Lab Activity: One-Way ANOVA

In this lab activity, you will perform one-way ANOVA to test claims regarding the equality of a set of population means.

Student Learning Outcomes

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

- Perform one-way ANOVA using Statcato
- Interpret the results of a one-way ANOVA test

Preliminary

Read Chapter 13 F Distribution and ANOVA in:

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

Make sure you understand the following **key concepts** (**LR: Key Concepts**):

analysis of variance (ANOVA), properties of F distribution, treatment / factor, variance between samples, variance within samples, F statistic, numerator degrees of freedom, denominator degrees of freedom

Background

In this lab, you will use datasets containing three different measures of readability levels of advertisements in a number of magazines (Source: http://lib.stat.cmu.edu/DASL/Datafiles/magadsdat.html. Original Source: F.K. Shuptrine and D.D. McVicker, "Readability Levels of Magazine Ads," Journal of Advertising Research, 21:5 (October 1981), p 47.).

The magazines are categorized into three groups according to the educational level of their readers:

Educational Level	Magazines
High	1. Scientific American 2. Fortune 3. The New Yorker
Medium	4. Sports Illustrated 5. Newsweek 6. People
Low	7. National Enquirer 8. Grit 9. True Confessions

Six advisements were randomly selected from each of the magazines. For each advertisement, three different readability measures were collected:

1. WDS = number of words
2. SEN = number of sentences
3. 3SYL = number of 3+ syllable words

You will perform one-way ANOVA tests to determine whether advertisement readabilities of the three groups of magazines are different.

Formulating the Hypothesis Test

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

- **Claim:** The ads readability levels (based on WDS) are not all the same for the three groups of magazines.
- State the **null** and **alternative hypotheses**. Let μ_1, μ_2, μ_3 be the population means of a readability measure of the three groups of magazines.
  - H_0:
  - H_a:
- Is this a **right-tailed**, **left-tailed**, or **two-tailed** test?

Loading Data

For this part of the lab, you will use the **WDS** (number of words) data. The data file is 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/magazines-wds.xls. Select "Excel" in the dataset file type drop-down menu.
- Click **Load Dataset**.

The WDS data values for each of three groups of magazines (high, medium, and low education levels) are in C1, C2, and C3, respectively.

Performing One-Way ANOVA

Using Statcato, you will perform a one-way ANOVA test of the WDS data. Use a significance level of 5%.

Performing One-Way ANOVA

Go to `Statistics > Analysis of Variance > One-Way ANOVA`.

- In the **Inputs** panel, select **C1**, **C2**, and **C3** (holding the Ctrl key, click on each column name). Click the **Add to list** button. You should see the column names in the **Responses** list.
- For **Significance Level**, enter **0.05**.
- Click **OK**.

The results of the one-way ANOVA test are shown in the Log window. Copy the computation results from the Log window to **LR: ANOVA**.

Interpreting the Results

Based on the computer-generated results, you will make interpretations on the equality of the readability measures of the three magazine groups. Record your answers in **LR: Interpretation**.

For one-way ANOVA, Statcato produces a table showing the following values for the variation between groups (treatment) and the variation within groups (error):

- DOF = degrees of freedom
- SS = sum of squares
- MS = mean of squares

It also shows the test statistic *F*, the critical value corresponding to the given significance level, and the p-value.

Decisions on Null Hypothesis

Based on the significance level α 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.

Discussion

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

1. Following the procedures described above:
    a. Use a 0.10 significance level to test the claim that ads readability levels of the three magazine groups (based on SEN) are the same. (Data file: http://www.statcato.org/labs/data/magazines-sen.xls)
    b. Use a 0.10 significance level to test the claim that ads readability levels of the three magazine groups (based on 3SYL) are different. (Data file: http://www.statcato.org/labs/data/magazines-3syl.xls)
2. Based on the tests performed above, does it appear that ads readability levels are dependent of the educational levels of the targeted readers? Give a possible explanation for the presence or absence of dependency.