Math 140 PROJECT Directions and Grading Rubric
One-Population Mean Hypothesis T-Test
(Use with Teachout textbook Chapter 3)

PROJECT GRADING RUBRIC

- **First and Last name, Project title, Instructor's Name, Section#, Semester and Year** *(2 points)*
- **Anti-cheating statement** *(2 points)*
- **Five StatKey Pictures:** *(5 points each)*
    - **Histogram** (Picture of Histogram of your quantitative data with slider set to 5 bars)
    - **Summary Statistics** (Picture of Summary Statistics for your quantitative data)
    - **Degrees of Freedom** (Picture of Degrees of Freedom input box with correct degrees of freedom)
    - **Critical Value Graph** (Picture of T – Distribution graph corresponding to correct degrees of freedom and tail, 0.05 significance level in the top box, and critical value in bottom box.)
    - **P-value Graph** (Picture of T – Distribution graph corresponding to correct degrees of freedom and tail with the T – test statistic in the bottom box and P-value in top box).
- **Null and Alternative Hypotheses with correct symbolic notation and units** *(3 points each)*
- **Sentence Explanations: Assumptions, Significance, Tail Explanations** *(3 points each)*
- **T-test stat definition sentence, P-value definition sentence, Conclusion** *(4 points each)*
- **All other problems:** *(2 points each)*

PROJECT REPORT DIRECTIONS: Use the quantitative column of data, population of interest, and claim assigned to you by your instructor. You do not need to include the questions. Just provide the answers and StatKey pictures requested for each number.

Put the following title and anti-cheating statement at the top of your report.

First and Last Name
Math 140 Project#4 One-Population Mean Hypothesis Test
Instructor's Name
Section# for your class
Semester and Year

Cheating Statement: Confirm that you did not cheat. If true, write the following:
I did not cheat on this project. I did not copy someone else's answers. I did the work myself. No one else did this project for me.

Answer the following questions:

1. **What is the quantitative question?**

2. **What is your population of interest?**

3. **What is the claim about the population mean average that you are testing?**

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Part II: Use your claim in #3 to write the Null Hypothesis and the Alternative Hypothesis.

4. **Write your null hypothesis using the population mean average symbol (μ) and symbol = , ≤ , or ≥**

5. **Write your alternative hypothesis using the population mean average symbol (μ) and symbol ≠ , > , or <**

6. **Is the claim the null hypothesis (H_0) or is the claim the alternative hypothesis (H_A) ?**

7. **Is your hypothesis test a "right-tailed test", a "left-tailed test" or a "two-tailed test**

Part III: Paste your column of quantitative data into StatKey, create a histogram and check the One-Population Mean T-test assumptions.

Open the Project Data Excel Spreadsheet. Highlight the column of numerical measurement data assigned to you, right click and copy.

Go to www.lock5stat.com and click on StatKey. Click on "One Quantitative Variable" under the "Descriptive Statistics and Graphs" menu in StatKey.

Click on "Edit Data" and Copy and Paste your quantitative column of data into StatKey. If you have a title at the top, Check the box for "header row". If you do not have a title at the top, do NOT check the box that says header row. Push OK.

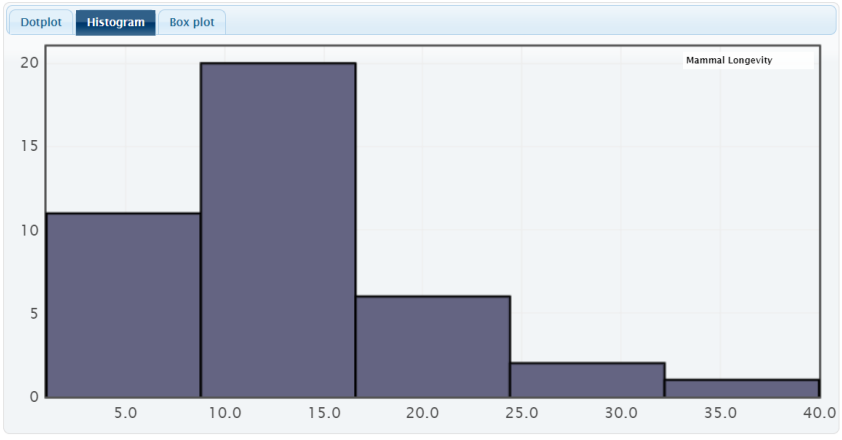
Click on "Histogram" and change the number of buckets to 5. This will give you 5 bars in your histogram. Copy the graph and the "Summary Statistics" next to the graph.

Put these StatKey Pictures on the Project Report:

8. **Copy and Paste a picture of the 5 bar histogram into your project report.**

9. **Also copy and paste the "Summary Statistics" printout on the right of the histogram into your project report.** Make sure the table is large enough to read the numbers. If the table is too small, your instructor will not be able to grade your report!

Example #8 & #9:



Summary Statistics

Statistic	Value
Sample Size	40
Mean	13.150
Standard Deviation	7.245
Minimum	1
Q_1	8.000
Median	12.000
Q_3	15.500
Maximum	40

Histogram Controls Set Limits

Number of buckets: 5

lower bound | upper bound | frequency

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Check the following three T-test conditions with your histogram and summary statistics from StatKey.

10. **Condition #1: Your sample data provided was collected randomly. Do you think the data will represent the population? Explain why or why not.**

11. **Condition #2: Do you think the individual observations in your data are independent of each other or are they related in some way. Explain why or why not.**

12. **Condition #3: What was the sample size? What is the shape of your data? Does your data have either a normal (bell shaped) histogram OR a sample size of at least 30? Explain why or why not.**

Part IV: Calculate your Degrees of Freedom, Standard Error, and the T – Test Statistic

13. **What is your sample standard deviation** (s) **in your StatKey "Summary Statistics" table?**

14. **What is your sample size (n) in your StatKey "Summary Statistics" table?**

15. **Calculate the standard error for your data using the following formula and the answers to #14 and #15. Be sure to show your work.**

    Standard Error = $\frac{Sample\ Standard\ Deviation}{Square\ root\ of\ Sample\ Size} = \frac{s}{\sqrt{n}}$

    Example: Standard Error = 7.245 ÷ $\sqrt{40}$ = 1.145535

16. **What is the population mean average** (μ) **listed in the null hypothesis** (H_0)**?** Example: Suppose the null hypothesis is 10

17. **What is your sample mean average** ($\bar{x}$) **in your StatKey "Summary Statistics" table?** Example: The sample mean average ($\bar{x}$) in the StatKey Summary Statistics table is 13.150

18. **Calculate the T-test statistic using the following formula and the answers to #15, #16 and #17. Be sure to show your work. Round your answer to the thousandths place. (3 numbers to the right of decimal.) The T-test statistic may be negative or positive. Be sure to put the correct sign.**

    T – Test Statistic = $\frac{(Sample\ Mean - Population\ Mean)}{Standard\ Error} = (\bar{x} - \mu) \div standard\ error$

    Example: T – Test Statistic = (13.150 – 10) ÷ 1.145535 = +2.750

19. **Write the definition sentence explaining the T – Test Statistic in context.** If the T-test statistic in #17 is positive, then the sample mean is this number of standard errors above the population mean in null hypothesis. If the T-test statistic in #17 is negative, then the sample mean is this number of standard errors below the population mean in null hypothesis.

    Example: "The sample mean of 13.150 years was 2.750 standard errors above the population mean of 10 years in the null hypothesis."

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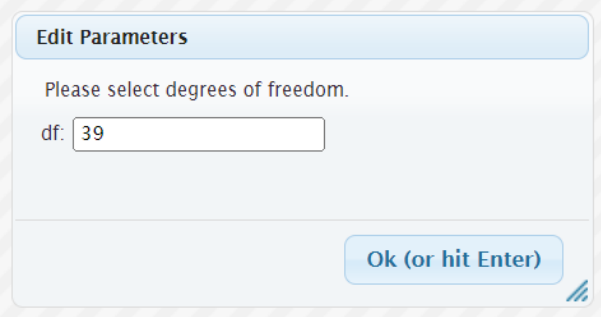
20. **Calculate the Degrees of Freedom for your data using the formula (df = n – 1). "n" is your sample size. Be sure to show your work.**

Example: Degrees of Freedom = n – 1 = 40 – 1 = 39

Part V: Use StatKey and a 5% (0.05) Significance Level to calculate your Critical Value

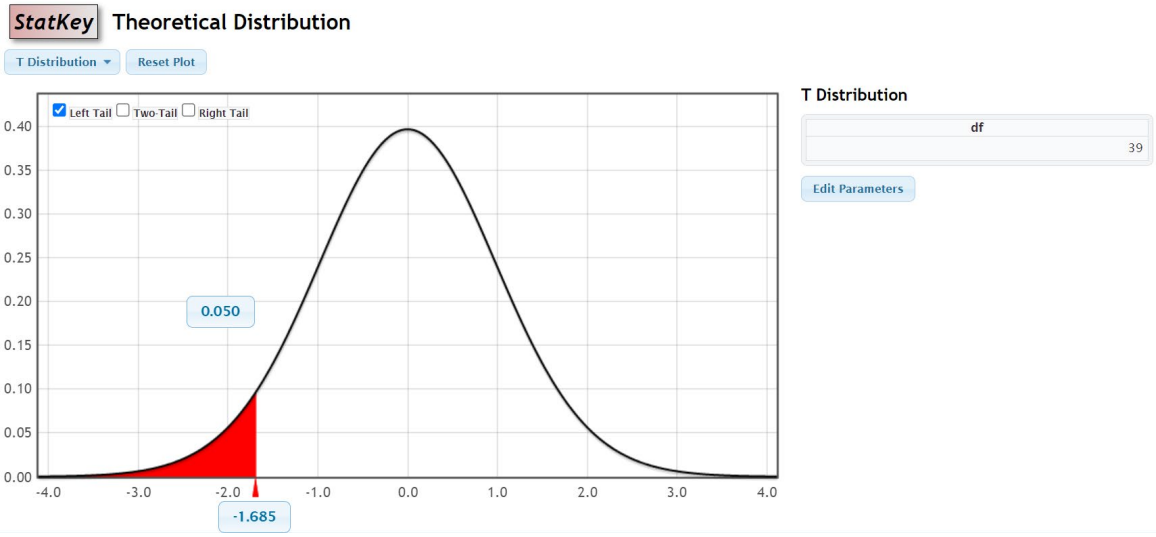
21. ***Go to StatKey. Under "Theoretical Distributions", click on " t ". Enter the degrees of freedom you listed in #20 into the df box and push OK. Take a picture of your degrees of freedom box.***

Example:



22. Show the StatKey T-distribution Critical Value picture with correct degrees of freedom, 0.05 significance level and the correct tail for your alternative hypothesis.

Left Tail with df = 39 example (critical value -1.685):



Right Tail with df = 39 example (critical value +1.685):

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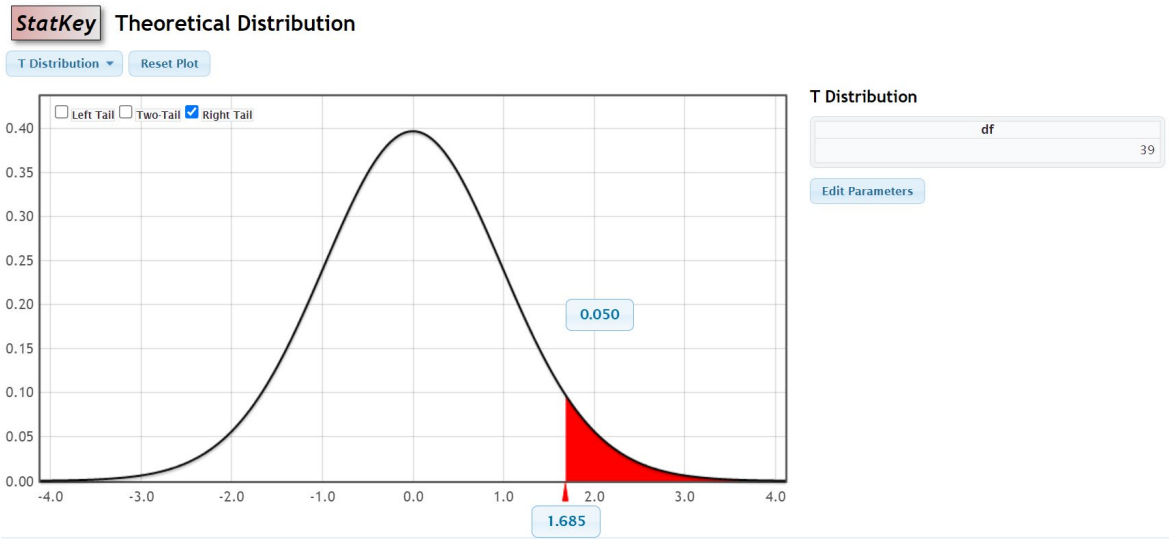
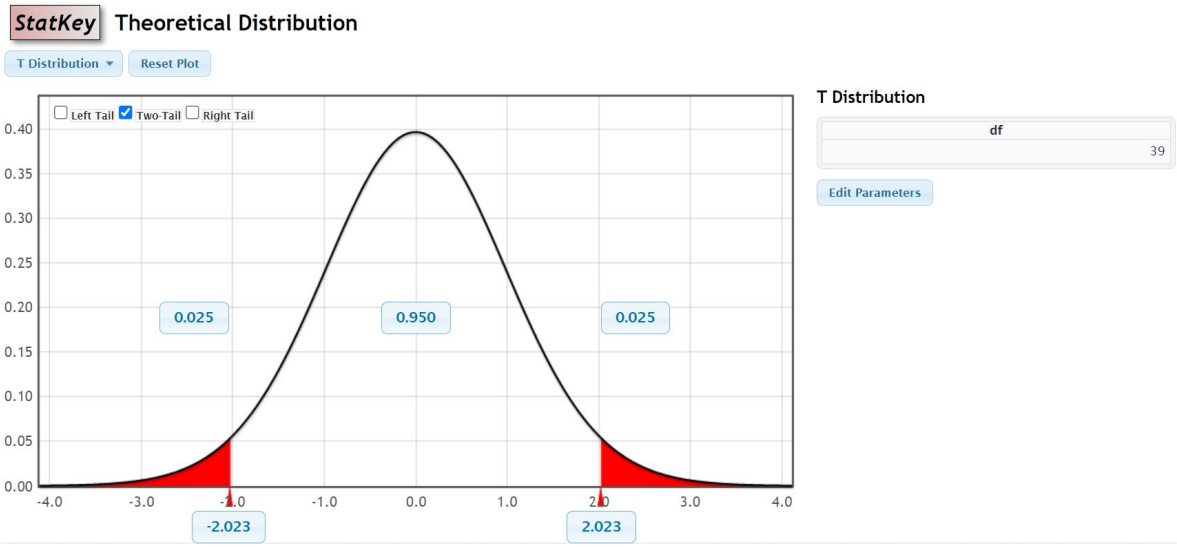


Two Tails with df = 39 example (notice 0.05 split into 0.025 in each tail, critical values -2.023 and +2.023):



23. **What is your critical value or values?** (This is where your tail or tails start.)

24. **Look at your T – Test Statistic answer in #18 and tail with your critical value or values. Does your T – Test Statistic fall in the tail or not? (If your test is two-tailed, does your T – Test Statistic fall in either one of the tails or not?)**

25. **Does the sample mean significantly disagree with the population mean in the null hypothesis or does the sample mean not significantly disagree with the population mean in the null hypothesis? Explain why.** (T-test stat in tail means the sample mean significantly disagree with the population mean null hypothesis. T-test stat NOT in tail means the sample mean does NOT significantly disagree with population mean in the null hypothesis)

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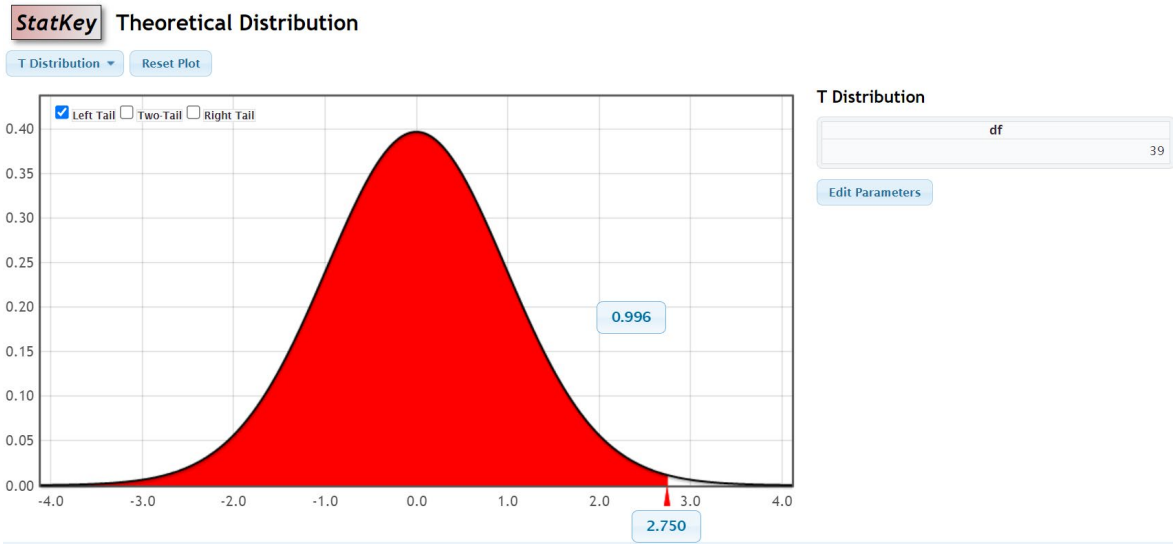
26. **Does the sample data significantly disagree with the null hypothesis or does the sample data not significantly disagree with the null hypothesis? Explain why.** (T-test stat in tail means the sample data significantly disagree with null hypothesis. T-test stat NOT in tail means the sample data does NOT significantly disagree with null hypothesis.)

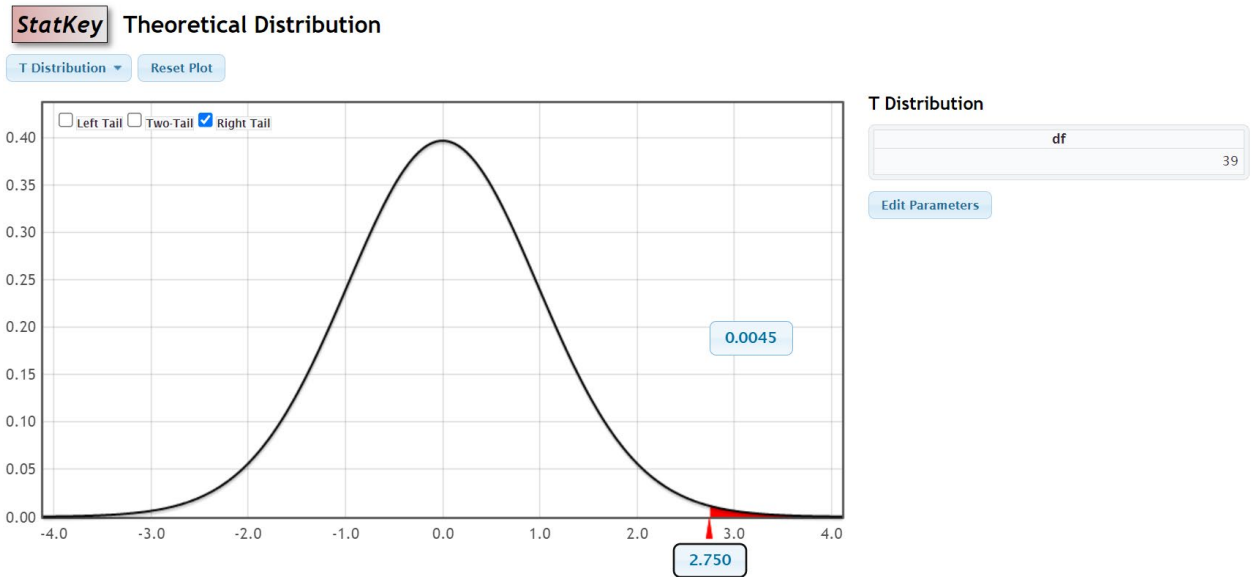
PART VI: Use StatKey and the T – Test Statistic to calculate the P-Value

27. **Show the StatKey T-distribution P-value picture with correct degrees of freedom, the T-test statistic from #18 in the bottom box, and the correct tail for your alternative hypothesis.**

Left Tail with df = 39 and T-test statistic = +2.750 example (P-value = 0.996 = 99.6%):



Right Tail with df = 39 and T-test statistic = +2.750 example (P-value = 0.0045 = 0.45%):



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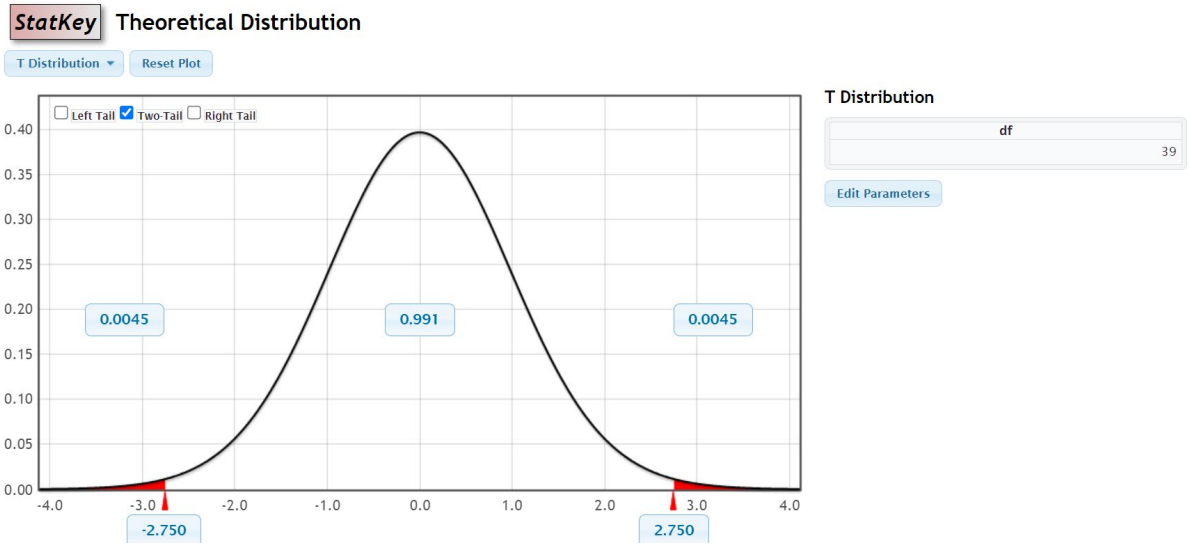
Two Tails with df = 39 and T-test statistic = +2.750 example (P-value = 0.0045 + 0.0045 = 0.009 = 0.9%):



28. **What is your P-value? Write your P-value as a decimal proportion AND as a percentage.**

29. **Write the P-value definition sentence in context to explain your P-value.**

    Example: "If the null hypothesis is true and the population mean average lifespan of mammals is 10 years, then there is a 0.45% probability of getting this sample data or more extreme by sampling variability."

30. **Is your P-value lower or higher than your 5% significance level? Is your P-value low or high?** (If the P-value is lower than the 5% significance level, it is considered a Low P-value. If the P-value is higher than the 5% significance level, it is considered a High P-value. If a P-value was exactly 5%, that would be considered a low P-value.)

31. **If the null hypothesis was true, could the sample data have occurred because of sampling variability or is it unlikely to be sampling variability?** (Low P-value indicates that the data is unlikely to have occurred because of sampling variability. High P-value indicates that the data could have occurred because of sampling variability.)

32. **Did your data pass all three of the T-test conditions in #10, #11 and #12?**

33. **Considering the assumptions, is your P-value significant evidence or not significant evidence?** If the P-value is low and the data passed all the conditions, the P-value is considered significant evidence. If the P-value is low and the data did NOT pass all one or more of the conditions, then the P-value is NOT significant evidence. A high P-value (with or without passing conditions) is NOT significant.)

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PART VII: Interpretations and Final Conclusion

34. **Considering the assumptions and P-value, should we Reject the Null Hypothesis or Fail to reject the Null Hypothesis?** If the P-value is low and the data passed all the conditions, then you should REJECT the NULL HYPOTHESIS. If the P-value is low and the data did NOT pass all of the assumptions, then you should FAIL TO REJECT THE NULL HYPOTHESIS. A high P-value (with or without conditions) always indicates that you should FAIL TO REJECT THE NULL HYPOTHESIS.

35. **Write the standard conclusion sentence in context for your test addressing evidence, assumptions and the claim in context.** Here is an example sentence. You have to pick between "significant evidence" or "not significant evidence", "reject" or "support", depending on your P-value, passing or failing the assumptions, and if your claim is the null or alternative hypothesis.

    Conclusion: There (**is** or **is not**) significant evidence to (**reject** or **support**) the claim that the population mean average…

    Remember use "reject" in your sentence if Ho was your claim in #6. Use "support" if Ha was your claim in #6. If your P-value was higher than the 5% significance level or if the data did not pass ALL of the assumptions, then you should say there is "not significant evidence". Only if your P-value is lower than the significance level AND your data passed all the assumptions, then you can say there "is significant evidence". Don't forget to describe your claim in context.

    Example: There is significant evidence to SUPPORT the claim that the population mean lifespan of mammals is more than 10 years.