Statistics 10 Summer 2009

LAB 5 CONFIDENCE INTERVAL FOR POPULATION MEAN AND PROPORTION

The purpose of Lab 5 is to develop the concept of a confidence interval for population mean and proportion using technology. During Lab 7 students should learn how to estimate a population mean and proportion on the base of a single sample, using FATHOM, and interpret the results.
This lab uses Fathom's simulations to create the Confidence Interval for Population Mean.

From **Moodle** open the **Survey Data** file that contains data from a sample of 1325 UCLA students who completed the Stat 10.
Consider the collection of 1325 observations as the population of Stat 10 students.
Rename collection to **Population**.

Part 1. Confidence Interval for the population mean student's age. Fathom simulations.

Sample of size n = 10

1. Select collection and go to ***Collection – Sample Cases.*** A new collection **Sample of Population** will appear. Rename it as **Sample of Population (n = 10)**. Double click on collection **Sample of Population (n = 10)** to open **Inspector/Sample** and

   a. Select "Animation on"
   b. Select "With replacement"
   c. Select "Replace existing cases"
   d. Select 10 cases.
   e. Use "Sample more cases". You will see a blue flying ball – your new random sample drawn from the population.
   f. Check you new sample of 10 observations using Inspector/Cases.

2. On the ***Inspector*** window select ***Measures***.
   - Click on ***"new"*** and type the name of the sample statistics ***Mean_Age***. Double click on the Formula cell. On the Formula window type ***mean(ageinmonths)***. The numerical value of the sample mean appears as Value.
   - Continue and create the following measures: mean (***Mean_Age***), standard deviation (***SD_Age***), sample size (***size***), critical value z for 95% Confidence Level (***z***), margin of error (***ME***), confidence interval's lower bound (***LB***), confidence interval's upper bound (***UB***):

Measure	Value	Formula
Mean_Age		$mean(ageinmonths)$
SD_Age		$s(ageinmonths)$
size		$count(ageinmonths)$
z	1.96	
ME		$z \cdot \frac{SD\_Age}{sqrt(size)}$
LB		$Mean\_Age - ME$
UB		$Mean\_Age + ME$

3. Select the **Sample of Population (n = 10)** and go to menu ***Collection – Collect Measures***. The new collection **Measures from Sample of Population (n = 10)** appears. Open ***Inspector*** to check the new collection. By default, 5 sets of measures had been created. Go to tab ***Collect measures***. Check "Replace existing cases" and change the number of measures to 20. (20 sample means and other measures of the sample of size 10 will be collected). To speed-up the process, click the Animation box so that the animation is off.

4. Open the tab ***Cases,*** click on *"new"* and add the Attribute ***index*** (indicator that shows the number of the sample in use, index = 1,2…20). Double click on the formula sell and type ***caseIndex***.

5. Drag the new graph from the shelf and plot the attribute ***index*** on the horizontal and the attribute ***Mean_Age*** on the vertical axes. 20 sample means appear. Make your graph wider and longer.

6. Go to the collection **Population** and find the value of the population mean for the variable ***ageinmonths***. Select your graph and go to menu ***Graph – Plot Function***. Type the value of the population mean. The horizontal blue line appears; it shows us the true value of the Population Mean.

7. Double click on the graph and go to the tab **Cases** on the ***Graph Inspector***, scroll down and type ***ME*** on the formula sell for **yErrorBar.** 20 confidence intervals appear on the scatterplot. Rescale your graph if needed.

8. Copy/Paste all graphs and tables in your report file.

9. Observe your confidence intervals and answer the following questions:

    a. Why do the widths of the confidence intervals differ?
    b. How many confidence intervals do not cross the blue line? What does that mean?
    c. Explain what the 95% Confidence Level means.

Sample of size n = 50

10. Open Inspector for the **Sample of Population (n = 10)** and change the number of cases to 50. Select "Sample more cases". Rename the collection as **Sample of Population (n = 50)**

11. Repeat all steps and simulate twenty 95% confidence intervals using the sample of size 50.

12. Copy/paste all graphs and tables in your report file.

13. Observe your confidence intervals. How many confidence intervals do not cross the blue line? What that means?

14. Compare your results for the sample of size 10 and 50. Describe and <u>explain</u> your findings.

Part 2. Confidence Interval for Population Proportion.

1. Open ***Inspector*** and check the **Attributes** and **Comments**. You will use the attribute **Glasses.**

2. Create a bar chart for the variable **Glasses**.

3. Create a **Summary** and find a Population Proportion of students who wear glasses. Go to menu **Summary** and select **Add Formula**. Print ***columnproportion*.** (Or you can use any Fathom options appropriate for these purposes)
   Record the population proportion of students who wear glasses.

4. Create a **Simple Random Sample** of 30 students:
   Select collection **Population**. Go to **Collection – Sample Cases.** A new collection **Sample of Population** will appear. Double click on collection to open **Inspector/Sample** and
   g. Change the number of units in the sample (cases). Select 30 cases.
   h. Clean the option "With replacement".
   i. Select "Sample more cases".
   j. Check you new sample of 30 observations using Inspector/Cases.

5. Drag a **Summary** object from the shelf. Use the **Sample of Population** collection to create the summary table for the attribute **Glasses**. Find a Sample Proportion of students who wear glasses. Record the number of students who wear glasses in your sample.

6. Drag an **Estimate** object from the shelf. An empty estimate window appears. From the pop-up menu choose ***Estimate Proportion***.

7. The blue text is editable. Edit the blue text and print **yes** in the place of **Category** and **Glasses** on the place of **AttributeName**. Then replace the number of students who wear glasses and total number of 30 students in the sample.
   The sample proportion of students who wear glasses appears.
   Below you can see the 95% Confidence Interval for population proportion. Record it.

8. Use the same sample to build the 80%, 90% and 99.5% confidence intervals. Record their values. Compare the four confidence intervals you got. Make your conclusion about the confidence level and precision of estimate.

9. Look at the known value of the population proportion from p.3. Answer the following questions:
   a. Do all of your confidence intervals contain the true value of population proportion? Explain your findings.
   b. Make your conclusion.

Use the Textbook Chapters 19 and 23.

10 extra points will be given for the report's excellence.

LAB 5 must be turned in before the final exam, Wednesday, July 29th. No late work will be graded.