7. Comparing Means Using *t*-tests.

Objectives

♦ Calculate one sample *t*-tests
♦ Calculate paired samples *t*-tests
♦ Calculate independent samples *t*-tests
♦ Graphically represent mean differences

In this chapter, we will learn to compare means using *t*-tests. We will cover information that is presented in the *Fundamentals* textbook in Chapters, 12, 13, and 14 and in the *Methods* book as Chapter 7. One important thing to note is that SPSS uses the term paired sample *t*-test to reflect what the textbook refers to as related samples *t*-tests. They are the same thing.

One Sample *t*-tests

One sample *t*-tests are typically used to compare a sample mean to a known population mean. Let's use the moon illusion example illustrated in the text. We want to know if there was a moon illusion using the apparatus. If there was, the obtained ratio should not equal 1. Let's try this together.

✔ **Open** *moon illusion.sav*.

✔ Select **Analyze/Compare Means/One-Sample *t*-test**.

✔ Select illusion as the **Test Variable**. Type 1 in as the **Test Value**. We are testing the null hypothesis that the sample mean = 1. Then, click **Options**.

✔ Notice, SPSS allows us to specify what **Confidence Interval** to calculate. Leave it at 95%. Click **Continue** and then **Ok**. The output follows.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
ELEVATE	10	1.46	.34	.11

One-Sample Test

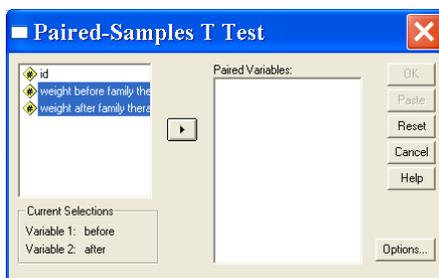|	Test Value = 1					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
ELEVATE	4.298	9	.002	.46	.22	.71

✔ Notice that descriptive statistics are automatically calculated in the one-sample *t*-test. Does our *t*-value agree with the one in the textbook? Look at the **Confidence Interval.** Notice that it is not the confidence interval of the mean, but the confidence interval for the difference between the sample mean and the test value we specified, in this case 1.

Now, let's move on to related or paired samples *t*-tests.

Paired Samples *t*-tests

A paired samples *t*-test is used to compare two related means. It tests the null hypothesis that the difference between two related means is 0. Let's begin with the example of weight gain as a function of family therapy in the text. We want to see if the difference in weight before and after a family therapy intervention is significantly different from 0.

✔ **Open** *anorexia family therapy.sav*. You don't need to save *moon illusion.sav* since we didn't change the data file.

✔ Select **Analyze/Compare Means/Paired Samples *t*-test**.

✔ Select weight before and weight after family therapy and click them into the **Paired Variables** box using the arrow. Then click **Options**. Notice you can select the confidence interval you want again. Leave it at 95%, click **Continue**, and then click **Ok**. The output follows.

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	weight before family therapy	83.2294	17	5.0167	1.2167
	weight after family therapy	90.4941	17	8.4751	2.0555

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	weight before family therapy & weight after family therapy	17	.538	.026

Paired Samples Test

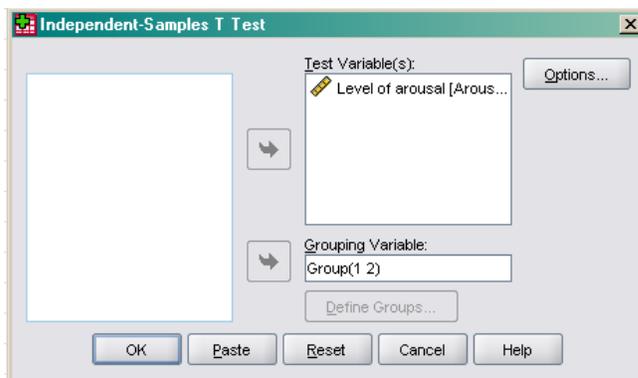|		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	weight before family therapy - weight after family therapy	-7.2647	7.1574	1.7359	-10.9447	-3.5847	-4.185	16	.001

✔ Notice, the descriptives were automatically calculated again. Compare this output to the results in the text. Are they in agreement? The mean difference is negative here because weight after the treatment was subtracted from weight before the treatment. So the mean difference really shows that subjects tended to weigh more after the treatment. If you get confused by the sign of the difference, just look at the mean values for the before and after weights. Notice that this time the confidence interval is consistent with what we would expect. It suggests we can be 95% confident that the actual weight gain of the population of anorexics receiving family therapy is within the calculated limits.

✔ If you want to see the mean difference graphically, try to make a bar graph using what you learned in Chapter 3. [Hint: Select **Graphs/Legacy/Bar**, then select **Simple** and **Summaries of separate variables**. Select weight before and weight after family therapy for **Bars Represent**. Use mean as the **Summary** score. Click **Ok**. Edit your graph to suit your style.] Mine appears below.
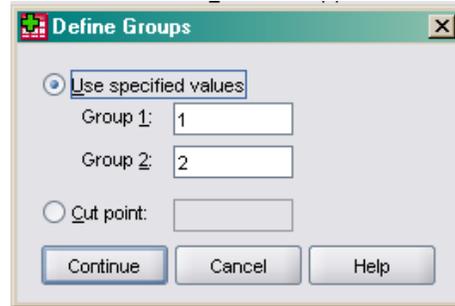
Independent Samples *t*-test

An independent samples *t*-test is used to compare means from independent groups. Let's try one together using the horn honking example in the text. We will test the hypothesis that people from the Adams et al. (1996) study that homophobic subjects are more aroused by homosexual videos.

✔ **Open** *Homophobia.sav*. You don't need to save *anorexia family therapy.sav* since we did not change the data file.

✔ Select **Analyze/Compare Means/Independent Samples *t*-test**.

✔ Select latency as the **Test Variable** and group as the **Grouping Variable**. Then, click **Define Groups**.

✔ Type 1 for **Group 1** and 2 for **Group 2,** to indicate what groups are being compared. Then, click **Continue**. The **Options** are the same as the other kinds of t-tests. Look at them if you would like. Then, click **Ok**. The

Define Groups

⊙ Use specified values

Group 1: `1`

Group 2: `2`

○ Cut point:

[Continue] [Cancel] [Help]

Group Statistics

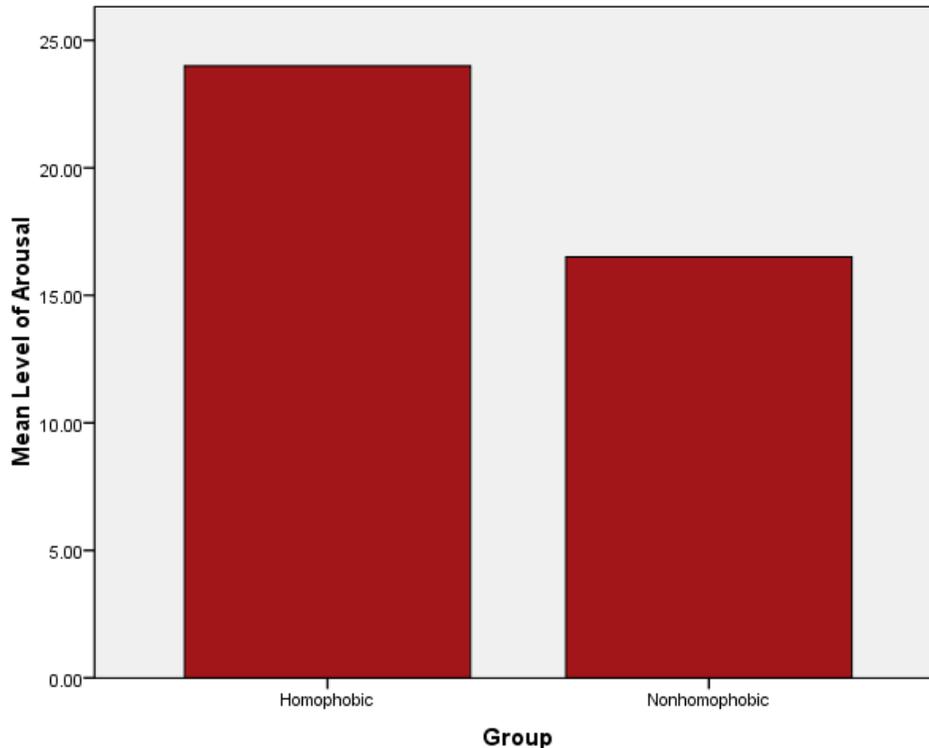| Group		N	Mean	Std. Deviation	Std. Error Mean
Level of arousal	Homophobic	35	24.0000	12.20125	2.06239
	Nonhomophobic	29	16.5034	11.79656	2.19057

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Level of arousal	Equal variances assumed	.391	.534	2.484	62	.016	7.49655	3.01834	1.46298	13.53012
	Equal variances not assumed			2.492	60.495	.015	7.49655	3.00866	1.47935	13.51375

✔ As before, the descriptives were calculated automatically. Remember, with an independent groups *t*-test, we are concerned with homogeneity of variance because it determines whether or not to use the pooled variance when calculating t. Since **Levene's test for the equality of variances** is significant, we know the variances are significantly different, so they probably should not be pooled. Thus, we will use the t reported in the row labeled **Equal variances not assumed**. Compare this value to the *t* value reported in the text. The results support the hypothesis that men who score high on a homopohobic scale also show higher levels of arousal to a homosexual videa.

Now, let's create a bar graph to illustrate this group difference.

✔ Select **Graphs/Legacy/Bar**. Then select **Simple** and **Summaries for groups of cases** and click **Define**. Then select latency for **Bars Represent**, and select group for **Category Axis**. Click **Ok**. Edit the graph to suit your style. My graph follows.

In this chapter, you have learned to calculate each of the 3 types of *t*-tests covered in the textbook. You have learned to display mean differences graphically as well. Complete the following exercises to help you internalize when each type of *t*-test should be used.

Exercises

1. Use the data in *sat.sav* to compare the scores of students who did not see the reading passage to the score you would expect if they were just guessing (20) using a one-sample t test. Compare your results to the results in the textbook in Section 12.9. What conclusions can you draw from this example?

2. Open *moon illusion paired.sav*. Use a paired samples *t*-test to examine the difference in the moon illusion in the eyes elevated and the eyes level conditions. Compare your results to the results presented in Section 13.3 in the textbook.

3. Create a bar graph to display the difference, or lack thereof, in the moon illusion in the eyes level and eye elevated conditions, from the previous exercise.

4. Using the data in *horn honking.sav*, create a boxplot illustrating the group differences in latencies for low status and high status cars. Compare your boxplot to the one in the textbook in Figure 14.3.

5. Open *anorexia weight gain.sav*. In this data set, weight gain was calculated for three groups of anorexics. One group received family therapy, another cognitive

behavioral therapy, and the final group was a control group. Use an independent samples *t*-test to compare weight gain between the control group and family therapy group. Compare your results to the data presented in the textbook in Table 14.1.

6. In the same data set, use independent *t*-tests to compare the weight gain for the cognitive behavior therapy and control group and for the two therapy groups. Now that you have compared each of the groups, what conclusions would you draw about which type of therapy is most effective?

7. Using the same data set, create a bar graph or box plot that illustrates weight gain for all 3 groups.