Lesson 12: Inference for Two Means; Paired Data

Homework

Instructions: You are encouraged to collaborate with other students on the homework, but it is important that you do your own work. Before working with someone else on the assignment, you should attempt each problem on your own.

Problems

1. In your own words, explain the difference between conducting a hypothesis test with one mean, sigma unknown and conducting a hypothesis test with matched pairs.

In the Boy Scouts of America, boys are taught several methods for starting fires without using matches. These methods include striking flint and steel and touching a battery to steel wool. A scoutmaster wanted to know if there was a difference between the mean amounts of time required to start a fire using these two methods. He asked six randomly selected boys in the scout troop to make two fires each, using only one of the methods for each fire. The scoutmaster recorded the time (in seconds) required for each boy to start a fire using these two methods. The data are given below. (Assume that the times required to start a fire by these methods are normally distributed.)

	Flint.and.Steel	Battery.and.Steel.Wool
Adam	354	151
Dallin	366	269
Juan	100	205
Logan	287	407
Pang	266	205
Terrence	124	235

Use this information to answer questions 2 through 4.

2. Explain why this is an example of paired data.

3. Create and interpret a 95% confidence interval for the mean difference in the amount of time required by the two methods.

4. Does there appear to be a difference in the mean time required to start a fire by these two methods? Justify your answer.

The Zung Self-Rating Anxiety Scale (SAS) was developed by William W. K. Zung, a psychiatrist from Duke University, to quantify and compare anxiety levels (Wikipedia). Many stress-relief courses use this scale to measure the change in participants' anxiety from before the course to after. You want to determine if a particular course is effective at changing stress levels before you consider participating. *Define the differences as the individual's Zung SAS score after the course minus their score before the course.* Open the data file ZungSim. Use this information to answer questions 5 through 16.

5. Create and interpret a 95% confidence interval of the true mean difference of the before and after stress levels.

6. Does the confidence interval contain 0? If so, what does that tell us?

You also want to conduct a hypothesis test to get a better understanding of the effectiveness of this course and test to see if there is a difference. Use a level of significance of $\alpha = 0.05$.

7. State the null and alternative hypotheses.

8. Make an appropriate graph of the data.

9. Verify that the requirements to conduct a hypothesis test are met.

10. Give relevant summary statistics (mean, standard deviation, sample size).

11. Report the sample test statistic. Give its degrees of freedom.

12. Sketch the sampling distribution using the t-distribution applet, showing the test statistic and shading the P-value.

13. State the P-value.

14. Give the decision rule for this test.

15. Present your conclusion in an English sentence relating the results to the original context.

16. If you did problems #4 through #15 correctly, you would have gotten the same conclusions between the confidence interval and the hypothesis test. Why do you suppose that the conclusions are the same?

A study was conducted to test retention in language learning. 20 psychologists were randomly selected from around the country to participate in the study. At the end of an intensive three day Spanish course the subjects completed the MLA listening test. One week later they were given the same test. Suppose that you are a researcher conducting this study. Conduct a hypothesis test to determine if there was a significant decrease between test scores from the end of the course to one week after the course. Open the data file MLA_Data Data. *Define the differences as the Week Later minus Course End.* Use a level of significance of $\alpha = 0.05$. Use this information to answer questions 17 through 24.

17. State the null and alternative hypotheses.

18. Make an appropriate graph of the data.

19. Verify that the requirements to conduct a hypothesis test are met.

20. Give relevant summary statistics (mean, standard deviation, sample size).

21. Report the sample test statistic. Give its degrees of freedom.

22. State the P-value. Also examine the t-distribution area using the t-distribution applet.

23. Give the decision rule for this test.

24. Present your conclusion in an English sentence relating the results to the original context.