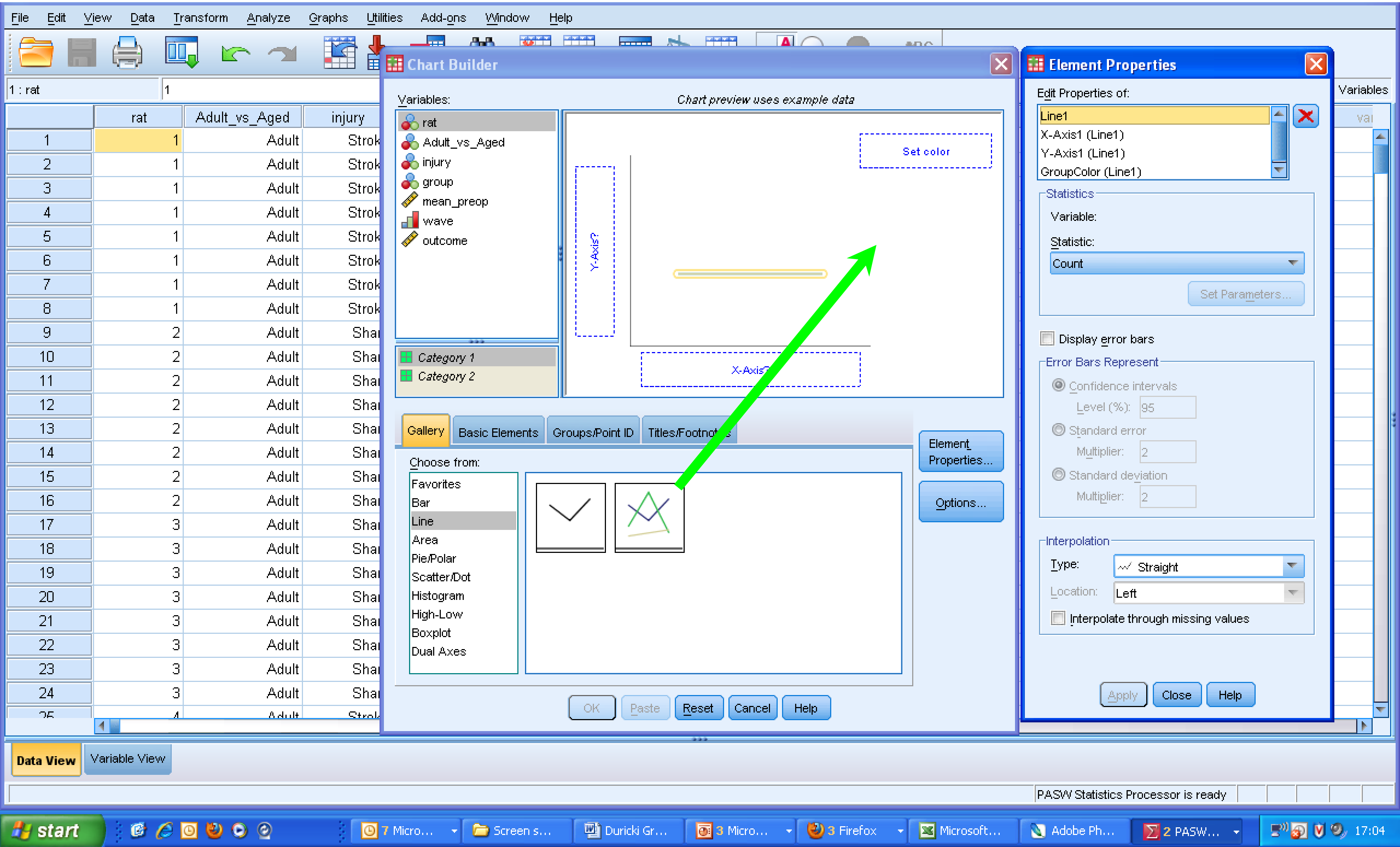
Supplementary Tutorial, Slide 10: To plot individual rat performances over time, from “long format” data, click Graphs>Chart Builder



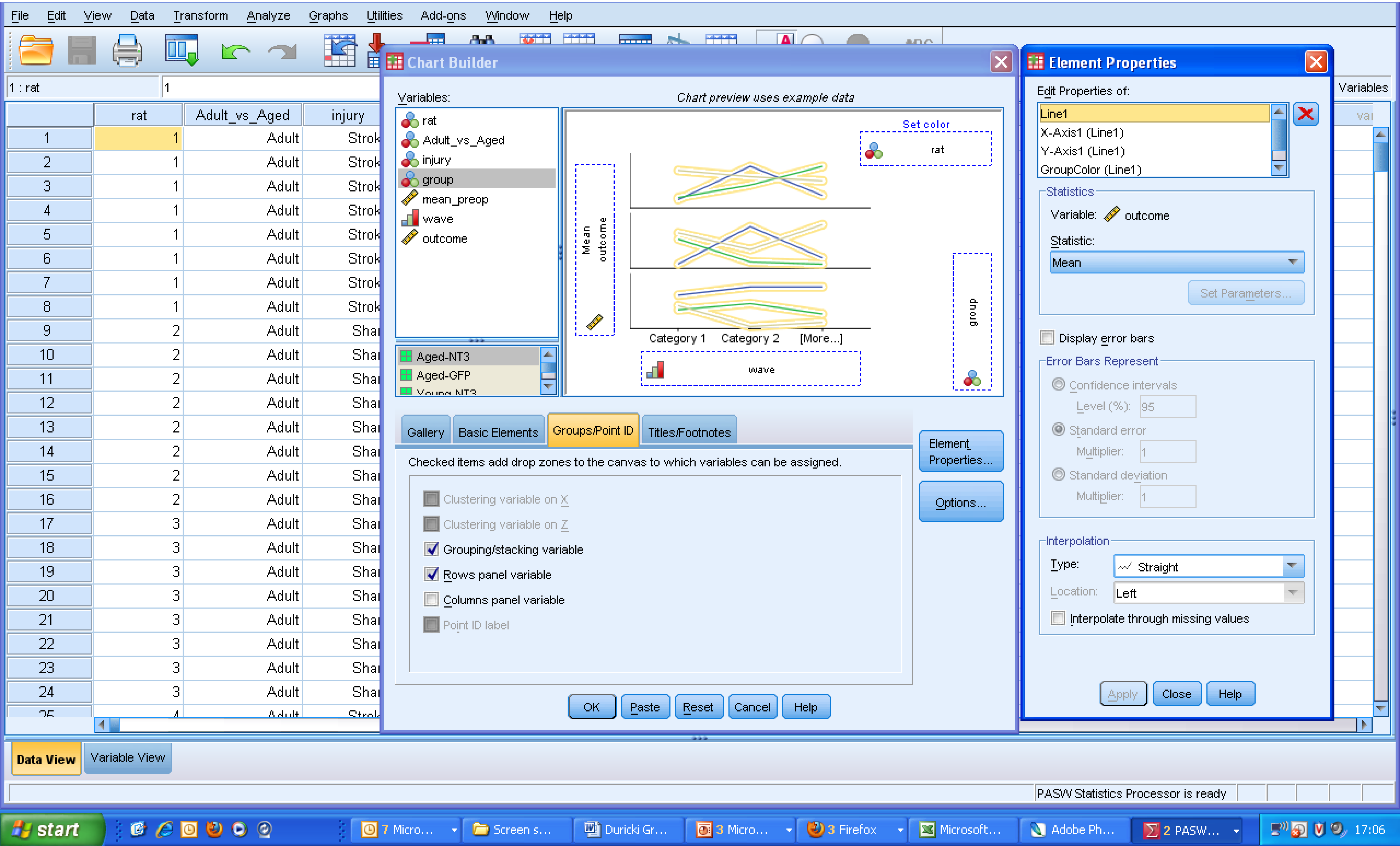
Supplementary Tutorial, Slide 11: The Warning dialog reminds you to make sure you set up the variable types in Variable View properly (*i.e.*, select Nominal / Ordinal / Scale correctly for each variable)



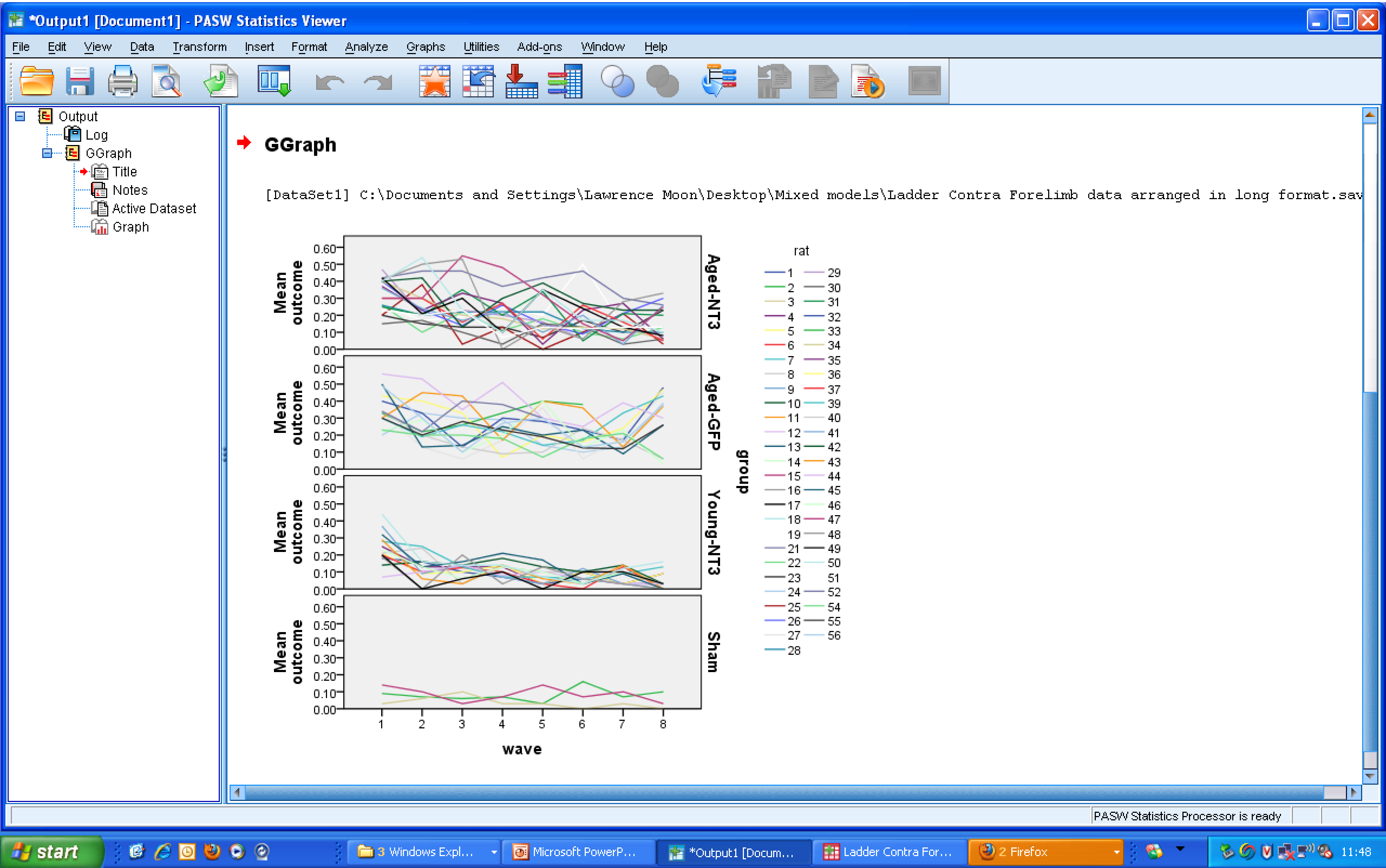
Supplementary Tutorial, Slide 12: Click on “Line” then drag the icon with three lines into the “Chart preview” window



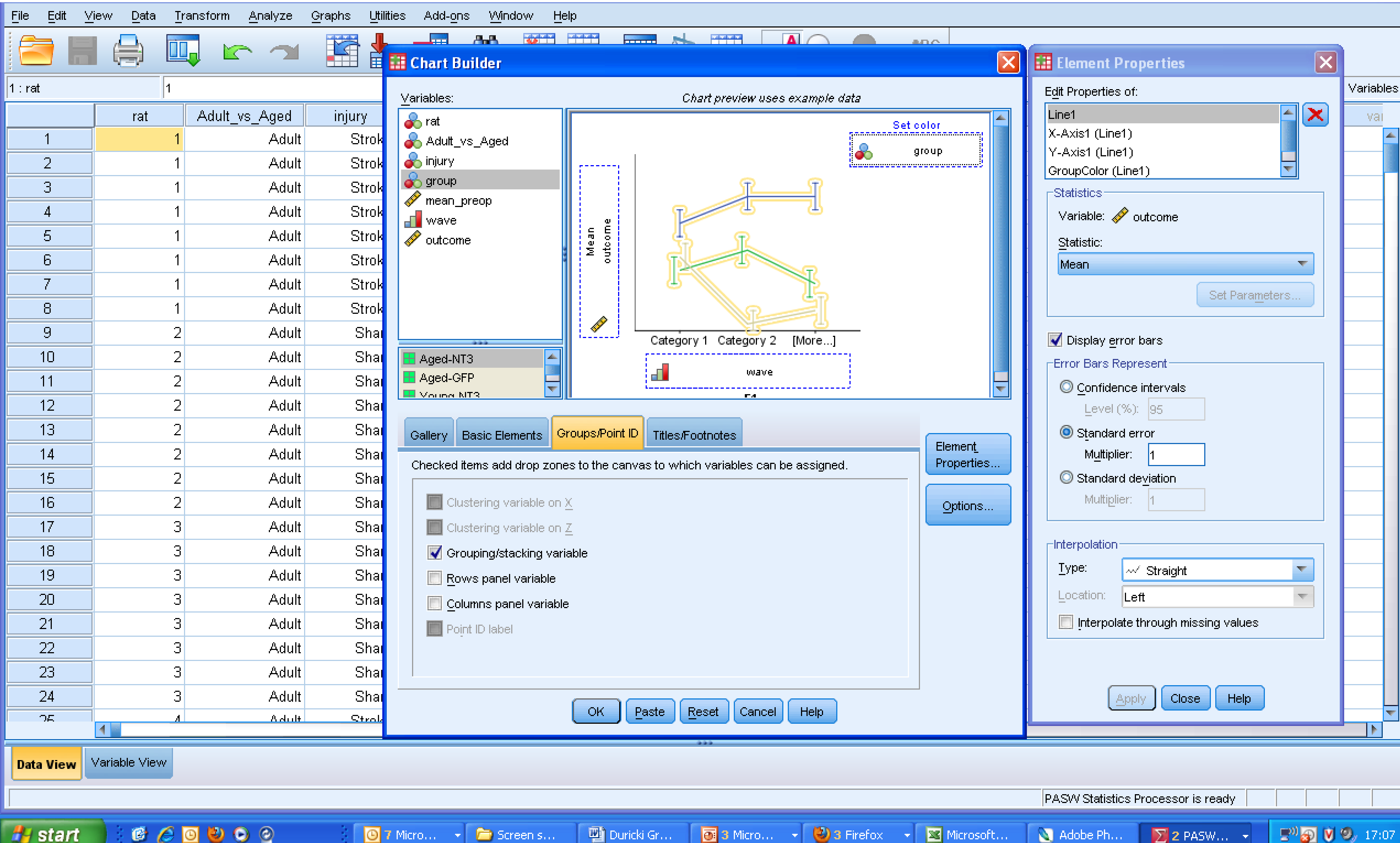
Supplementary Tutorial, Slide 13:



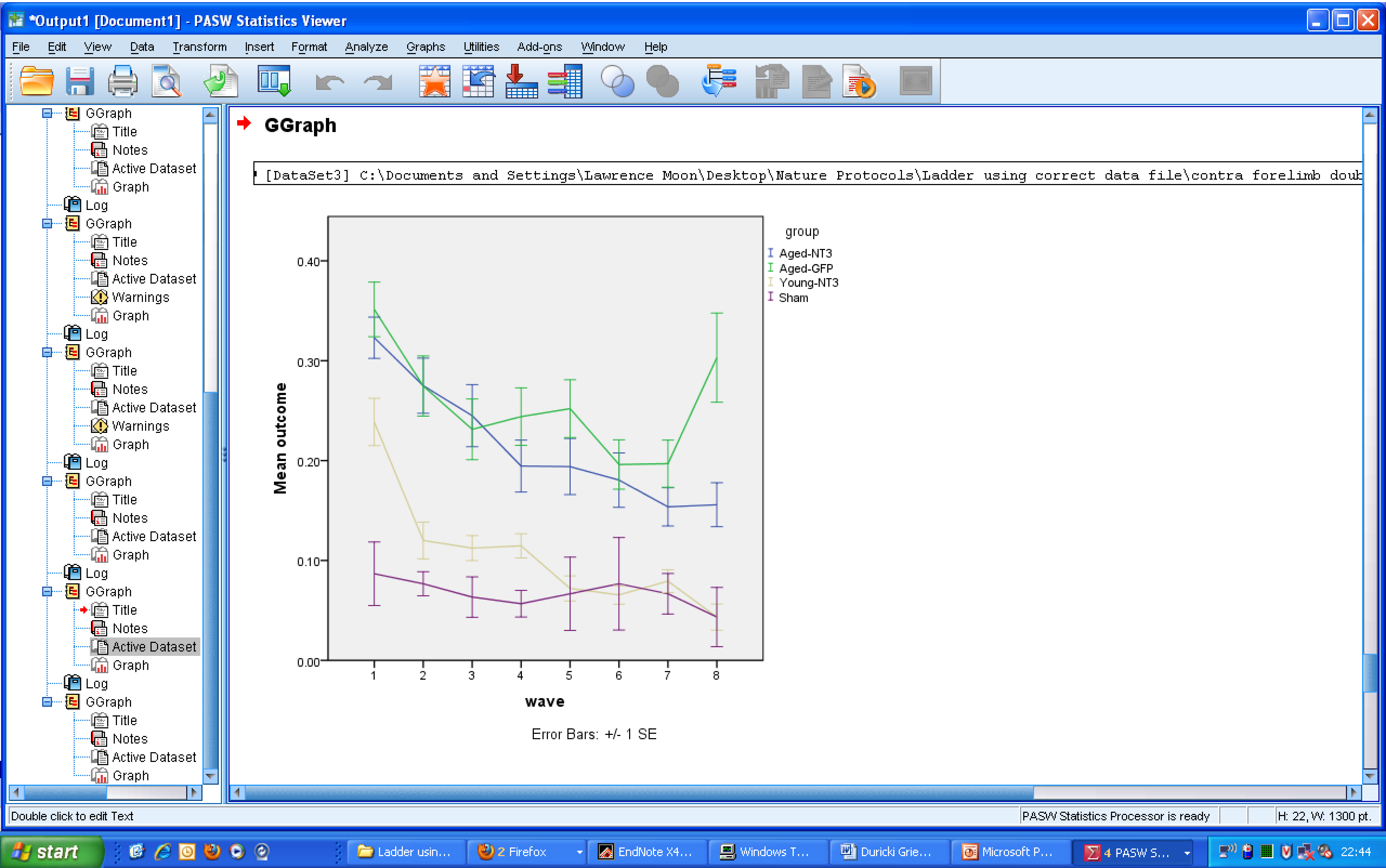
Supplementary Tutorial, Slide 14 and Figure 4: Graphs showing individual rat performances over time arranged by group and colour coded according to Subject number (rat).



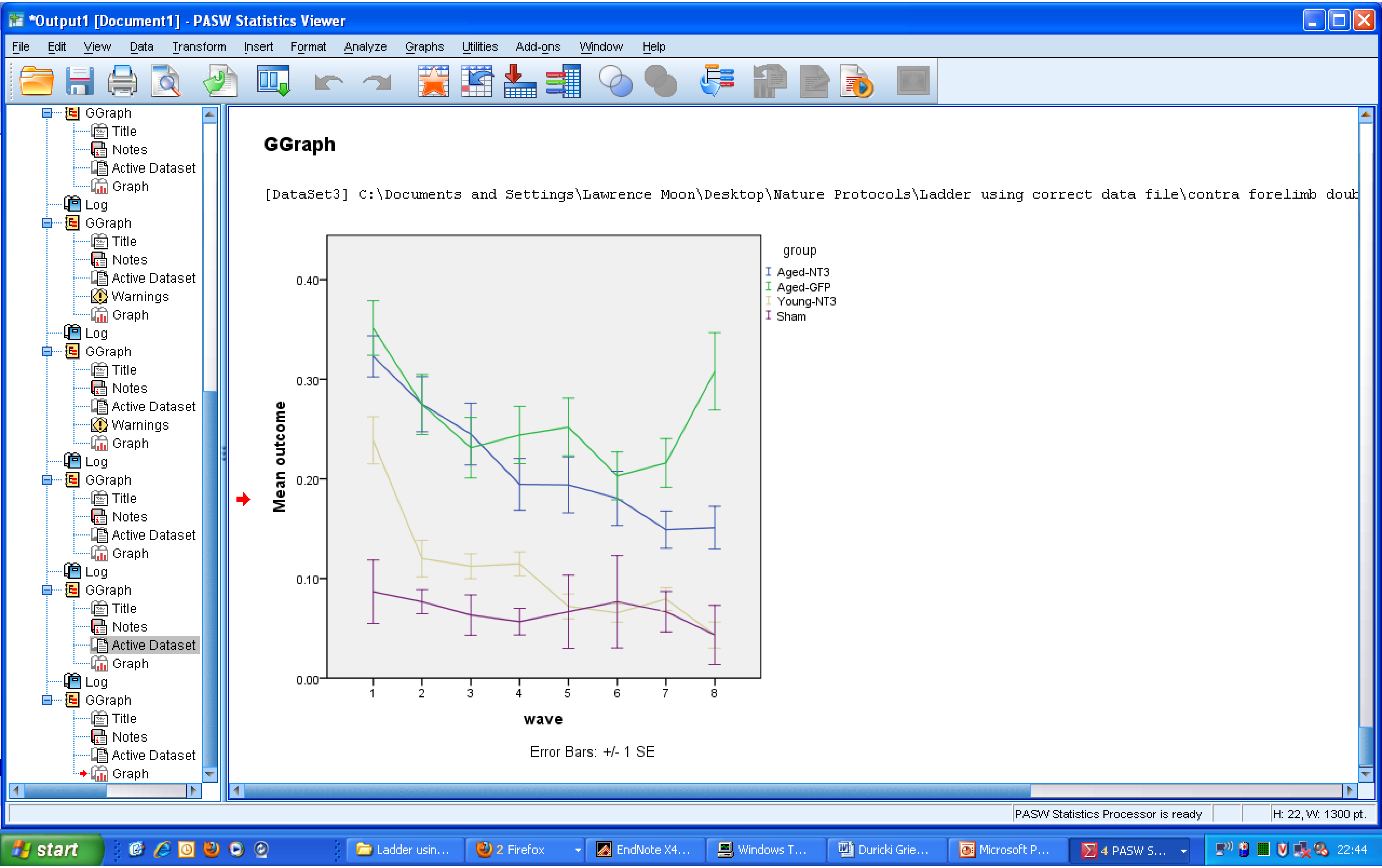
Supplementary Tutorial, Slide 15: How to generate a graph of mean group performance over time.



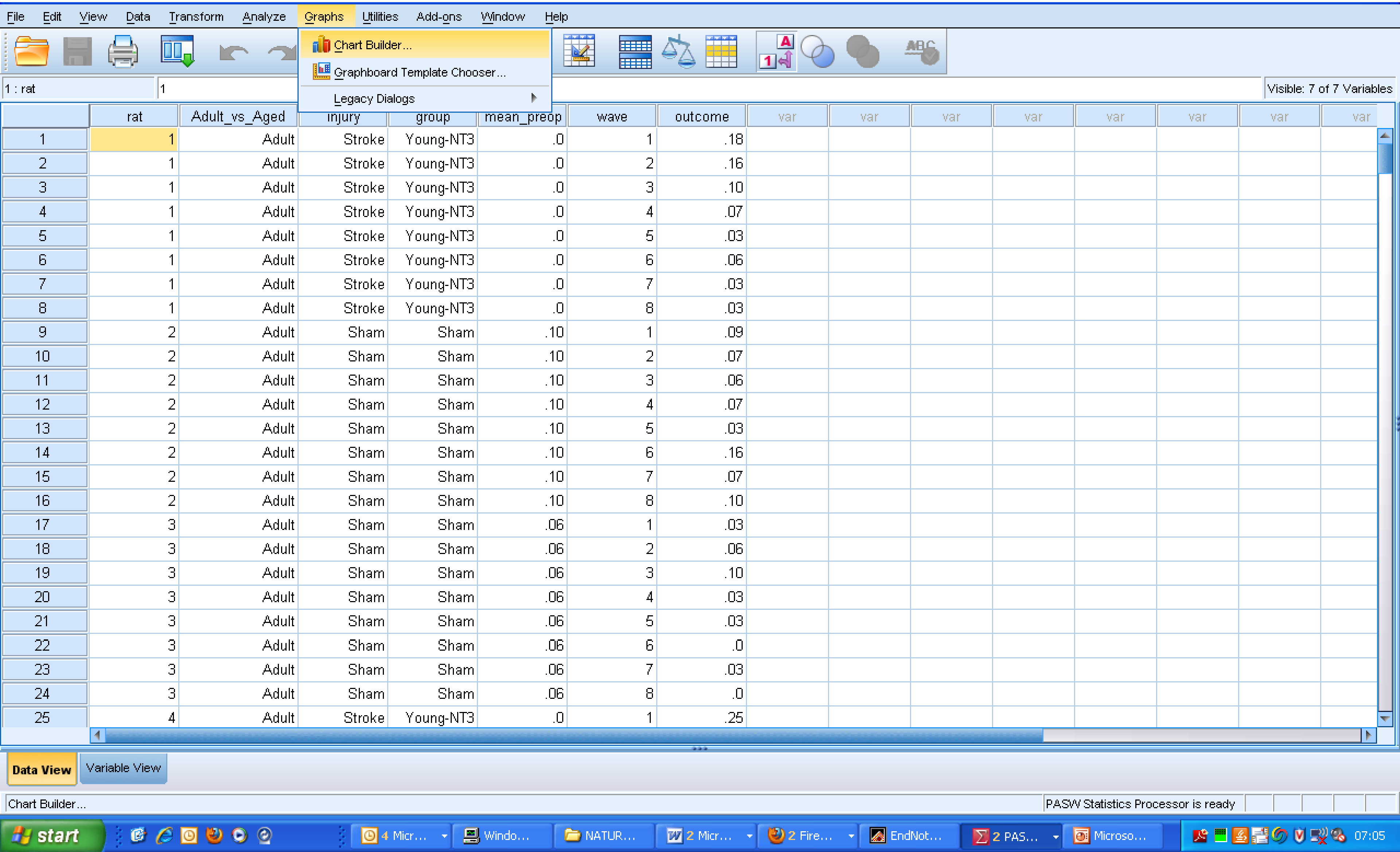
Supplementary Tutorial, Slide 16 and Figure 5: Graphs showing mean performances over time arranged by group. Note that the last data points for AAV-NT3 and AAV-GFP do not include data from rats with missing values



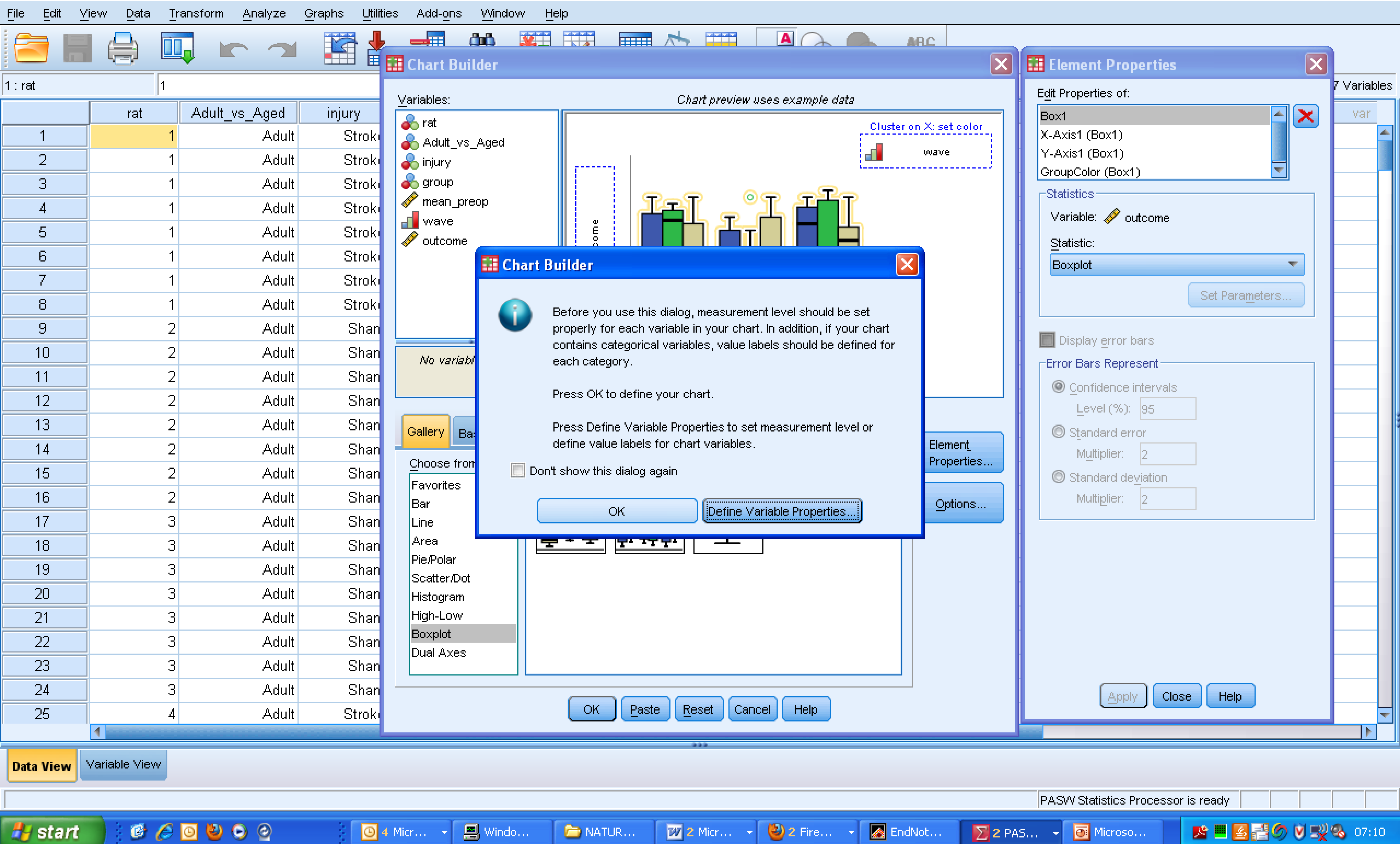
Supplementary Tutorial, Slide 17: Same data but plotted with missing values replaced by Last Value Carried Forward. Data points now include all available data from all animals.



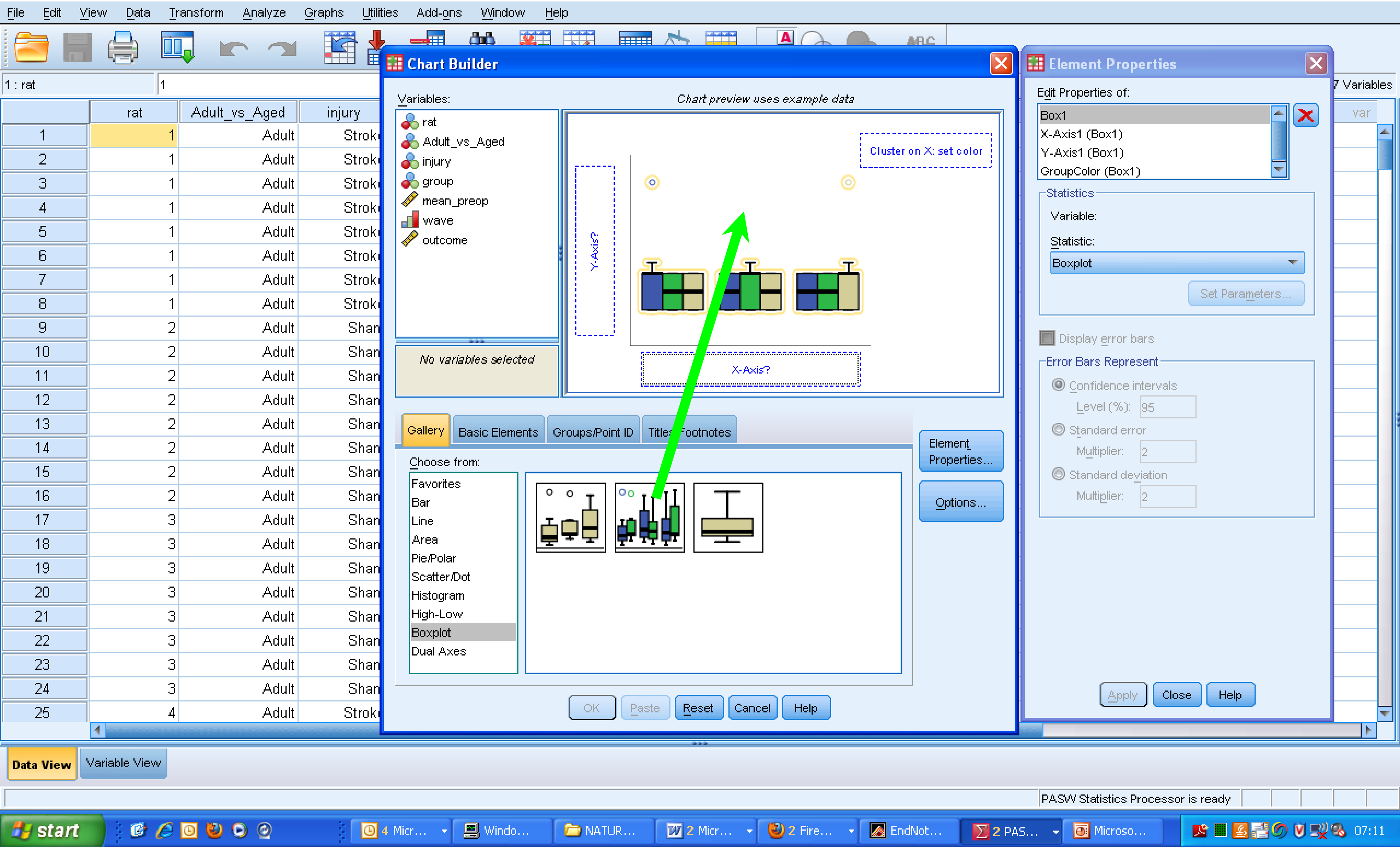
Supplementary Tutorial, Slide 18: How to determine if group variances are similar *i.e.*, test if group variances are “heterogeneous”



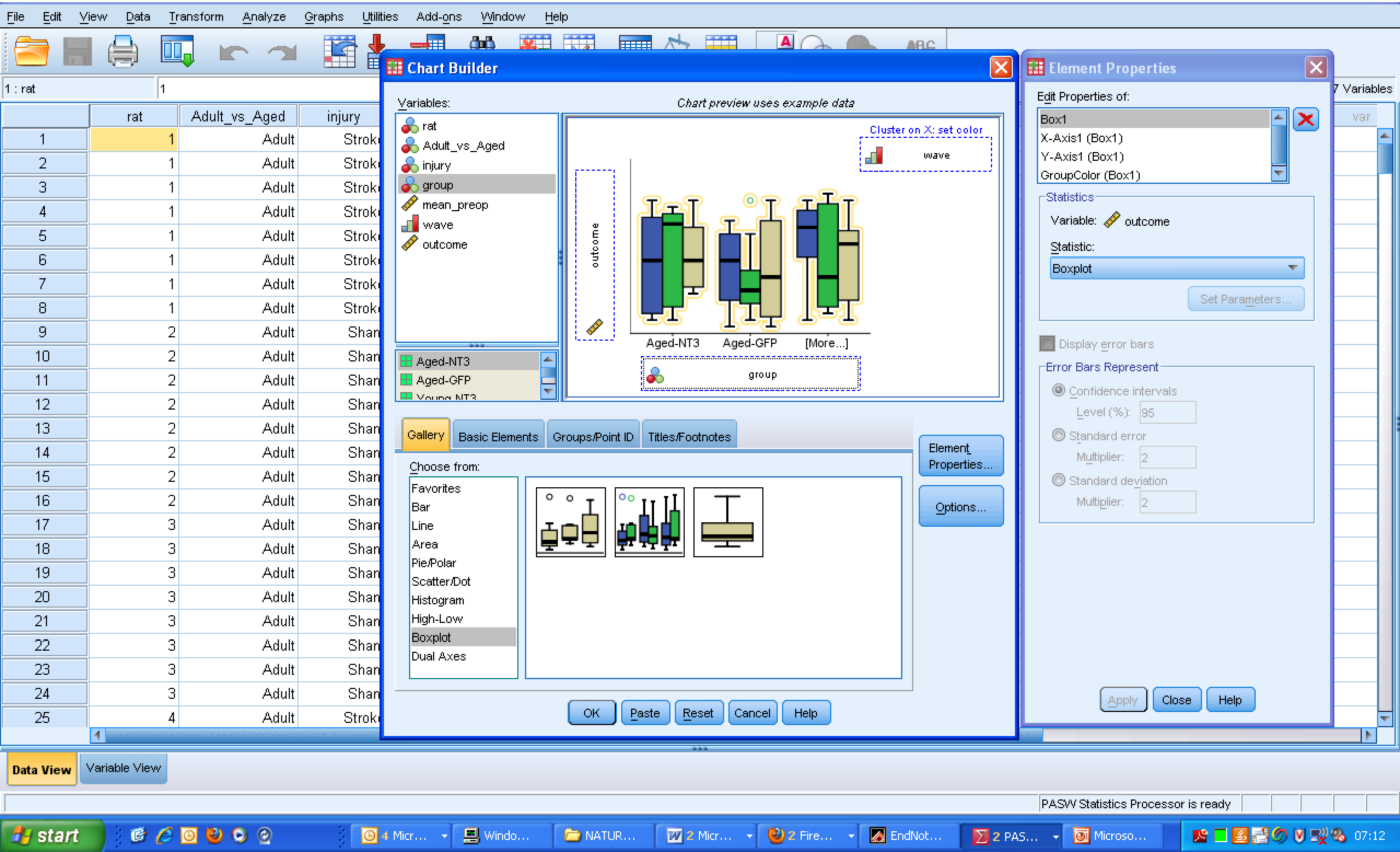
Supplementary Tutorial, Slide 19:



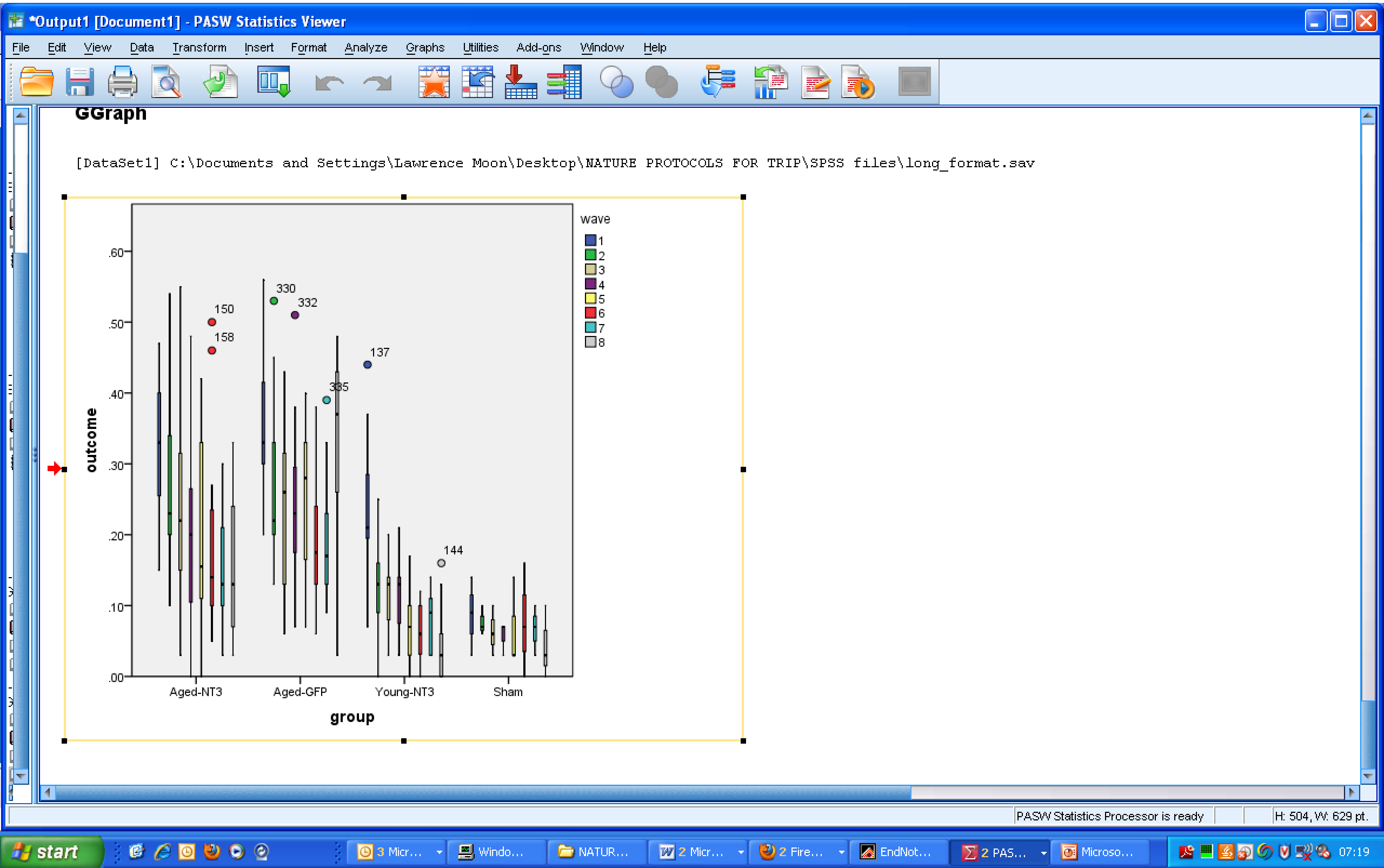
Supplementary Tutorial, Slide 20:



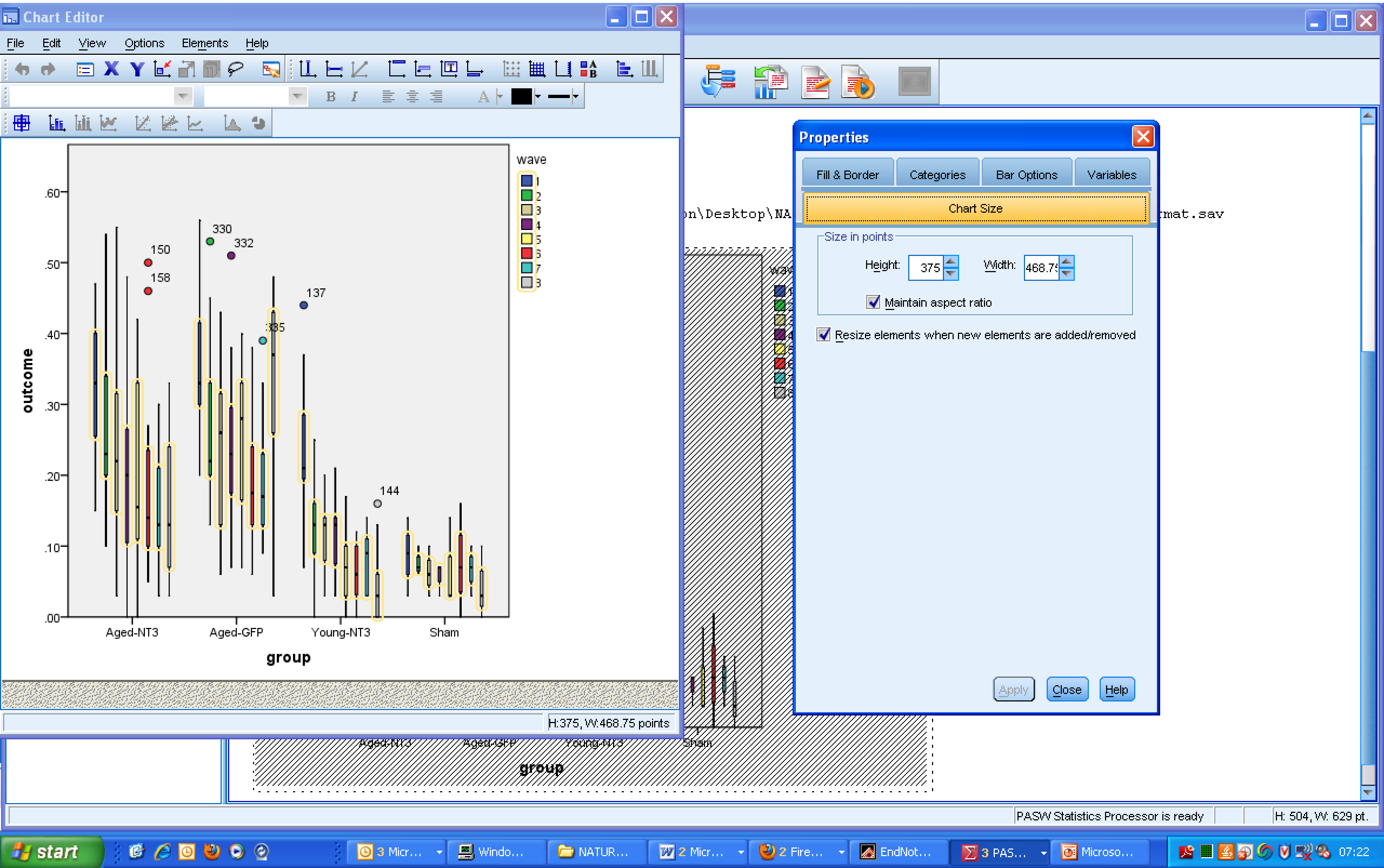
Supplementary Tutorial, Slide 21:



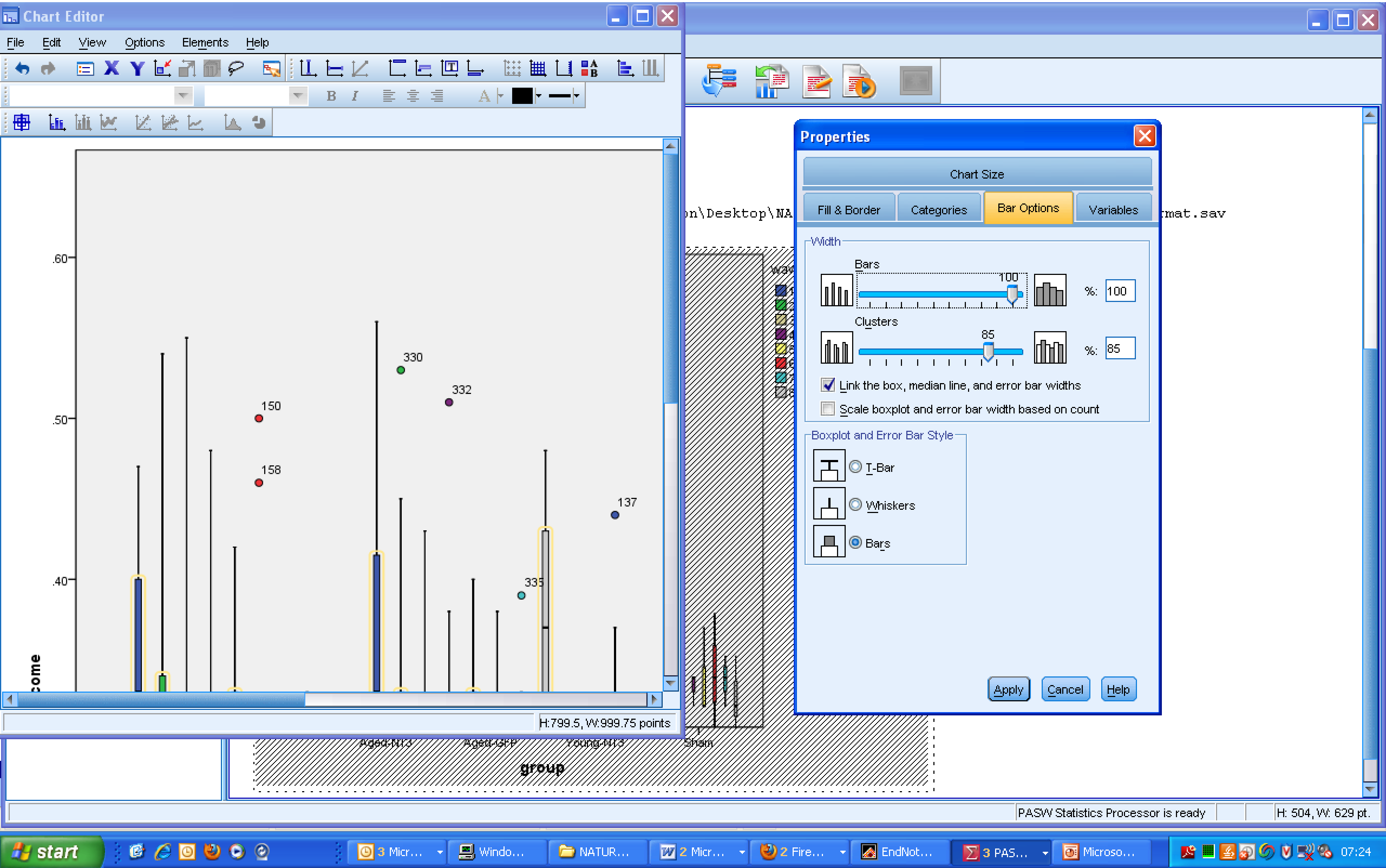
Supplementary Tutorial, Slide 22:



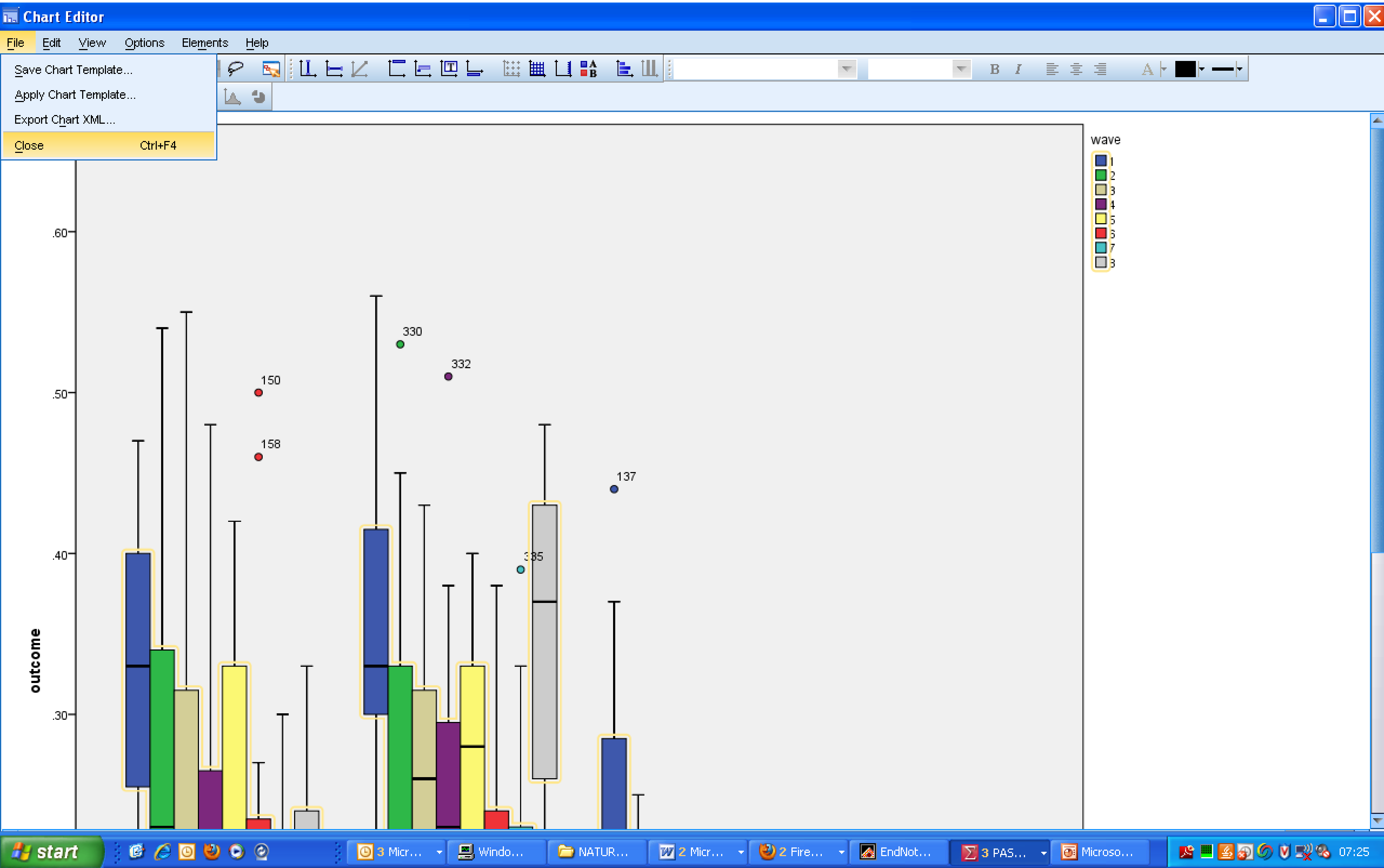
Supplementary Tutorial, Slide 23



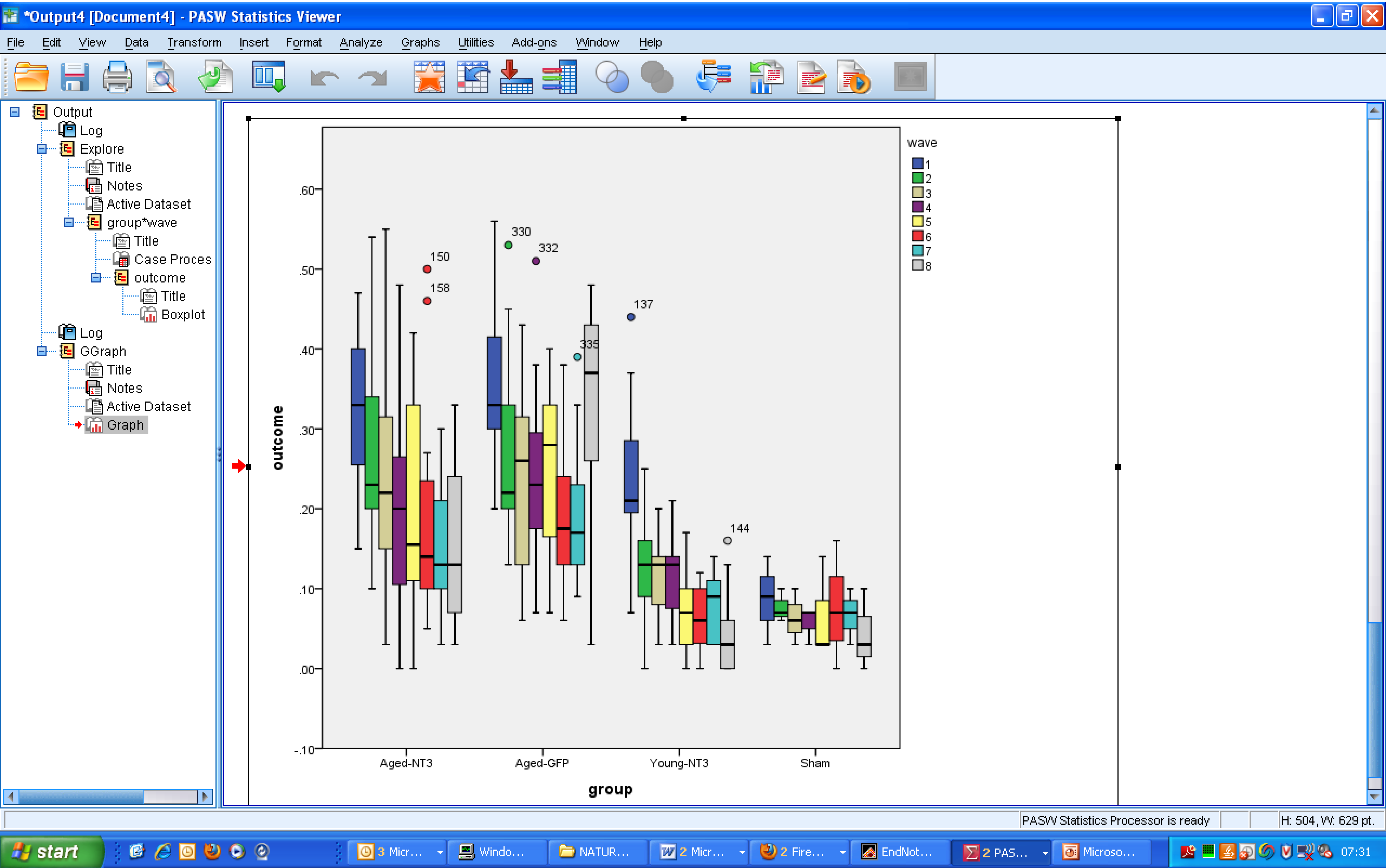
Supplementary Tutorial, Slide 24:



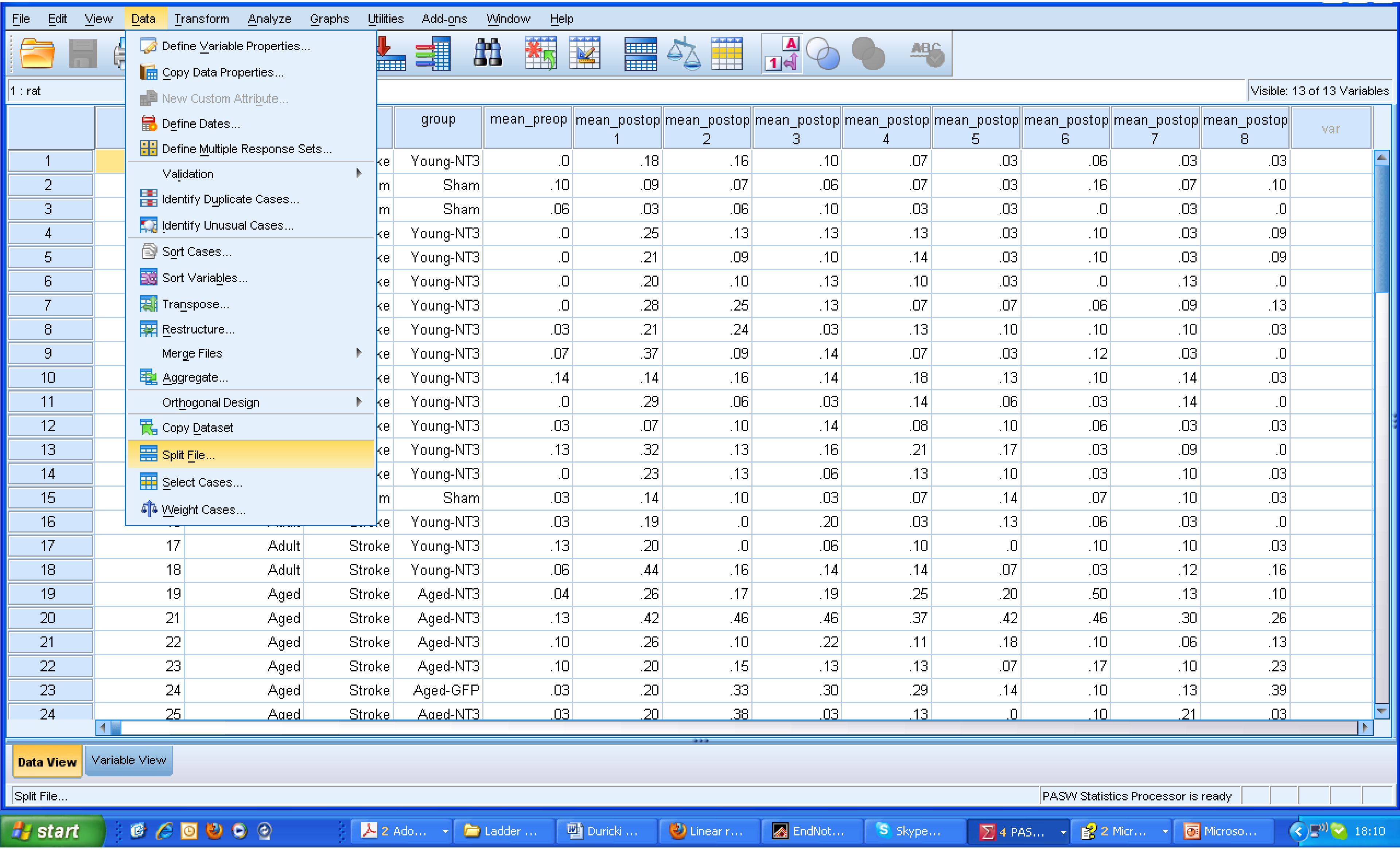
Supplementary Tutorial, Slide 25:



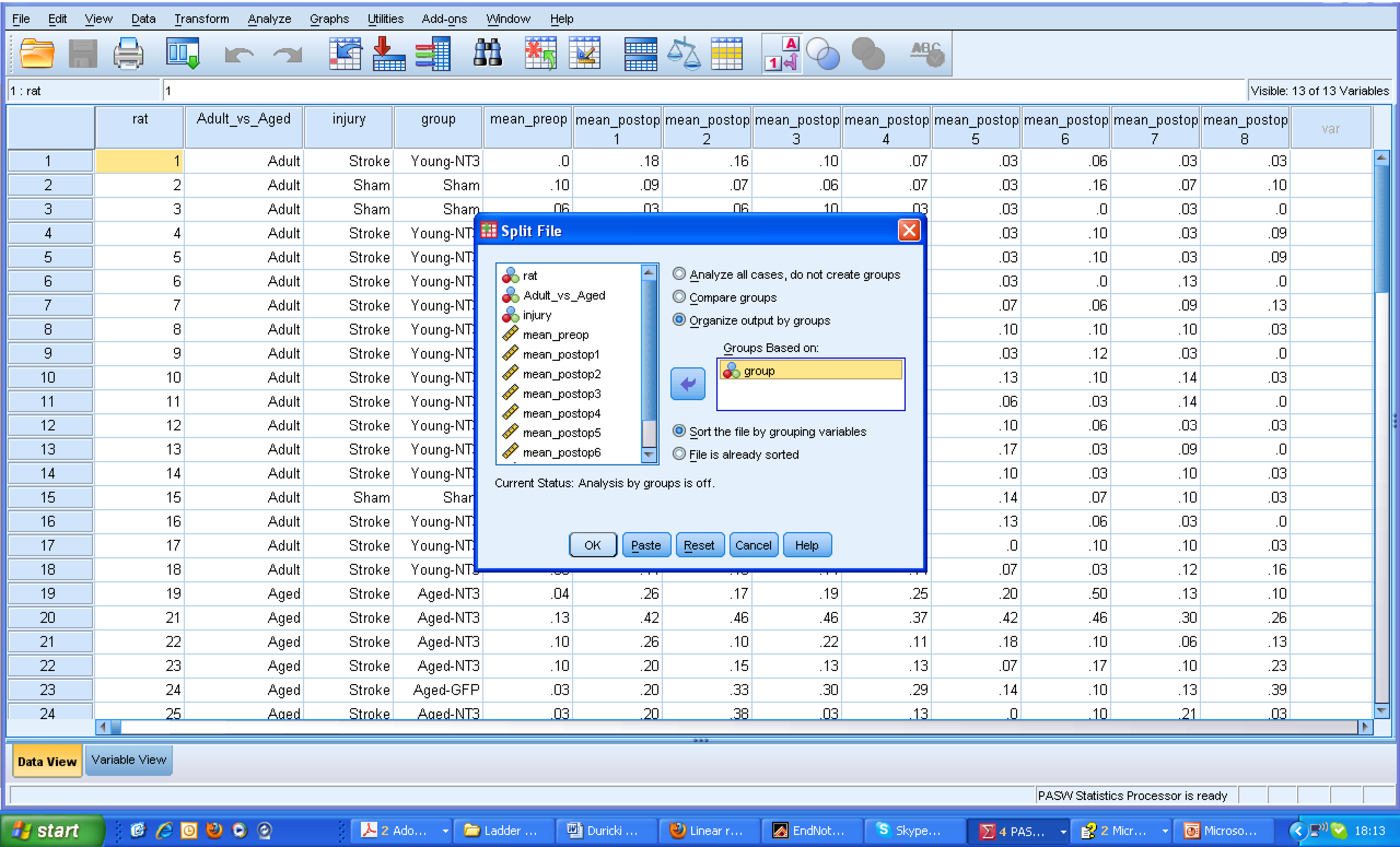
Supplementary Tutorial, Slide 26:



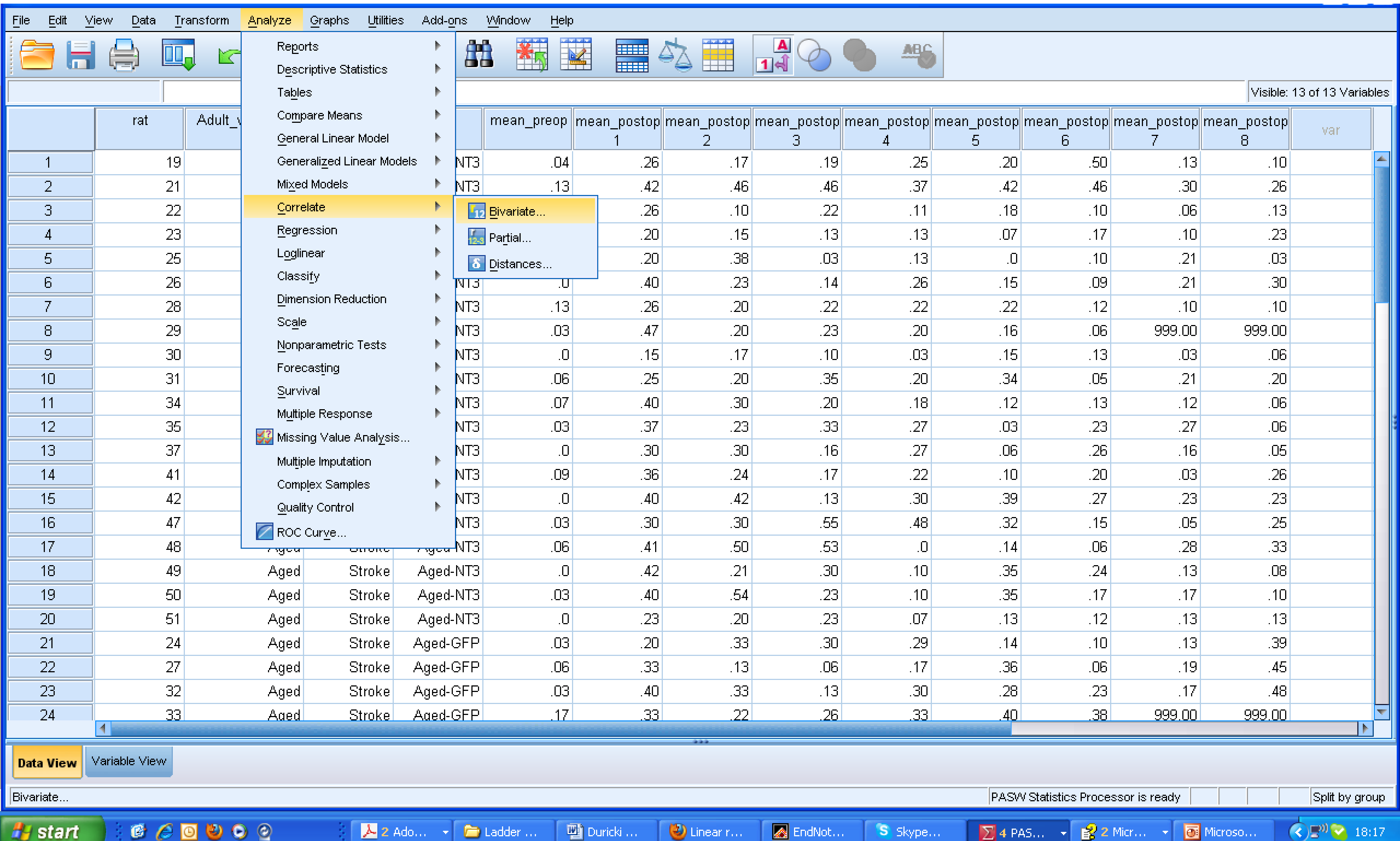
Supplementary Tutorial, Slide 27:



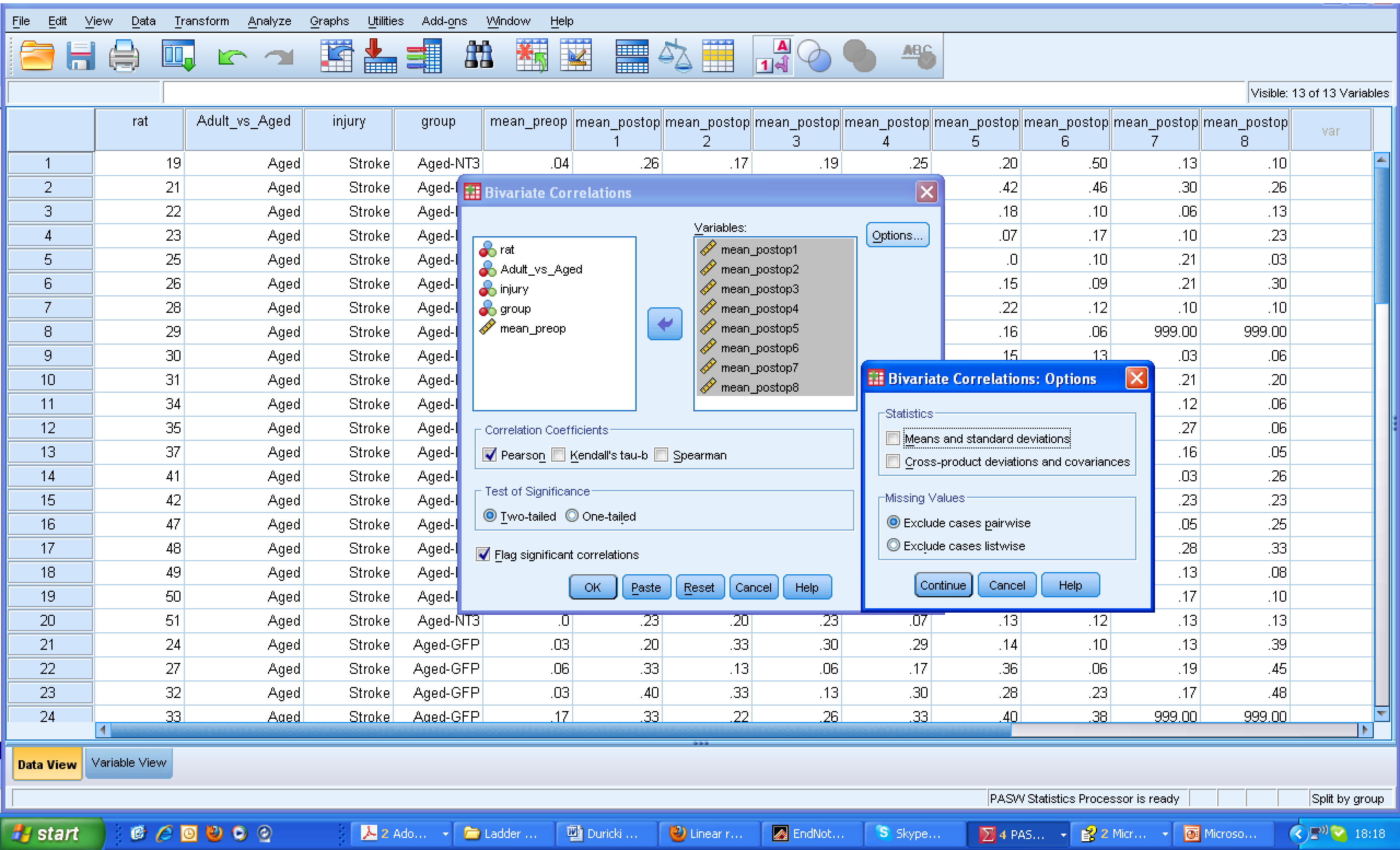
Supplementary Tutorial, Slide 28:



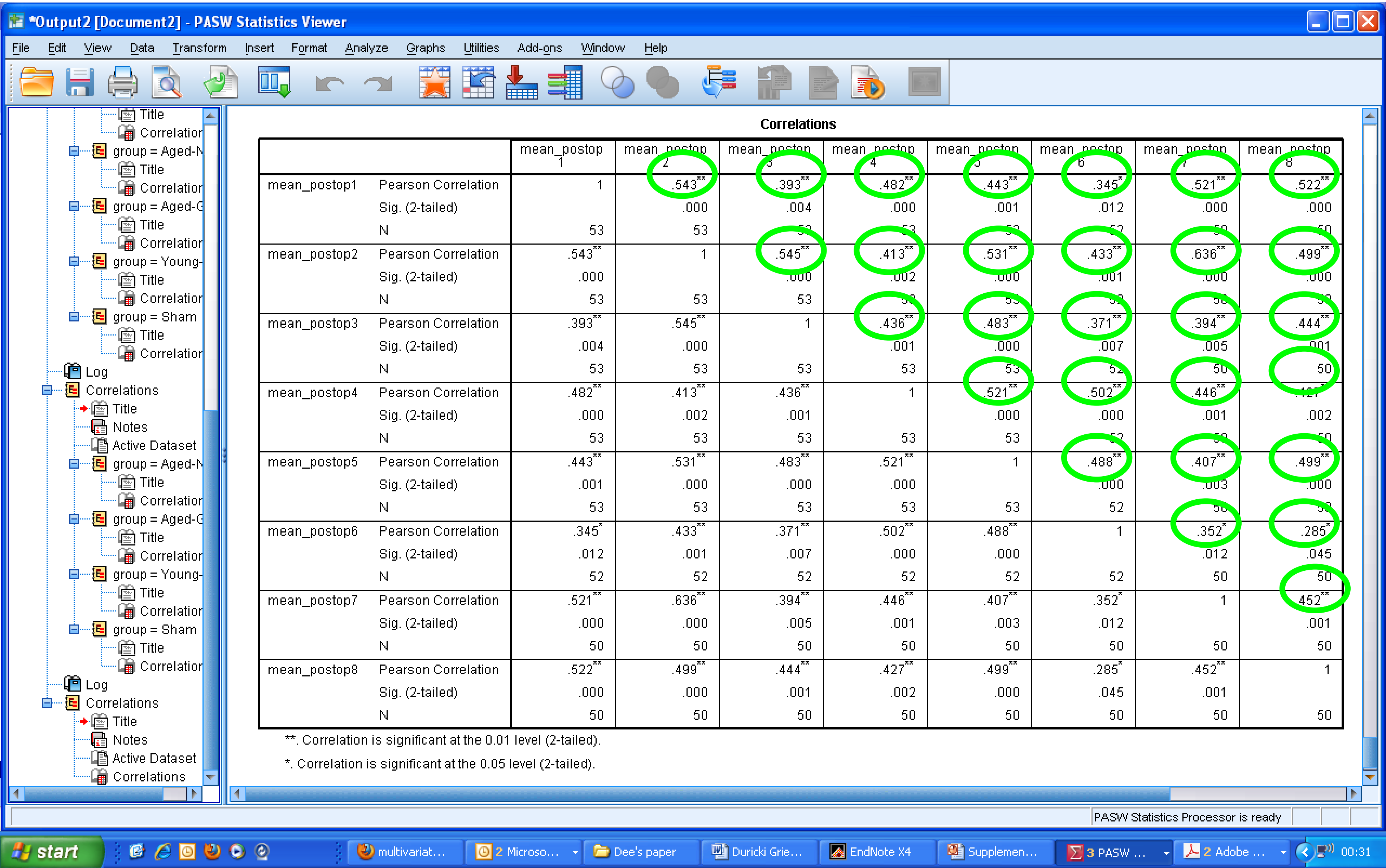
Supplementary Tutorial, Slide 29:



Supplementary Tutorial, Slide 30:



Supplementary Tutorial, Slide 31: These correlations were generated without splitting the output by “group”. There is a significant and positive correlation between most pairs of time points. The size of the correlation stays similar with increasing separation of time points. This suggests that a compound symmetric (CS) covariance structure may be appropriate.



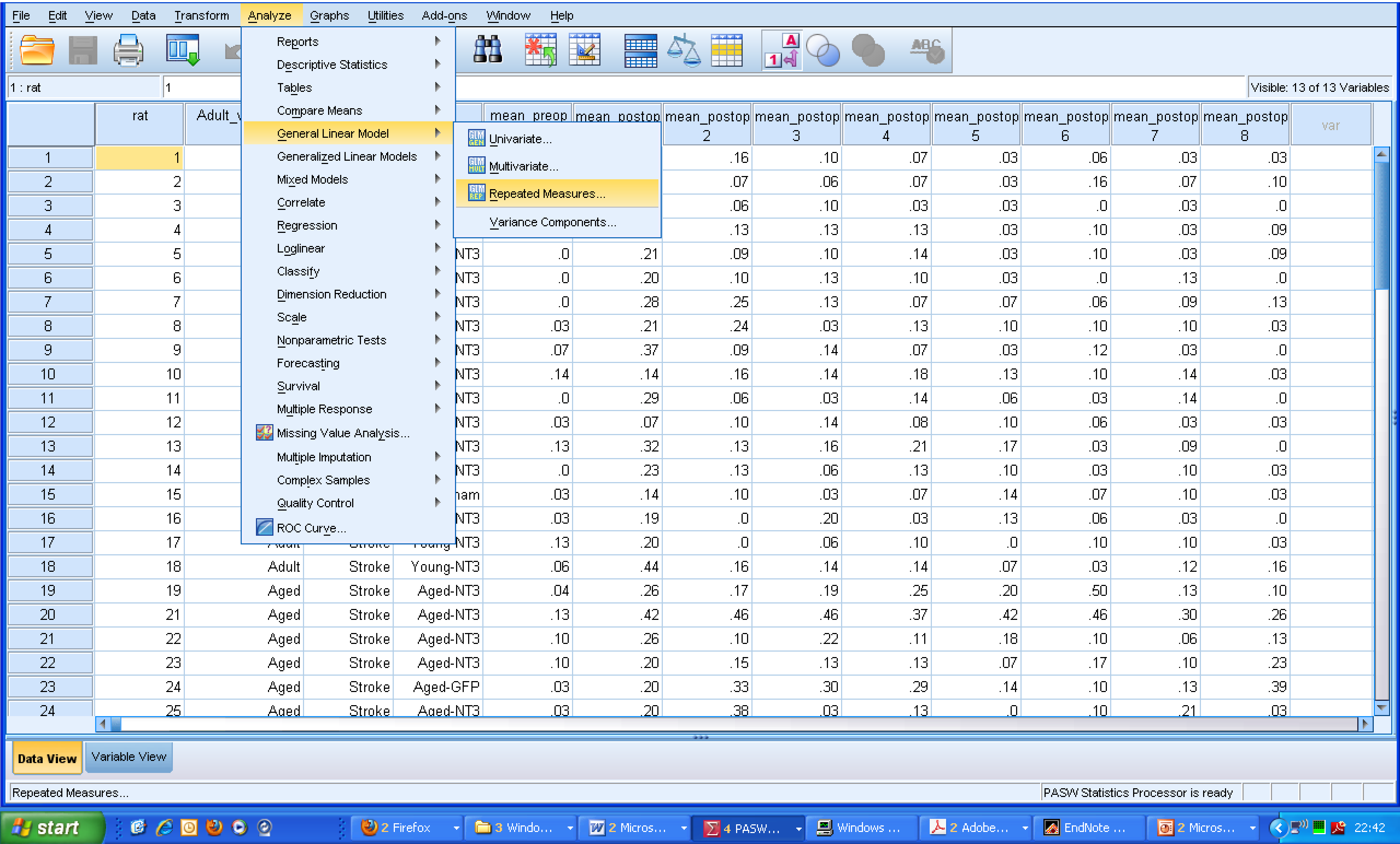
Correlations

		mean_postop1	mean_postop2	mean_postop3	mean_postop4	mean_postop5	mean_postop6	mean_postop7	mean_postop8
mean_postop1	Pearson Correlation	1	.543**	.393**	.482**	.443**	.345*	.521**	.522**
	Sig. (2-tailed)		.000	.004	.000	.001	.012	.000	.000
	N	53	53	53	53	53	52	50	50
mean_postop2	Pearson Correlation	.543**	1	.545**	.413**	.531**	.433**	.636**	.499**
	Sig. (2-tailed)	.000		.000	.002	.000	.001	.000	.000
	N	53	53	53	53	53	52	50	50
mean_postop3	Pearson Correlation	.393**	.545**	1	.436**	.483**	.371**	.394**	.444**
	Sig. (2-tailed)	.004	.000		.001	.000	.007	.005	.001
	N	53	53	53	53	53	52	50	50
mean_postop4	Pearson Correlation	.482**	.413**	.436**	1	.521**	.502**	.446**	.427**
	Sig. (2-tailed)	.000	.002	.001		.000	.000	.001	.002
	N	53	53	53	53	53	52	50	50
mean_postop5	Pearson Correlation	.443**	.531**	.483**	.521**	1	.488**	.407**	.499**
	Sig. (2-tailed)	.001	.000	.000	.000		.000	.003	.000
	N	53	53	53	53	53	52	50	50
mean_postop6	Pearson Correlation	.345*	.433**	.371**	.502**	.488**	1	.352*	.285*
	Sig. (2-tailed)	.012	.001	.007	.000	.000		.012	.045
	N	52	52	52	52	52	52	50	50
mean_postop7	Pearson Correlation	.521**	.636**	.394**	.446**	.407**	.352*	1	.452**
	Sig. (2-tailed)	.000	.000	.005	.001	.003	.012		.001
	N	50	50	50	50	50	50	50	50
mean_postop8	Pearson Correlation	.522**	.499**	.444**	.427**	.499**	.285*	.452**	1
	Sig. (2-tailed)	.000	.000	.001	.002	.000	.045	.001	
	N	50	50	50	50	50	50	50	50

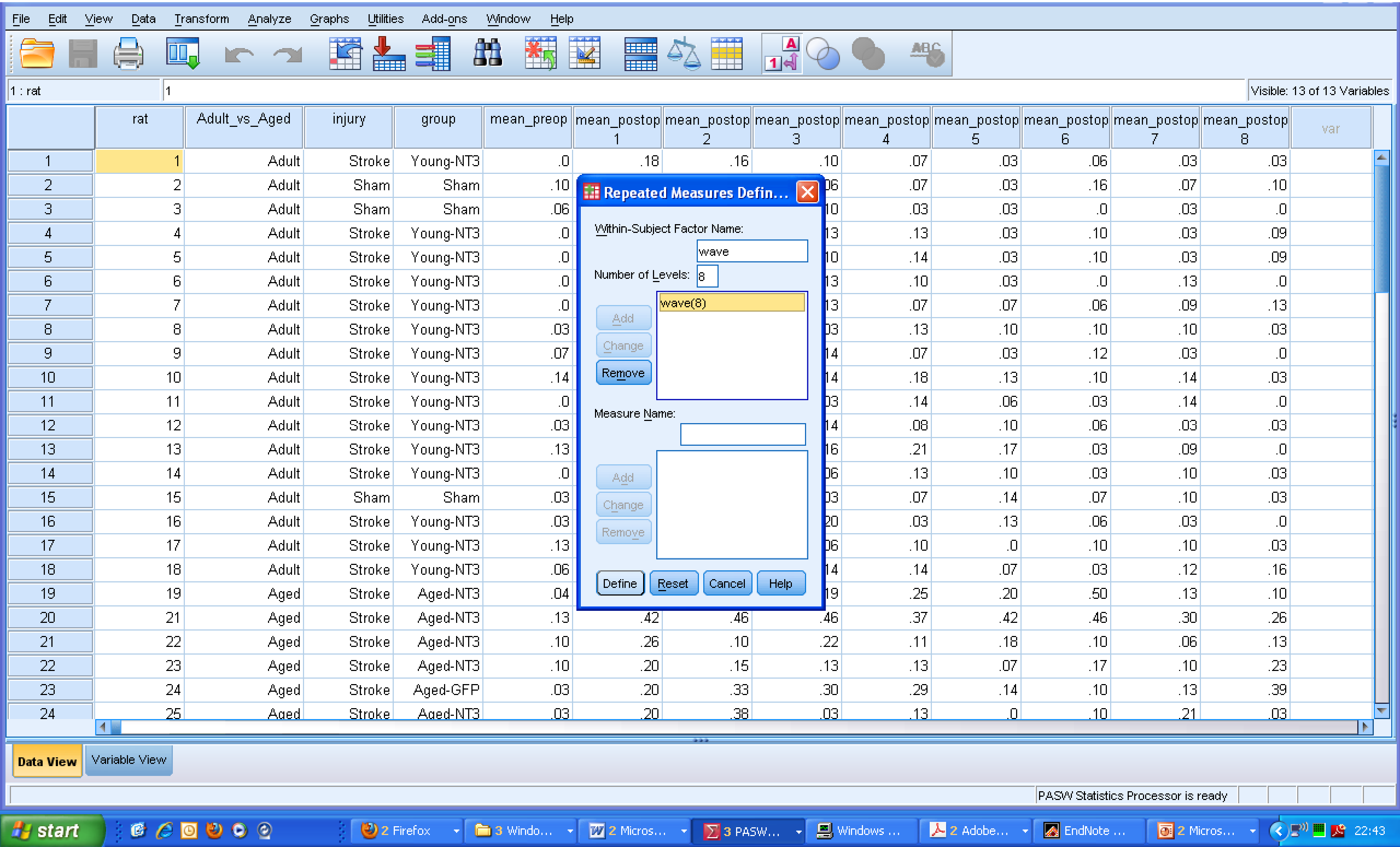
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

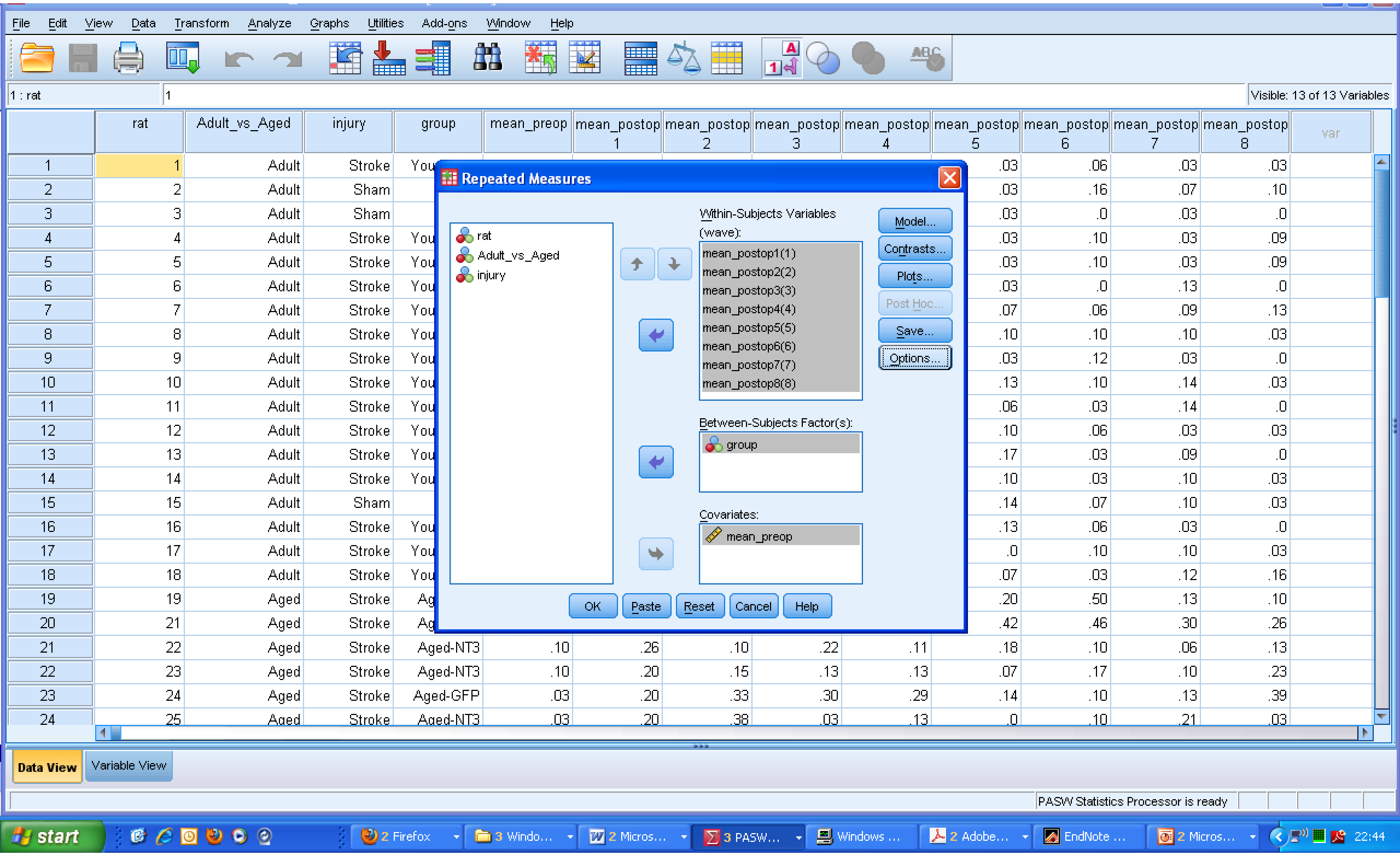
Supplementary Tutorial, Slide 32: RM ANCOVA



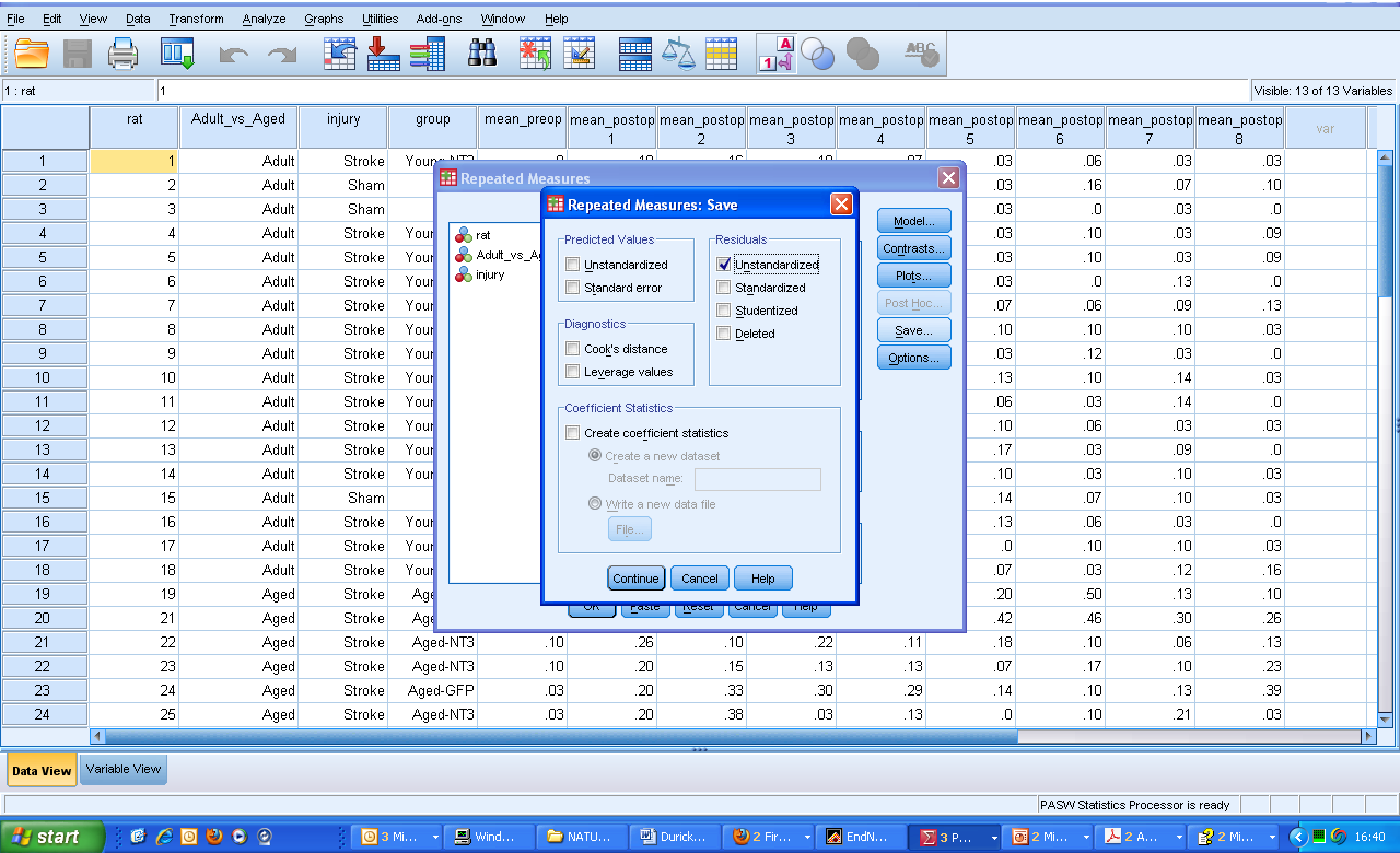
Supplementary Tutorial, Slide 33



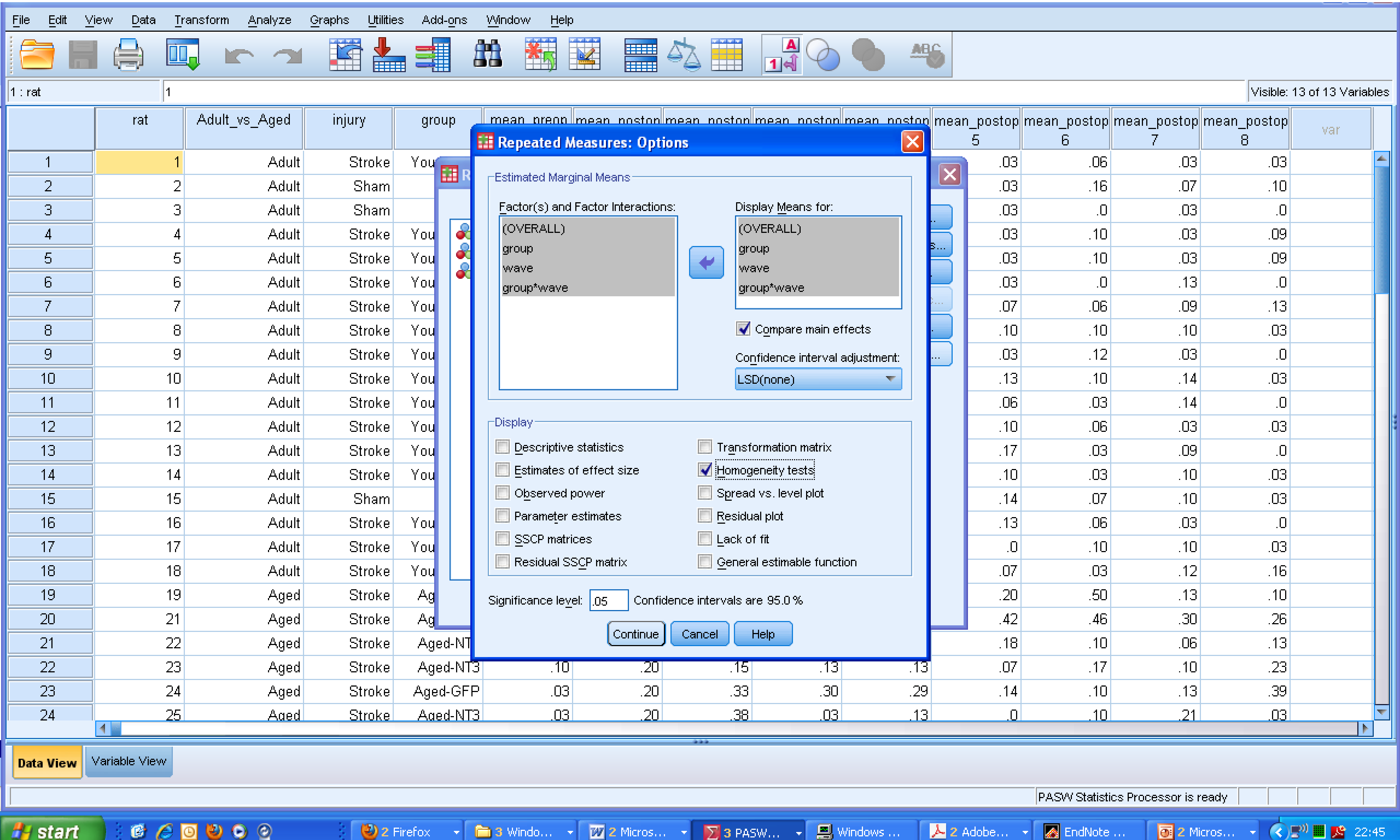
Supplementary Tutorial, Slide 34: Note that the Repeated Measure only includes the eight post-treatment time points and does <u>not</u> include the pre-operative baseline measurement time point (as this reduces the power of the test).



Supplementary Tutorial, Slide 35:

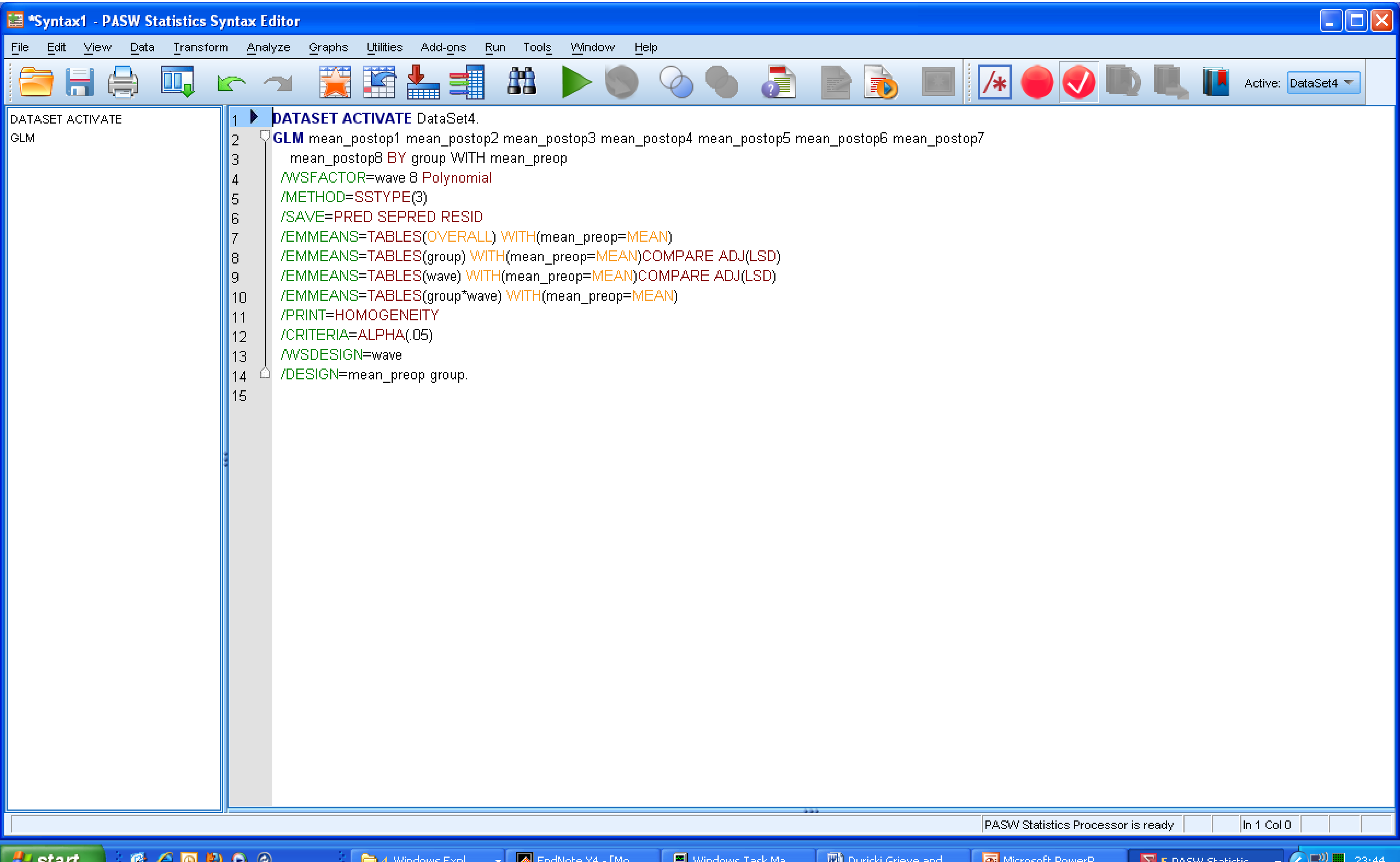


Supplementary Tutorial, Slide 36



Supplementary Tutorial, Slide 37. Here's the Syntax you generated. To obtain pairwise comparisons for the interaction, delete the full stop at the end and add these lines:

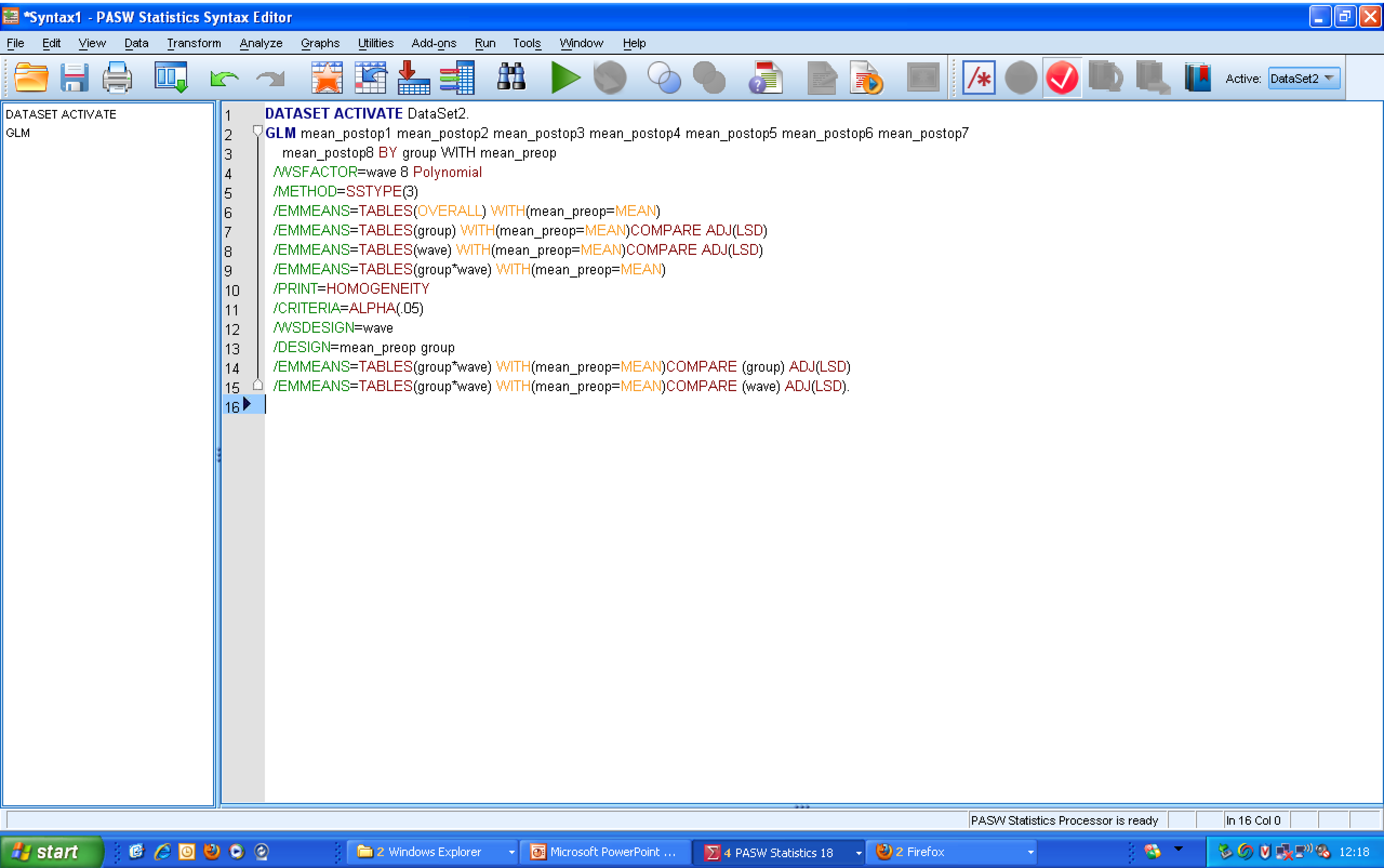
/EMMEANS=TABLES(group*wave) WITH(mean_preop=MEAN)COMPARE (group) ADJ(LSD)
/EMMEANS=TABLES(group*wave) WITH(mean_preop=MEAN)COMPARE (wave) ADJ(LSD).



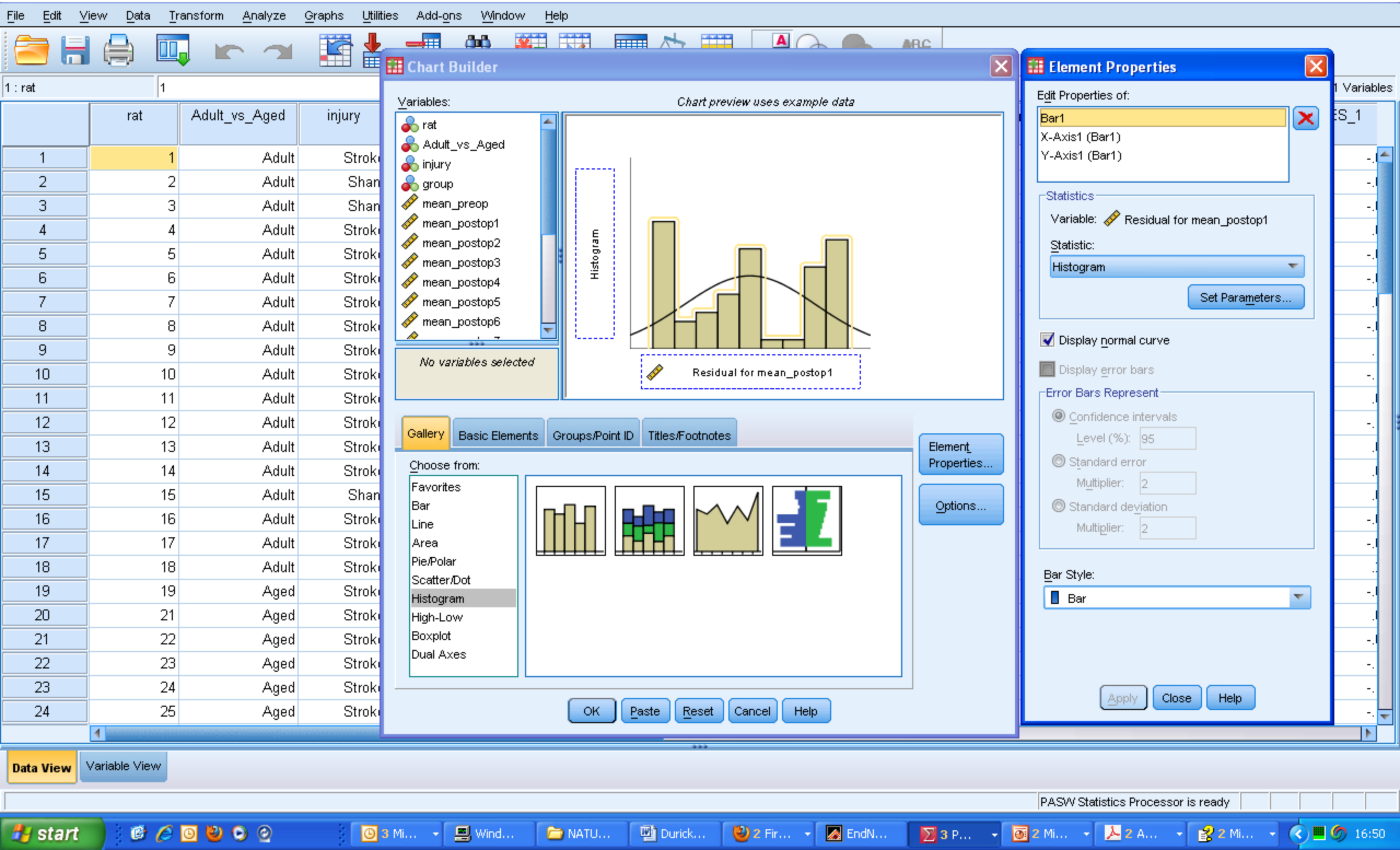
Supplementary Tutorial, Slide 38

Ensure there is ONLY one full stop (period), at the end.

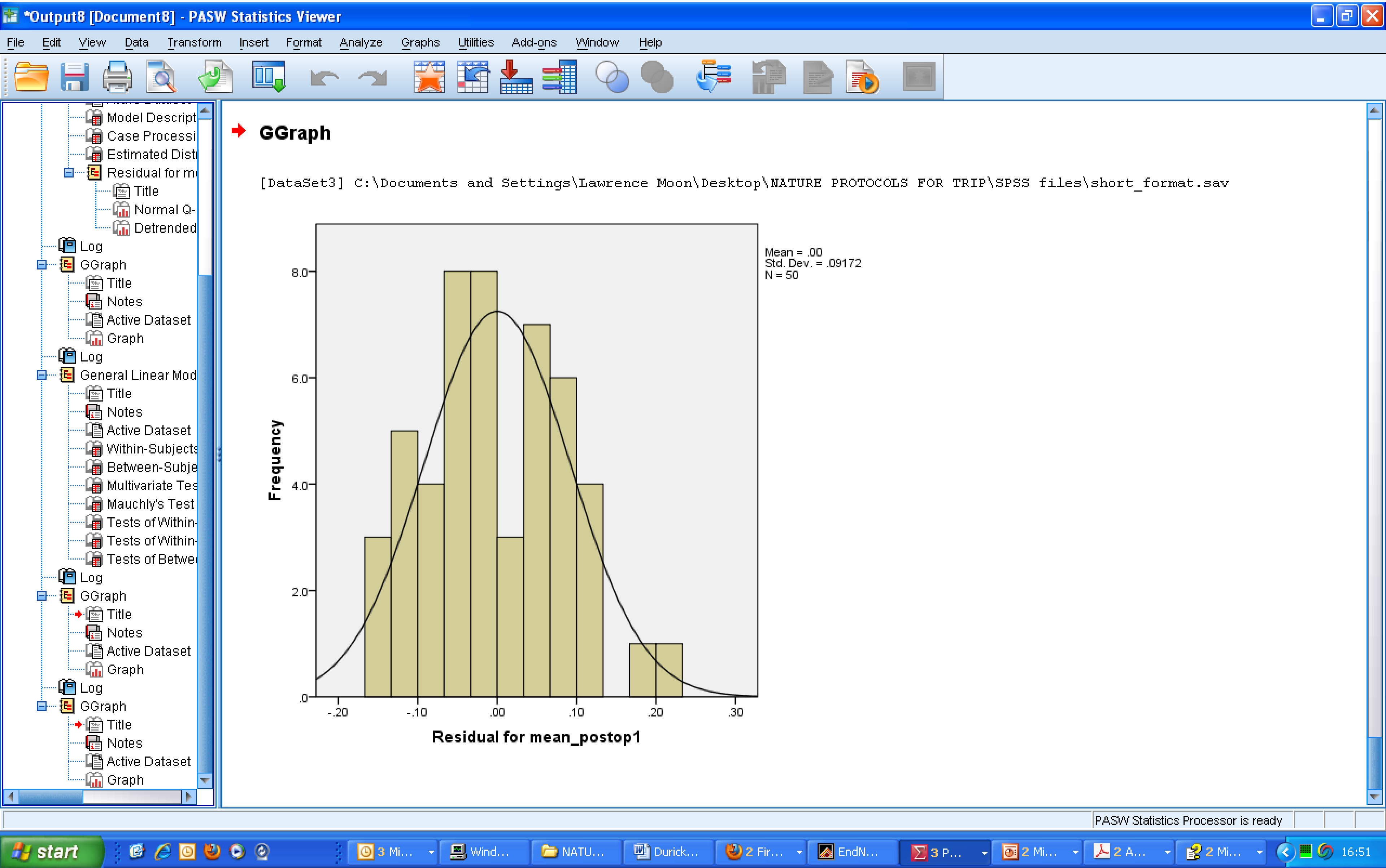
Now click Run>All



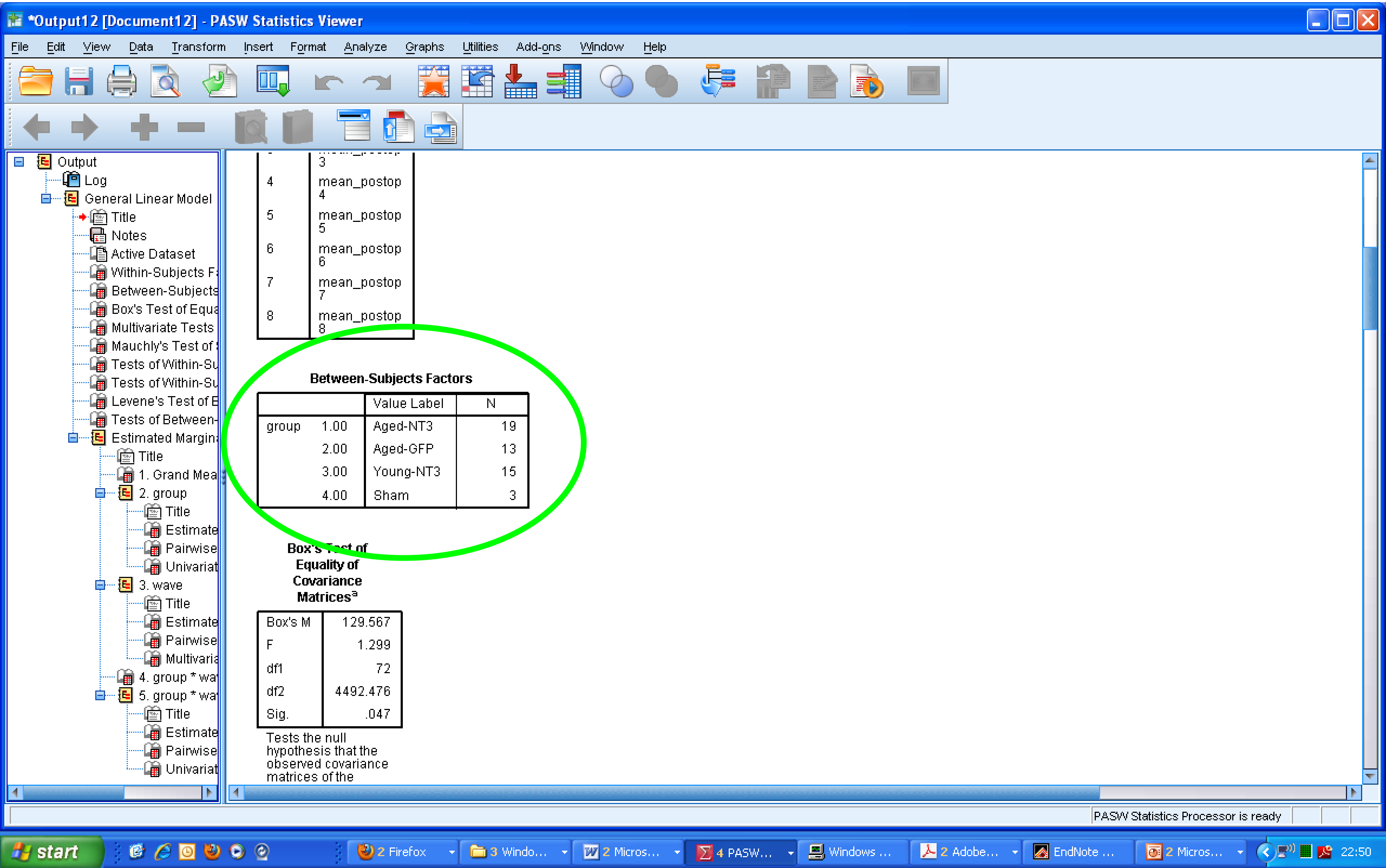
Supplementary Tutorial, Slide 39



Supplementary Tutorial, Slide 40



Supplementary Tutorial, Slide 41



4	mean_postop 4
5	mean_postop 5
6	mean_postop 6
7	mean_postop 7
8	mean_postop 8

Between-Subjects Factors

		Value Label	N
group	1.00	Aged-NT3	19
	2.00	Aged-GFP	13
	3.00	Young-NT3	15
	4.00	Sham	3

Box's Test of Equality of Covariance Matrices[a]

Box's M	129.567
F	1.299
df1	72
df2	4492.476
Sig.	.047

Tests the null hypothesis that the observed covariance matrices of the

Supplementary Tutorial, Slide 42

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
wave	.675	16.657	2[illegible]	.940	.905	1.000	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

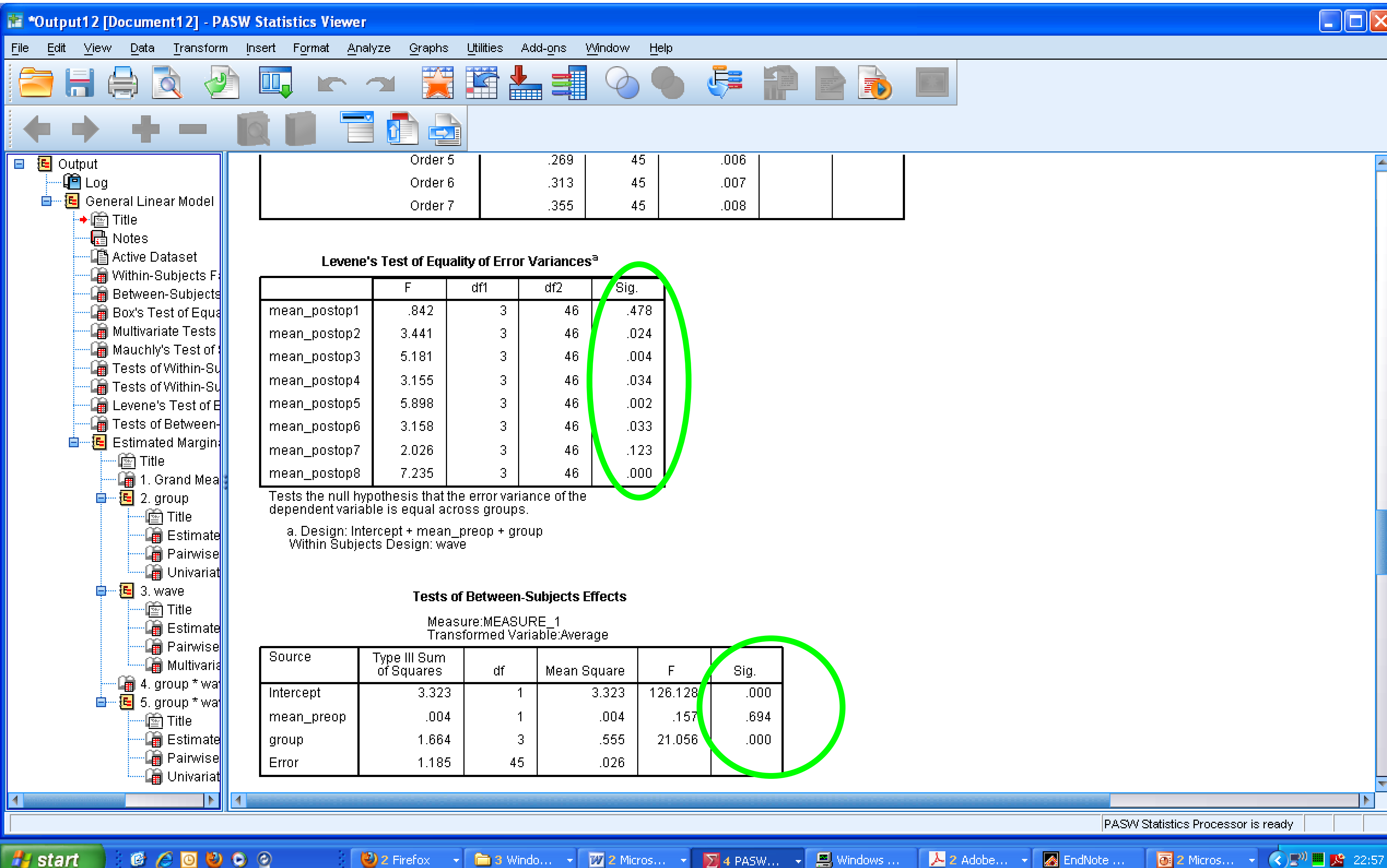
b. Design: Intercept + mean_preop + group
Within Subjects Design: wave

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
wave	Sphericity Assumed	.211	7	.030	4.031	.000
	Greenhouse-Geisser	.211	6.337	.033	4.031	.001
	Huynh-Feldt	.211	7.000	.030	4.031	.000
	Lower-bound	.211	1.000	.211	4.031	.051
wave * mean_preop	Sphericity Assumed	.035	7	.005	.660	.706
	Greenhouse-Geisser	.035	6.337	.005	.660	.691
	Huynh-Feldt	.035	7.000	.005	.660	.706
	Lower-bound	.035	1.000	.035	.660	.421
wave * group	Sphericity Assumed	.265	21	.013	1.685	.032
	Greenhouse-Geisser	.265	19.012	.014	1.685	.038
	Huynh-Feldt	.265	21.000	.013	1.685	.032
	Lower-bound	.265	3.000	.088	1.685	.184

Supplementary Tutorial, Slide 43



*Output12 [Document12] - PASW Statistics Viewer

Order 5	.269	45	.006		
Order 6	.313	45	.007		
Order 7	.355	45	.008		

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
mean_postop1	.842	3	46	.478
mean_postop2	3.441	3	46	.024
mean_postop3	5.181	3	46	.004
mean_postop4	3.155	3	46	.034
mean_postop5	5.898	3	46	.002
mean_postop6	3.158	3	46	.033
mean_postop7	2.026	3	46	.123
mean_postop8	7.235	3	46	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + mean_preop + group
Within Subjects Design: wave

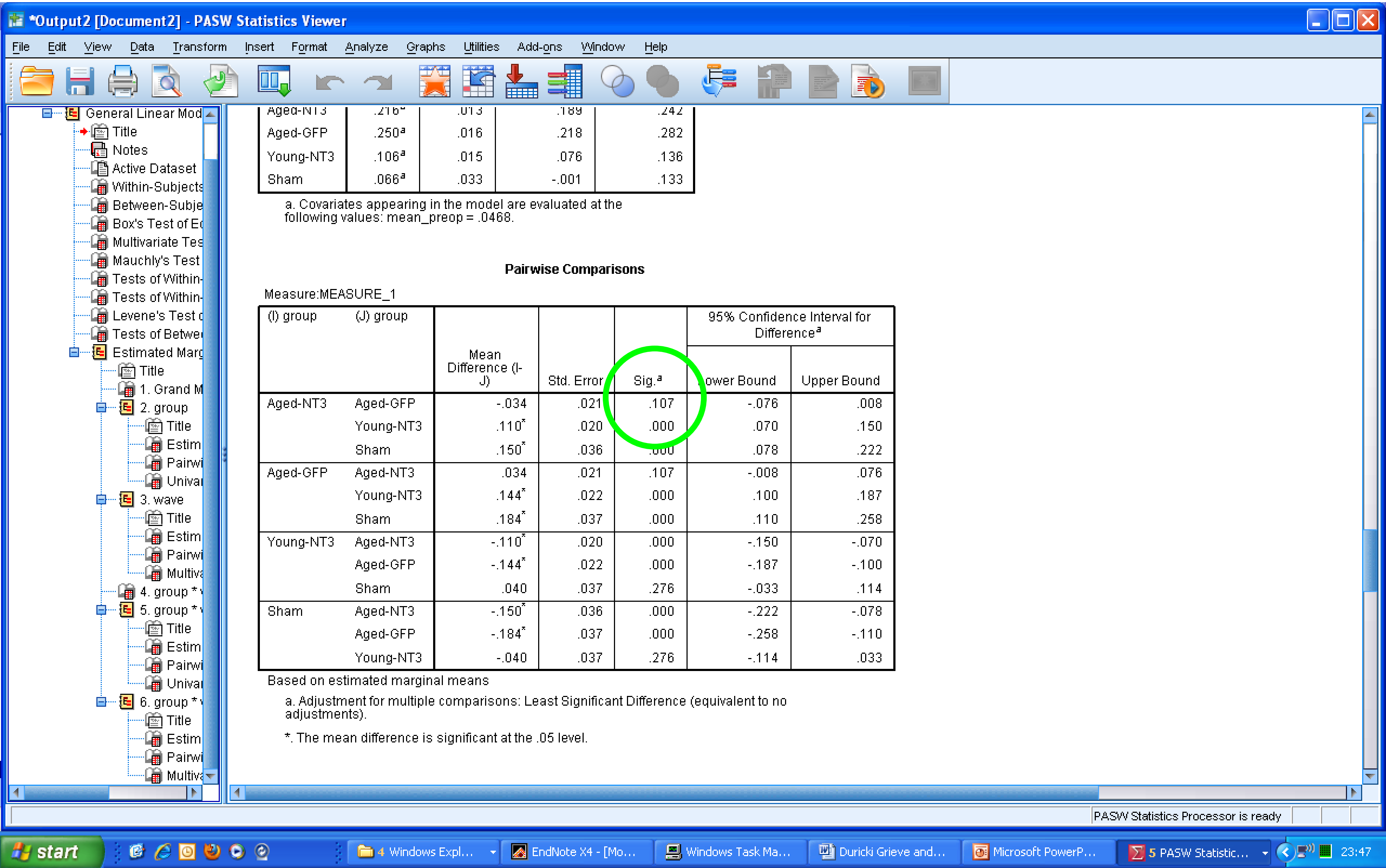
Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	3.323	1	3.323	126.128	.000
mean_preop	.004	1	.004	.157	.694
group	1.664	3	.555	21.056	.000
Error	1.185	45	.026		

PASW Statistics Processor is ready

Supplementary Tutorial, Slide 44



Aged-NT3	.216[a]	.013	.189	.242
Aged-GFP	.250[a]	.016	.218	.282
Young-NT3	.106[a]	.015	.076	.136
Sham	.066[a]	.033	-.001	.133

a. Covariates appearing in the model are evaluated at the following values: mean_preop = .0468.

Pairwise Comparisons

Measure:MEASURE_1

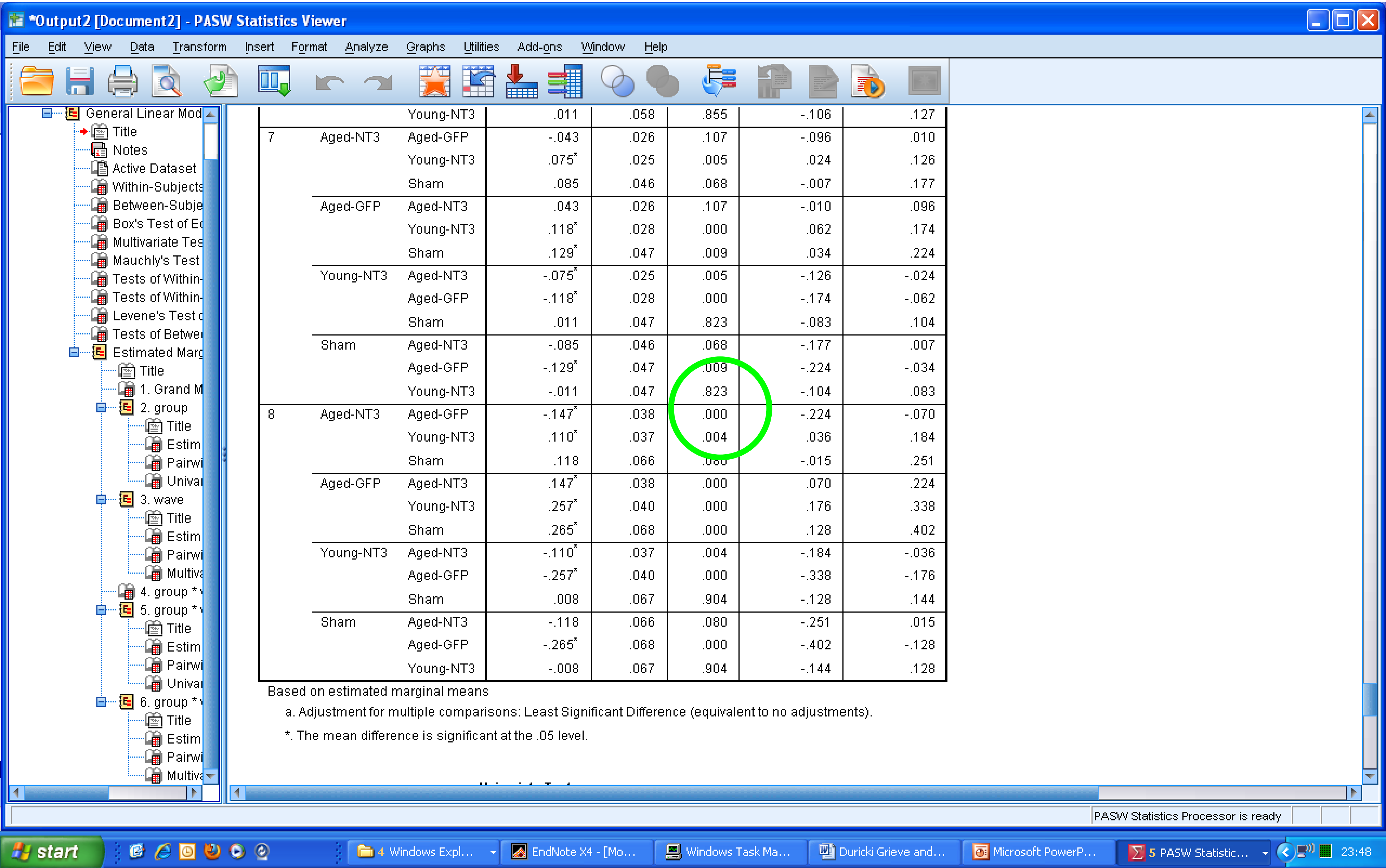
(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Aged-NT3	Aged-GFP	-.034	.021	.107	-.076	.008
	Young-NT3	.110*	.020	.000	.070	.150
	Sham	.150*	.036	.000	.078	.222
Aged-GFP	Aged-NT3	.034	.021	.107	-.008	.076
	Young-NT3	.144*	.022	.000	.100	.187
	Sham	.184*	.037	.000	.110	.258
Young-NT3	Aged-NT3	-.110*	.020	.000	-.150	-.070
	Aged-GFP	-.144*	.022	.000	-.187	-.100
	Sham	.040	.037	.276	-.033	.114
Sham	Aged-NT3	-.150*	.036	.000	-.222	-.078
	Aged-GFP	-.184*	.037	.000	-.258	-.110
	Young-NT3	-.040	.037	.276	-.114	.033

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the .05 level.

Supplementary Tutorial, Slide 45: Scroll down to group * wave and then inspect pairwise comparisons



		Young-NT3	.011	.058	.855	-.106	.127
7	Aged-NT3	Aged-GFP	-.043	.026	.107	-.096	.010
		Young-NT3	.075*	.025	.005	.024	.126
		Sham	.085	.046	.068	-.007	.177
	Aged-GFP	Aged-NT3	.043	.026	.107	-.010	.096
		Young-NT3	.118*	.028	.000	.062	.174
		Sham	.129*	.047	.009	.034	.224
	Young-NT3	Aged-NT3	-.075*	.025	.005	-.126	-.024
		Aged-GFP	-.118*	.028	.000	-.174	-.062
		Sham	.011	.047	.823	-.083	.104
	Sham	Aged-NT3	-.085	.046	.068	-.177	.007
		Aged-GFP	-.129*	.047	.009	-.224	-.034
		Young-NT3	-.011	.047	.823	-.104	.083
8	Aged-NT3	Aged-GFP	-.147*	.038	.000	-.224	-.070
		Young-NT3	.110*	.037	.004	.036	.184
		Sham	.118	.066	.080	-.015	.251
	Aged-GFP	Aged-NT3	.147*	.038	.000	.070	.224
		Young-NT3	.257*	.040	.000	.176	.338
		Sham	.265*	.068	.000	.128	.402
	Young-NT3	Aged-NT3	-.110*	.037	.004	-.184	-.036
		Aged-GFP	-.257*	.040	.000	-.338	-.176
		Sham	.008	.067	.904	-.128	.144
	Sham	Aged-NT3	-.118	.066	.080	-.251	.015
		Aged-GFP	-.265*	.068	.000	-.402	-.128
		Young-NT3	-.008	.067	.904	-.144	.128

Based on estimated marginal means

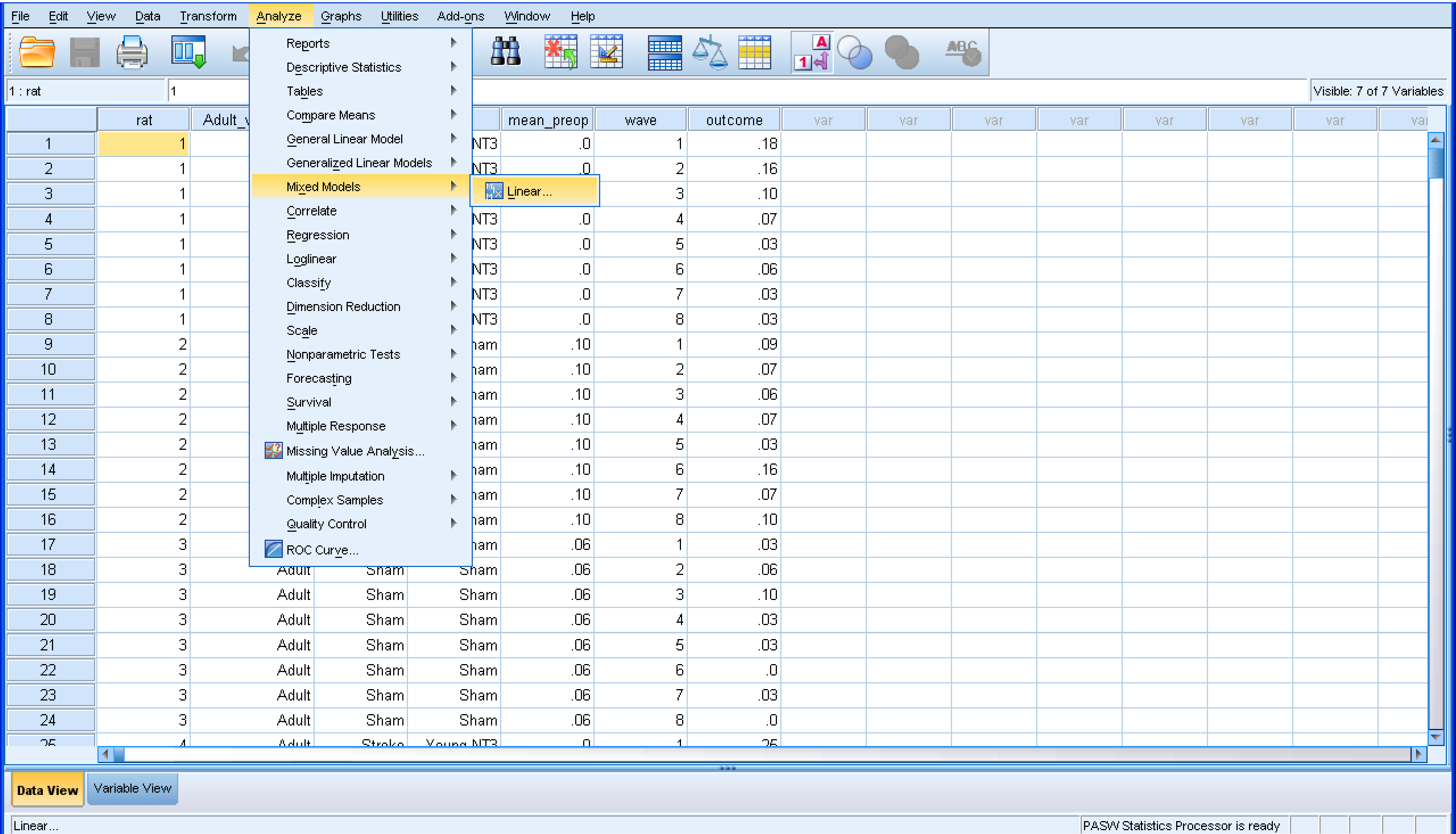
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the .05 level.

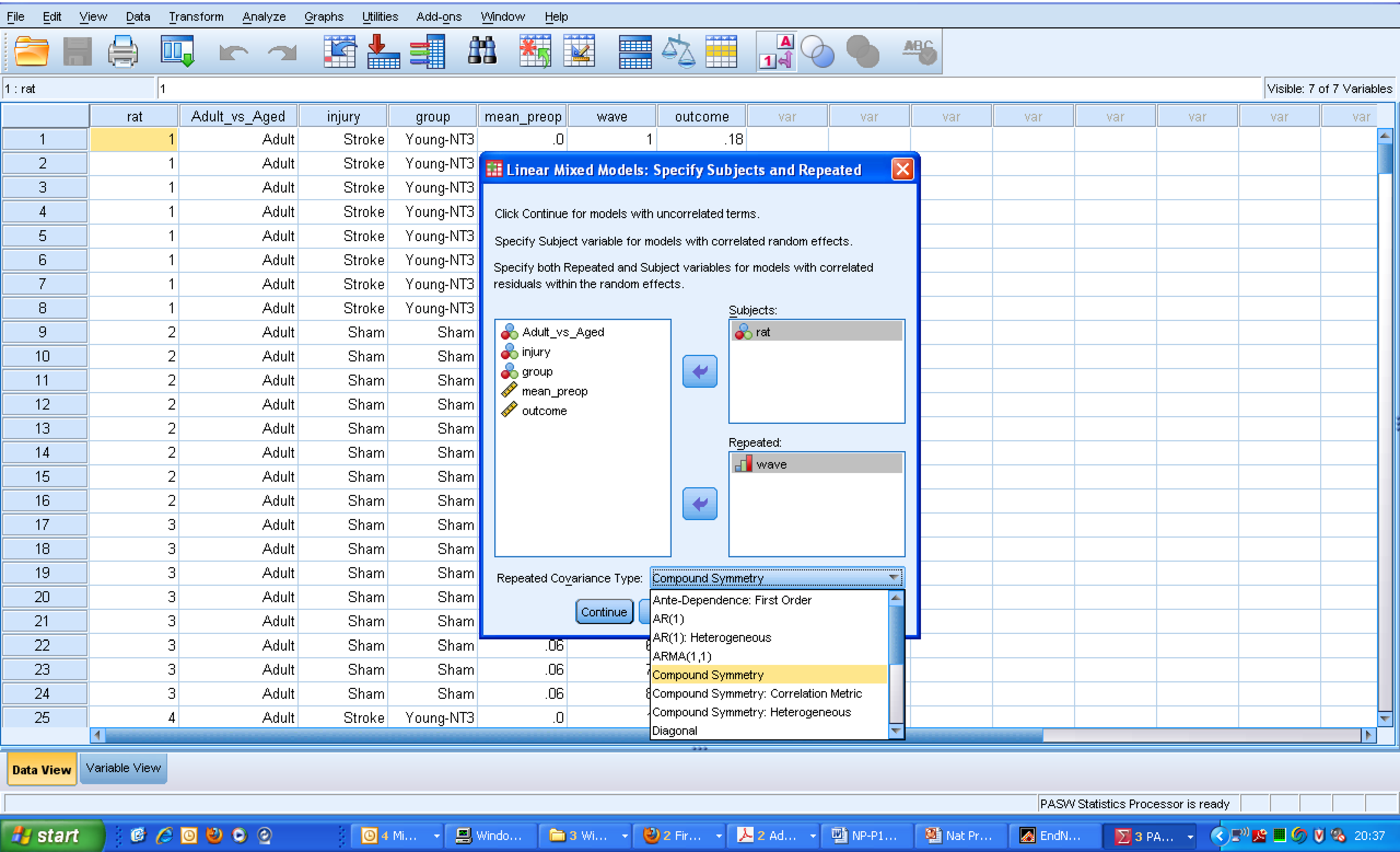
Supplementary Tutorial, Slide 46. Make sure you downloaded and unzipped the "Supplementary Data 1" file from Nature Protocols or from www.lawrencemoon.co.uk/resources/mixedmodels.asp

File>Open> "long_format.sav"

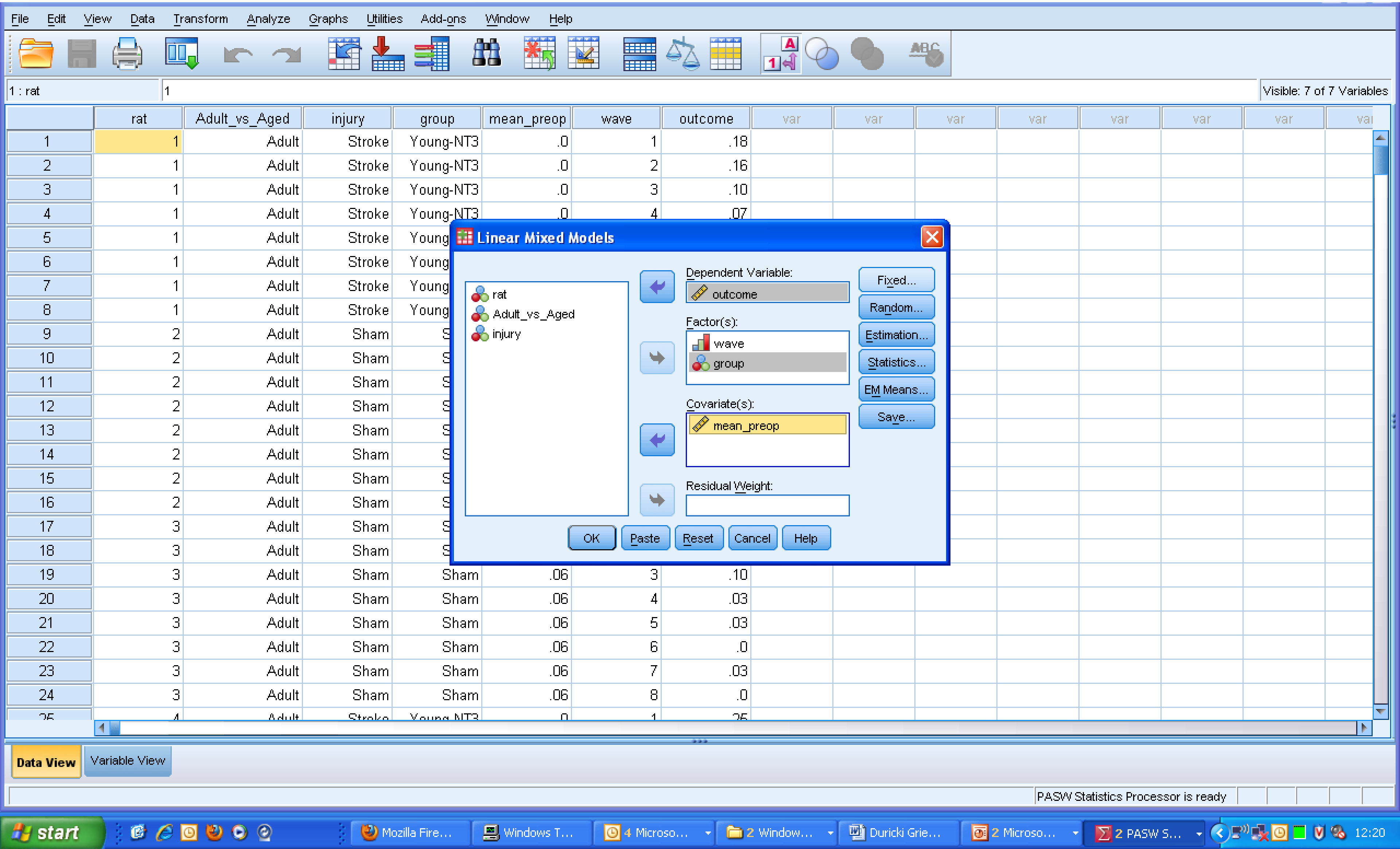
Analyze>Mixed Models>Linear



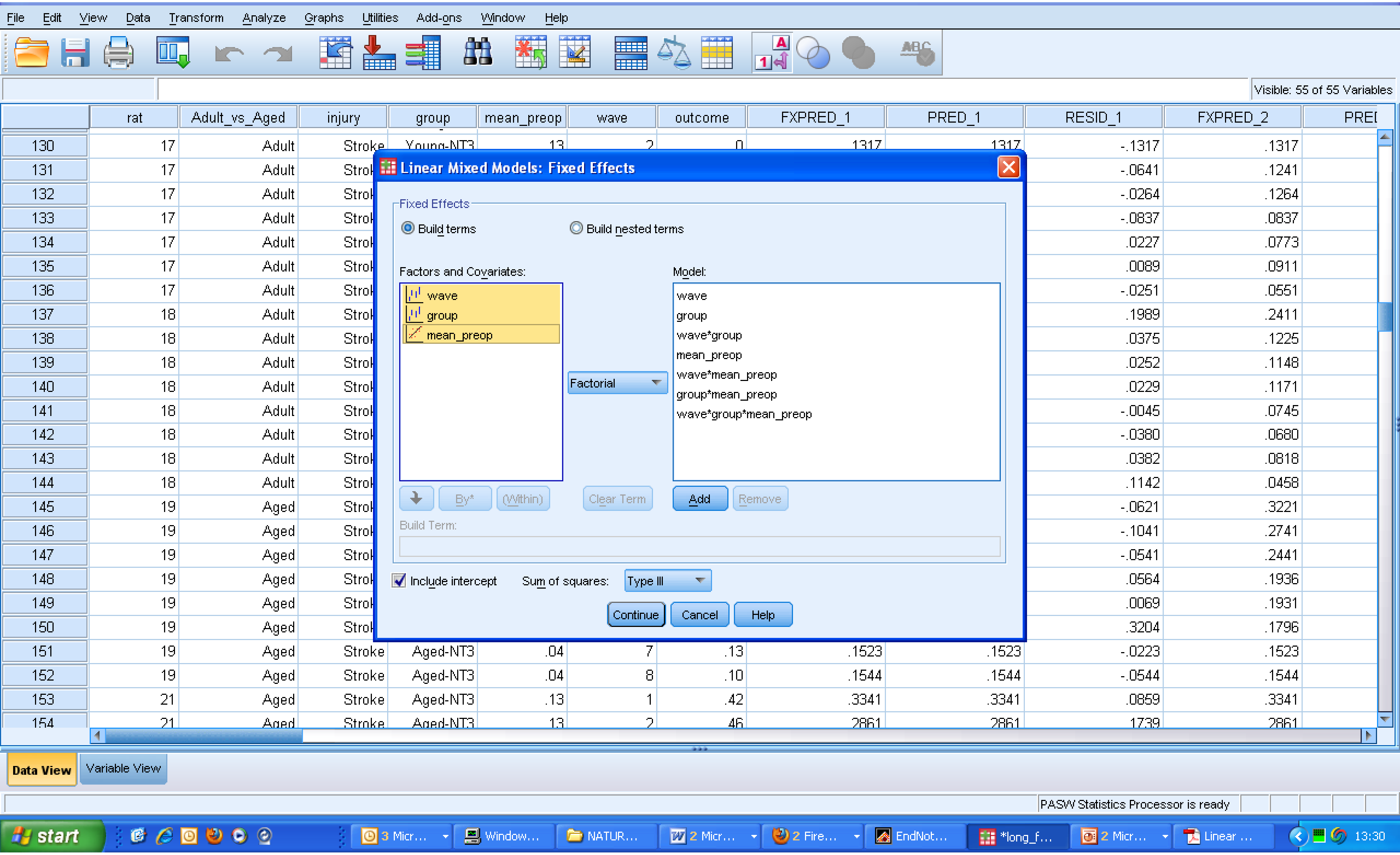
Supplementary Tutorial, Slide 47 and Figure 3



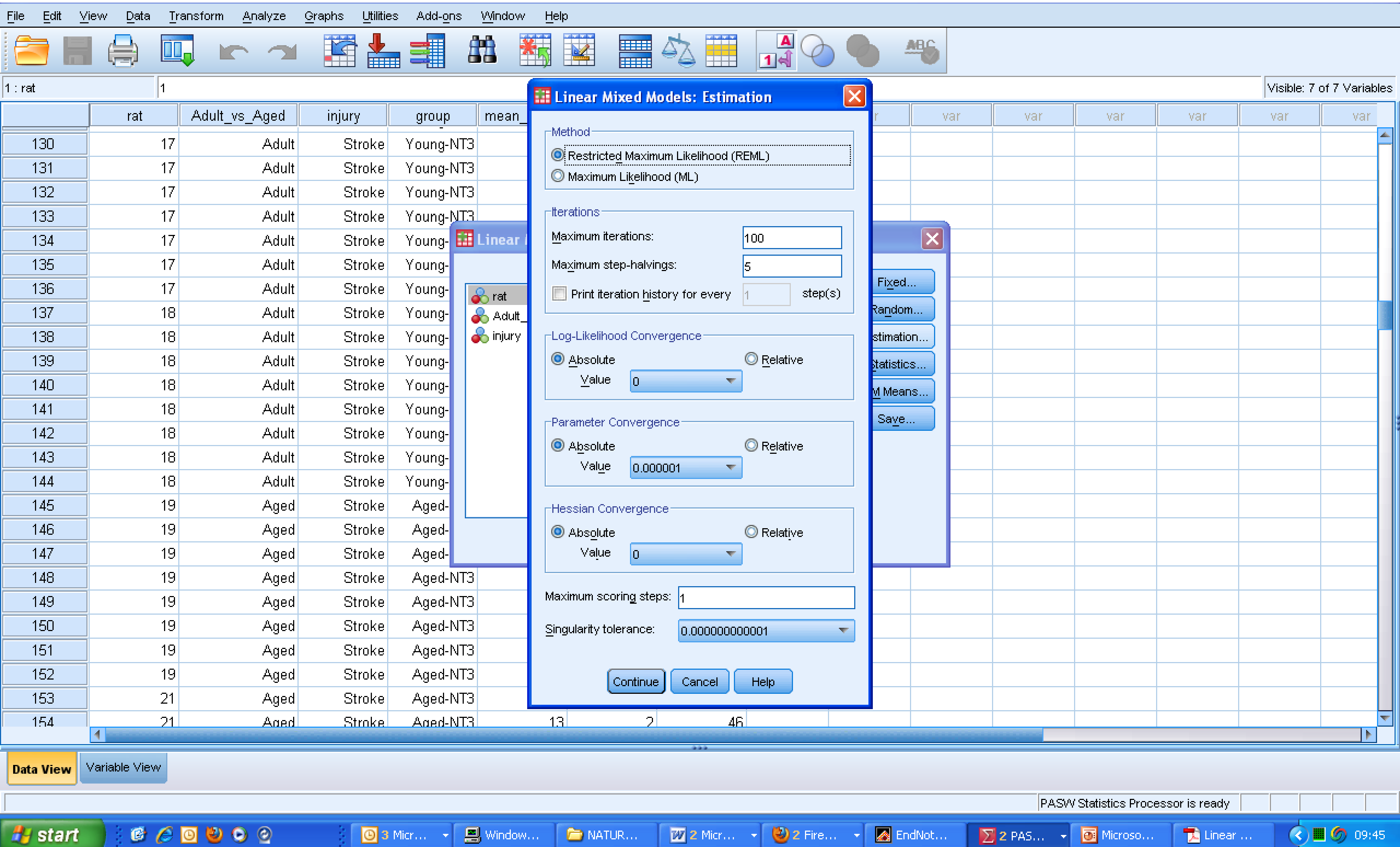
Supplementary Tutorial, Slide 48 and Figure 3



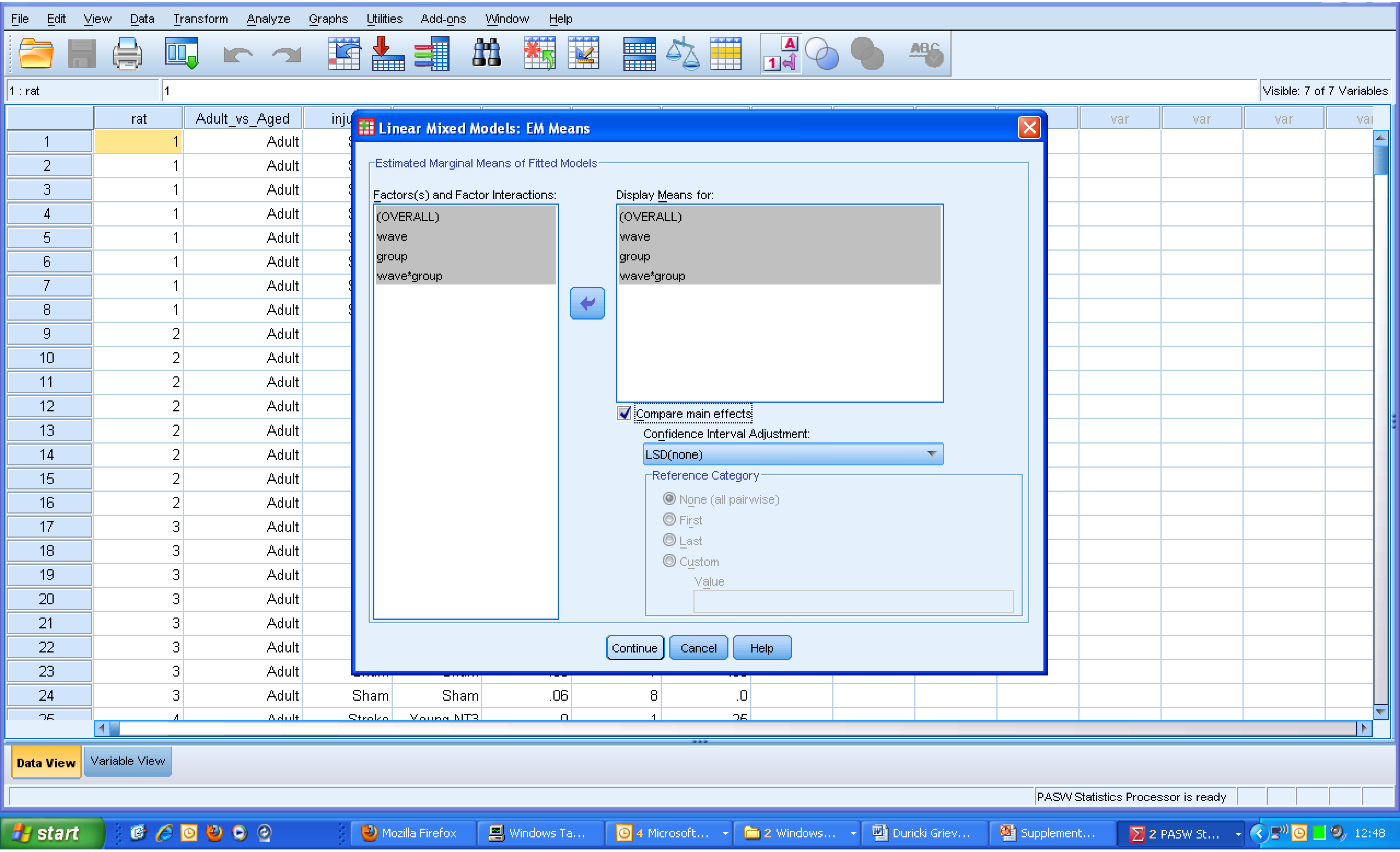
Supplementary Tutorial, Slide 49 and Figure 4



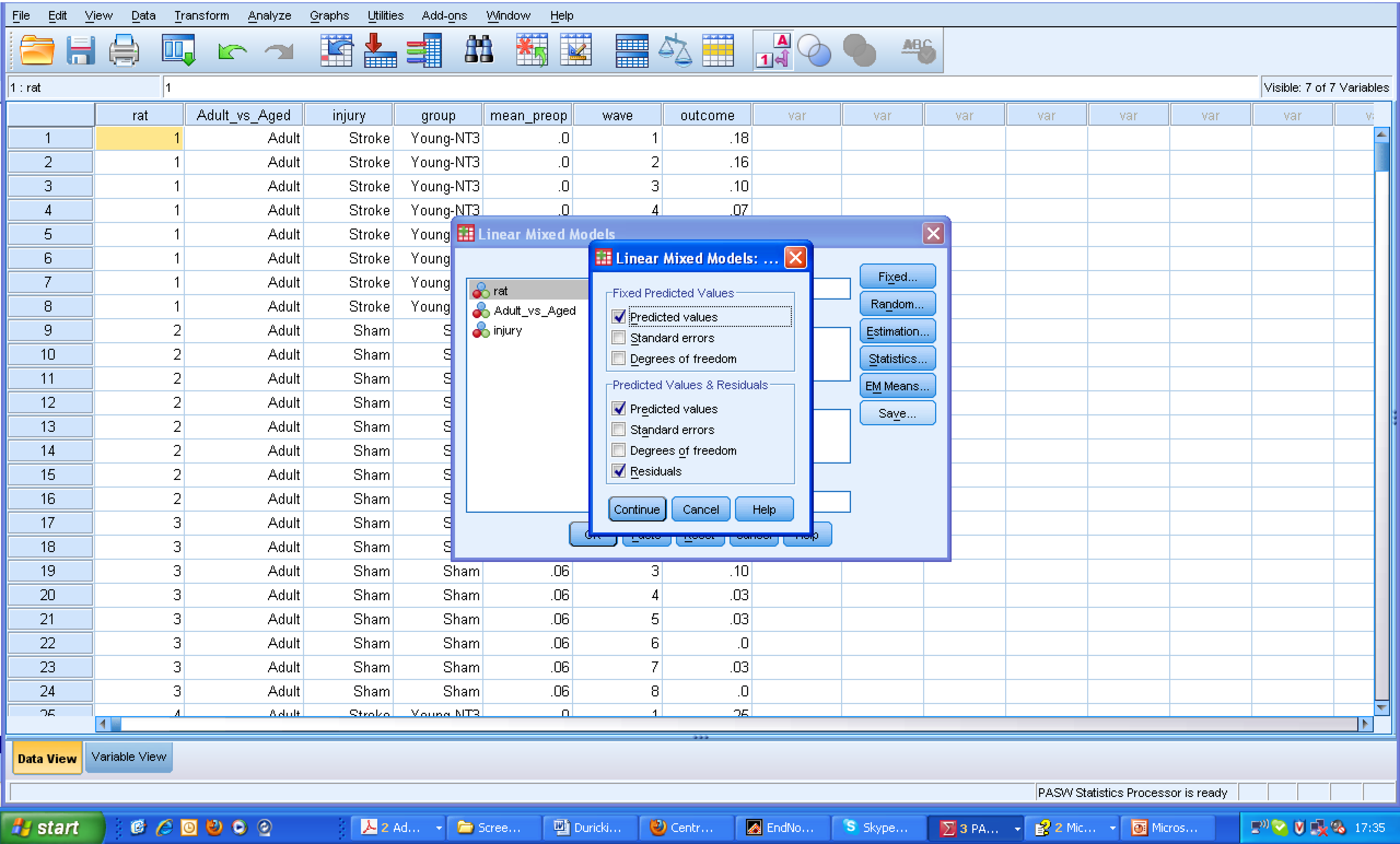
Supplementary Tutorial, Slide 50 and Figure 4



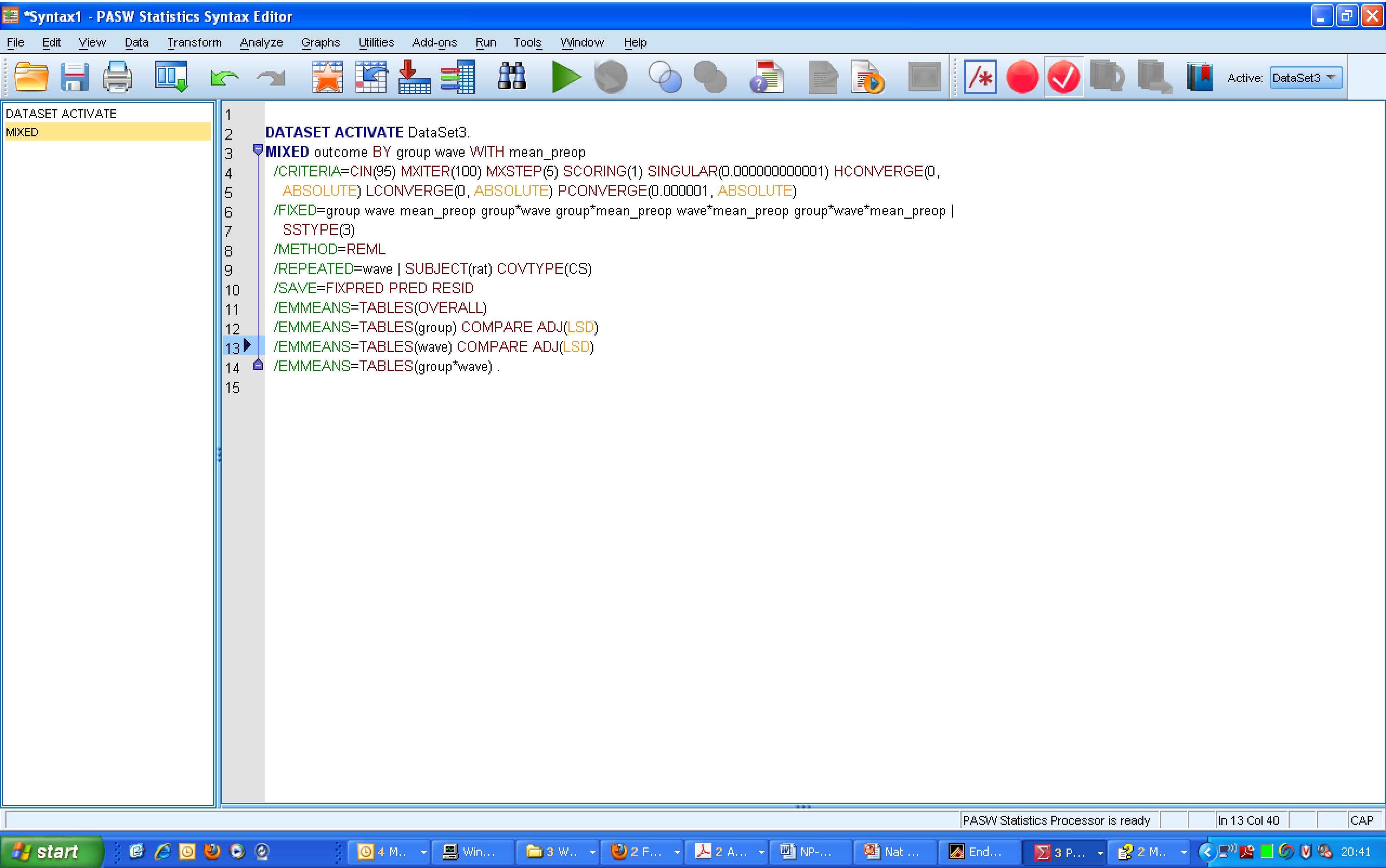
Supplementary Tutorial, Slide 51 and Figure 5



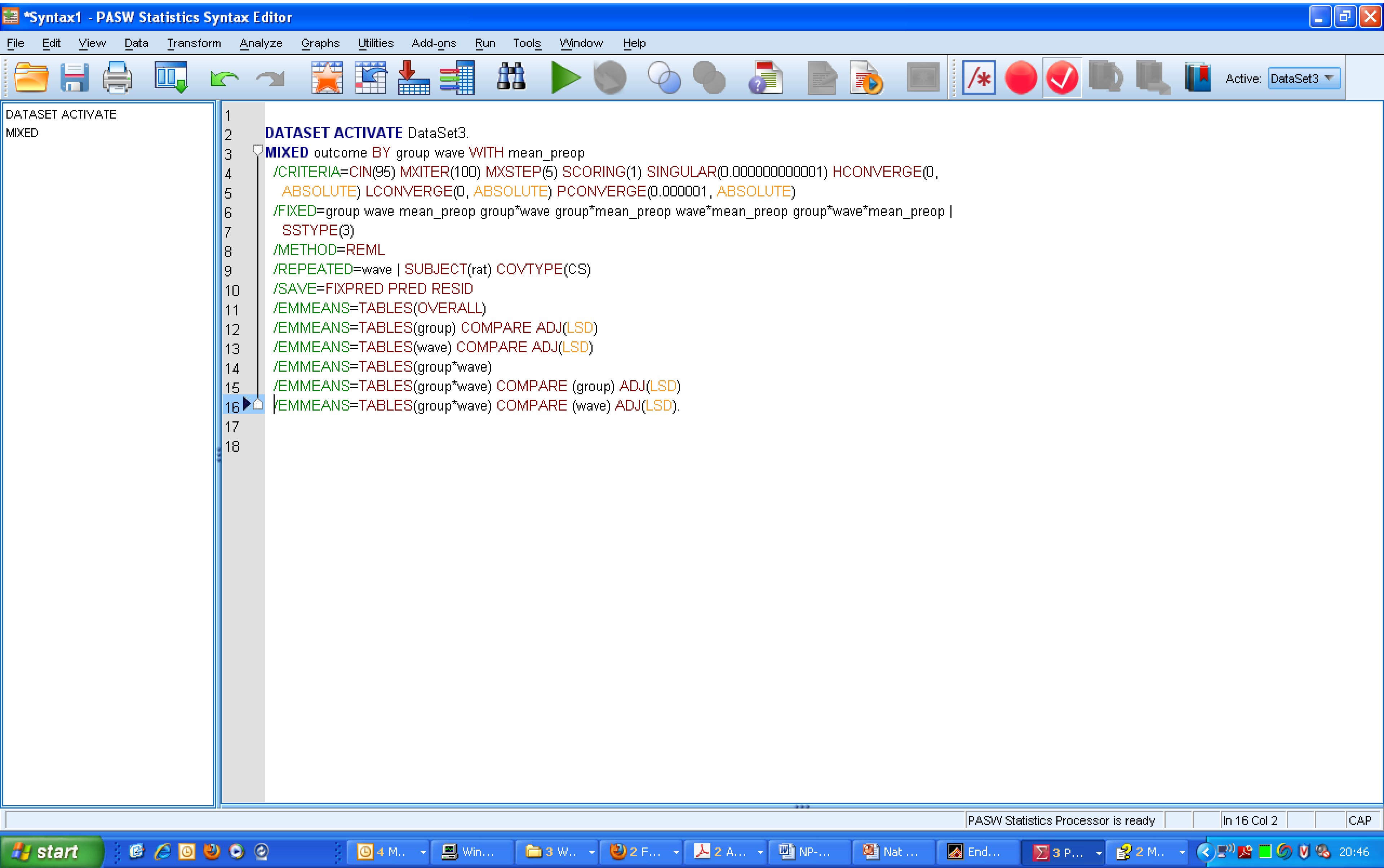
Supplementary Tutorial, Slide 52 and Figure 5



Supplementary Tutorial, Slide 53:



Supplementary Tutorial, Slide 54 and Figure 6



Supplementary Tutorial, Slide 55: Analysis using linear model and a Compound Symmetric covariance structure and estimated using REML

*Output2 [Document2] - PASW Statistics Viewer

Mixed Model Analysis

```
[DataSet3] C:\Documents and Settings\Lawrence Moon\Desktop\NATURE PROTOCOLS FOR TRIP\SPSS files\long_format.sav
```

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables	Number of Subjects
Fixed Effects	Intercept	1		1		
	group	4		3		
	wave	8		7		
	mean_preop	1		1		
	group * wave	32		21		
	group * mean_preop	4		3		
	wave * mean_preop	8		7		
	group * wave * mean_preop	32		21		
Repeated Effects	wave	8	Compound Symmetry	2	rat	53
Total		98		66		

a. Dependent Variable: outcome.

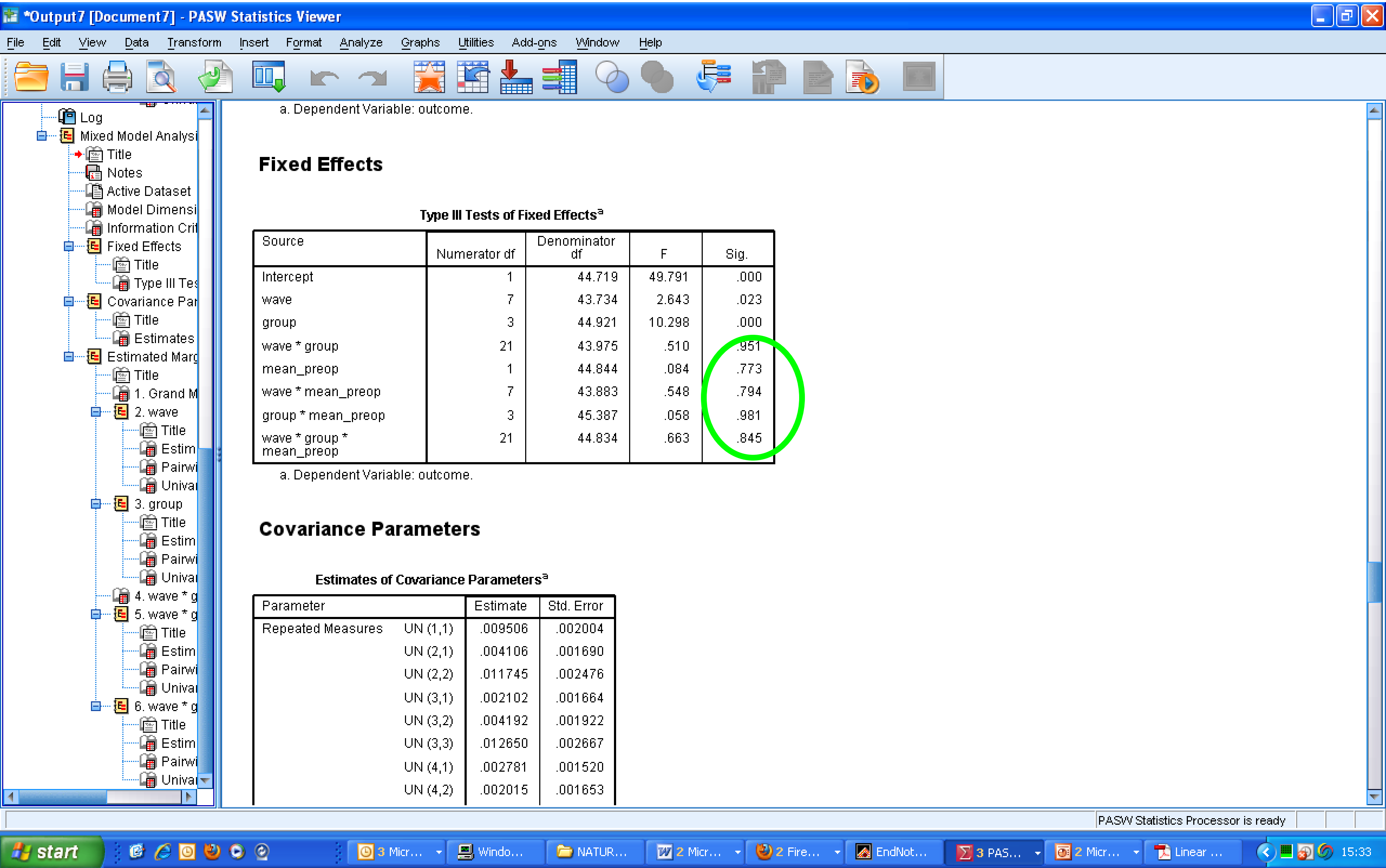
Information Criteria[a]

-2 Restricted Log Likelihood	-711.131
Akaike's Information Criterion (AIC)	-707.131
Hurvich and Tsai's Criterion (AICC)	-707.097
Bozdogan's Criterion (CAIC)	-697.398
Schwarz's Bayesian Criterion (BIC)	-699.398

The information criteria are displayed

PASW Statistics Processor is ready

Supplementary Tutorial, Slide 56



a. Dependent Variable: outcome.

Fixed Effects

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	44.719	49.791	.000
wave	7	43.734	2.643	.023
group	3	44.921	10.298	.000
wave * group	21	43.975	.510	.951
mean_preop	1	44.844	.084	.773
wave * mean_preop	7	43.883	.548	.794
group * mean_preop	3	45.387	.058	.981
wave * group * mean_preop	21	44.834	.663	.845

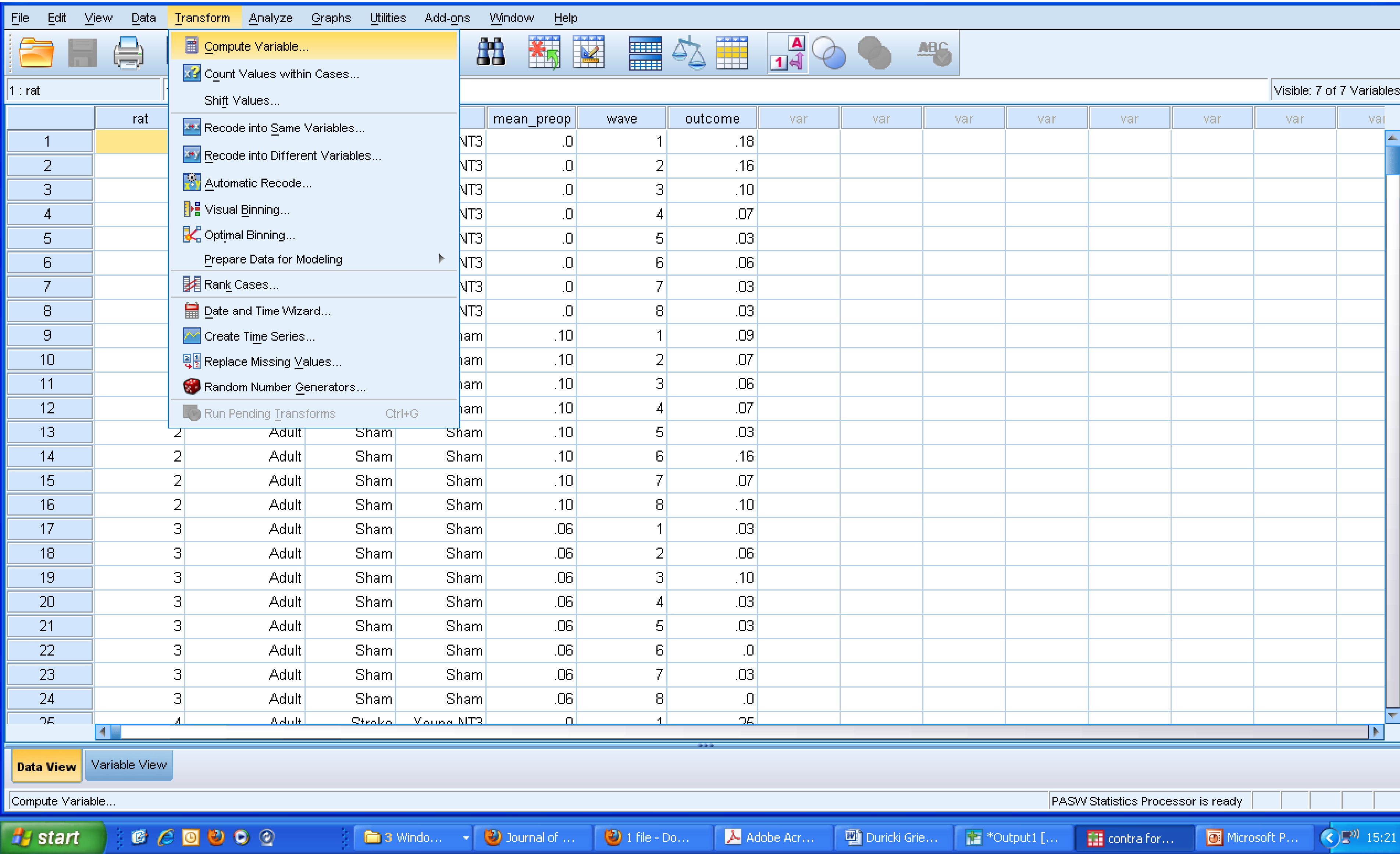
a. Dependent Variable: outcome.

Covariance Parameters

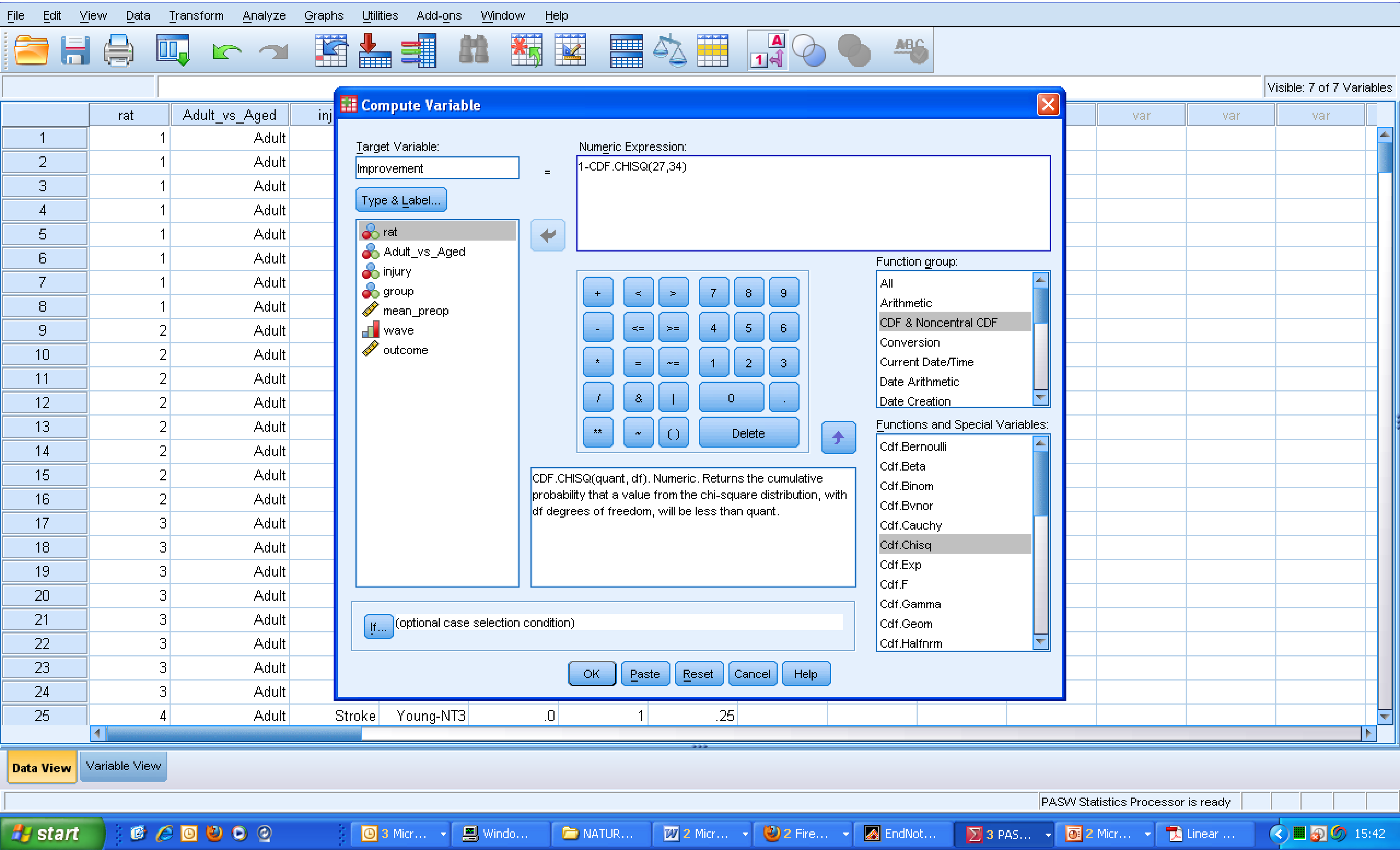
Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error
Repeated Measures	UN (1,1)	.009506	.002004
	UN (2,1)	.004106	.001690
	UN (2,2)	.011745	.002476
	UN (3,1)	.002102	.001664
	UN (3,2)	.004192	.001922
	UN (3,3)	.012650	.002667
	UN (4,1)	.002781	.001520
	UN (4,2)	.002015	.001653

Supplementary Tutorial, Slide 57: Comparing -2LL from two different models



Supplementary Tutorial, Slide 58: Comparing -2LL from two different models



Supplementary Tutorial, Slide 59: Comparing -2LL from two different models

1 : Improvement .79754546430483

Visible: 8 of 8 Variables

	rat	Adult_vs_Aged	injury	group	mean_preop	wave	outcome	Improvement
1	1	Adult	Stroke	Young-NT3	.0	1	.18	.80
2	1	Adult	Stroke	Young-NT3	.0	2	.16	.80
3	1	Adult	Stroke	Young-NT3	.0	3	.10	.80
4	1	Adult	Stroke	Young-NT3	.0	4	.07	.80
5	1	Adult	Stroke	Young-NT3	.0	5	.03	.80
6	1	Adult	Stroke	Young-NT3	.0	6	.06	.80
7	1	Adult	Stroke	Young-NT3	.0	7	.03	.80
8	1	Adult	Stroke	Young-NT3	.0	8	.03	.80
9	2	Adult	Sham	Sham	.10	1	.09	.80
10	2	Adult	Sham	Sham	.10	2	.07	.80
11	2	Adult	Sham	Sham	.10	3	.06	.80
12	2	Adult	Sham	Sham	.10	4	.07	.80
13	2	Adult	Sham	Sham	.10	5	.03	.80
14	2	Adult	Sham	Sham	.10	6	.16	.80
15	2	Adult	Sham	Sham	.10	7	.07	.80
16	2	Adult	Sham	Sham	.10	8	.10	.80
17	3	Adult	Sham	Sham	.06	1	.03	.80
18	3	Adult	Sham	Sham	.06	2	.06	.80
19	3	Adult	Sham	Sham	.06	3	.10	.80
20	3	Adult	Sham	Sham	.06	4	.03	.80
21	3	Adult	Sham	Sham	.06	5	.03	.80
22	3	Adult	Sham	Sham	.06	6	.0	.80
23	3	Adult	Sham	Sham	.06	7	.03	.80
24	3	Adult	Sham	Sham	.06	8	.0	.80
25	4	Adult	Stroke	Young-NT3	.0	1	.25	.80

Data View | Variable View

PASW Statistics Processor is ready

Supplementary Tutorial, Slide 60 and Figure 7: Analysis using linear model and CS covariance structure estimated using REML

*Output3 [Document3] - PASW Statistics Viewer

Fixed Effects

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	47.908	131.126	.000
wave	7	336.463	6.797	.000
group	3	48.011	23.637	.000
wave * group	21	336.633	1.600	.047
mean_preop	1	48.599	.607	.440

a. Dependent Variable: outcome.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error
Repeated Measures	CS diagonal offset	.007501	.000579
	CS covariance	.002281	.000664

a. Dependent Variable: outcome.

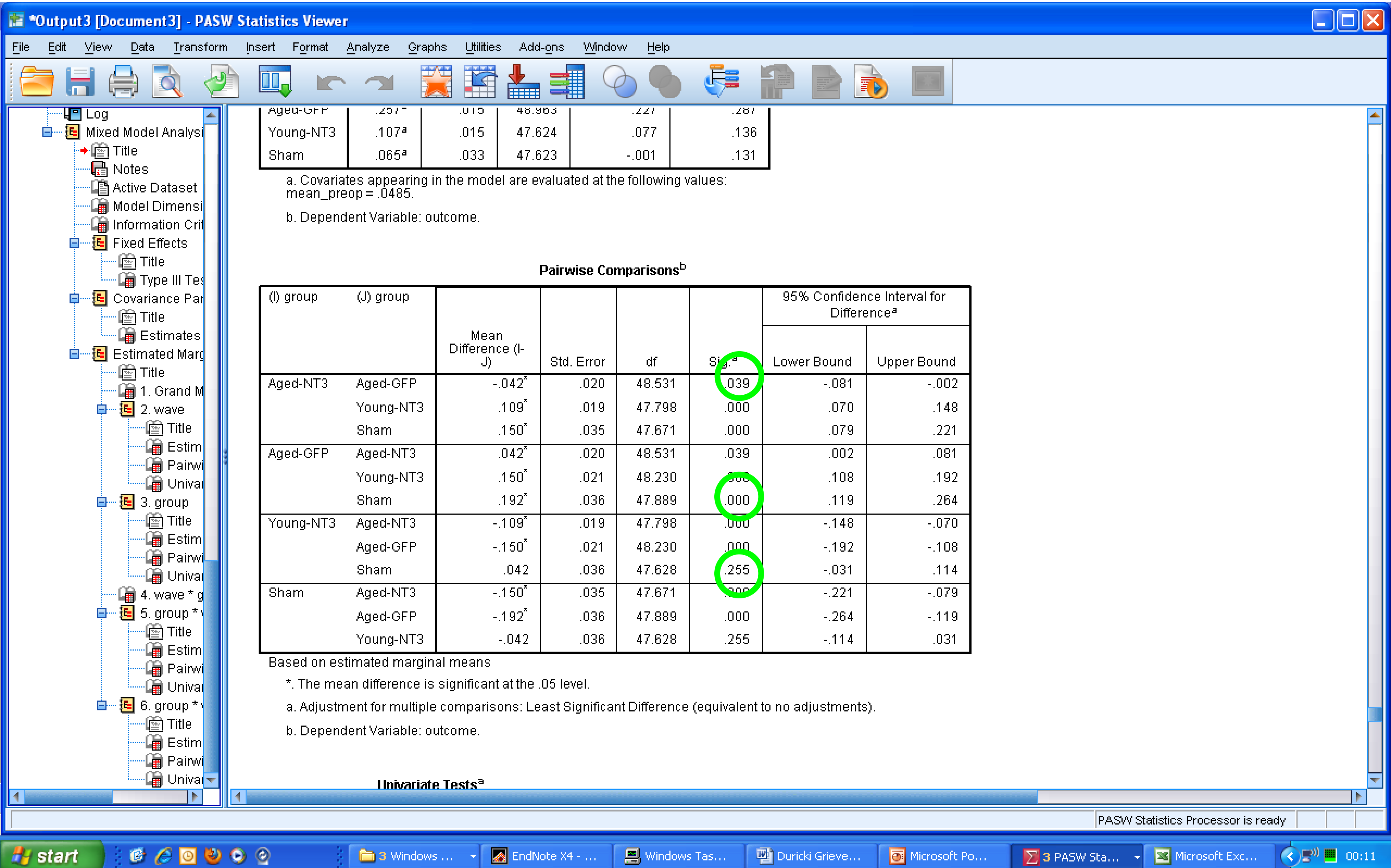
Estimated Marginal Means

1. Grand Mean[b]

Mean	Std. Error	df	95% Confidence Interval	
			Lower Bound	Upper Bound
.161[a]	.010	47.822	.140	.182

PASW Statistics Processor is ready

Supplementary Tutorial, Slide 61 and Figure 7



Aged-GFP	.257[a]	.015	48.963	.227	.287
Young-NT3	.107[a]	.015	47.624	.077	.136
Sham	.065[a]	.033	47.623	-.001	.131

a. Covariates appearing in the model are evaluated at the following values: mean_preop = .0485.

b. Dependent Variable: outcome.

Pairwise Comparisons[b]

(I) group	(J) group	Mean Difference (I-J)	Std. Error	df	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
Aged-NT3	Aged-GFP	-.042*	.020	48.531	.039	-.081	-.002
	Young-NT3	.109*	.019	47.798	.000	.070	.148
	Sham	.150*	.035	47.671	.000	.079	.221
Aged-GFP	Aged-NT3	.042*	.020	48.531	.039	.002	.081
	Young-NT3	.150*	.021	48.230	.000	.108	.192
	Sham	.192*	.036	47.889	.000	.119	.264
Young-NT3	Aged-NT3	-.109*	.019	47.798	.000	-.148	-.070
	Aged-GFP	-.150*	.021	48.230	.000	-.192	-.108
	Sham	.042	.036	47.628	.255	-.031	.114
Sham	Aged-NT3	-.150*	.035	47.671	.000	-.221	-.079
	Aged-GFP	-.192*	.036	47.889	.000	-.264	-.119
	Young-NT3	-.042	.036	47.628	.255	-.114	.031

Based on estimated marginal means

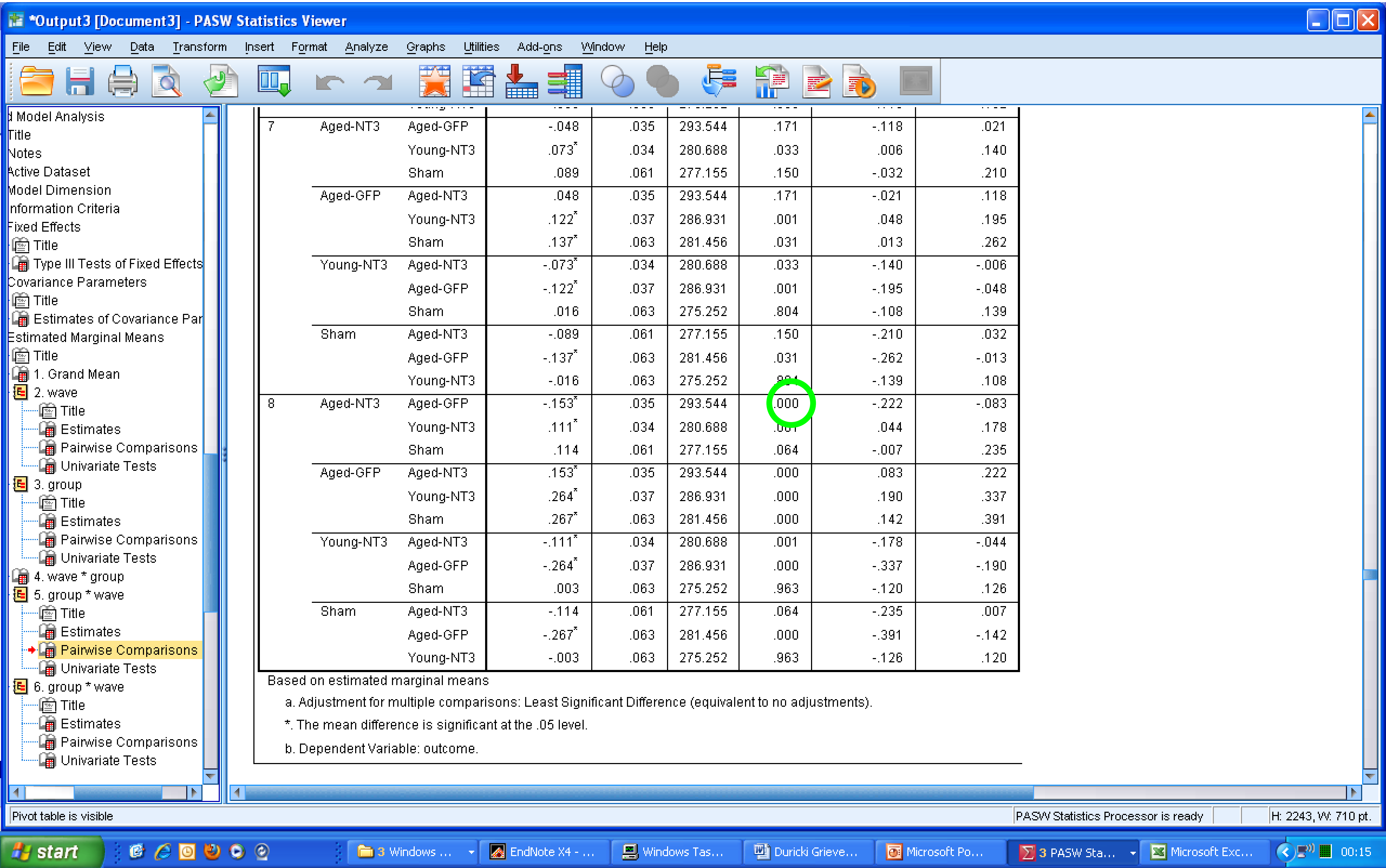
*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

b. Dependent Variable: outcome.

Univariate Tests[a]

Supplementary Tutorial, Slide 62



7	Aged-NT3	Aged-GFP	-.048	.035	293.544	.171	-.118	.021
		Young-NT3	.073*	.034	280.688	.033	.006	.140
		Sham	.089	.061	277.155	.150	-.032	.210
	Aged-GFP	Aged-NT3	.048	.035	293.544	.171	-.021	.118
		Young-NT3	.122*	.037	286.931	.001	.048	.195
		Sham	.137*	.063	281.456	.031	.013	.262
	Young-NT3	Aged-NT3	-.073*	.034	280.688	.033	-.140	-.006
		Aged-GFP	-.122*	.037	286.931	.001	-.195	-.048
		Sham	.016	.063	275.252	.804	-.108	.139
	Sham	Aged-NT3	-.089	.061	277.155	.150	-.210	.032
		Aged-GFP	-.137*	.063	281.456	.031	-.262	-.013
		Young-NT3	-.016	.063	275.252	[illegible]	-.139	.108
8	Aged-NT3	Aged-GFP	-.153*	.035	293.544	.000	-.222	-.083
		Young-NT3	.111*	.034	280.688	[illegible]	.044	.178
		Sham	.114	.061	277.155	.064	-.007	.235
	Aged-GFP	Aged-NT3	.153*	.035	293.544	.000	.083	.222
		Young-NT3	.264*	.037	286.931	.000	.190	.337
		Sham	.267*	.063	281.456	.000	.142	.391
	Young-NT3	Aged-NT3	-.111*	.034	280.688	.001	-.178	-.044
		Aged-GFP	-.264*	.037	286.931	.000	-.337	-.190
		Sham	.003	.063	275.252	.963	-.120	.126
	Sham	Aged-NT3	-.114	.061	277.155	.064	-.235	.007
		Aged-GFP	-.267*	.063	281.456	.000	-.391	-.142
		Young-NT3	-.003	.063	275.252	.963	-.126	.120

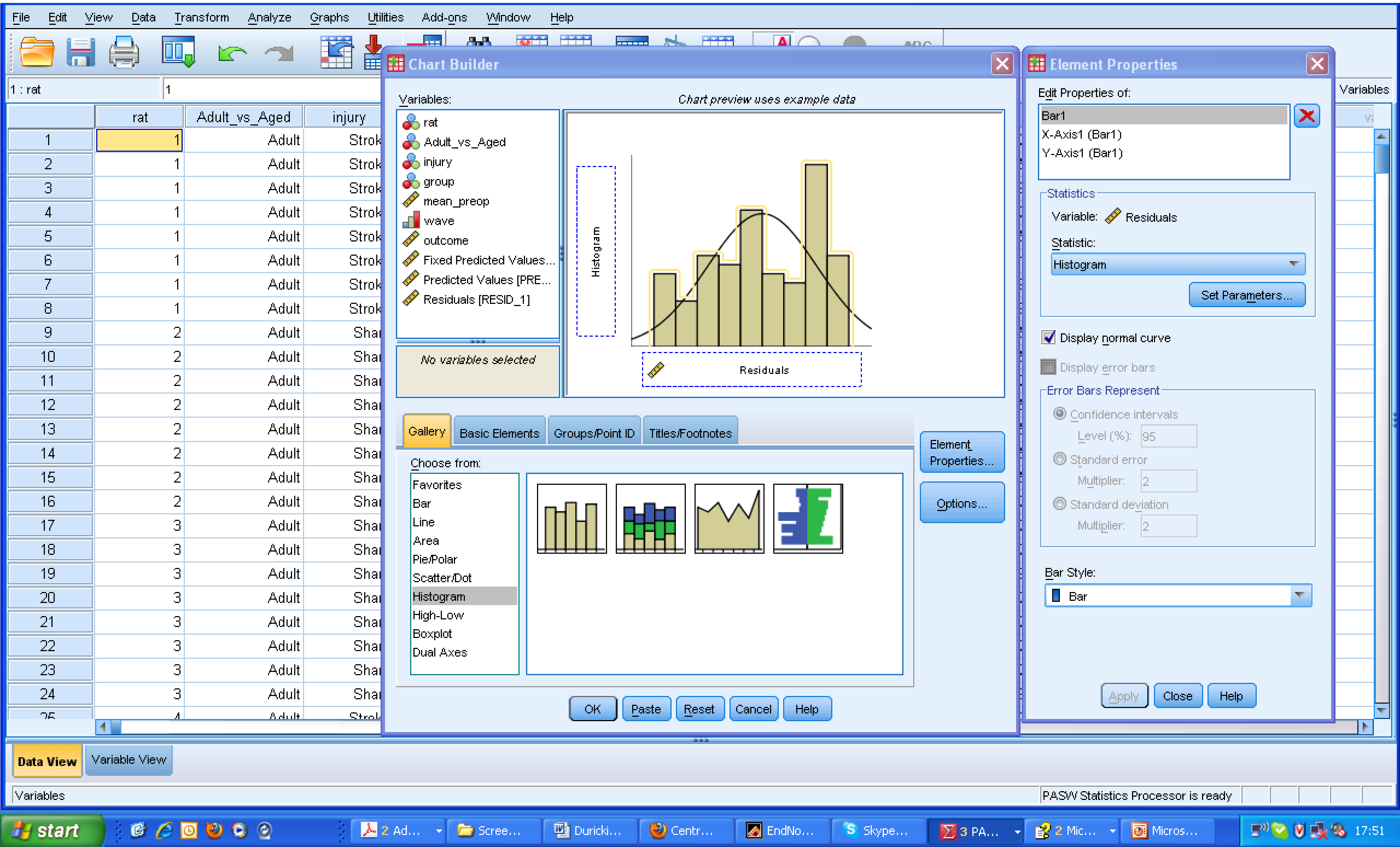
Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

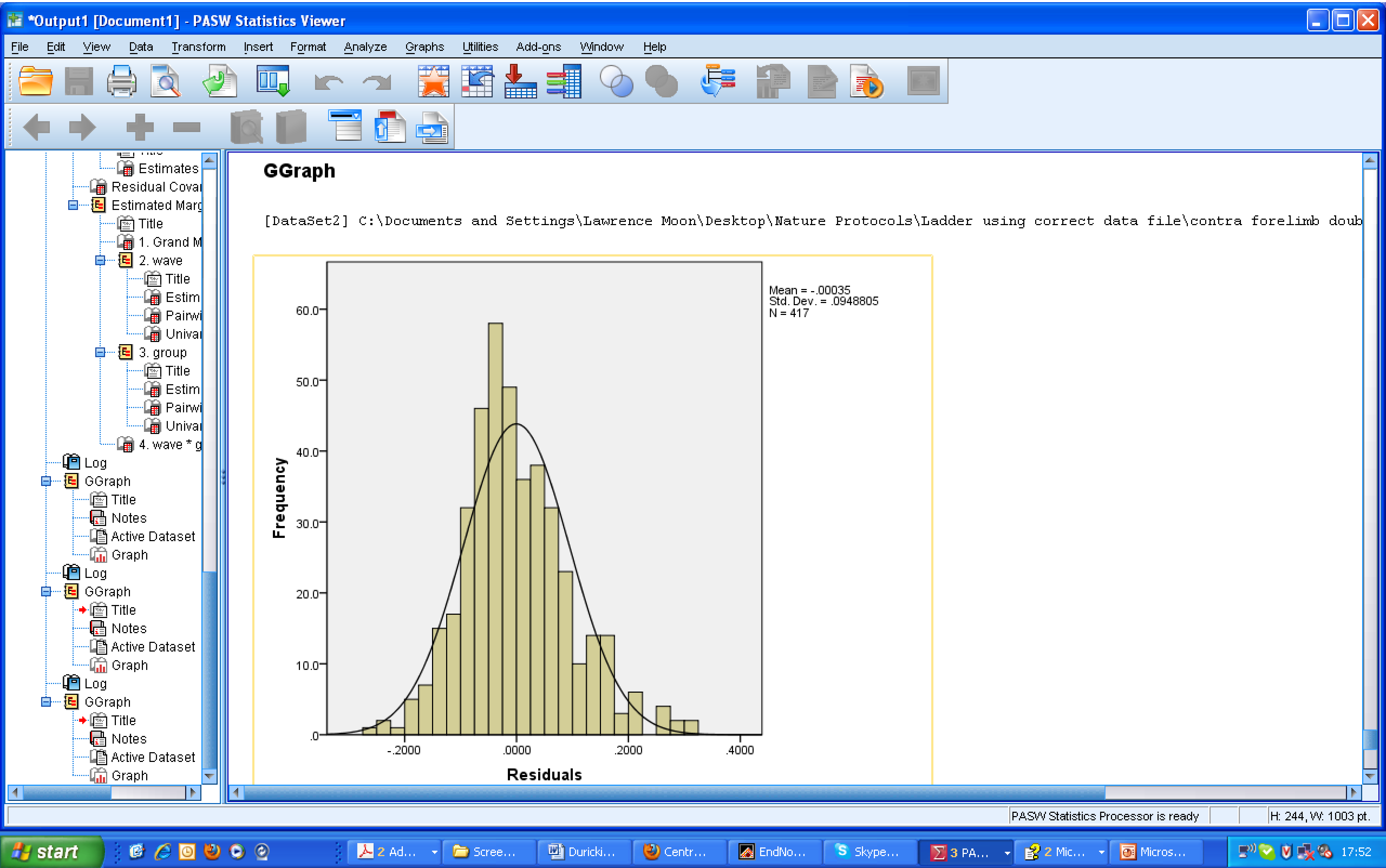
*. The mean difference is significant at the .05 level.

b. Dependent Variable: outcome.

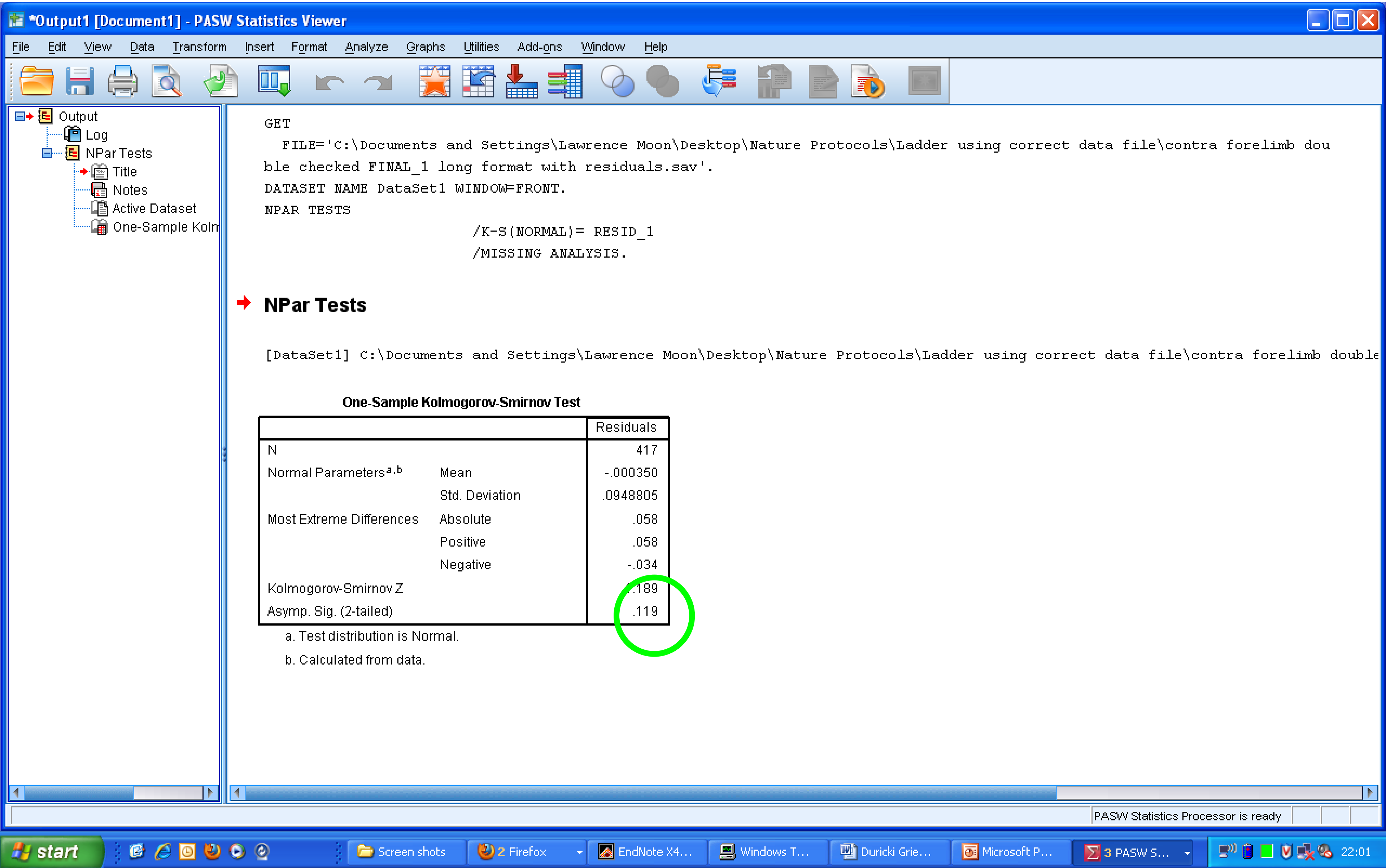
Supplementary Tutorial, Slide 63



Supplementary Tutorial, Slide 64



Supplementary Tutorial, Slide 65



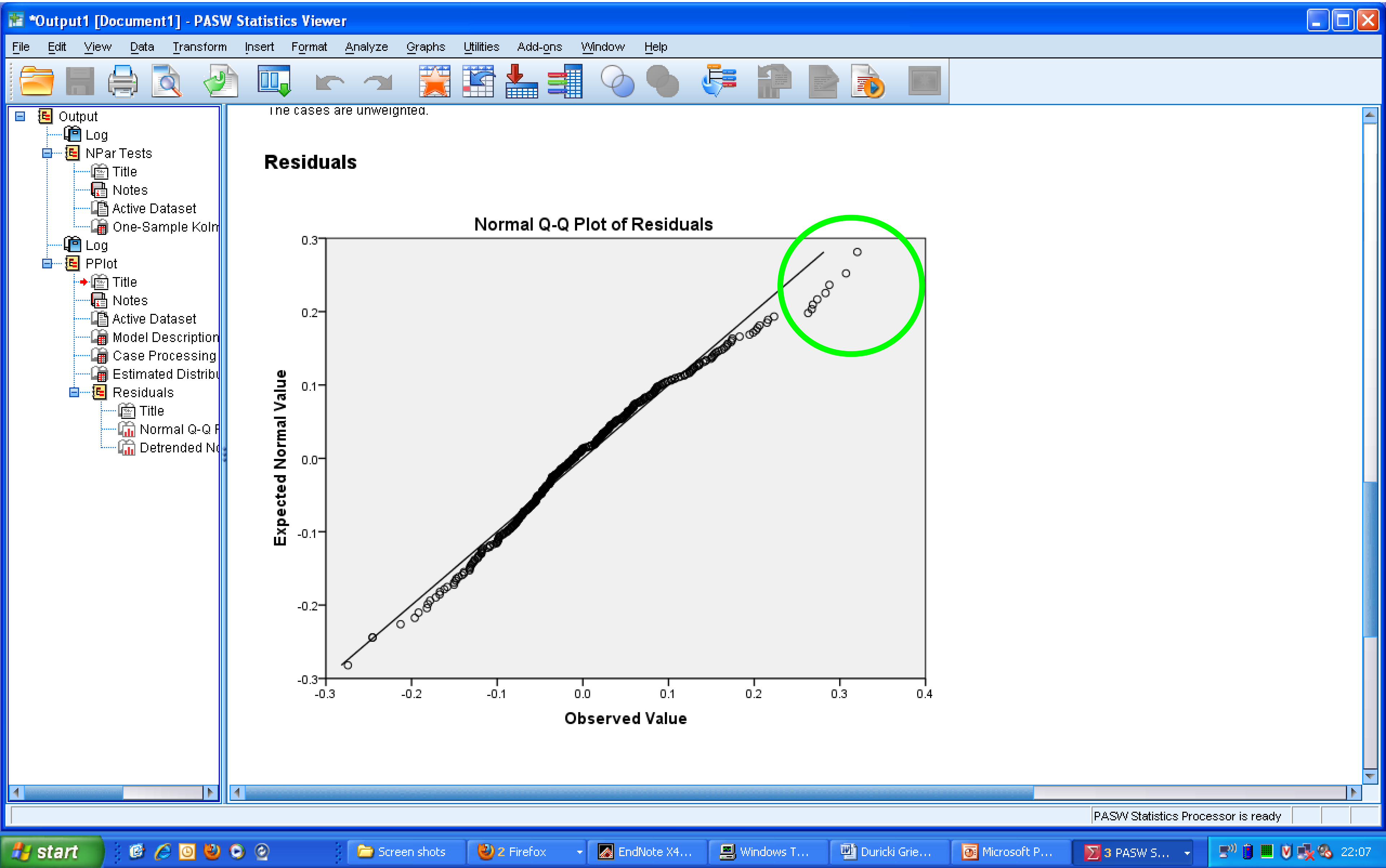
One-Sample Kolmogorov-Smirnov Test

		Residuals
N		417
Normal Parameters[a,b]	Mean	-.000350
	Std. Deviation	.0948805
Most Extreme Differences	Absolute	.058
	Positive	.058
	Negative	-.034
Kolmogorov-Smirnov Z		1.189
Asymp. Sig. (2-tailed)		.119

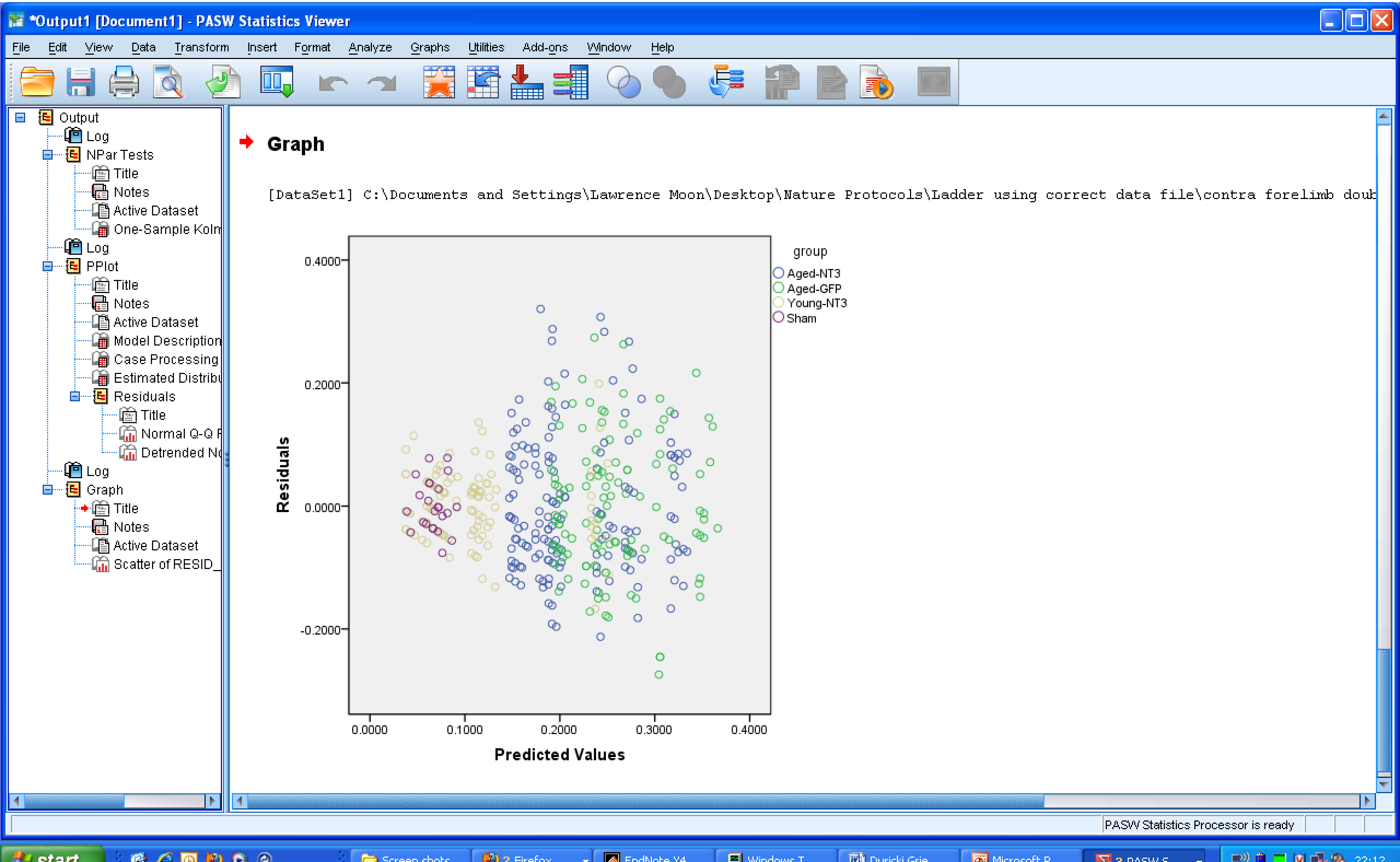
a. Test distribution is Normal.

b. Calculated from data.

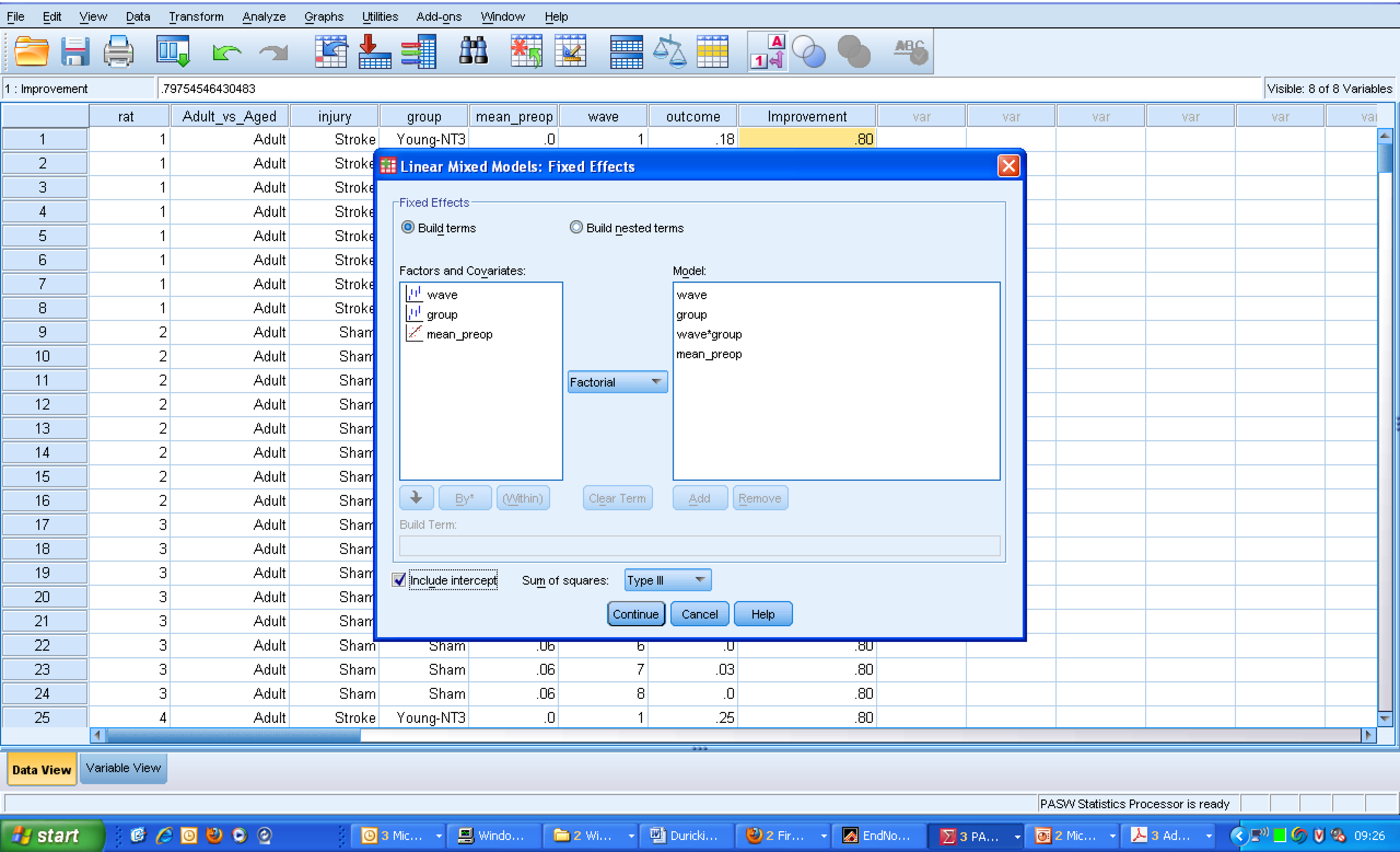
Supplementary Tutorial, Slide 66: The vast majority of circles fall on the diagonal line, with only a few outliers (green circle). This Q-Q plot indicates the assumption of normality is reasonable.



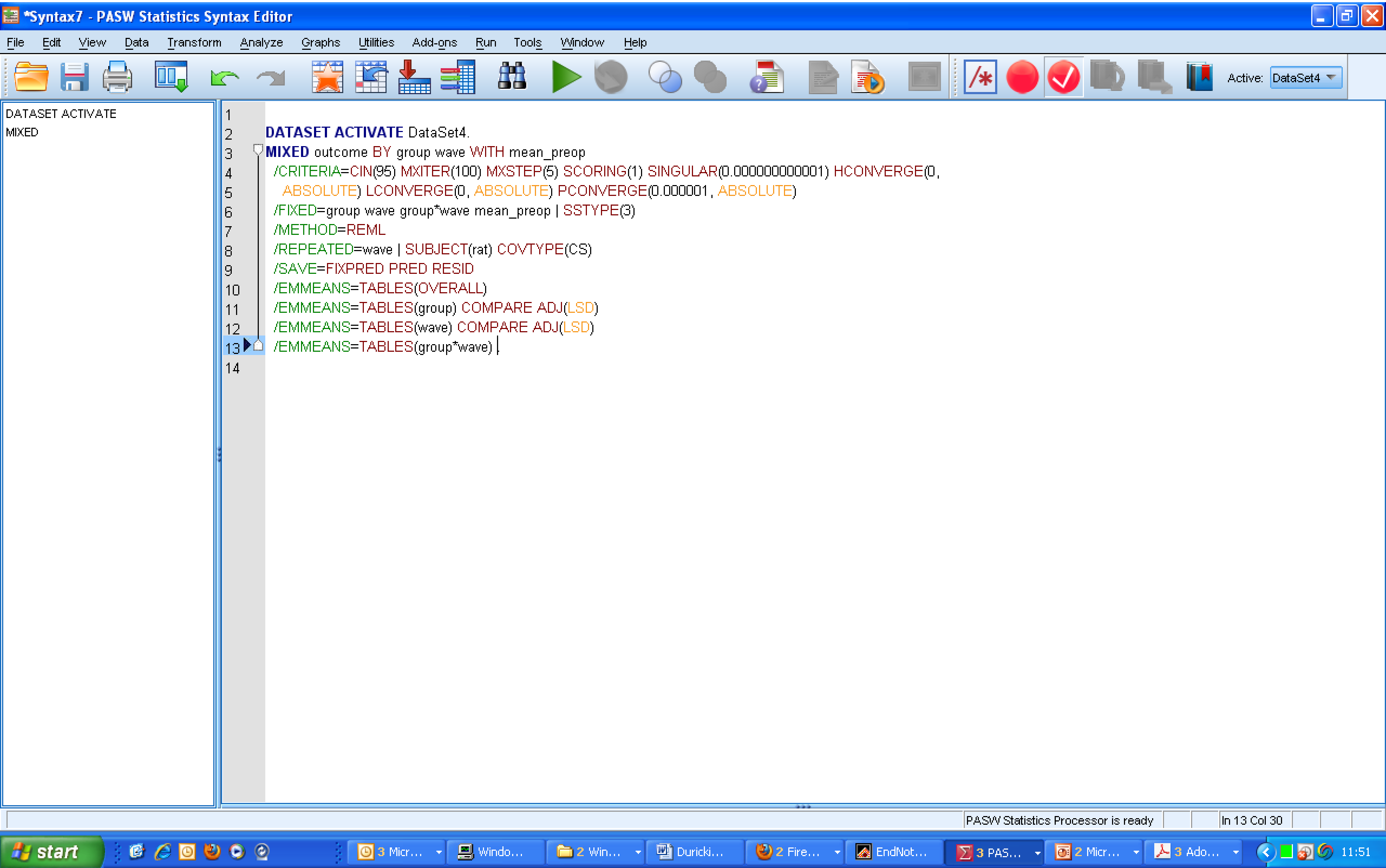
Supplementary Tutorial, Slide 67: A scatterplot of the residuals against their predicted values shows no obvious correlation within groups. However, the variability of the residuals is smaller for the sham and young groups than for the two aged groups.



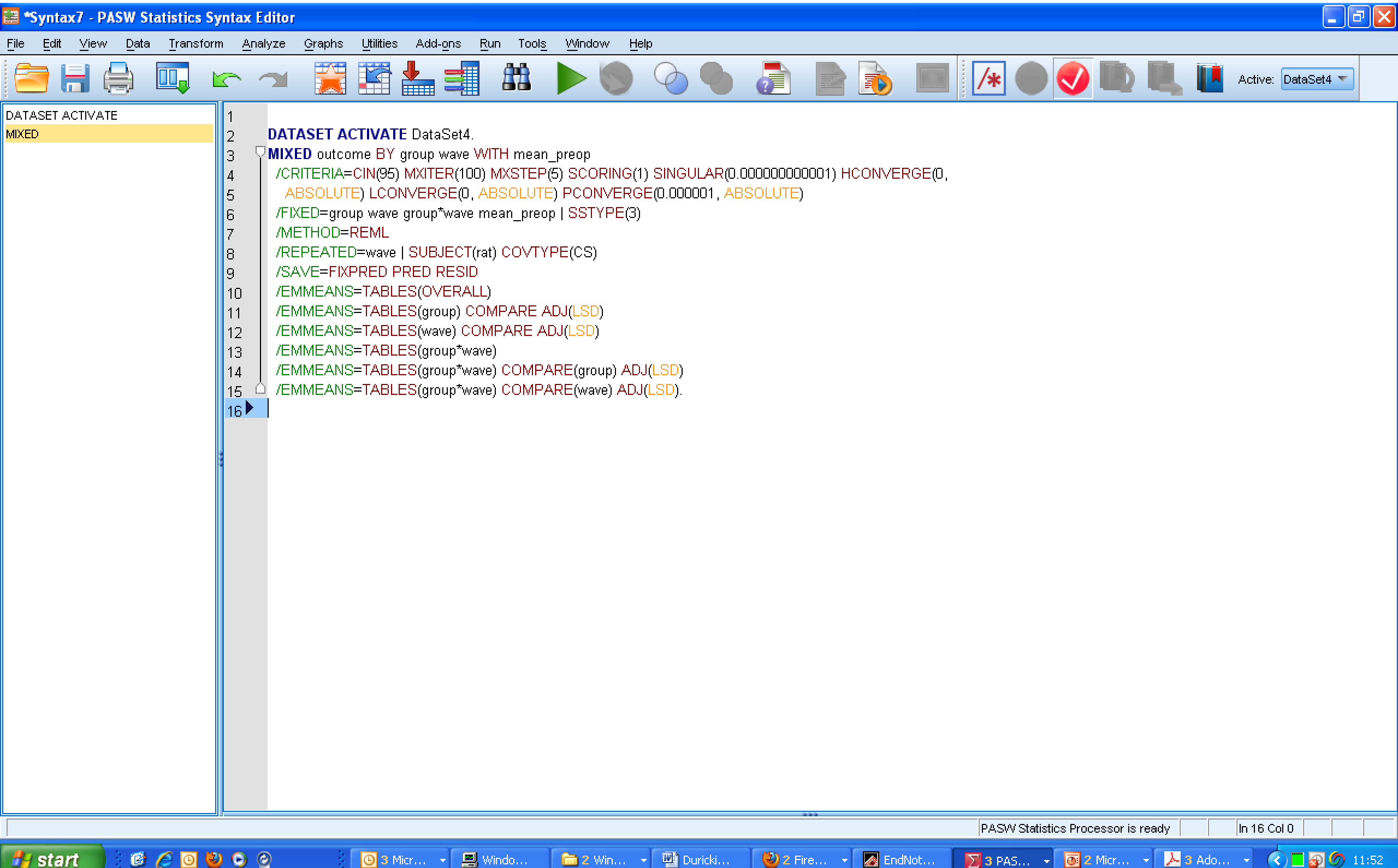
Supplementary Tutorial, Slide 68: Making the model more parsimonious



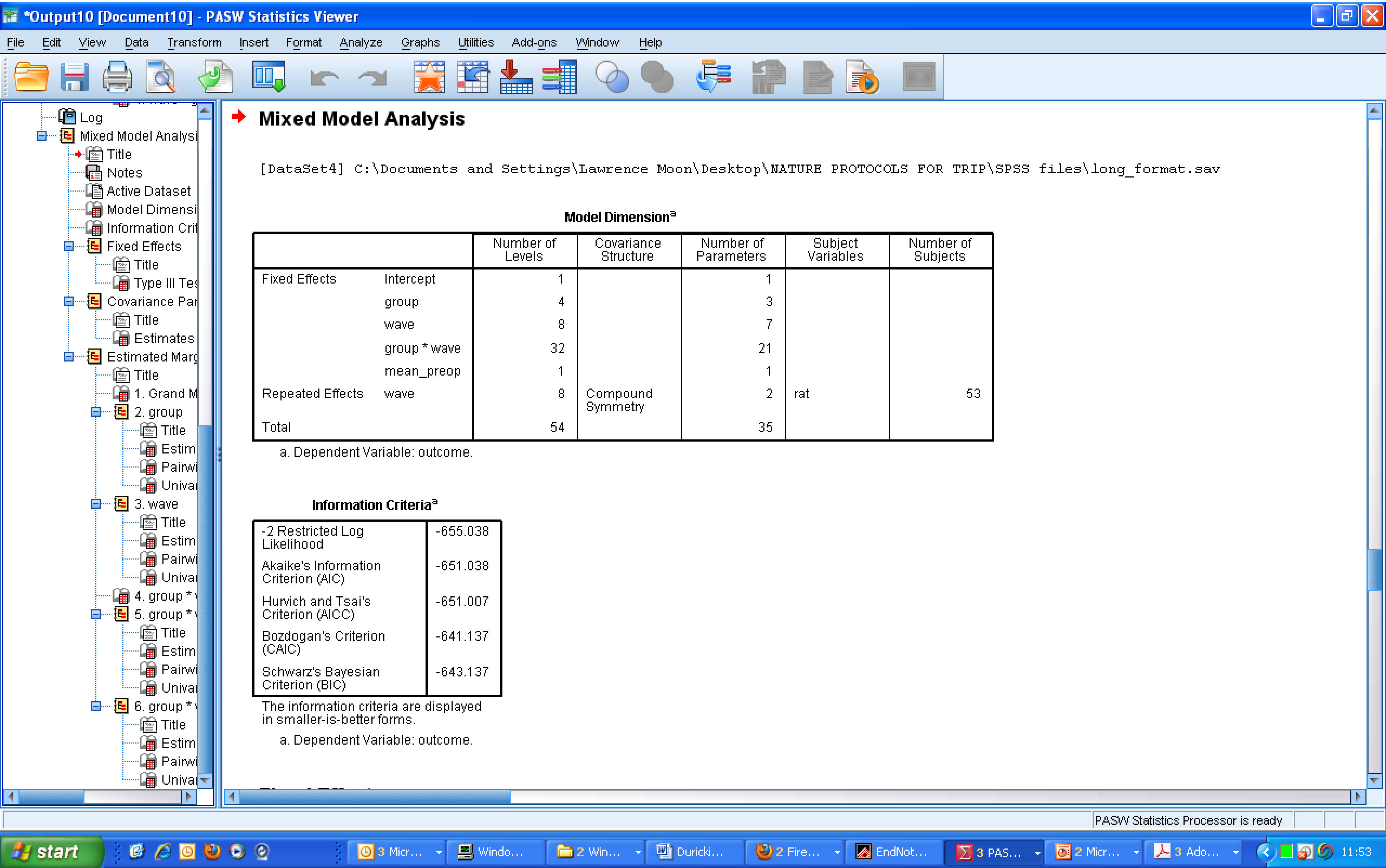
Supplementary Tutorial, Slide 69: Analysis using CS covariance structure with estimation performed using REML



Supplementary Tutorial, Slide 70:



Supplementary Tutorial, Slide 71:



Mixed Model Analysis

[DataSet4] C:\Documents and Settings\Lawrence Moon\Desktop\NATURE PROTOCOLS FOR TRIP\SPSS files\long_format.sav

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables	Number of Subjects
Fixed Effects	Intercept	1		1		
	group	4		3		
	wave	8		7		
	group * wave	32		21		
	mean_preop	1		1		
Repeated Effects	wave	8	Compound Symmetry	2	rat	53
Total		54		35		

a. Dependent Variable: outcome.

Information Criteria[a]

-2 Restricted Log Likelihood	-655.038
Akaike's Information Criterion (AIC)	-651.038
Hurvich and Tsai's Criterion (AICC)	-651.007
Bozdogan's Criterion (CAIC)	-641.137
Schwarz's Bayesian Criterion (BIC)	-643.137

The information criteria are displayed in smaller-is-better forms.

a. Dependent Variable: outcome.

Supplementary Tutorial, Slide 72:

*Output10 [Document10] - PASW Statistics Viewer

Fixed Effects

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	47.908	131.126	.000
group	3	48.011	23.637	.000
wave	7	336.463	6.797	.000
group * wave	21	336.633	1.600	.047
mean_preop	1	48.599	.607	.440

a. Dependent Variable: outcome.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error
Repeated Measures	CS diagonal offset	.007501	.000579
	CS covariance	.002281	.000664

a. Dependent Variable: outcome.

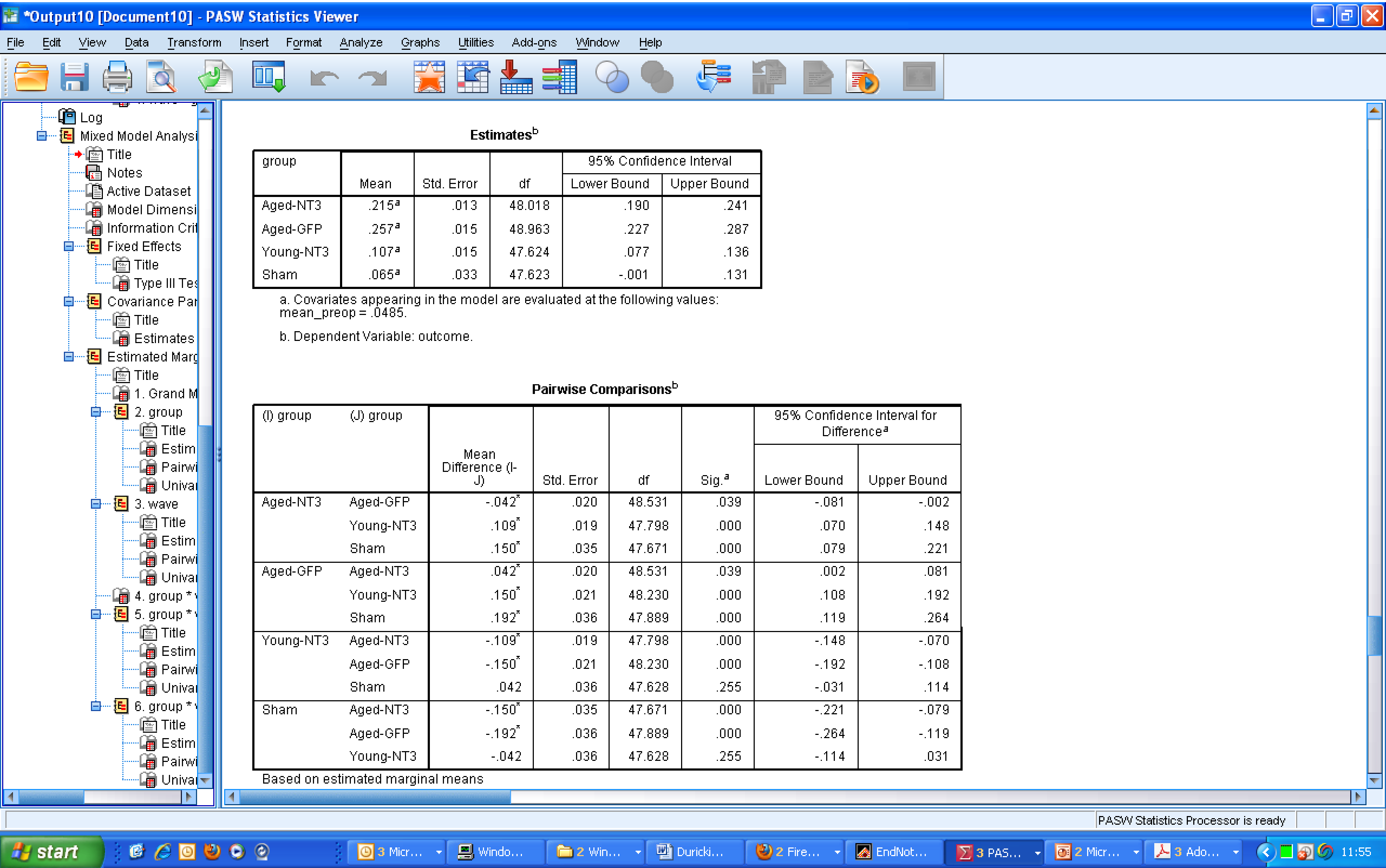
Estimated Marginal Means

1. Grand Mean[b]

Mean	Std. Error	df	95% Confidence Interval	
			Lower Bound	Upper Bound
.161[a]	.010	47.822	.140	.182

a. Covariates appearing in the model are evaluated at the following values: mean_preop = .0485

Supplementary Tutorial, Slide 73:



Estimates[b]

group	Mean	Std. Error	df	95% Confidence Interval	
				Lower Bound	Upper Bound
Aged-NT3	.215[a]	.013	48.018	.190	.241
Aged-GFP	.257[a]	.015	48.963	.227	.287
Young-NT3	.107[a]	.015	47.624	.077	.136
Sham	.065[a]	.033	47.623	-.001	.131

a. Covariates appearing in the model are evaluated at the following values: mean_preop = .0485.

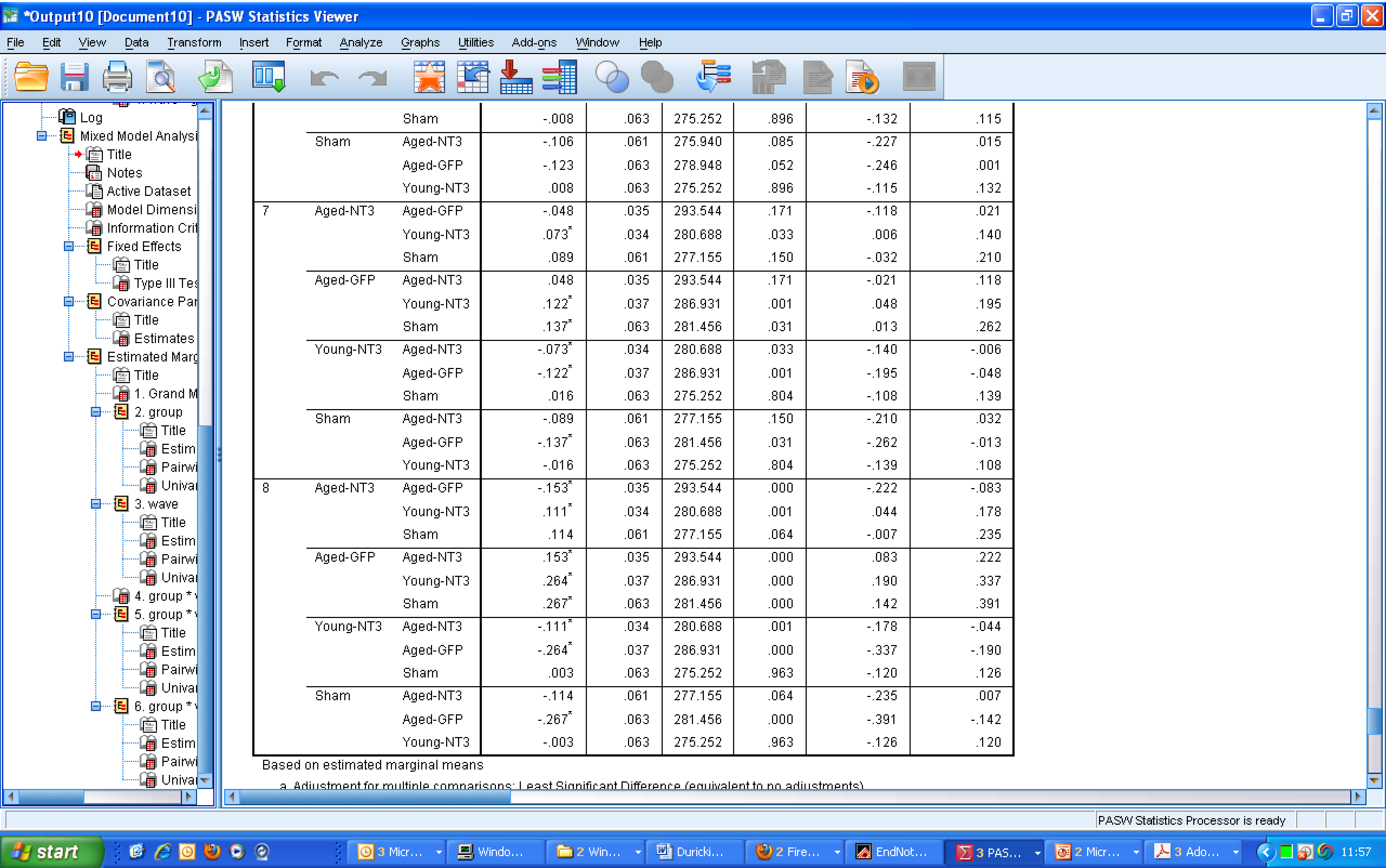
b. Dependent Variable: outcome.

Pairwise Comparisons[b]

(I) group	(J) group	Mean Difference (I-J)	Std. Error	df	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
Aged-NT3	Aged-GFP	-.042*	.020	48.531	.039	-.081	-.002
	Young-NT3	.109*	.019	47.798	.000	.070	.148
	Sham	.150*	.035	47.671	.000	.079	.221
Aged-GFP	Aged-NT3	.042*	.020	48.531	.039	.002	.081
	Young-NT3	.150*	.021	48.230	.000	.108	.192
	Sham	.192*	.036	47.889	.000	.119	.264
Young-NT3	Aged-NT3	-.109*	.019	47.798	.000	-.148	-.070
	Aged-GFP	-.150*	.021	48.230	.000	-.192	-.108
	Sham	.042	.036	47.628	.255	-.031	.114
Sham	Aged-NT3	-.150*	.035	47.671	.000	-.221	-.079
	Aged-GFP	-.192*	.036	47.889	.000	-.264	-.119
	Young-NT3	-.042	.036	47.628	.255	-.114	.031

Based on estimated marginal means

Supplementary Tutorial, Slide 74:

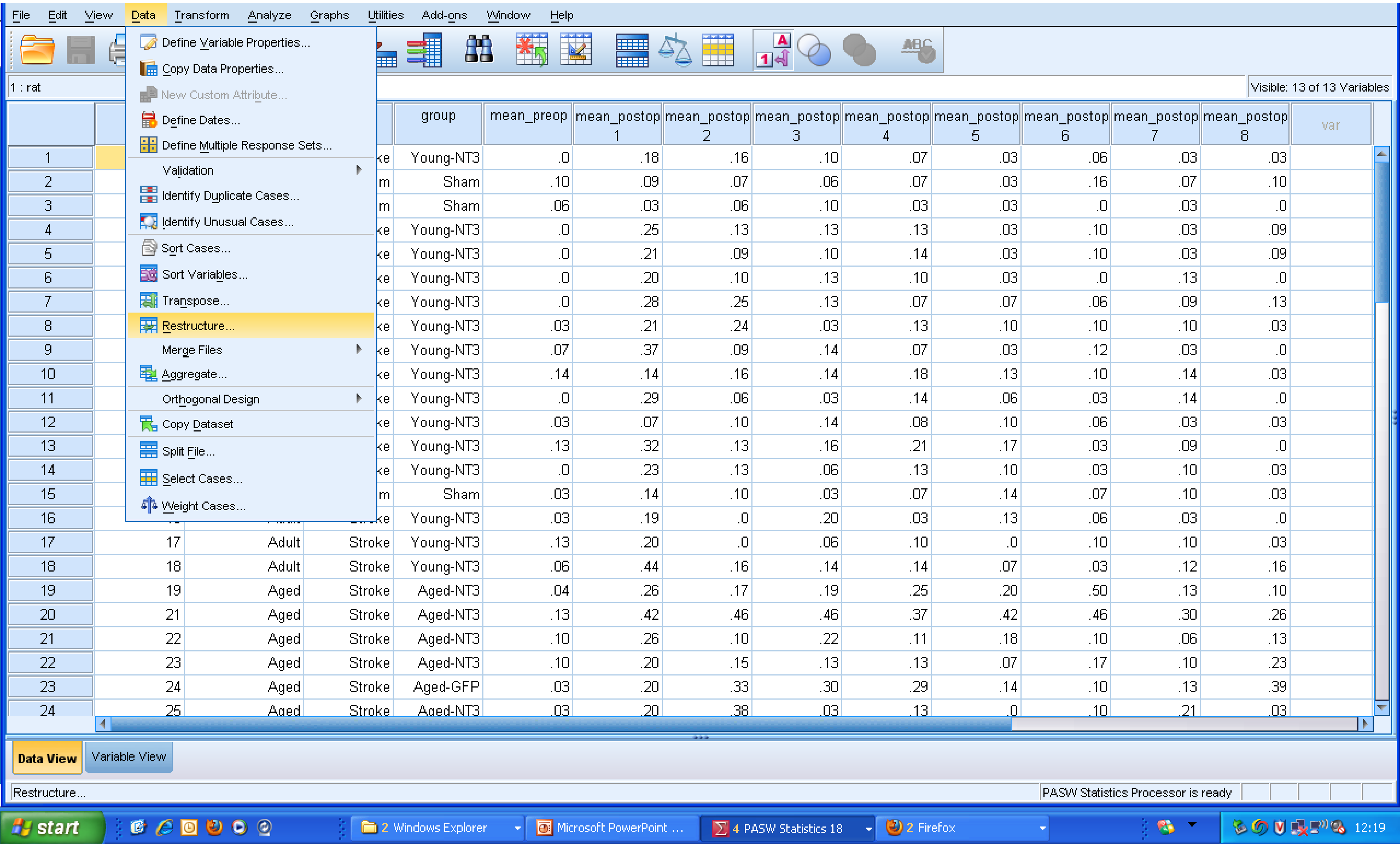


		Sham	-.008	.063	275.252	.896	-.132	.115
	Sham	Aged-NT3	-.106	.061	275.940	.085	-.227	.015
		Aged-GFP	-.123	.063	278.948	.052	-.246	.001
		Young-NT3	.008	.063	275.252	.896	-.115	.132
7	Aged-NT3	Aged-GFP	-.048	.035	293.544	.171	-.118	.021
		Young-NT3	.073*	.034	280.688	.033	.006	.140
		Sham	.089	.061	277.155	.150	-.032	.210
	Aged-GFP	Aged-NT3	.048	.035	293.544	.171	-.021	.118
		Young-NT3	.122*	.037	286.931	.001	.048	.195
		Sham	.137*	.063	281.456	.031	.013	.262
	Young-NT3	Aged-NT3	-.073*	.034	280.688	.033	-.140	-.006
		Aged-GFP	-.122*	.037	286.931	.001	-.195	-.048
		Sham	.016	.063	275.252	.804	-.108	.139
	Sham	Aged-NT3	-.089	.061	277.155	.150	-.210	.032
		Aged-GFP	-.137*	.063	281.456	.031	-.262	-.013
		Young-NT3	-.016	.063	275.252	.804	-.139	.108
8	Aged-NT3	Aged-GFP	-.153*	.035	293.544	.000	-.222	-.083
		Young-NT3	.111*	.034	280.688	.001	.044	.178
		Sham	.114	.061	277.155	.064	-.007	.235
	Aged-GFP	Aged-NT3	.153*	.035	293.544	.000	.083	.222
		Young-NT3	.264*	.037	286.931	.000	.190	.337
		Sham	.267*	.063	281.456	.000	.142	.391
	Young-NT3	Aged-NT3	-.111*	.034	280.688	.001	-.178	-.044
		Aged-GFP	-.264*	.037	286.931	.000	-.337	-.190
		Sham	.003	.063	275.252	.963	-.120	.126
	Sham	Aged-NT3	-.114	.061	277.155	.064	-.235	.007
		Aged-GFP	-.267*	.063	281.456	.000	-.391	-.142
		Young-NT3	-.003	.063	275.252	.963	-.126	.120

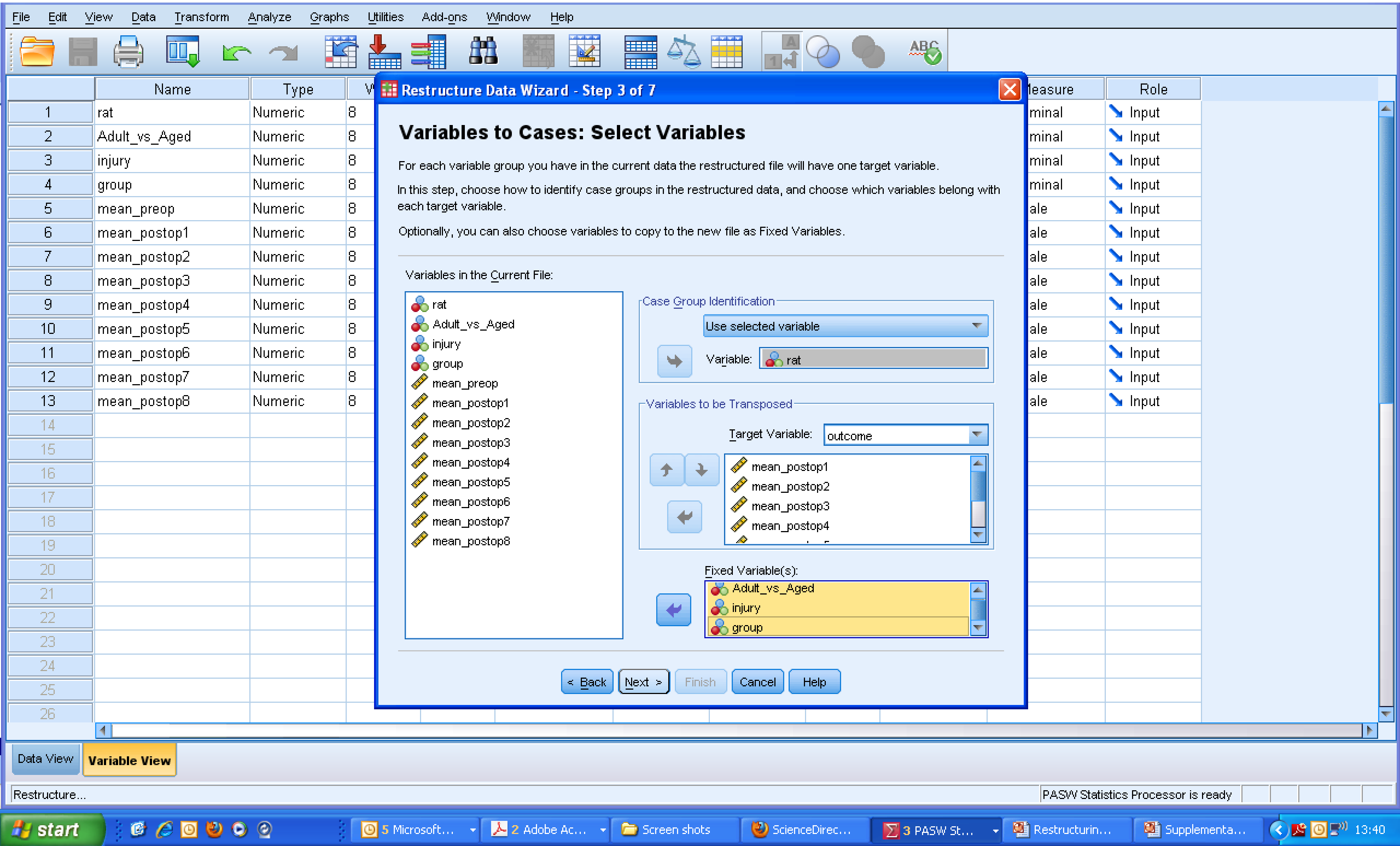
Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

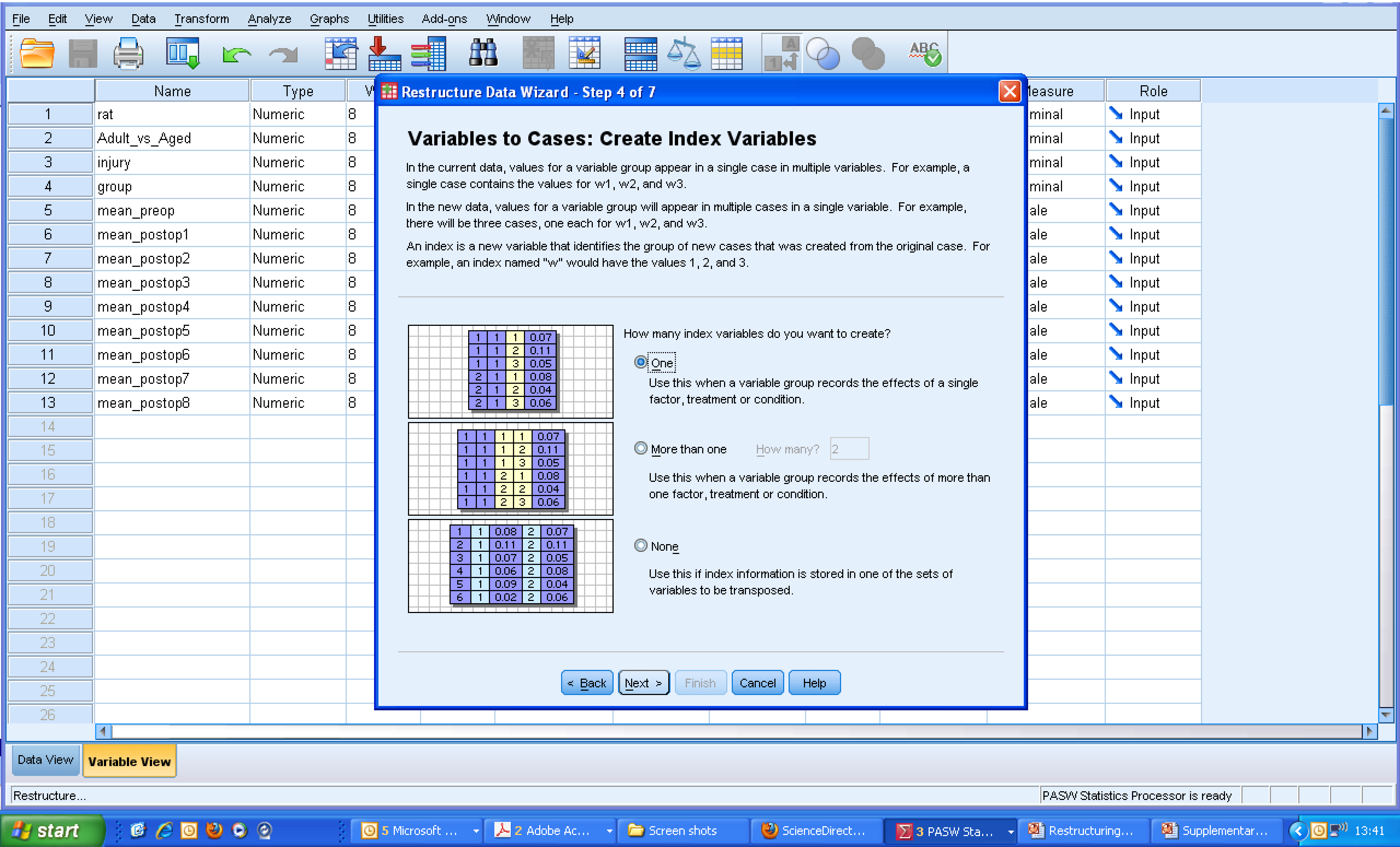
Supplementary Tutorial, Slide 75: Restructuring data. First save the data file by File>Save As because the Restructuring overwrites your existing file.
Next click Data>Restructure.



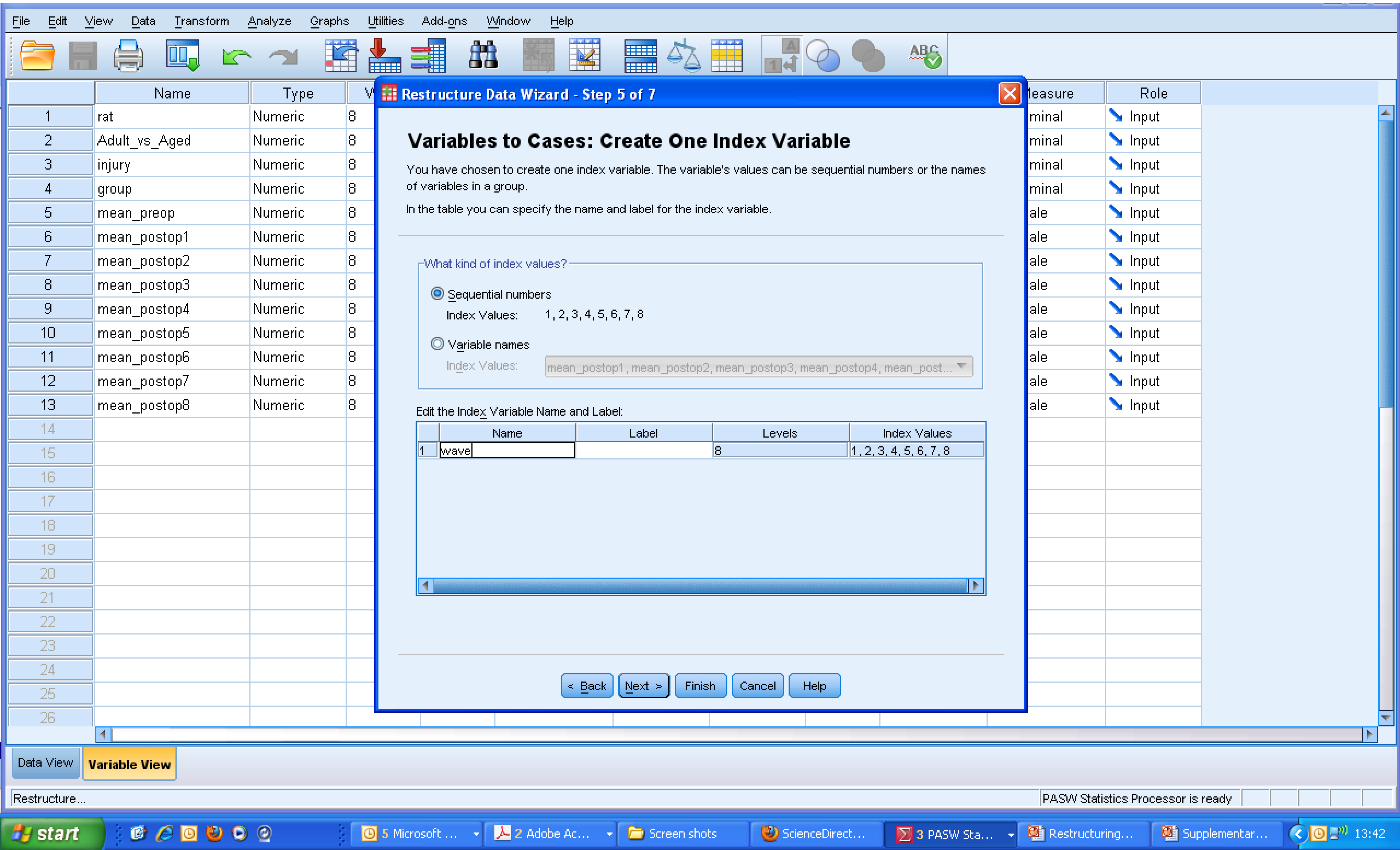
Supplementary Tutorial, Slide 78: Restructuring data



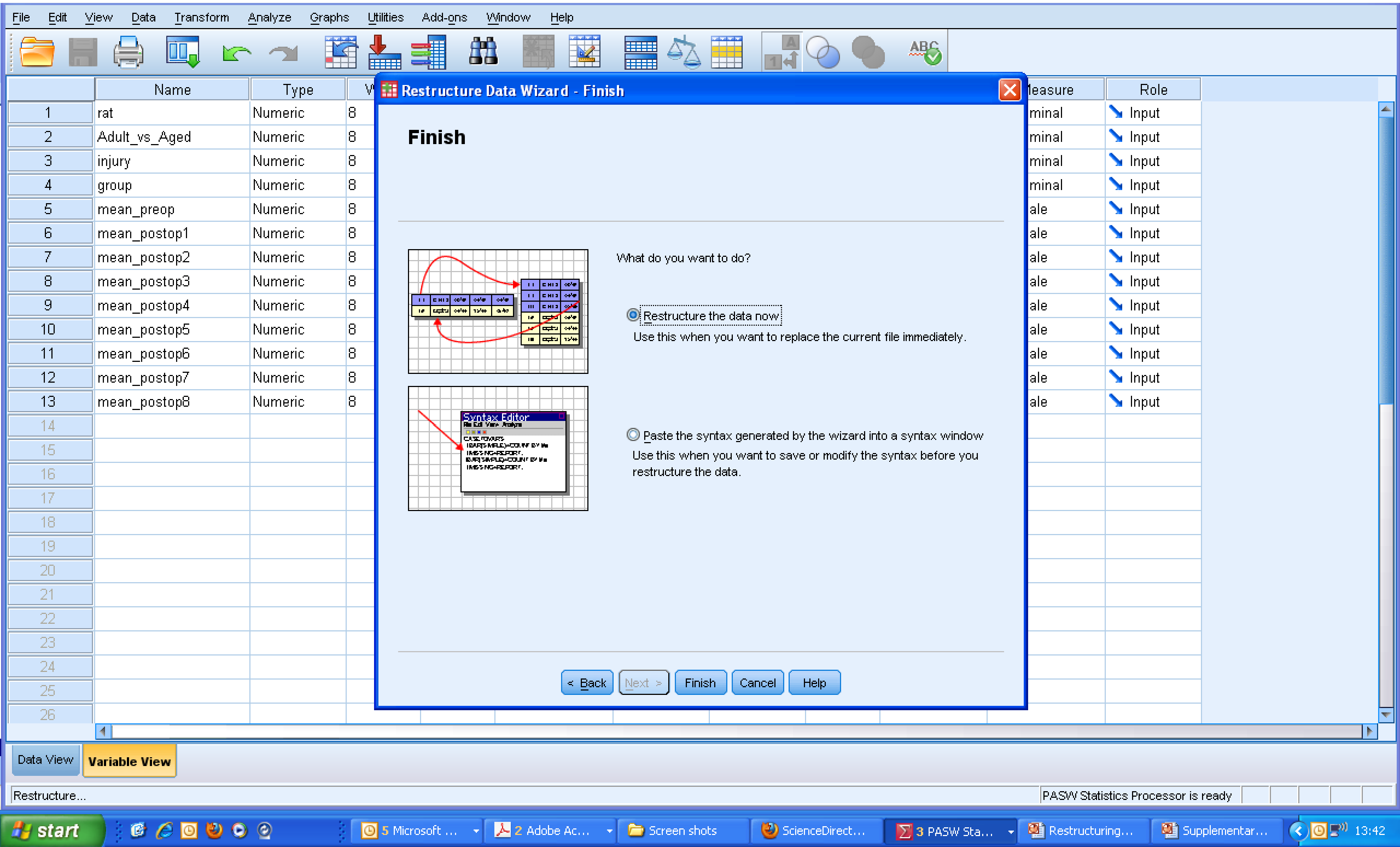
Supplementary Tutorial, Slide 79: In this case, you only have One index variable. See next slide for an explanation of the indexing variable.



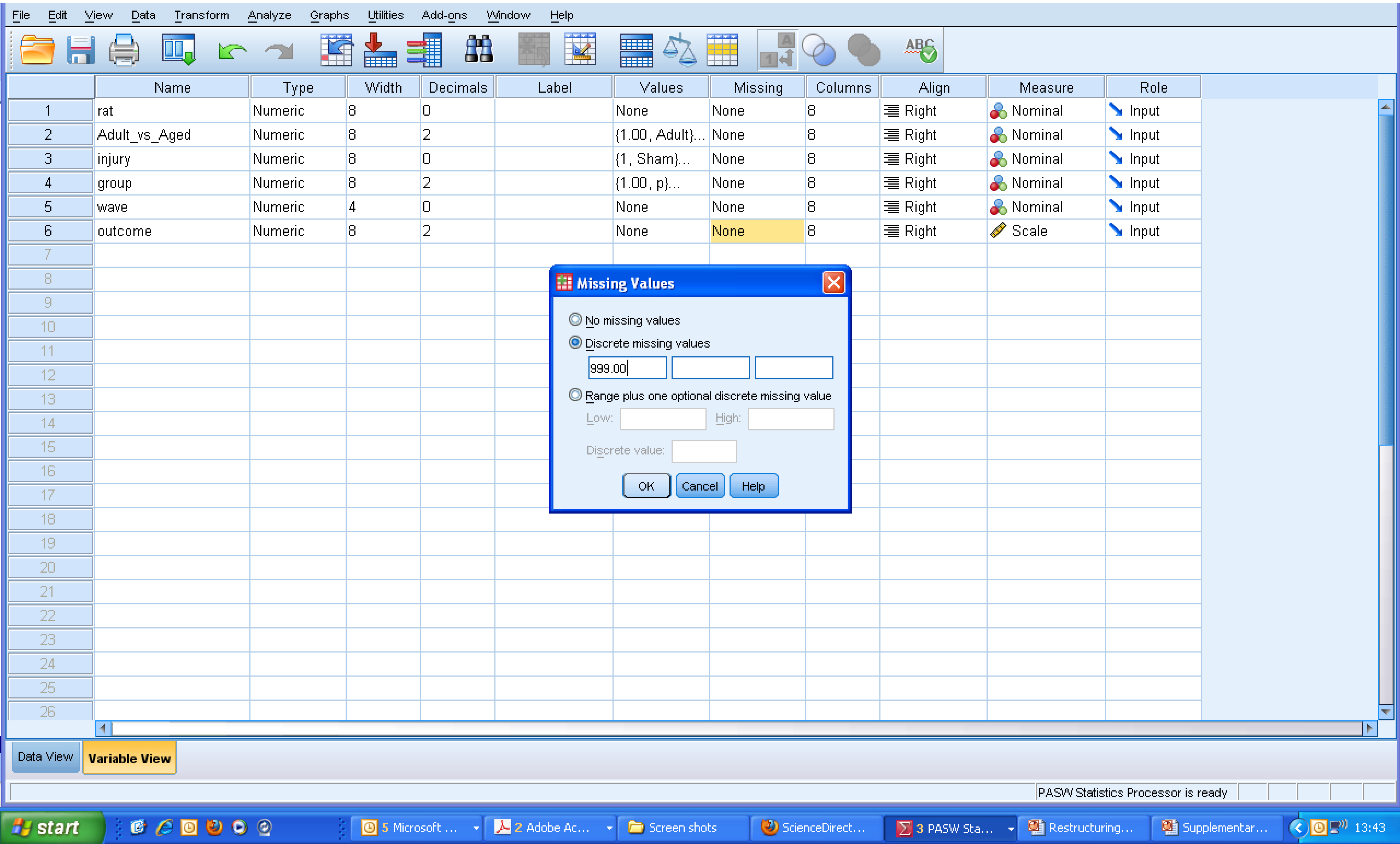
Supplementary Tutorial, Slide 80: Type “wave” into the “Name” for your first indexing variable. This generates a new variable called “wave” with eight levels corresponding to your Repeated Measure time points.



Supplementary Tutorial, Slide 81: Click Next, Next, Finish, OK.



Supplementary Tutorial, Slide 82: Annoyingly, SPSS does not carry forward the “missing value” designation. To fix this, click “Variable View” and the blue “…” icon in “Missing” for “outcome”. Click on “Discrete missing values” and enter “999.00” in one box.



Supplementary Tutorial, Slide 83: Users of SPSS version 19 or later can use the GENLINMIXED procedure to fit linear models with general error covariance structures and different variance components for different groups of subjects.

Entire books have been written about the GENLINMIXED procedure, so a full explanation is beyond the scope of this article.

However, the following Syntax may be used as guidance to begin fitting a model which would allow males and females to have different error variance components for a Scale (i.e., quantitative, continuous) dependent variable called “weight”, an independent variable called “iv1” and a repeated measure called “time”.

```
GENLINMIXED
/DATA_STRUCTURE SUBJECTS=subject REPEATED_MEASURES=time GROUPING=male COVARIANCE_TYPE=IDENTITY
/FIELDS TARGET=weight TRIALS=NONE OFFSET=NONE
/TARGET_OPTIONS DISTRIBUTION=NORMAL LINK=IDENTITY
/FIXED EFFECTS=time male iv1 USE_INTERCEPT=TRUE
...
```

Specify whatever BUILD_OPTIONS and EMMEANS_OPTIONS you want.
The output format needs to be changed from “Diagram” to “Table”.

We thank an anonymous reviewer for providing this suggestion.