

Lab 6 (100 points + 10 points BONUS) - One Sample t Confidence Interval and Hypothesis Test

Objectives: Confidence interval and hypothesis tests for one-sample

A. (10 points) Online Prelab

B (90 points) In this lab, we are concerned with the Average Test Score (TestScore) (Data Set: Clean US Data)

In high schools, they once said that a grade of 75% is “average.” A high schooler, Antonio, wants to test whether the population mean of the Average Test Score is 75%. Since the maximum grade on this test is 2400, the hypothesis is whether the population mean of Average Test Score is $0.75 \times 2400 = 1800$. Note that the average test score in each county is considered a random variable, so it has a population mean. We are inferring about a population average for a variable that is itself an average.

1. (10 points) Code. There should not be a separate command for the confidence interval; though there will be two commands for hypothesis tests. See the tutorial for an explanation of what is meant by this.
2. (10 points) Create a histogram, boxplot, and a Normal probability plot using these data. Briefly describe each plot and what it indicates about the data. After you have described each graph, provide a general description of the data including information about the shape of the distribution and any unusual aspects of the data, including outliers.
3. (6 points) Is it appropriate to analyze these data using the t-procedures? Explain your response by stating what the assumptions are and then use the graphs to justify your answer. Be sure to include all of the assumptions even those that can not be confirmed via graphs so have to be assumed.
4. (5 points) Find the sample mean, sample standard deviation, and the standard error of the mean (standard deviation of the estimator) for “TestScore.” What does this tell you about the data? Please write at least one sentence concerning how these numeric values describe the distribution. You may calculate the standard error by hand or via computer software. If you perform the calculations by hand, please show your work.
5. (10 points) Find the 95% confidence interval for the mean “TestScore.” Please interpret your result.
6. (5 points) Before performing the hypothesis test (or looking at the output for the hypothesis test), would you reject or fail to reject the claim that the mean of Average Test Score is 1800 at a 5% significance level? Please explain your answer. Hint: Use the results of question 5. You will receive **0 points** if you refer to the results of the hypothesis test.
7. (12 points) Do these data provide evidence that the average “TestScore” is different from 1800? Carry out a hypothesis test using the four-step procedure, with a significance level of 5%. Please provide the relevant output required for the steps and explicitly include all four steps in your answer. No calculations are required because the necessary information is obtained from the software output.

8. (12 points) Another high school student, Bhudevi, thinks that the percentage should be closer to $\frac{2}{3}$'s (67%). That would mean that we are testing to see if the Average Test Score is $0.67 \times 2400 = 1608$. Do these data provide evidence that the average "TestScore" is different from 1608? Carry out a hypothesis test using the four-step procedure, with a significance level of 5%. Please provide the relevant output required for the steps and explicitly include all four steps in your answer. No calculations are required because the necessary information is obtained from the software output.
9. (20 points) What would you tell the high school students concerning the population mean of Average Test Score ("TestScore")? Remember that you performed two separate hypothesis tests so that you will have to provide an answer to each student, Antonio (hypothesis test with $\mu_0 = 1800$) and Bhudevi (hypothesis test with $\mu_0 = 1608$). Make sure that you do not use technical terms. However, you do need to justify your answers using the results of your inference and additional information. New information (not already presented in the report) is required for full credit. This information may be additional calculations or from personal knowledge. In your discussion, please include the answers to the following questions:
- a) Is it appropriate to perform the hypothesis test?
 - b) Is there an effect? If there is an effect, how big a difference is there?
 - c) In practical terms, what would you tell the student concerning their hypotheses?
 - d) Can your conclusion be generalized to the states that were not included in the data set?

The answers to questions a) and d) only need to be provided once. Please explain all of your answers and write them in complete English sentences. Full credit for b) - d) will not be given for answers without explanations.

10. (10 points) BONUS How are the results for calculating the lower confidence bound different from calculating the lower limit of the confidence interval?
- a) (5 points) Code to create a lower 95% confidence bound for the mean of Average Test Score. Even if the code is in Part 1, please repeat it here.
 - b) (5 points) Report the confidence bound (provide the appropriate output) and the output for the confidence interval (copied from Part 5). How are the results of the two calculations different? Specifically, which quantities in the formulae are different and which is larger, the lower confidence bound or the lower limit of the confidence interval?