One Factor Repeated Measure ANOVA (Multivariate Approach)

Example: Effect of digitalis on calcium levels in dogs

Goal: To determine if the level of digitalis affects the mean level of calcium in dogs when repeated measures were obtained from each dog.

A study was conducted to compare the effect of three levels of digitalis on the level of calcium in the heart muscle of dogs. It is sufficient to note that the general level of calcium uptake varies from one animal to another so that comparisons of digitalis levels were based on repeated measurements from the same dog. That is the tissue for a heart muscle was measured repeatedly from the same dog for the three levels of digitalis (A, B, and C). Four dogs were randomly chosen in this study.

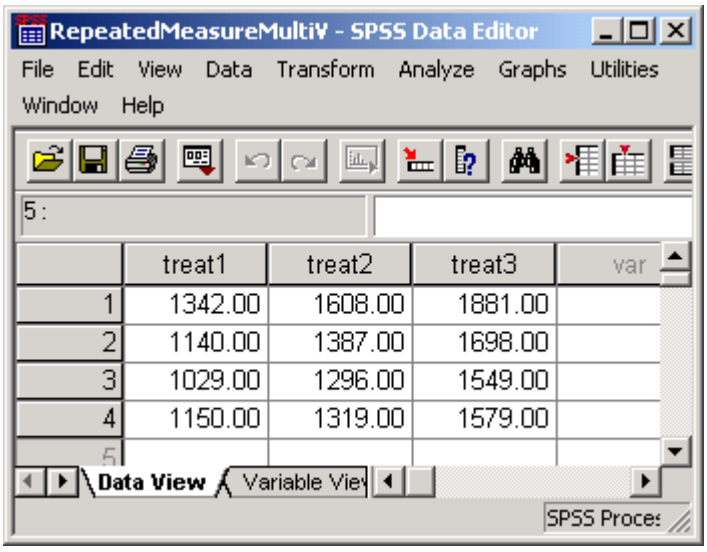
	Level of Digitalis		
Dog	A	B	C
1	1342	1608	1881
2	1140	1387	1698
3	1029	1296	1549
4	1150	1319	1579

Digitalis (DIJ'ih-TAL'is) is also known as digoxin (di-JOKS'in) and digitoxin (dij"ih-TOKS'in). It's a drug that strengthens the contraction of the heart muscle, slows the heart rate and helps eliminate fluid from body tissues. It's often used to treat congestive heart failure and is also used to treat certain arrhythmias (ah-RITH'me-ahz).

Digitalis has been described in medical literature for over 200 years. It's derived from the foxglove plant.

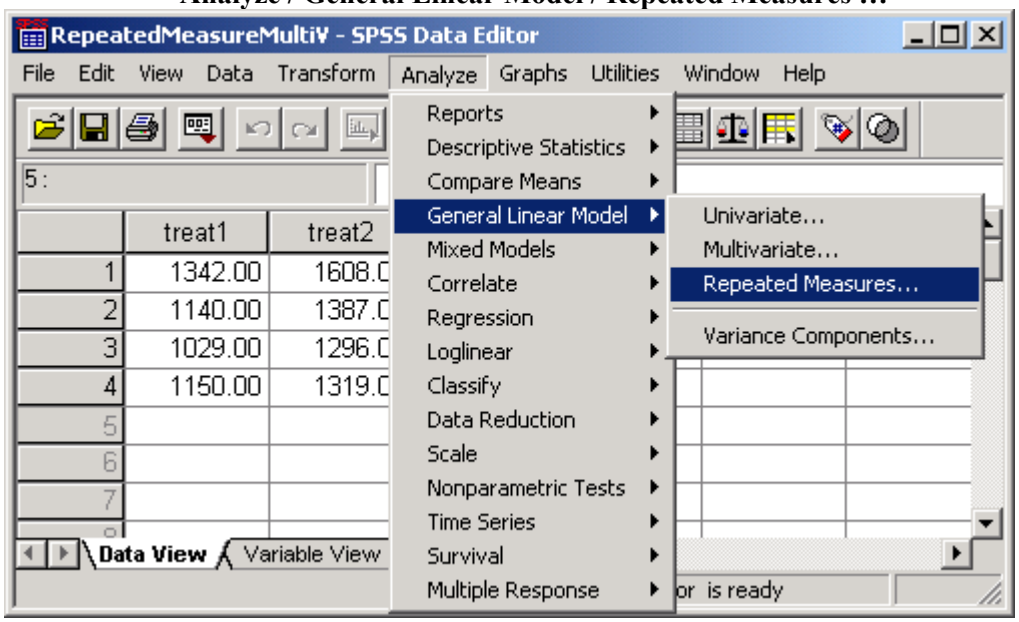
(*From The American Heart Association*)

1) Enter measurements from each treatment level for all experimental subjects, each column represents a treatment, and each row represents measures from a subject.

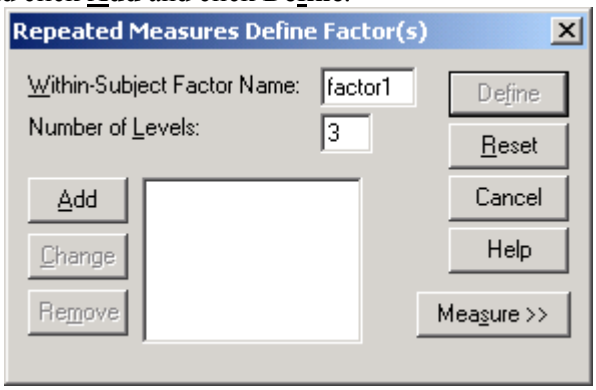


2) Click through the following sequence of options to perform repeated measures analysis.

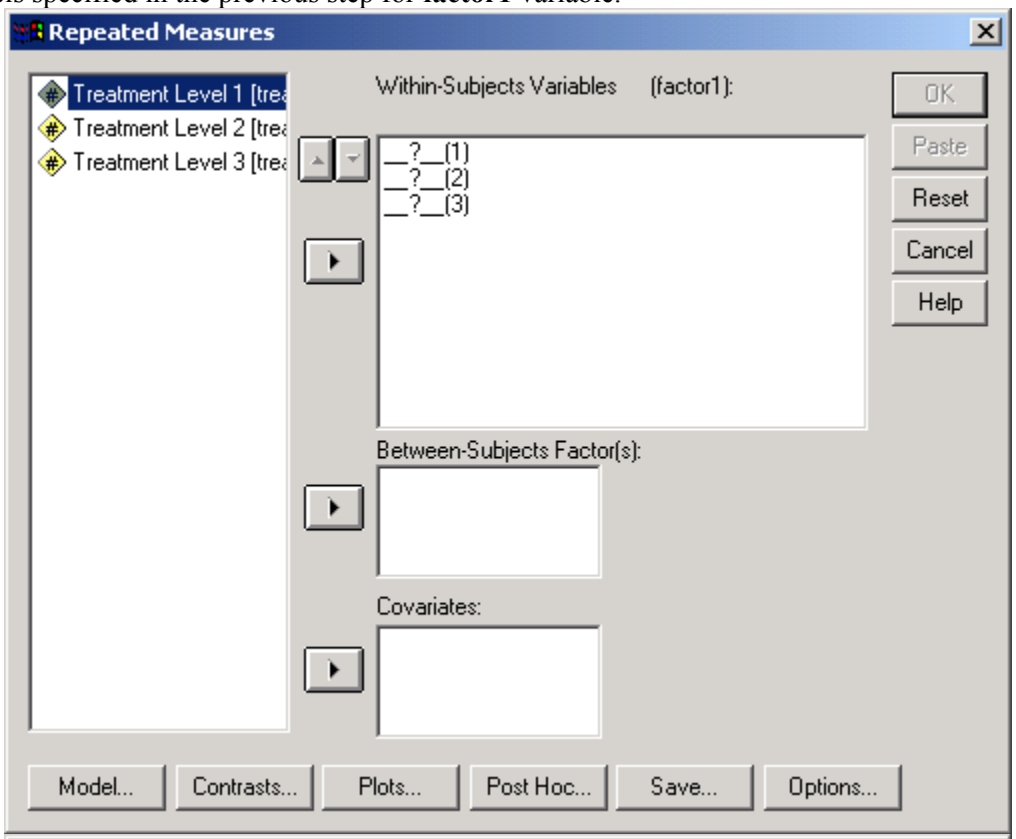
Analyze / General Linear Model / Repeated Measures …

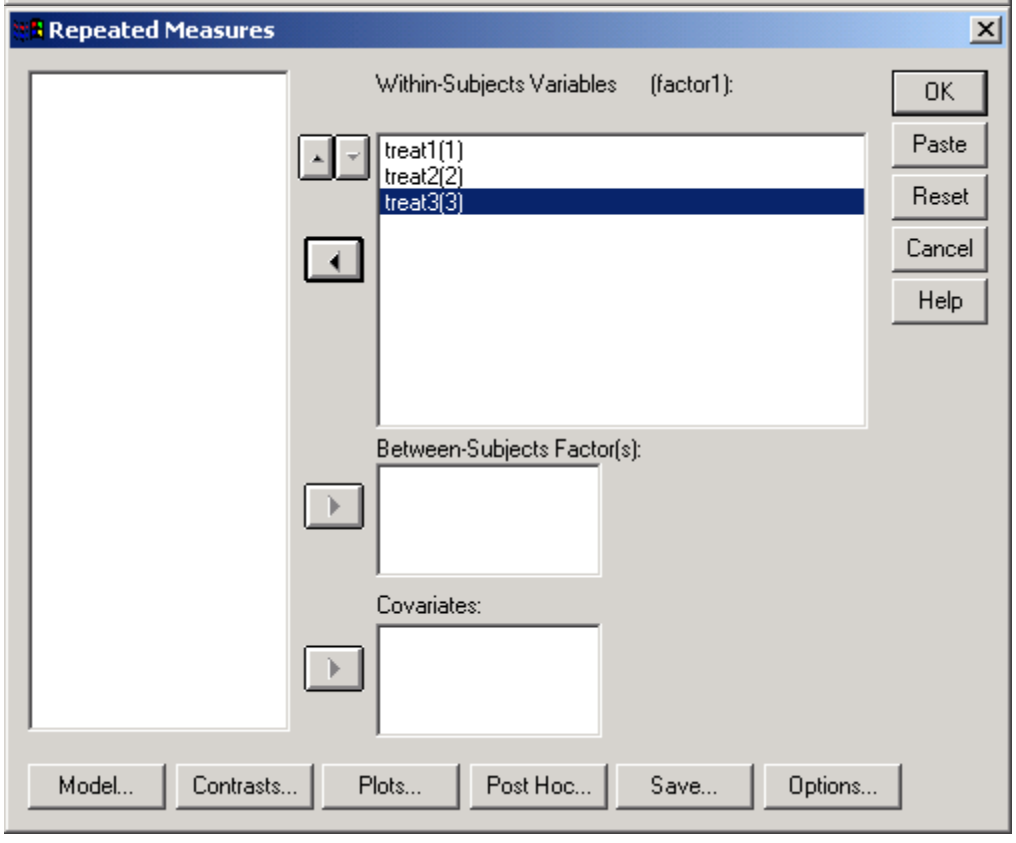


3) Enter **the number of treatment levels** (it would be 3 in this case for three treatment levels) and name the **within subject factor** (treatment factor variable, it is factor1 by default and it can be named differently) and click **Add** and click **Define**.

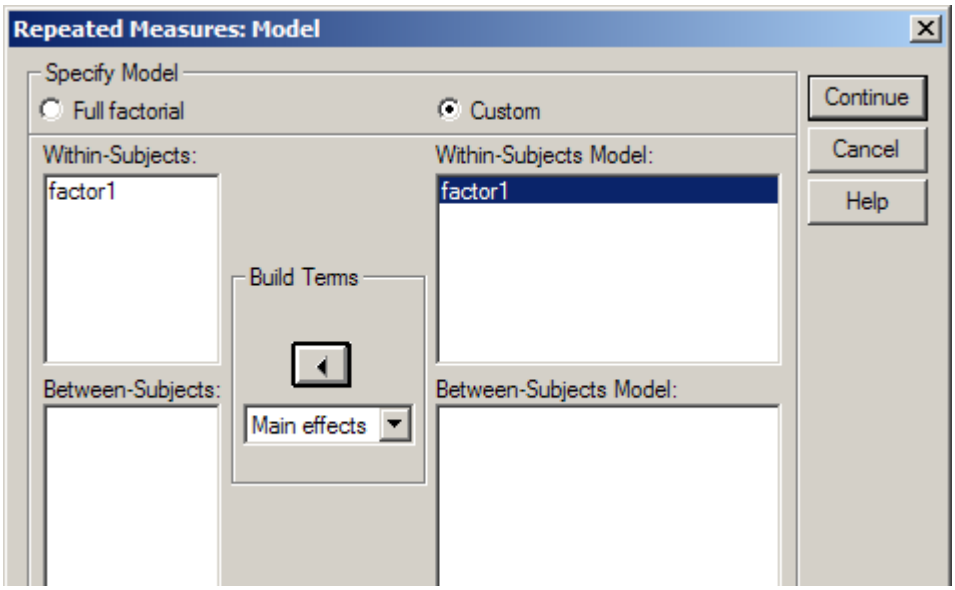


4) Since this is a one factor repeated measures ANOVA, and the factor is the Within-Subjects Factor, so the variables to be used are variables in the data sheet that represent different levels of the treatment factor. They need to be put into the Within-Subjects Factor box for the 3 factor levels specified in the previous step for **factor1** variable.

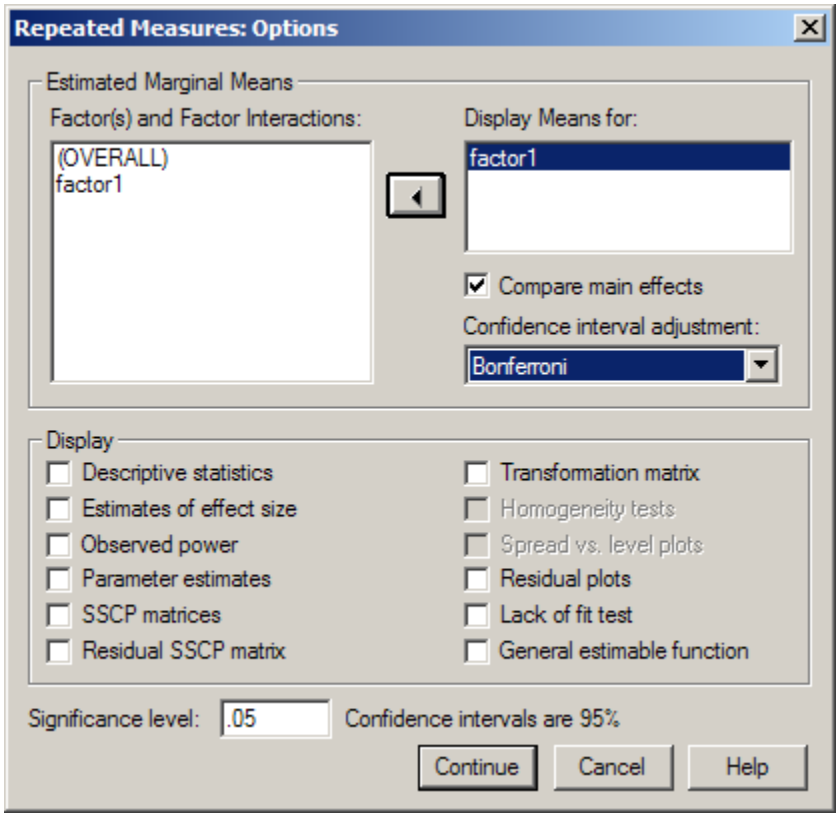




5) Click the **Model** button for specifying the model for analysis. Check the **Custom** bullet, click on Build Terms drop down menu and select **Main effects** option. Then, select **factor1** variable to put it in **Within-Subjects Model:** box and click **Continue**. This determines that the model to be used for the analysis will be one factor repeated measures model with only one treatment factor main effect.



6) Click the **Options** button in the Repeated Measures dialog box, and select factor1 (the treatment variable) into **Display Means for: box**, and check **Compare main effects** box and select the multiple comparison method listed in the **Confidence interval adjustment: box** for multiple comparisons and click **Continue** and click **OK** in Repeated Measures dialog box.



SPSS Output

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
FACTOR1	Pillai's Trace	.994	163.698[a]	2.000	2.000	.006
	Wilks' Lambda	.006	163.698[a]	2.000	2.000	.006
	Hotelling's Trace	163.698	163.698[a]	2.000	2.000	.006
	Roy's Largest Root	163.698	163.698[a]	2.000	2.000	.006

a. Exact statistic

b.
Design: Intercept
Within Subjects Design: FACTOR1

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
FACTOR1	.451	1.594	2	.448	.645	.925	.500

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
Within Subjects Design: FACTOR1

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
FACTOR1	Sphericity Assumed	524177.167	2	262088.583	258.237	.000
	Greenhouse-Geisser	524177.167	1.291	406060.882	258.237	.000
	Huynh-Feldt	524177.167	1.851	283189.736	258.237	.000
	Lower-bound	524177.167	1.000	524177.167	258.237	.001
Error(FACTOR1)	Sphericity Assumed	6089.500	6	1014.917		
	Greenhouse-Geisser	6089.500	3.873	1572.438		
	Huynh-Feldt	6089.500	5.553	1096.629		
	Lower-bound	6089.500	3.000	2029.833		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	24021040.3	1	24021040.33	415.553	.000
Error	173415.000	3	57805.000		

Pairwise Comparisons

Measure: MEASURE_1

(I) FACTOR1	(J) FACTOR1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-237.250*	23.211	.006	-349.976	-124.524
	3	-511.500*	28.573	.001	-650.269	-372.731
2	1	237.250*	23.211	.006	124.524	349.976
	3	-274.250*	12.932	.001	-337.055	-211.445
3	1	511.500*	28.573	.001	372.731	650.269
	2	274.250*	12.932	.001	211.445	337.055

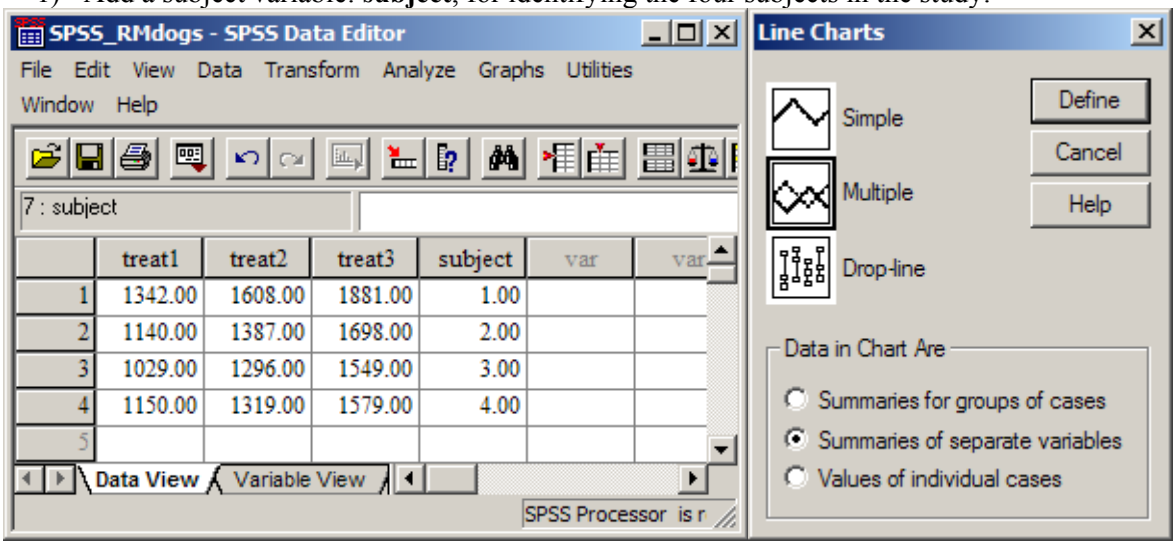
Based on estimated marginal means

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

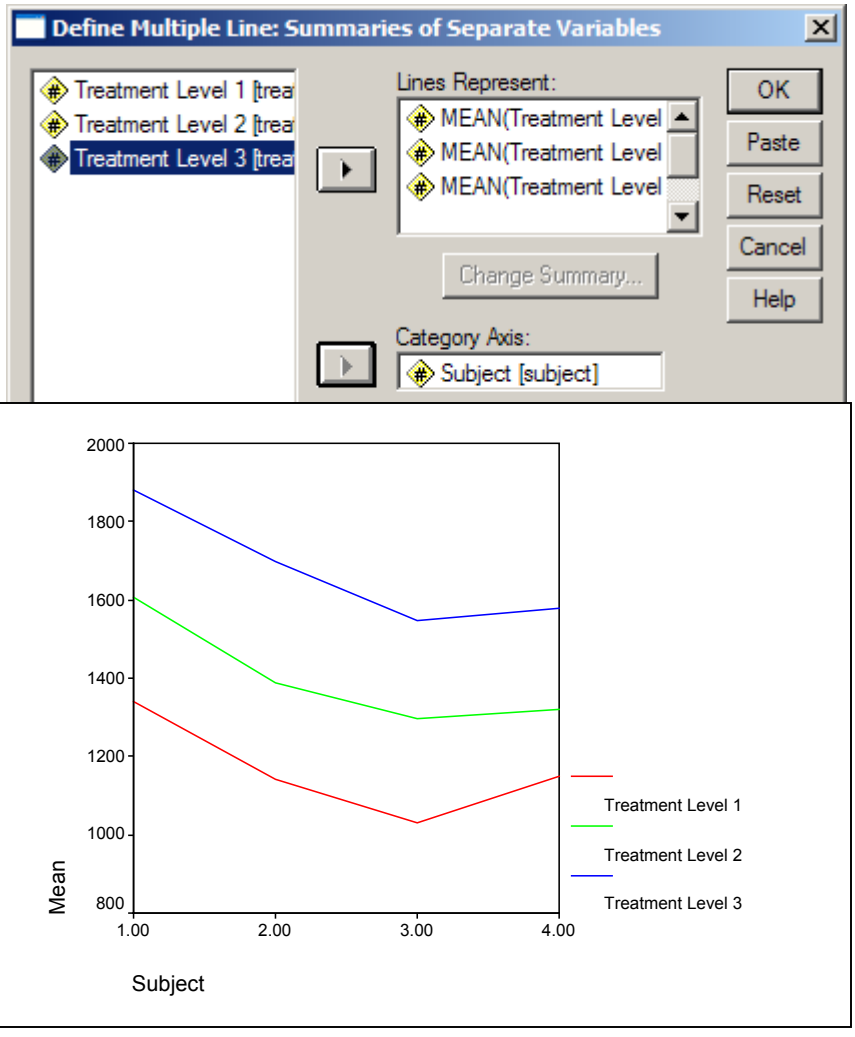
a. Adjustment for multiple comparisons: Bonferroni.

To Make Profile Line Chart

1) Add a subject variable: **subject**, for identifying the four subjects in the study.

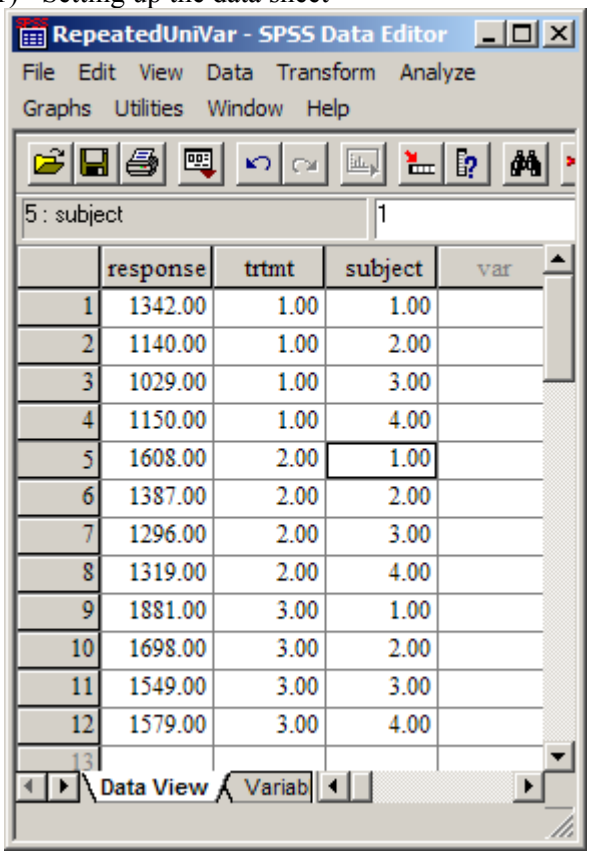


2) Click on **Graphs** option on SPSS menu bar and select **Line …** option. In the Line Charts dialog box click on **Multiple** and also click on **Summaries of separate variables** bullet, and then click **Define** button. Select all the treatment variables in **Line Represent:** box and put Subject variable in **Category Axis:** box and click **OK**.



One Factor Repeated Measure ANOVA (Univariate Mixed Effect Model Approach)
(Treatment as the Fixed Effect and the Subject as the Random Effect)
(This univariate approach can be used for randomized block design analysis.)

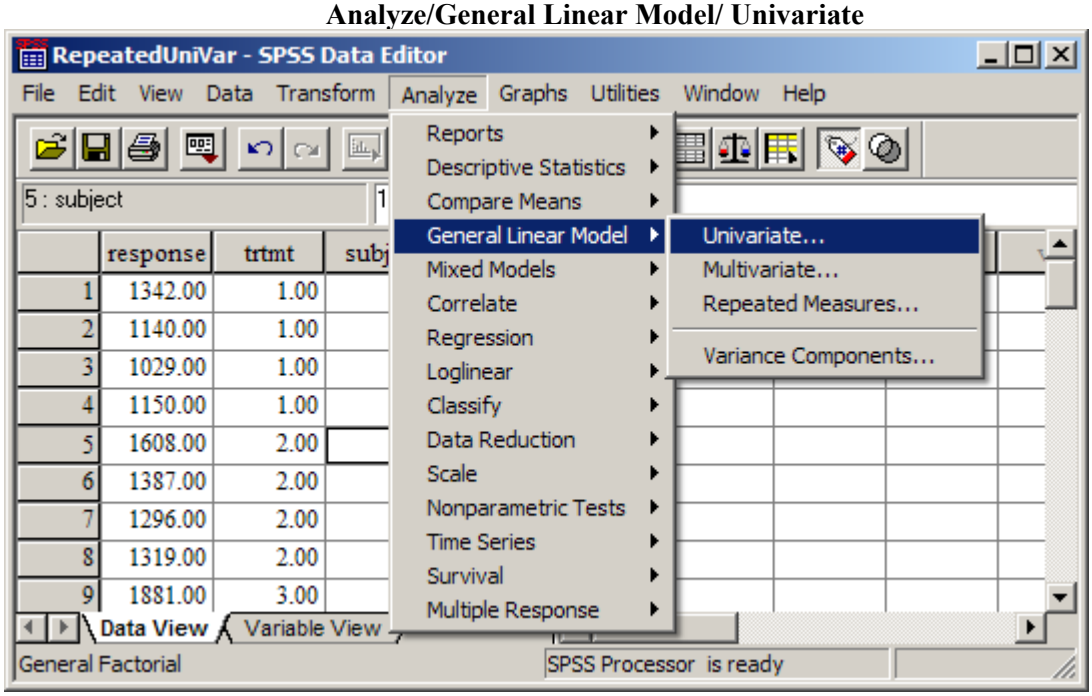
1) Setting up the data sheet



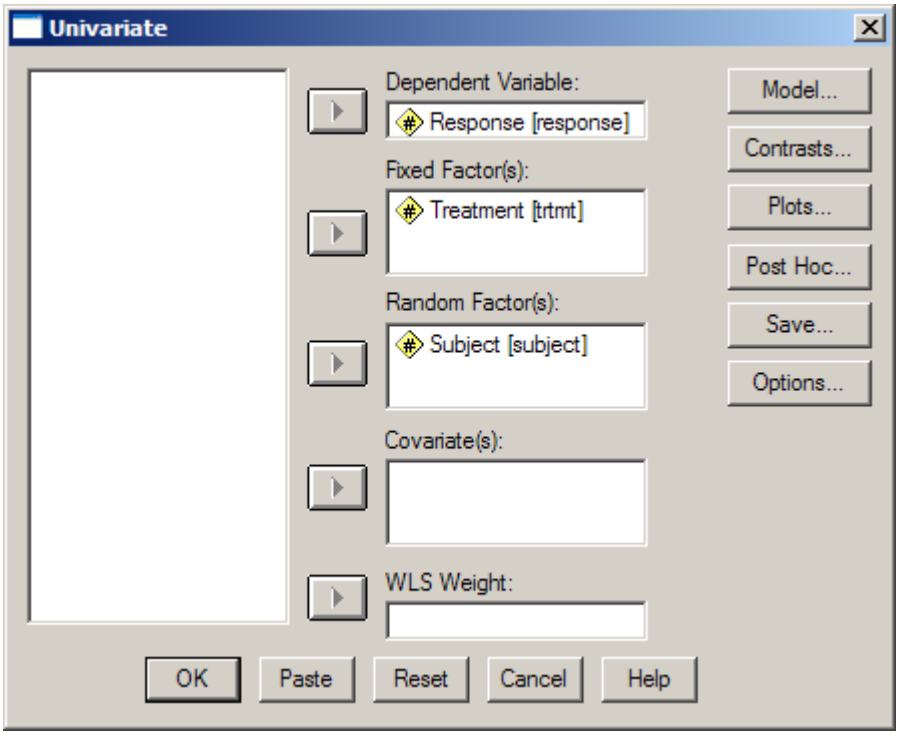
Set up of the data is similar to the Randomized Block Design situation.

2) To run repeated measure analysis with univariate approach, click through the following sequence of SPSS options.

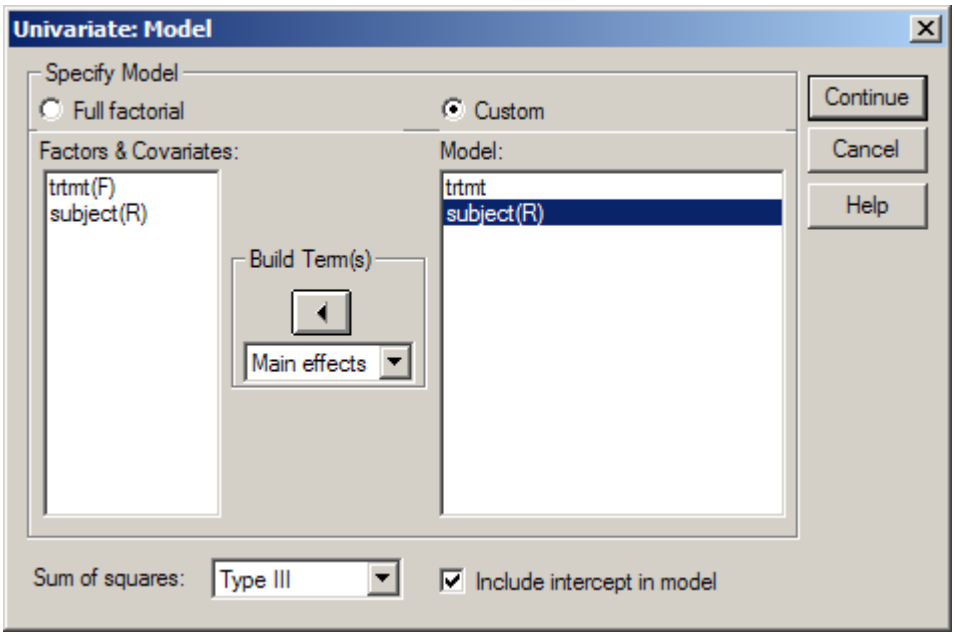
Analyze/General Linear Model/ Univariate



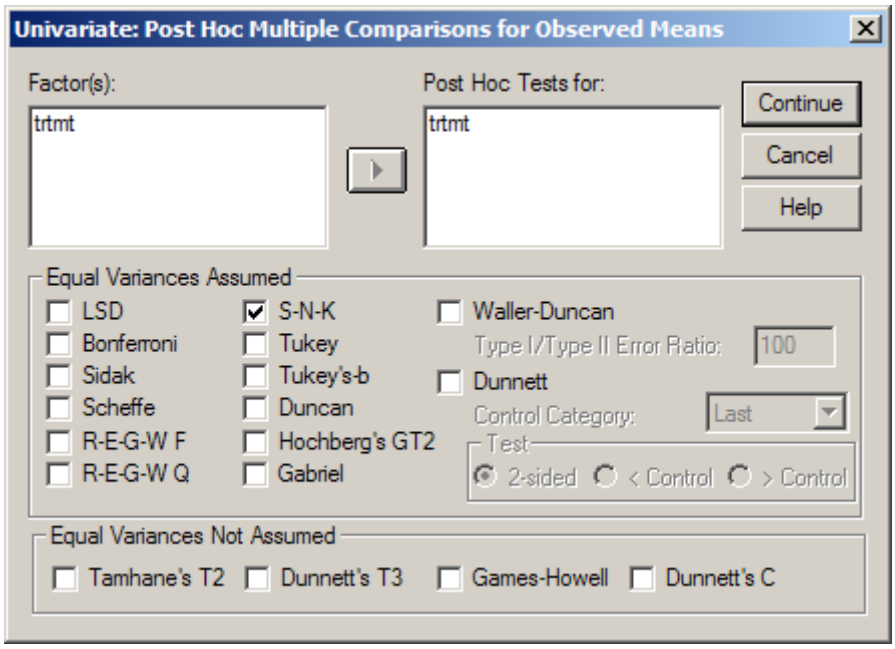
3) In the Univariate dialog box, put the response variable in the Dependent Variable box, put the Treatment variable in the Fixed Factor box, and put the Subject variable in the Random Factor box.



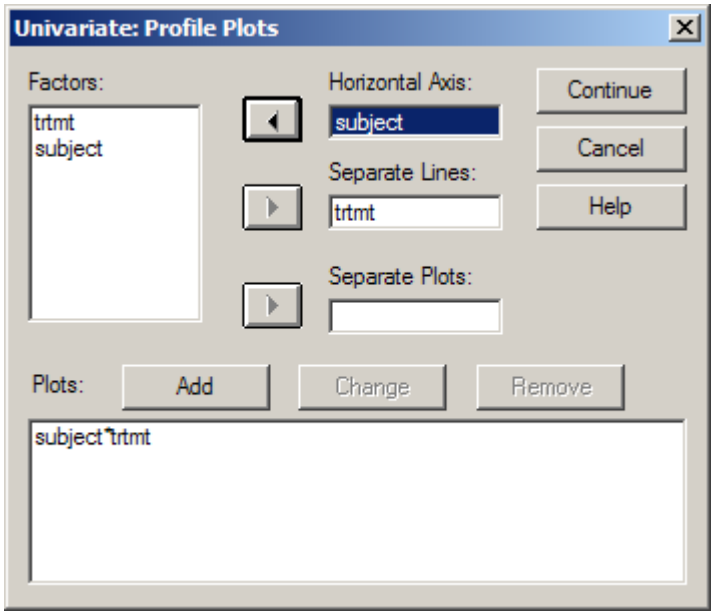
4) Click on Model button in the Univariate dialog box, and first click on the drop-sown menu below Build Term(s) title and select **Main effects** option, and then use the selection button to select and select trtmt (Treatment) and subject variables as Main effects, and click **Continue**.



5) **For performing Post Hoc analysis:** First, click Post Hoc button in the Univariate dialog box and the following dialog will appear. Select the trtmt variable in Post Hoc Tests for: box and check S-N-K box and then click Continue button.



6) **For making a profile chart**, in Univariate dialog box, click on Plot button. Put subject variable in Horizontal Axis and put trtmt variable in Separate Lines. SPSS will draw profile line chart. Each line in the chart will represent outcome from each of the treatment group. Click Add to add the chart to the list to be plotted, and click on Continue button.



7) After all the options have been selected, click OK in the Univariate dialog box to execute the analysis.

Output for Using Univariate Approach with Treatment as the Fixed Effect and the Subject as the Random Effect

Tests of Between-Subjects Effects

Dependent Variable: Response

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	24021040.33	1	24021040.33	415.553	.000
	Error	173415.000	3	57805.000[a]		
TRTMT	Hypothesis	524177.167	2	262088.583	258.237	.000
	Error	6089.500	6	1014.917[b]		
SUBJECT	Hypothesis	173415.000	3	57805.000	56.955	.000
	Error	6089.500	6	1014.917[b]		

a. MS(SUBJECT)

b. MS(Error)

Response

Student-Newman-Keuls[a,b]

Treatment	N	Subset 1	Subset 2	Subset 3
1.00	4	1165.2500		
2.00	4		1402.5000	
3.00	4			1676.7500
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1014.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.