SPSS Chapter 14 Example 1 – One-Way Analysis of Variance

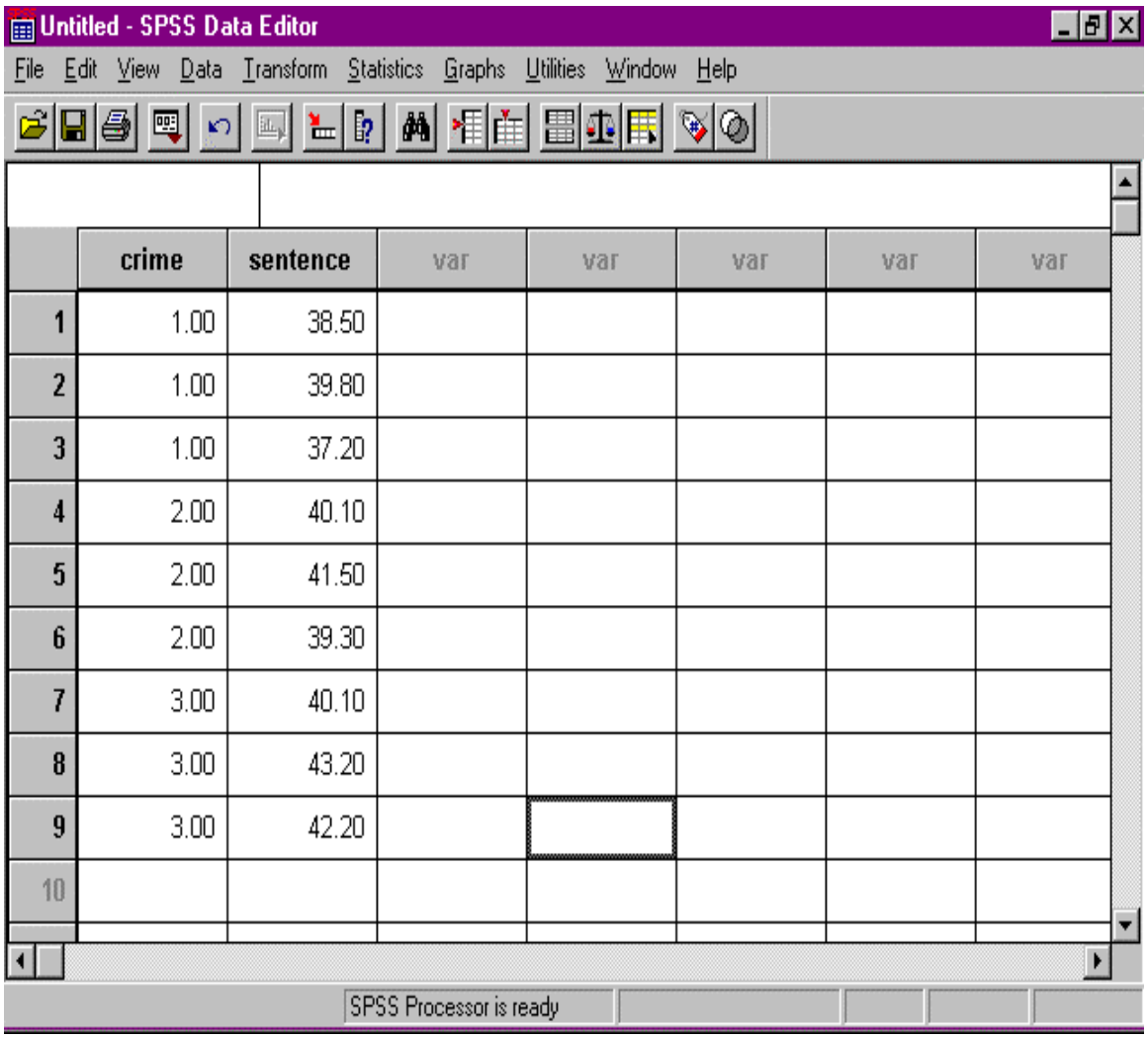
Gebotys and Roberts, *Canadian journal Behavioural Science* (1987) 19, p 479, examined the public's attitude towards sentencing by giving each subject a short story describing a crime and then asking the subject to sentence the offender. The data below are based on this study. There are three treatment/crime conditions: break and enter (A_1), robbery (A_2), and manslaughter (A_3). Three subjects are randomly assigned to each treatment for a total of 9 subjects and a sentence, in months, is recorded.

We are interested in comparing the sentences of the three crime conditions. We are testing:

H_o: $\mu_B = \mu_R = \mu_M$ (all of the means are equal)

H_a: $\mu_B \neq \mu_R \neq \mu_M$ (at least one of the means is different from the rest)

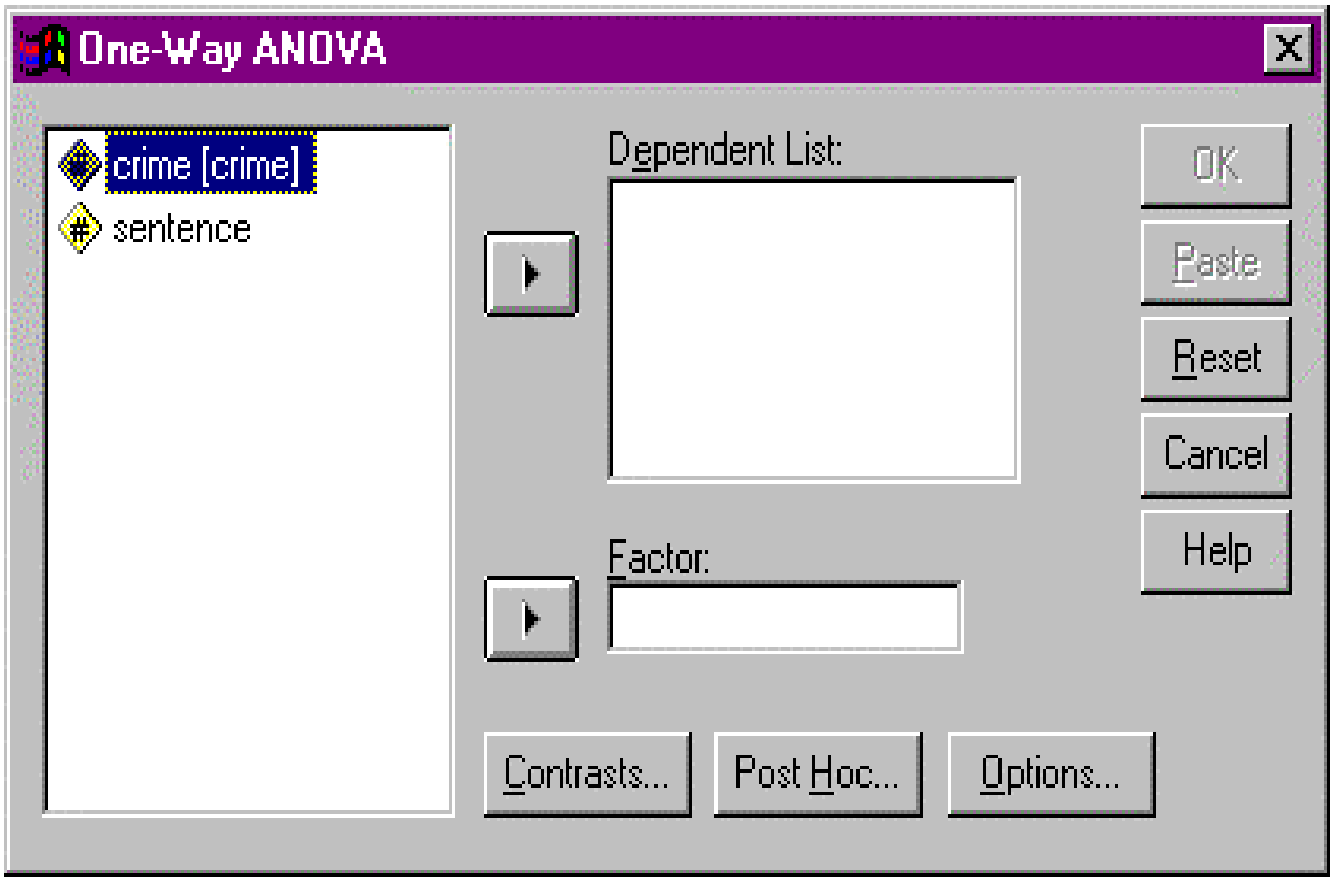
After opening the file, the data appear in the SPSS Data Editor window just like the following (please note that for the variable entitled Crime, break and enter = 1, robbery = 2, and manslaughter = 3):



	crime	sentence	var	var	var	var	var
1	1.00	38.50					
2	1.00	39.80					
3	1.00	37.20					
4	2.00	40.10					
5	2.00	41.50					
6	2.00	39.30					
7	3.00	40.10					
8	3.00	43.20					
9	3.00	42.20					
10							

Follow these steps to perform a One-Way ANOVA:

1. Click **Analyze**, click **Compare Means**, and click **One-Way ANOVA**. The following window will appear.

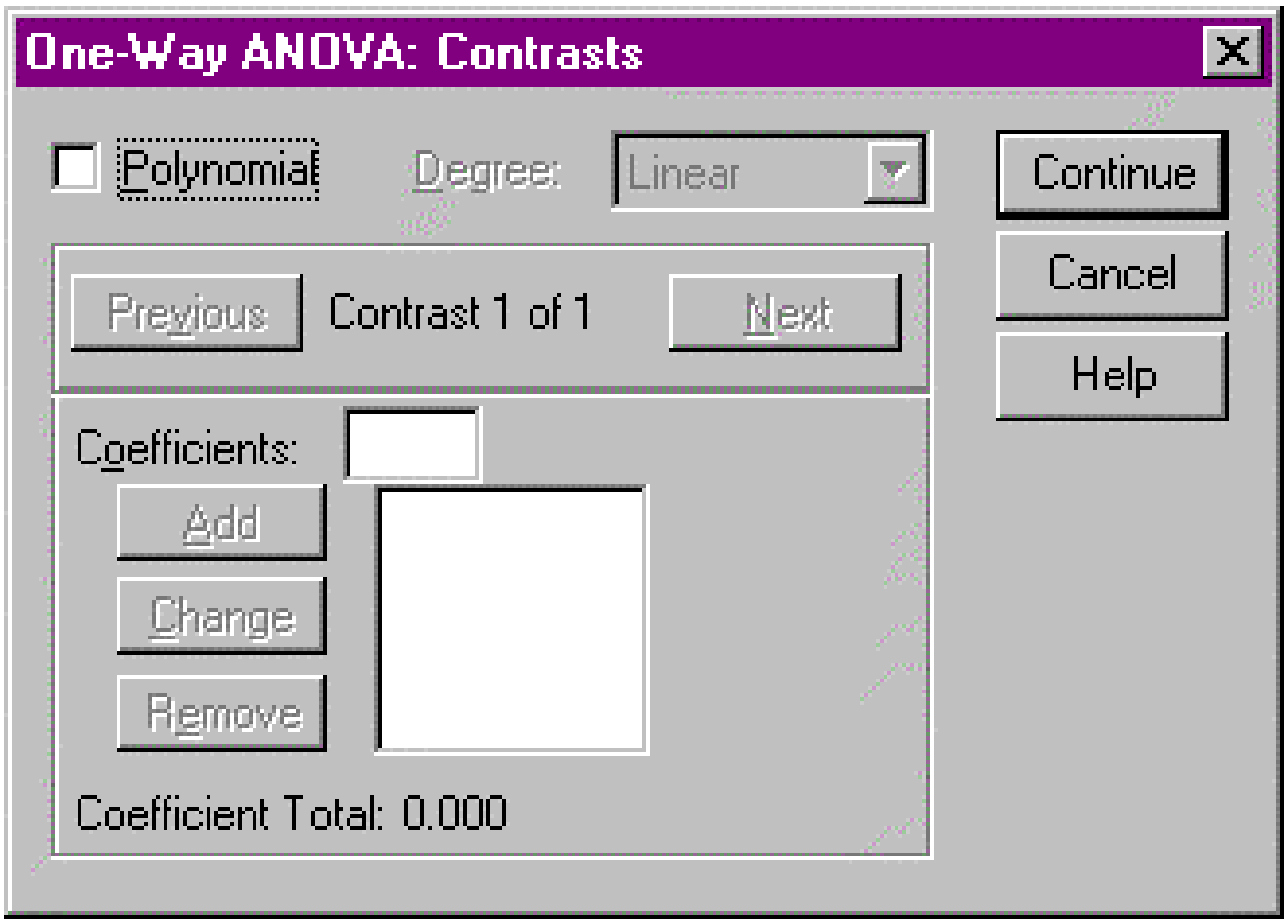


2. Click **"sentence"** and click the arrow to move **"sentence"** into the box entitled **Dependent List**.

3. Click **"crime"** and click the arrow to move **"crime"** into the box entitled **Factor**.

4. To obtain a graph of the means click **Options**, **Means Plot**, and **Continue**.

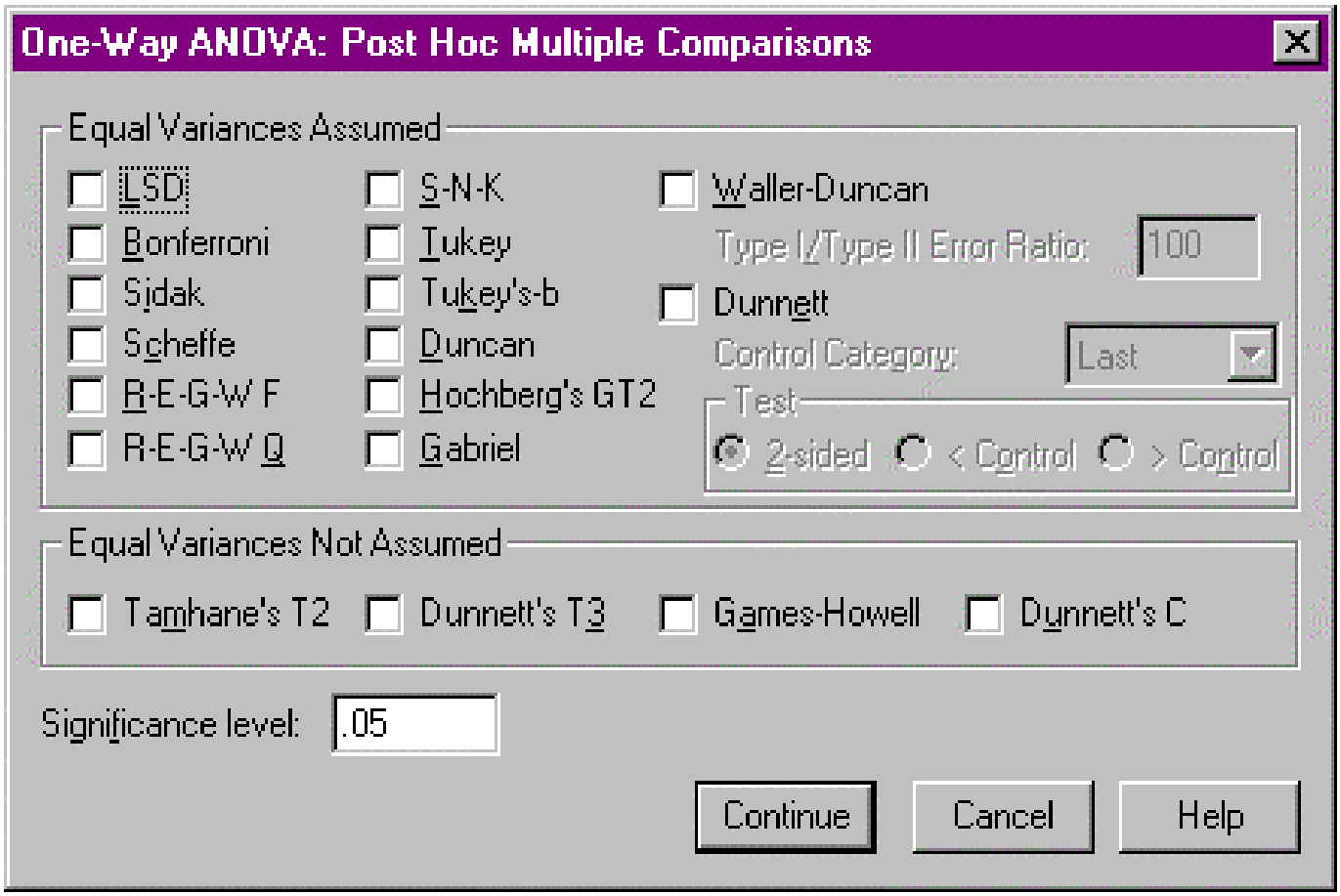
5. To calculate contrasts, click the button entitled **Contrasts** and the following window will appear.



6. A reading of the literature indicates that there may be a difference between the mean sentence of A_2 and the mean sentence of A_3 and then if the difference doesn't exist, it seems reasonable to test for a difference between the mean of A_1 and the common value (average value) for A_2 and A_3. So we are interested in two contrasts: robbery vs. manslaughter (0, 1, -1) as well as break and enter vs. robbery and manslaughter (-2, 1, 1). The coefficients of each contrast are entered separately in the box entitled **Coefficients**. After the first coefficient is entered (i.e., 0) click **Add**. Enter the remaining coefficients of the first contrast (i.e., 1 and –1) in the same manner. Click **Next** to enter the second contrast.

7. Repeat step 5 for the second contrast, then click **Continue**.

8. To calculate post hoc multiple comparisons, click the button entitled **Post Hoc** and the following window will appear.

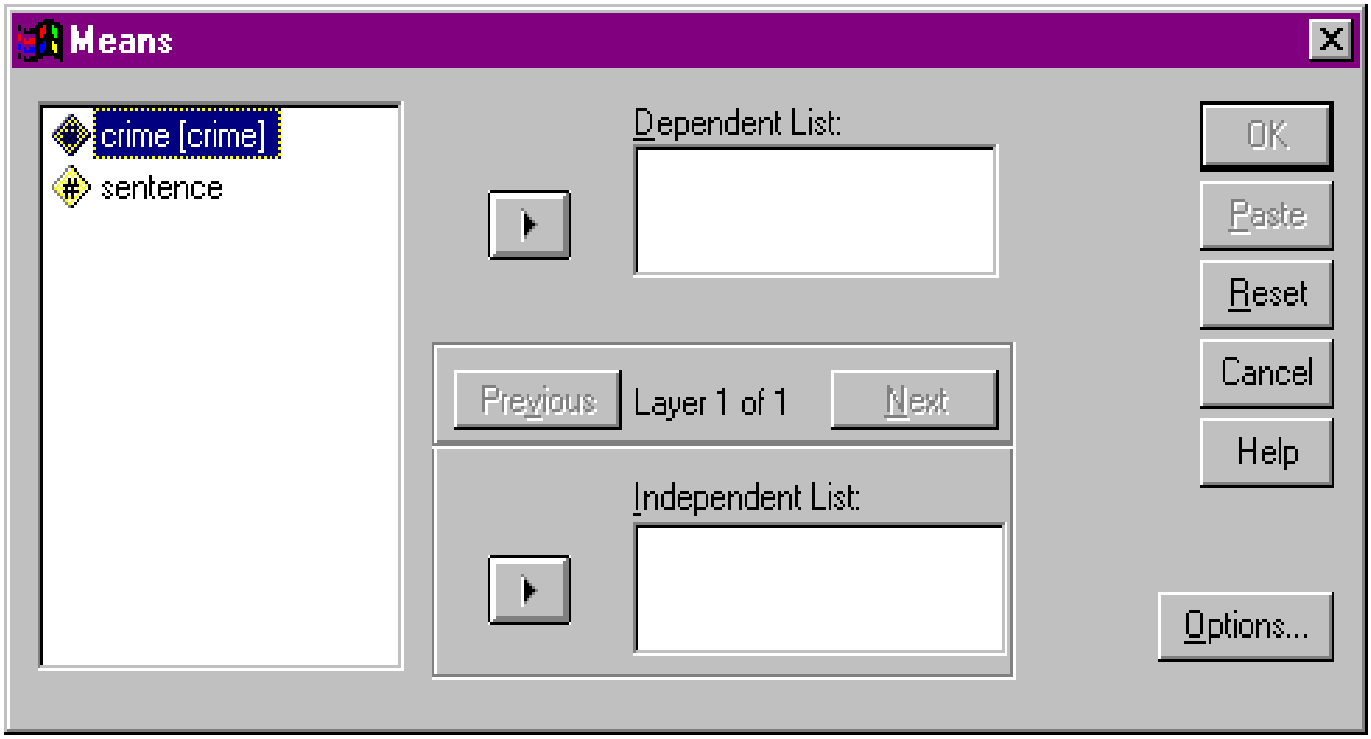


9. Click **LSD** and **Bonferroni** so that a checkmark appears in the boxes before those multiple comparisons. Click **Continue**.

10. Click **OK**.

11. To obtain descriptive statistics:

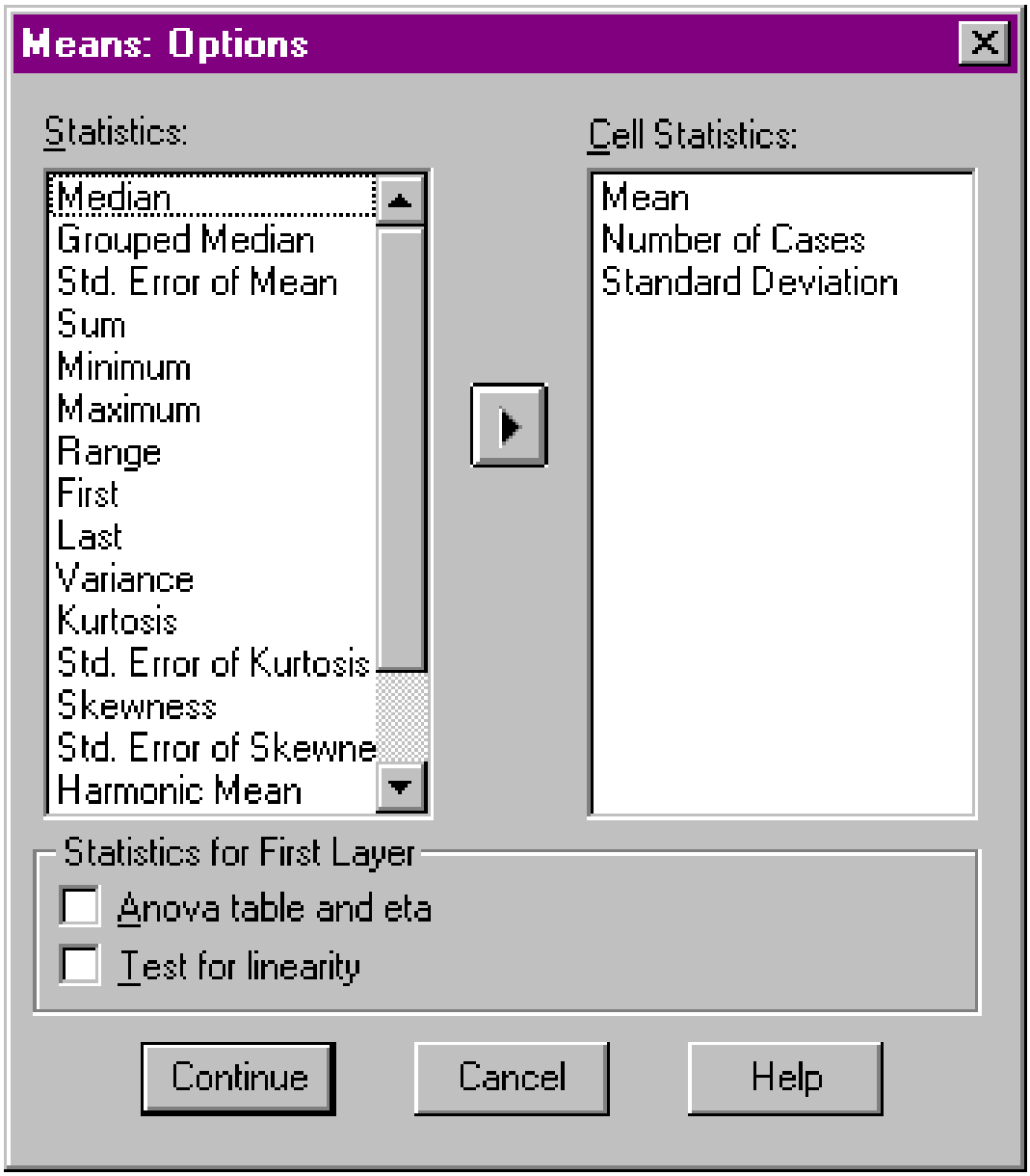
    1. Click **Analyze**, **Compare Means**, and **Means**. The following window will appear.



    2. Click **"sentence"** and click the arrow to move **"sentence"** into the box entitled **Dependent List**.

    3. Click **"crime"** and click the arrow to move **"crime"** into the box entitled **Independent List**.

4. Click **Options**. The following window will appear.



5. Choose **Mean**, **Standard Deviation**, **Number of Cases**, etc.. Click **Continue**.

12. Click **OK**.

The SPSS output for this example of the One-Way ANOVA is the following:

ANOVA

SENTENCE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	16.702	2	8.351	4.611	.061
Within Groups	10.867	6	1.811		
Total	27.569	8			

The F statistic is 4.6 with 2 and 6 degrees of freedom. The p value is marginally significant at p = .06. Thus there are differences between the means, however the differences are not significant at the p = .05 level. We do not know where the means differ (see H_a). If the researchers have pre-planned the comparisons they wish to make (a priori contrasts) and they are orthogonal, then orthogonal contrasts can be used to test the comparisons. This can be done even if the ANOVA (as in this example) is non-significant. The contrasts are given below. Check to see if they are orthogonal.

Contrast Coefficients

	crime		
Contrast	break&enter	robbery	manslaughter
1	0	1	-1
2	-2	1	1

If we look in the Sig. column of the Contrast Tests table it is clear that contrast 2 is significant; there is a significant difference between mean sentencing of break and enter vs. robbery and manslaughter crimes. We usually assume that variances are equal and check this assumption using tests and graphical displays.

Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
SENTENCE	Assume equal variances	1	-1.5333	1.0988	-1.395	6	.212
		2	5.1333	1.9032	2.697	6	.036
	Does not assume equal variances	1	-1.5333	1.1170	-1.373	3.591	.249
		2	5.1333	1.8711	2.743	4.124	.050

The results of the LSD and Bonferonni methods are given below. Note these are not preplanned comparisons. These types of pairwise comparisons are usually used in exploratory studies and require the ANOVA F test to be significant.

Multiple Comparisons

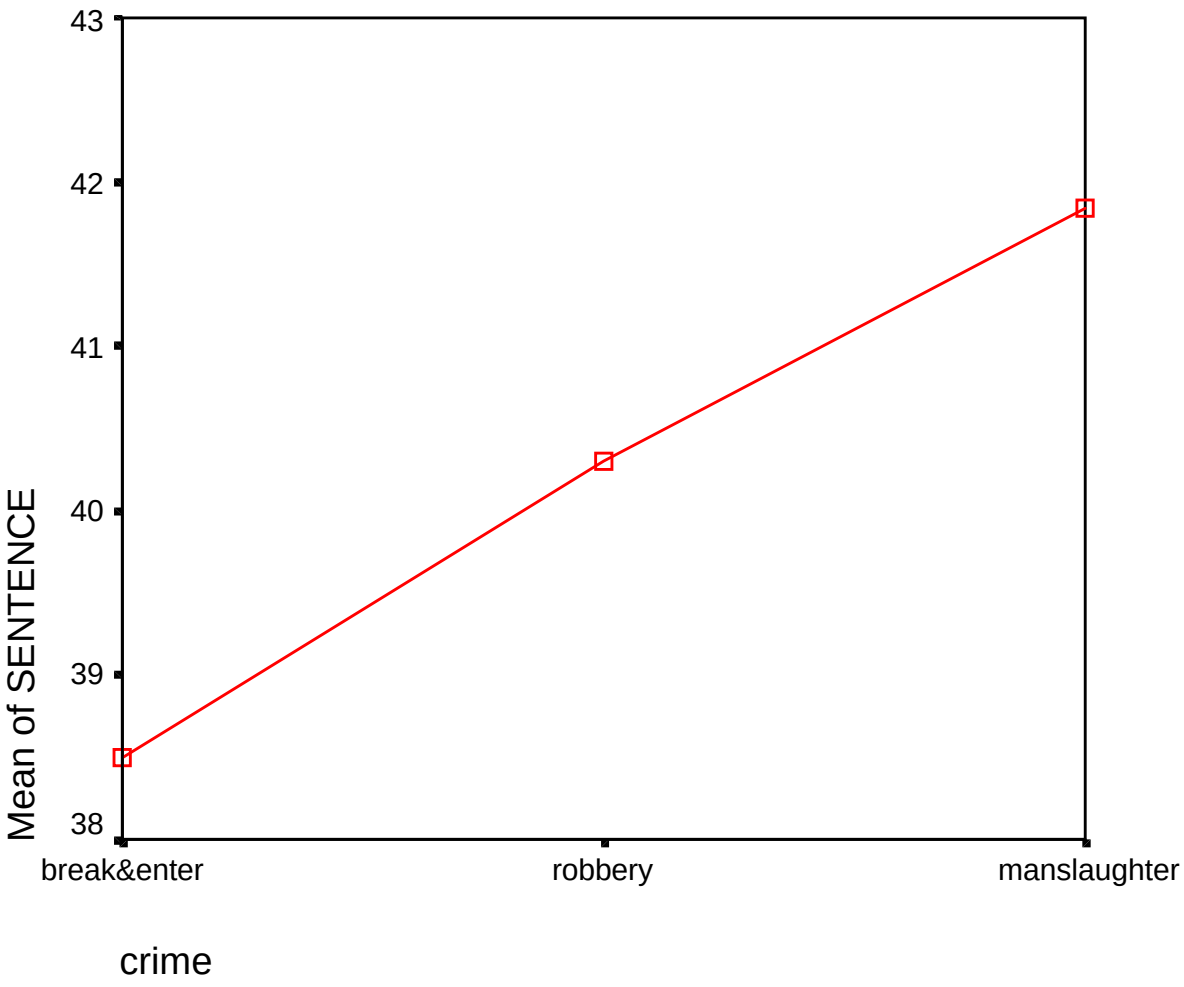
Dependent Variable: SENTENCE

			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
	(I) crime	(J) crime				Lower Bound	Upper Bound
LSD	break&enter	robbery	-1.8000	1.099	.153	-4.4887	.8887
		manslaughter	-3.3333*	1.099	.023	-6.0221	-.6446
	robbery	break&enter	1.8000	1.099	.153	-.8887	4.4887
		manslaughter	-1.5333	1.099	.212	-4.2221	1.1554
	manslaughter	break&enter	3.3333*	1.099	.023	.6446	6.0221
		robbery	1.5333	1.099	.212	-1.1554	4.2221
Bonferroni	break&enter	robbery	-1.8000	1.099	.458	-5.4123	1.8123
		manslaughter	-3.3333	1.099	.069	-6.9457	.2790
	robbery	break&enter	1.8000	1.099	.458	-1.8123	5.4123
		manslaughter	-1.5333	1.099	.637	-5.1457	2.0790
	manslaughter	break&enter	3.3333	1.099	.069	-.2790	6.9457
		robbery	1.5333	1.099	.637	-2.0790	5.1457

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

The LSD test indicates that the mean for break and enter differs significantly from the mean for manslaughter.

Means Plots



A graph of the means is presented for completeness. Note the means are presented on the next page.

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
SENTENCE * crim	9	100.0%	0	.0%	9	100.0%

Report

SENTENCE

crime	Mean	N	Std. Deviation
break&enter	38.5000	3	1.3000
robbery	40.3000	3	1.1136
manslaughter	41.8333	3	1.5822
Total	40.2111	9	1.8564