MATH 338

MIDTERM 1 - LAB PORTION

TUESDAY, NOVEMBER 6, 2018

Your name: _____

Your scores (to be filled in by Dr. Wynne):

Problem 1: ____/6

Problem 2: ____/3

Problem 3: ____/4

Total: ____/13

You have 50 minutes to complete this exam and an extra 10 minutes to save (as a .docx or .pdf file) and upload it to Titanium.

You may refer to your notes, your textbook, and any pre-existing online reference (eBook, R/Rguroo help, anything on Titanium). You may search for help online, but you must cite any source found through the search. You may ask Dr. Wynne to clarify what a question is asking for. You may not ask other people for help or use any other resources.

For full credit, show all work except for final numerical calculations (which can be done using a scientific/graphing calculator or R).

1. Post-menopausal women often develop sudden feelings of heat, skin redness, and sweating collectively known as hot flashes. Lambert and colleagues (2018) were interested in using Red Clover Extract to decrease the frequency and severity of these hot flashes in post-menopausal women. The rhfs.csv file on Titanium contains the self-reported change in hot flash intensity (HFI) over 12 weeks for their sample of 58 post-menopausal women.

Is there a significantly different effect of Red Clover Extract on hot flash intensity as compared to Placebo? Write 1-2 short paragraphs to answer this question. Support your answer by including and referring to software output.

Full credit will be given in this problem for a writeup that:

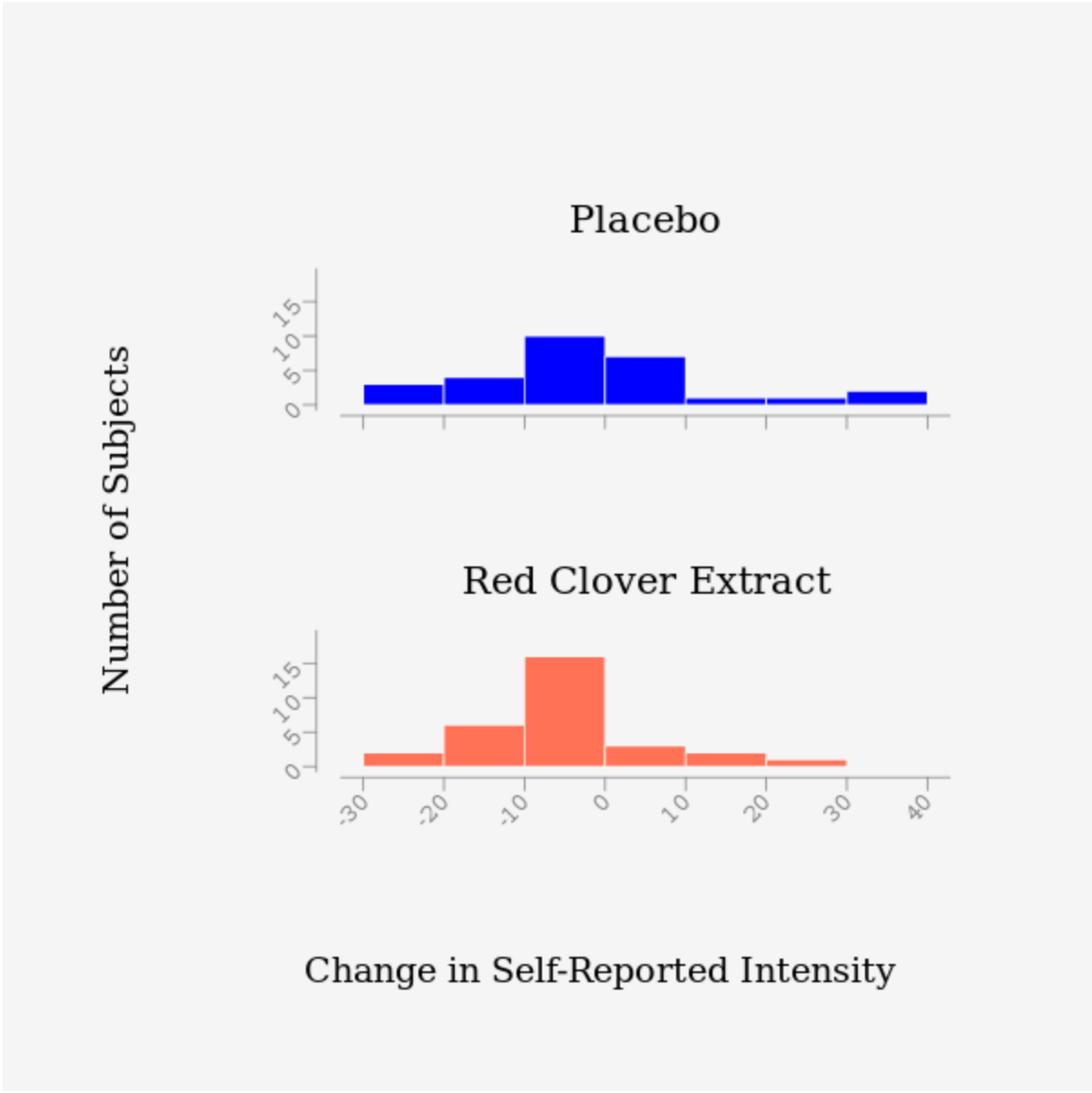
a) [2 pts] Includes appropriate background and exploratory analysis that informs your decision about the correct hypothesis test to use

b) [1 pt] Specifies an appropriate null hypothesis, alternative hypothesis, and significance level

c) [1 pt] Contains relevant, necessary and correct (R code and) software output

d) [2 pts] Makes a statistically justified decision/conclusion and interprets that conclusion in the context of the problem.

We have a single numerical variable measured in two different, seemingly independent samples. We suspect that two-sample procedures are appropriate. Based on the figure below, or based on the combined sample size of 58, we suspect t-procedures are appropriate.

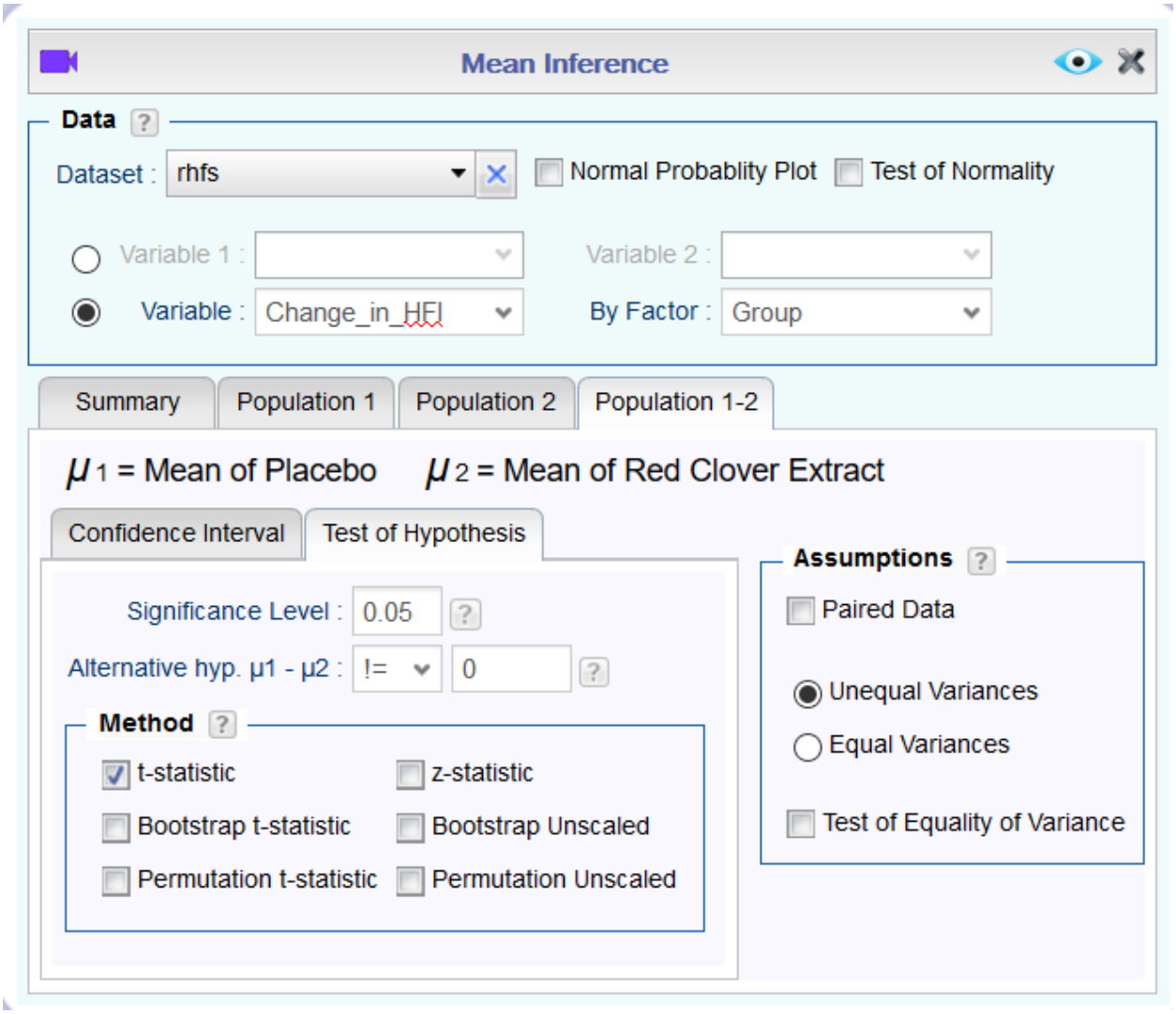


H_0: the two groups have the same population mean, $\mu_{RCE} = \mu_{placebo}$; or, the red clover extract has no effect on the mean change in hot flash intensity (compared to placebo)

H_a: the two groups have different population means; $\mu_{RCE} \neq \mu_{placebo}$; or, the red clover extract has an effect on the mean change in hot flash intensity (compared to placebo)

Significance level: $\alpha = 0.05$

We perform a two-sample t test:



We get the following output:

Test of Hypothesis: t-test
Change_in_HFI (Placebo) - Change_in_HFI (Red Clover Extract)

Research Hypothesis Ha: Mean of 'Change_in_HFI (Placebo) - Change_in_HFI (Red Clover Extract)' is not equal to 0
2.5% lower critical value in units of data = -6.84231
2.5% upper critical value in units of data = 6.84231
Unequal population variances was assumed.

Diff of Means	Std Error	Obs t Stat	DF	2.5% t-Lower Critical	2.5% t-Upper Critical	P-value
4.60714	3.40081	1.35472	46.8002	-2.01197	2.01197	0.182010

Test is not significant at 5% level.

Since the observed t-statistic is not in the critical region, or because the p-value of 0.182 is not < 0.05, we fail to reject the null hypothesis.

Conclusion: we did not find evidence of a significantly different effect of red clover extract on hot flash intensity as compared to red clover extract

2. Suppose a gas station chain is interested in showing that a competitor's gas prices are higher. One morning, they decide to send people out to record the Regular Unleaded gasoline price at 50 randomly selected competitor's stations throughout Southern California. The company knows the following:

- On this day, the company's own stations in Southern California sell Regular Unleaded for, on average, $3.80 per gallon
- Previous studies have suggested that a sample standard deviation of $0.15 per gallon is a reasonable assumption

Is 50 a large enough number of gas stations to show that the competitor's prices are higher, if the competitor's true average price is $3.85 per gallon? Write a short report (1-2 sentences) answering this question. Support your answer by including and referring to software output.

Rguroo hint: you can type in values of the relevant statistics into the Mean Inference Basics and Details dialog; you don't need a dataset to do this problem.

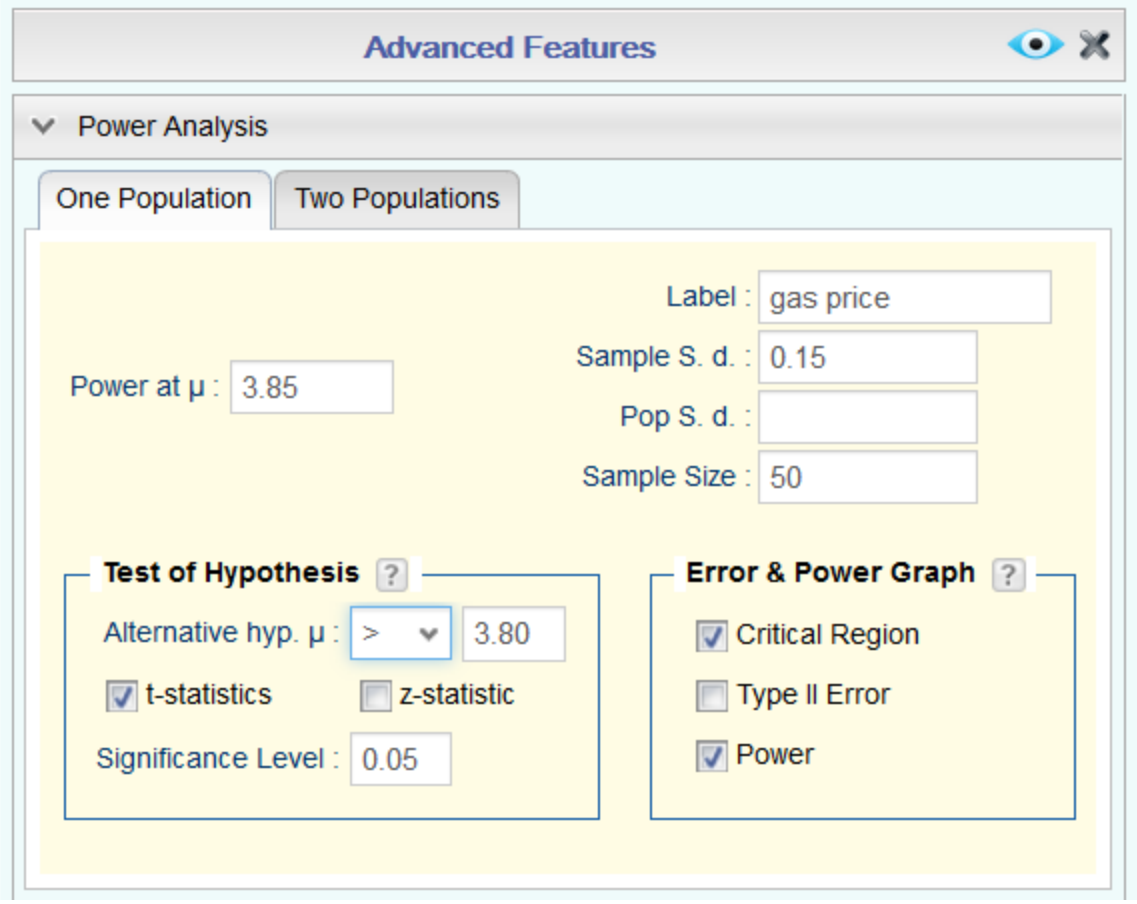
Full credit will be given in this problem for a writeup that:

a) [1 pt] Uses a correct statistical procedure

b) [1 pt] Contains relevant, necessary and correct (R code and) software output

c) [1 pt] Correctly interprets the software output in the context of the problem to answer the question.

We perform a one-sample t power analysis. The alternative hypothesis here is $\mu > 3.8$ since the gas station only cares if the competitor has higher prices.



We get around the Rguroo bug by filling in any number for the sample mean, then we look at the following table:

Power: t-Test for Mean
gas price

Research Hypothesis Ha: Mean of 'gas price' is greater than 3.8
Sample Size = 50
Standard Deviation = 0.15
Significance Level = 5%

Null	Alternative	Effect Size	Approx. Power	Exact Power
3.80000	3.85000	0.333333	0.751897	0.751564

Approximate Power is computed via normal approximation.

Given a significance level of 0.05, the power is 0.752, which is less than 0.8.

Conclusion: 50 samples is not sufficiently large for the gas station to detect a difference of $0.05.

3. They'll measure anything these days. The disgust.csv contains scores of 159 Americans on various scales that measure how disgusting they find germs, pathogens, and similar things.

The variable BODS in the dataset represents people's disgust with body odor, normalized from 1 (not disgusting at all) to 5 (completely disgusted by it). Estimate with 95% confidence the mean score on this scale of body odor disgust if all Americans were to take the researchers' survey. Write a short sentence interpreting your estimate.

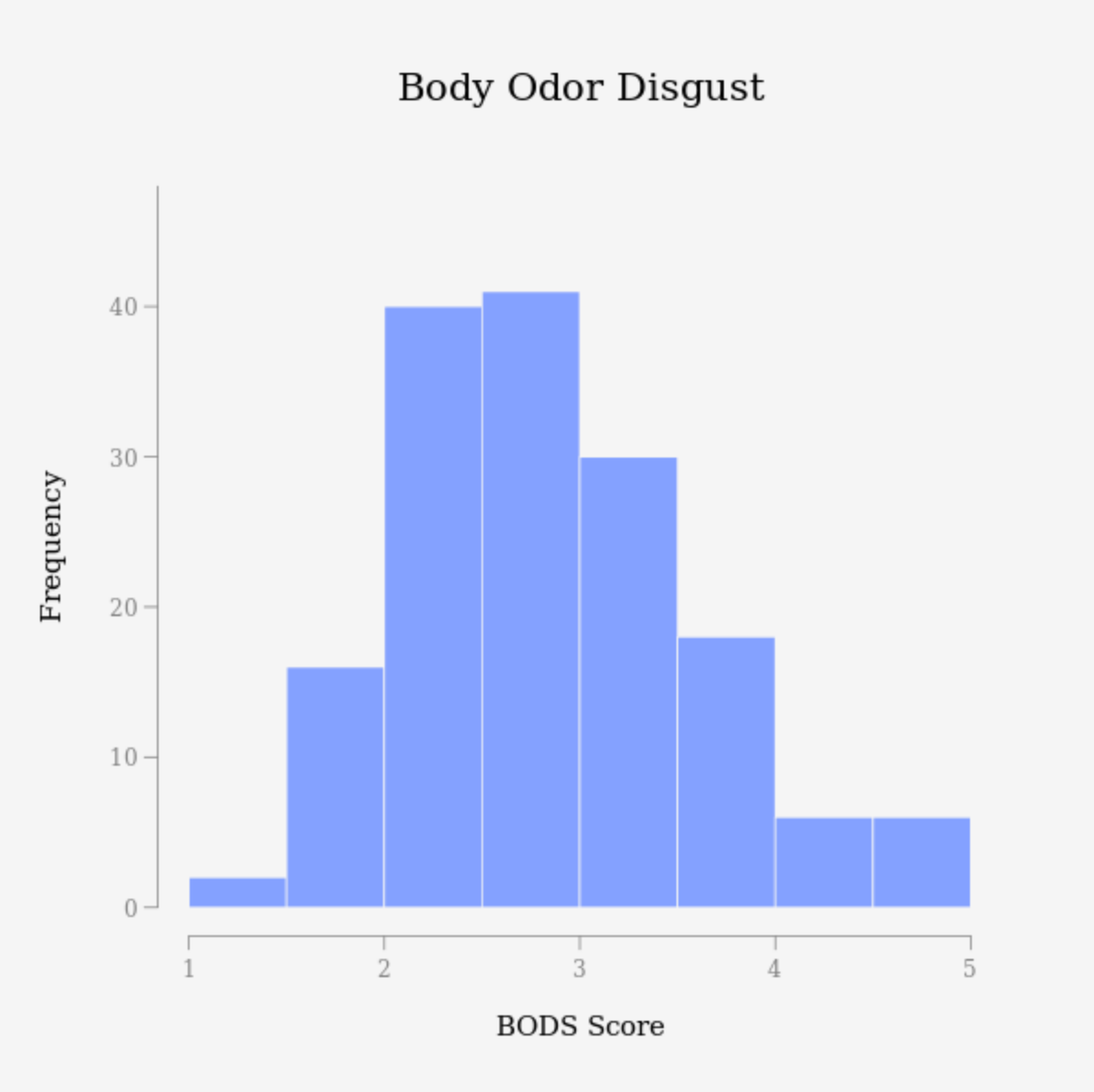
Full credit will be given in this problem for a writeup that:

a) [1 pt] Includes appropriate background and exploratory analysis that informs your decision about the correct confidence interval procedure to use

b) [1 pt] Contains relevant, necessary and correct (R code and) software output

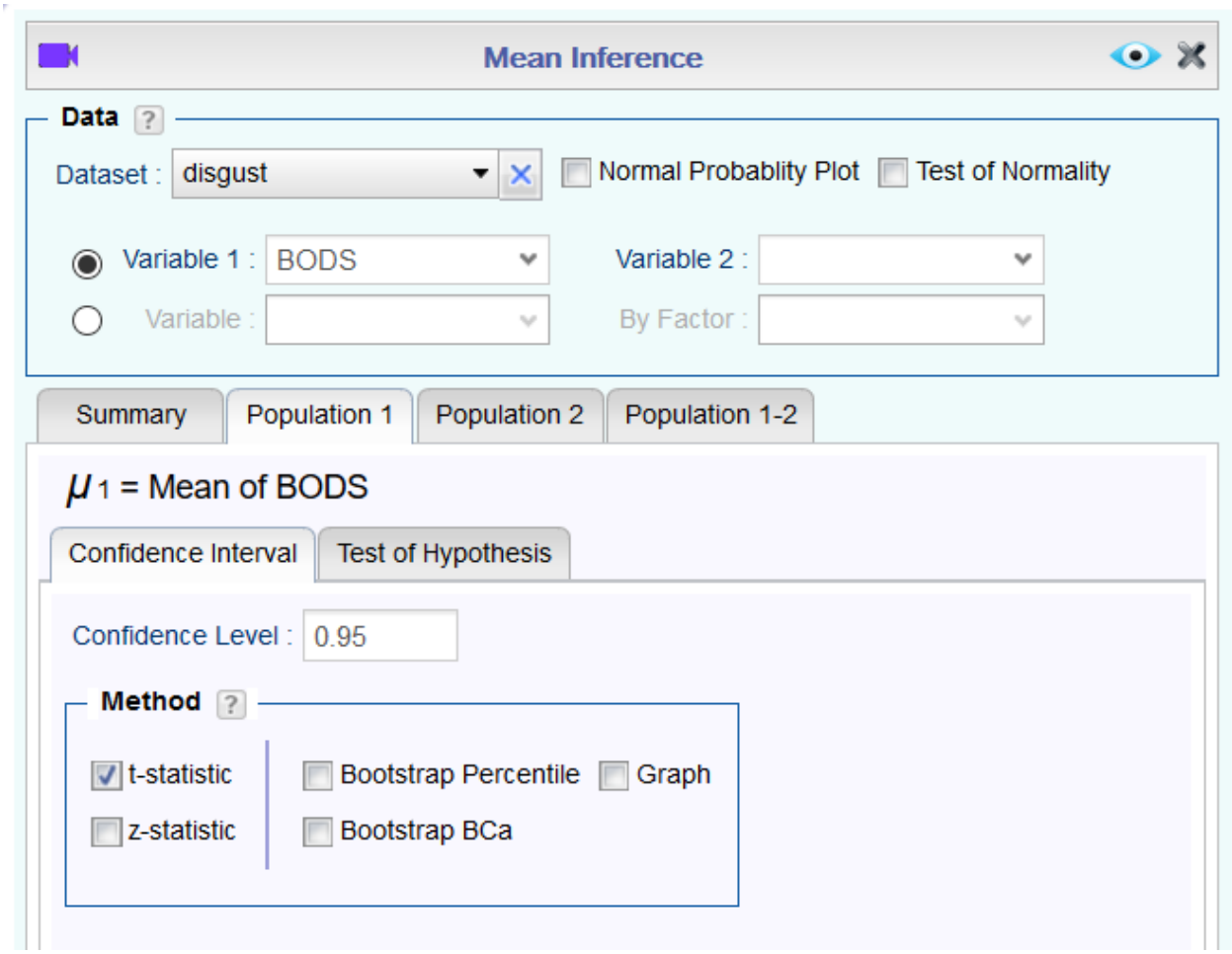
c) [2 pts] Correctly interprets the confidence interval in the context of the problem.

Although we have many different variables, we are only interested in one numerical variable, BODS. This suggests we are in the one-mean inference domain. With a sample size of 159, we are plenty good to use t-confidence intervals, but just in case you wanted to check:



The sample is skewed right, but not horribly so, and there are not any obvious outliers.

We perform the one-sample t confidence interval:



And we get the following output:

t-Based Confidence Interval

95% Confidence interval

Variable	Mean	Std Error	DF	Lower CL	Upper CL	Margin of Error
BODS	2.88434	0.0591339	158	2.76754	3.00113	0.116795

The 95% CI is (2.77, 3.00).

Interpretation: We are 95% confident that the population mean BODS score is between 2.77 and 3.00.

Alternative interpretation: We estimate the population mean BODS score to be 2.88. We are 95% confident that our estimate is within 0.059 of the actual population mean value.