8. Comparing Means Using One Way ANOVA

Objectives

- ♦Calculate a one-way analysis of variance
- ♦Run various multiple comparisons
- ♦Calculate measures of effect size

A One Way ANOVA is an analysis of variance in which there is only one independent variable. It can be used to compare mean differences in 2 or more groups. In SPSS, you can calculate one-way ANOVAS in two different ways. One way is through Analyze/Compare Means/One-Way ANOVA and the other is through Analyze/General Linear Model/Univariate. We'll try both in this chapter so we can compare them.

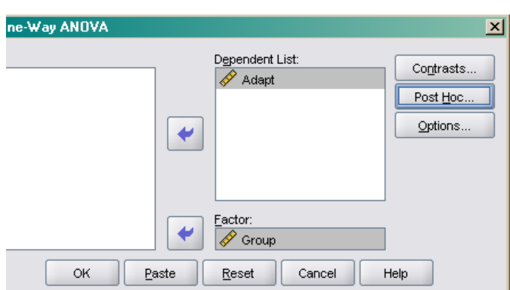
One-Way ANOVA

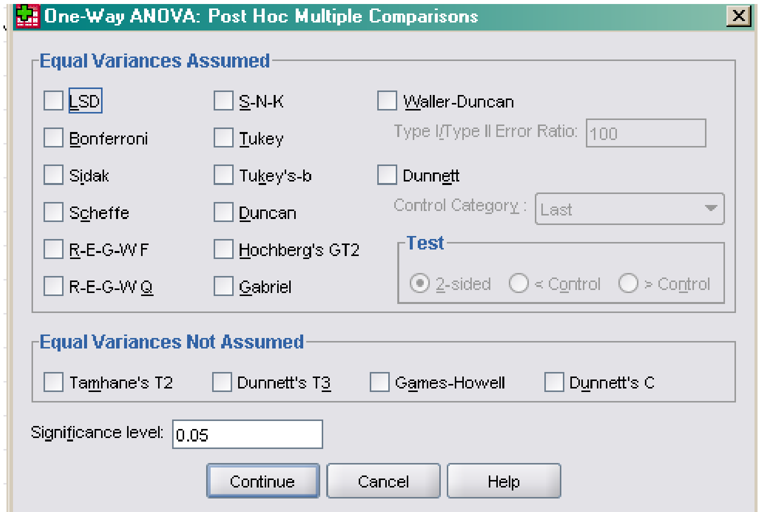
Let's begin with an example in the textbook illustrated in Table 16.6. Maternal role adaptation was compared in a group of mothers of low birth-weight (LBW) infants who had been in an experimental intervention, mothers of LBW infants who were in a control group, and mothers of full-term infants. The hypothesis was that mothers of LBW infants in the experimental intervention would adapt to their maternal role as well as mothers of healthy full-term infants, and each of these groups would adapt better than mothers of LBW infants in the control group.

✔ **Open** *maternal role adaptation.sav*.

✔ Select **Analyze/Compare Means/One-Way ANOVA**.

✔ Select maternal role adaptation for the **Dependent List** since it is the dependent variable. Select group as the **Factor** or independent variable. Then click **Post Hoc** to see various options for calculating multiple comparisons. If the ANOVA is significant, we can use the post hoc tests to determine which specific groups differ significantly from one another.

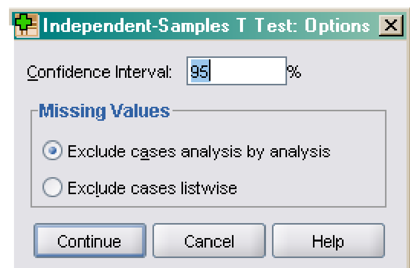




- As you can see, there are many options. Let's select **LSD** under **Equal Variances Assumed** since it is Fisher's Least Significant Difference Test which is calculated in the text, except that SPSS will test the differences even if the overall *F* is not significant.

- Note that .05 is the default under **Significance level**. After consulting with SPSS technical support, it is clear that this is the experiment-wise or family-wise significance level. So any comparison flagged by SPSS as significant is based on a Bonferroni Type Correction. You do not need to adjust the significance level yourself.

- Click **Options**. In the next dialog box, select **Descriptives** under **Statistics**, and select **Means plot** so SPSS will create a graph of the group means for us. The default under **Missing Values** is **Exclude cases analysis by analysis**. Let's leave this as is. Click **Continue** and then **Ok**. The output follows.



Descriptives

Adapt

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
LBW-Exp	29	14.97	4.844	.899	13.12	16.81	10	29
LBW-Control	27	18.33	5.166	.994	16.29	20.38	10	29
Full-Term	37	14.84	3.708	.610	13.60	16.07	10	25
Total	93	15.89	4.747	.492	14.91	16.87	10	29

ANOVA

Adapt

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	226.932	2	113.466	5.532	.005
Within Groups	1845.993	90	20.511		
Total	2072.925	92			

Post Hoc Tests

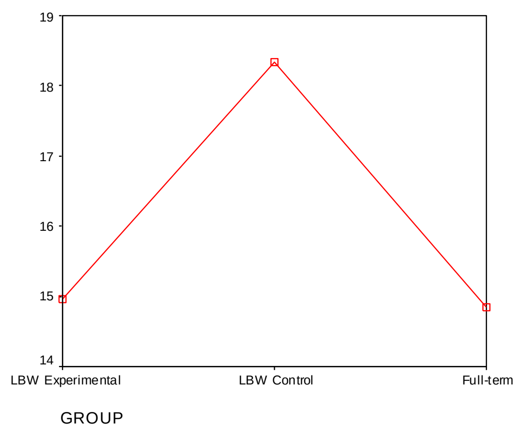
Multiple Comparisons

Adapt
LSD

					95% Confidence Interval	
(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
LBW-Exp	LBW-Control	-3.368*	1.211	.007	-5.77	-.96
	Full-Term	.128	1.123	.910	-2.10	2.36
LBW-Control	LBW-Exp	3.368*	1.211	.007	.96	5.77
	Full-Term	3.495*	1.146	.003	1.22	5.77
Full-Term	LBW-Exp	-.128	1.123	.910	-2.36	2.10
	LBW-Control	-3.495*	1.146	.003	-5.77	-1.22

*. The mean difference is significant at the 0.05 level.

Means Plots



✔ Compare this output to the results presented in the text.

We can see the descriptive statistics and the *F* value are the same. It is harder to compare the post hoc comparisons because SPSS does not display the *t* values. They simply report the mean difference and the significance level. The important thing to note is that the conclusions we can draw based on each of these approaches are the same.

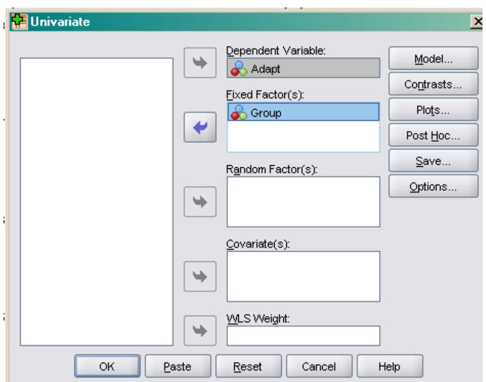
The plot that SPSS created is an effective way to illustrate the mean differences. You may want to edit the graph using what you learned in Chapter 3 to make it more elegant. Some people would prefer a bar chart since these are independent groups and a line suggests they are related. You could create a bar chart of these group means yourself.

Let's re-run the same analysis using the General Linear Model (GLM) and see how they are similar and different.

General Linear Model to Calculate One-Way ANOVAs

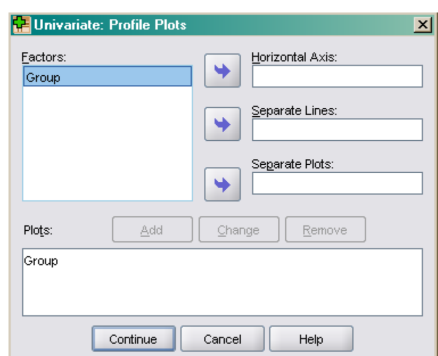
The Univariate General Linear Model is really intended to test models in which there is one dependent variable and multiple independent variables. We can use it to run a simple one-way ANOVA like the one above. One advantage of doing so is that we can estimate effect size from this menu, but we could not from the One-Way ANOVA menus. Let's try it.

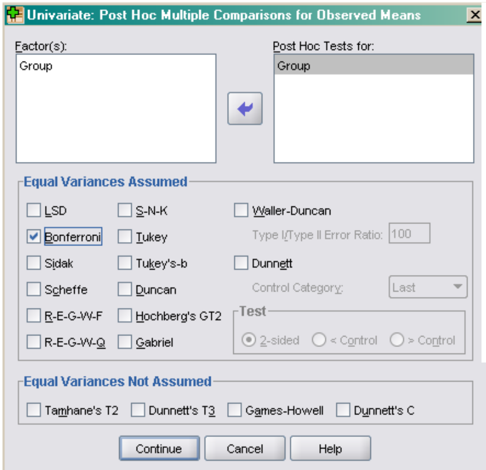
- ✓ Select **Analyze/General Linear Model/Univariate**.



- ✓ As you can see by this dialog box, there are many more options than the One-Way ANOVA. This is because the GLM is a powerful technique that can examine complex designs. We'll just focus on what is relevant to us. As before, select maternal role adaptation as the **Dependent Variable** and group as the **Fixed Factor** or independent variable. Then, click **Plots**.

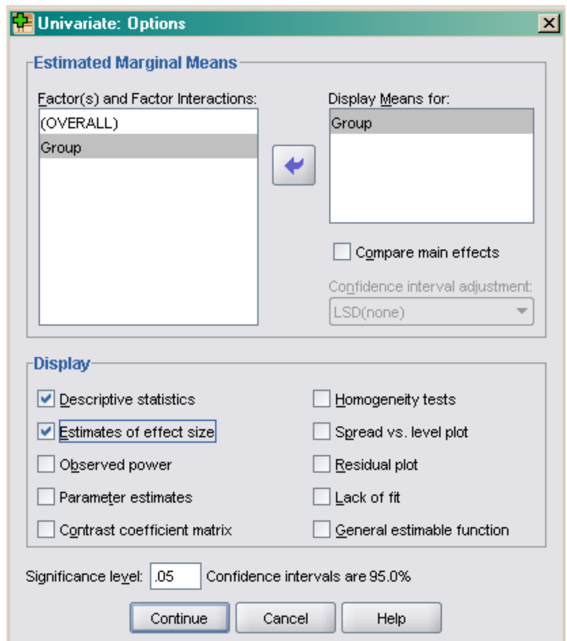
- ✓ Select group for the **Horizontal Axis** (X axis), and click add. Since there is only one dependent variable, SPSS knows that maternal role adaptation is on the Y axis without us needing the specify this. Click **Continue**.





- Since this procedure can be used with multiple independent variables, we need to specify which ones to run post hoc comparisons for even though there is only one in our design. Select group for **Post Hoc Tests for**. This time, let's select **Bonferroni** to see if it makes a difference.

- Under **Display**, select **Descriptive statistics** and **Estimates of effect size**. Then click **Continue**. In the main dialog box, click **Ok**. The output follows.



Between-Subjects Factors

		Value Label	N
Group	1	LBW-Exp	29
	2	LBW-Control	27
	3	Full-Term	37

Descriptive Statistics

Dependent Variable:Adapt

Group	Mean	Std. Deviation	N
LBW-Exp	14.97	4.844	29
LBW-Control	18.33	5.166	27
Full-Term	14.84	3.708	37
Total	15.89	4.747	93

Tests of Between-Subjects Effects

Dependent Variable:Adapt

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	226.932[a]	2	113.466	5.532	.005	.109
Intercept	23513.095	1	23513.095	1146.364	.000	.927
Group	226.932	2	113.466	5.532	.005	.109
Error	1845.993	90	20.511			
Total	25562.000	93				
Corrected Total	2072.925	92				

a. R Squared = .109 (Adjusted R Squared = .090)

Post Hoc Tests

Group

Multiple Comparisons

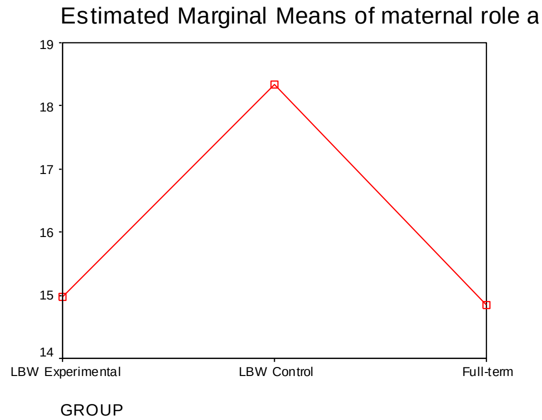
Adapt
Bonferroni

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
LBW-Exp	LBW-Control	-3.37*	1.211	.020	-6.32	-.41
	Full-Term	.13	1.123	1.000	-2.61	2.87
LBW-Control	LBW-Exp	3.37*	1.211	.020	.41	6.32
	Full-Term	3.50*	1.146	.009	.70	6.29
Full-Term	LBW-Exp	-.13	1.123	1.000	-2.87	2.61
	LBW-Control	-3.50*	1.146	.009	-6.29	-.70

Based on observed means.
The error term is Mean Square(Error) = 20.511.

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

Profile Plots



- ✔ Compare this output to the output from the One-Way ANOVA and the results in the textbook.

One difference is the appearance of the ANOVA summary table. Now, there is a row labeled intercept and another labeled adjusted. You can ignore these. The *F* value for Group is still the same, and that is what we are interested in. Notice the eta squared column. What does it say for group? Does this value agree with the text? Unfortunately SPSS does not calculate Omega squared, so you would have to do this by hand. (Unfortunately, it also does not calculate any of the more useful effect size measures, such as d. Did the Bonferroni and the previous LSD multiple comparisons yield the same results?

You could edit any of the tables and graphs to look more elegant. For example, the current title of the graph is cut off. You would probably want to name it something else or use two lines of text. Editing the output would be ideal if you wanted to include your output in a paper. Use what you learned in Chapters 3 and 4 of this Manual to do so.

In this chapter, you learned 3 methods to calculate a One-Way ANOVA. I prefer the General Linear Model approach since this is the only one that gives us the option of calculating multiple comparisons and eta squared. Of course, you may feel otherwise depending on the information you wish to calculate. Complete the following exercises.

Exercises

Each of these exercises is based on *Eysenck recall.sav*. This study is presented in section 16.1 in the textbook.

1. Use ANOVA to compare the means. Select a post hoc procedure of your choice. Summarize the results.

2. Edit the ANOVA summary table so that it is suitable for inclusion in a paper.

3. Use SPSS to calculate eta squared. Note, how did you do this?

4. Create a bar chart to illustrate the differences between groups.