

## Lab Activity: Hypothesis Testing – Two Independent Population Means

In this lab activity, you will conduct hypothesis testing for claims involving the means of two independent populations.

### Student Learning Outcomes

By the end of this chapter, you should be able to do the following:

- Perform hypothesis testing for two independent population means using Statcato
- Interpret the results of hypothesis tests

### Preliminary

**Read** Chapter 10 Hypothesis Testing: Two Means, Paired Data, Two Proportions in:

Illowsky, Barbara, and Susan Dean. Collaborative Statistics. Connexions. 2 Mar. 2010  
<<http://cnx.org/content/col10522/1.37/>>.

### Background


In this activity, you will test claims involving two population means using the results of an experiment that tests whether directed reading activities in the classroom help elementary school students improve aspects of their reading ability. The sample data consists of the reading scores of a treatment group that participated in the reading activities and a control group that did not participated in those activities. You will determine if the treatment group has a higher average reading score than the control group.

### Loading Data

This lab uses data obtained from <http://lib.stat.cmu.edu/DASL/Datafiles/DRPScores.html> (Original Source: Schmitt, Maribeth C., *The Effects on an Elaborated Directed Reading Activity on the Metacomprehension Skills of Third Graders*, Ph.D. dissertaion, Purdue University, 1987). The data file is also available on the Statcato web site.



#### Loading an Online Dataset

- Go to **File > Load Dataset**. Or click the  icon in the toolbar.
- Under Online Datasets, enter the web address: <http://www.statcato.org/labs/data/reading.xls>. Select “Excel” in the dataset file type drop-down menu.
- Click **Load Dataset**.

The data should now be in Data window. The labels of the samples (treated or control) are in C1, and the values (reading scores) are in C2.

## Formulating the Hypothesis Test

Answer the following questions in **LR: Hypotheses**.

- State the claim that you are testing.
- State the null and alternative hypotheses.
  - $H_0$ :
  - $H_a$ :
- Is this a right-tailed, left-tailed, or two-tailed test?
- Define the random variable for this test.

## Performing the Hypothesis Test – Known $\sigma$

Using Statcato, you will perform calculations for the hypothesis test assuming that the population standard deviations of the two populations ( $\sigma_{\text{treatment}}$  and  $\sigma_{\text{control}}$ ) are known to be 10.0 and using a significance level of 0.05 ( $\alpha = 0.05$ ).



### Performing Hypothesis Test: 2-Population Means

Go to **Statistics > Hypothesis Tests > 2-Population Means**.

- For **Inputs**, select **Samples in one column**. In the **Labels in column** drop-down menu, select **C1**. In the **Values in column** drop-down menu, select **C2**.
- For **Population Standard Deviations/Variances**, select **Population standard deviations known**. Enter **10.0** in the text boxes  $\sigma_1$  and  $\sigma_2$ .
- For **Alternative Hypothesis**, choose the appropriate form of the alternative hypothesis in the drop-down menu. Enter **0** in the **Hypothesized Mean Difference** text box.
- For **Significance Level**, enter **0.05**.
- Click **OK**.

Copy the computation results to **LR: Hypothesis Test – Known  $\sigma$** .

## Performing the Hypothesis Test – Unknown $\sigma$

Using Statcato, you will perform calculations for the hypothesis test assuming that the population standard deviations are unknown and using a significance of 0.05 ( $\alpha = 0.05$ ).



### Performing Hypothesis Test: 1-Population Mean

Go to **Statistics > Hypothesis Tests > 2-Population Means** (or select the corresponding item in the Dialog History).

- For **Inputs**, select **Samples in one column**. In the **Labels in column** drop-down menu, select **C1**. In the **Values in column** drop-down menu, select **C2**.
- For **Population Standard Deviations/Variances**, select **Population standard deviations known**. Enter **10.0** in the text boxes  $\sigma_1$  and  $\sigma_2$ .

- For **Alternative Hypothesis**, choose the appropriate form of the alternative hypothesis in the drop-down menu. Enter **0** in the **Hypothesized Mean Difference** text box.
- For **Significance Level**, enter **0.05**.
- Click **OK**.

Copy the computation results to **LR: Hypothesis Test – Unknown  $\sigma$** .

## ***Making Conclusions***

Based on the computer-generated results, you will make decisions and draw conclusions for the hypothesis tests. Record your answers in **LR: Interpretation**.

## **Decisions on Null Hypothesis**

Recall that

- If  $\alpha \leq \text{p-value}$ , do not reject  $H_0$ .
- If  $\alpha > \text{p-value}$ , reject  $H_0$ .

Based on the significance level  $\alpha$  and the computed p-values, decide whether to reject  $H_0$  and explain why.

## **Conclusions**

Based on your decisions on the null hypothesis, make a conclusion about your claim. For example, your conclusion could be worded as follows:

At the 5% level of significance, the sample data (shows / does not show) sufficient evidence to support the claim that \_\_\_\_\_.

## ***Discussion***

Answer the following questions in **LR: Discussion**.

1. Based on the results, does it appear that the reading activities are effective in helping students improve their reading ability?
2. In this experiment, what is the probability of concluding that the reading activities are effective in helping students improve their reading ability when they actually are not?