1 Sample Means Laboratory

One-Sample Hypothesis Testing and Confidence Intervals for Population Means

OVERVIEW

In this lab, you will work with descriptive statistics, one-sample hypothesis testing, and one-sample confidence intervals.

OBJECTIVES

By the end of the laboratory, you will be able to:

- Use *Minitab* to calculate descriptive statistics and interpret the output.
- Perform on-sample hypothesis testing using *Minitab*.
- Calculate a one-sample confidence interval using *Minitab* and interpret the output.

EQUIPMENT

- PC with *Minitab*
- Printer
- Diskette for saving work

BACKGROUND MATERIAL

Statistical Terms and Topics

- Mean
- Median
- Mode
- Standard deviation
- Standard error of the mean
- Sample standard deviation
- Null hypothesis

- Alternative/research hypothesis
- One-tailed test, upper tail
- One-tailed test, lower tail
- Two-tailed test
- Alpha rejection region
- Test statistic
- "t" test statistic
- "z" test statistic
- Observed significance level (*p*-value)
- Confidence interval
- Confidence level

Scenario

The average number of children per couple in the United States is typically thought to be 2.5. A sample of 51 students from a university was asked how many siblings they have (from the same mother and father).

Preliminaries

1. The distribution of number of children in a family should be normal. Draw a picture of a normal curve below. The mean, median, and mode of this picture should be 2.5 according to the scenario.

2. How do you believe our data should relate to the national average? Use a complete sentence to write your hypothesis. **Hint: We have no reason to believe our data will be any different from the national average.*

   _____
   _____
   _____

3. Now formulate the hypothesis using statistics notation.
   The **null hypothesis** is denoted H_o.
   The **alternative / research hypothesis** is denoted H_a.
   H_o: μ = _____
   H_a: μ __ _____ (*Hint: go back and review one-tailed and two tailed hypothesis tests)

Computer Exercise

4. Enter the following data to analyze. There are 51 data items. Double check to make sure that you have entered them all.

Number of Children in the Family

2	2	2	2
3	2	3	3
2	1	2	3
2	3	2	3
8	2	1	3
2	5	2	2
2	4	3	3
3	3	3	4
4	2	3	4
1	3	3	2
2	3	2	2
2	4	2	3
3	2	2	

4. Run the descriptive statistics on the number of children. Fill in the blanks with the appropriate answers.
   n _____ mean _____ median _____ mode _____

   standard deviation _____ range _____

5. Choose a maximum value of α that you are willing to tolerate. _____

6. Since you have more than 30 students, you will be performing a Z test. Go back to the picture you drew in #1, shade in the rough area of the graph where, if the test statistic falls in this range, we would believe that our test statistic is significantly **different** from the national average (i.e. the rejection region).

7. Perform the **1-Sample *Z*** test on *Minitab*. The steps are below, if you need them.

   Z test statistics = _____ *p*-value = _____

   - Go to **STAT >BASIC STATISTICS >1-SAMPLE Z.**
   - Select **children** to put in the variables box.
   - Click on **Test mean** and type 2.5 in the blank.
   - Under **Alternative** choose **Not equal.**
   - Type in the standard deviation from #5 as an approximation of **Sigma**.
   - Click **OK.**

8. Interpret the ***Z*** test.
   When using the ***Z*** test, if the observed significance level (*p*-value) is less than the chosen value of α, reject the null hypothesis. Otherwise, do not reject the null hypothesis.
   (i.e. *p*-value < α implies reject the null)
   Note*: You only "reject the null" or "do not reject the null." – You **never "accept the null."
   Based on the *p*-value and α, what do you conclude about the test?
   _____

9. Perform a **one-sample confidence interval** (CI) with a **90%** confidence level. Steps are below if needed.

   - Go to **STAT >BASIC STATISTICS >1-SAMPLE Z.**
   - Select **children** to put in the variables box.
   - Click on **Confidence** interval.
   - Type in **90** in the **Level** blank.

   90% CI _____

10. Now perform a one-sample (C.I.) with a **95%** and **99%** confidence level. Repeat the steps from #10, but type in **95** and **99** in the **Level** blank.

95% CI _____ 99% CI _____

11. Compare the three confidence intervals you just performed.
    Which is the confidence interval with the largest range?
    _____% CI
    Which is the confidence interval with the smallest range?
    _____% CI

12. Interpreting the confidence interval.
    We can be _____% confident that μ lies between (lower bound of interval) _____ and (upper bound of interval) _____.
    **Note*: This statement reflects our confidence in the estimation process rather than in the particular interval that is calculated from the sample data.

13. Now write out the statement above for one of the other confidence intervals.

_____
_____
_____
_____

Application to Psychology

One sample hypothesis testing tells us if the average of a set of data is significantly different from a given average. Think of two scenarios in a psychological setting where it might be important to perform a one-sample hypothesis test. Be prepared to share at least one with the class.

Ethics Application

Go back and look over the scenario. Notice that the participants were given details as to what the questionnaire was going to be used for and that they were told that they did not have to fill out the questionnaire if they felt uncomfortable.