Week 10 Quiz: One-sample Tests

Problem 1

A researcher wants to use a one-sample t-test to see if the average height of a certain species of plant differs from the known national average of 15 cm. The most important assumption for this test is:

a) The sample of plants was randomly selected.
b) The heights of the plants are normally distributed in the sample.
c) The population standard deviation is known.
d) The sample size is greater than 30.

Answer: B

Problem 2.

A quality control manager is testing if the average weight of cereal boxes is 500 grams. He weighs 25 boxes. For the one-sample t-test to be valid, what assumption is made about the 25 weight measurements?

a) They are a simple random sample from the population of cereal boxes.
b) They are independent of each other.
c) They come from a population that is approximately normally distributed.
d) All of the above.

Answer: D

Problem 3

The degrees of freedom for a one-sample t-test are calculated as:
a) n
b) $n - 1$
c) σ
d) $\sqrt{n}$

Answer: B

Problem 4

The general formula for the test statistic in a one-sample t-test is:

a) $t = \frac{\bar{x}-\mu}{s}$

b) $t = \frac{\bar{x}-\mu}{s/\sqrt{n}}$

c) $t = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$

d) $t = \frac{\bar{x}-s}{\mu/\sqrt{n}}$

Answer: C

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Problem 5

A researcher calculates a sample mean ($\bar{x}$) of 110, a sample standard deviation (s) of 15, from a sample size (n) of 16. If the null hypothesis states the population mean (μ_0) is 100, what is the calculated t-statistic?

a) 0.67
b) 2.67
c) 10.0
d) 1.67

Answer: B

Problem 6

If a sample mean is 50, the hypothesized population mean is 52, and the standard error is 0.8, what is the value of the t-test statistic?

a) -2.5
b) 2.5
c) -0.25
d) 1.6

Answer: A

Problem 7

The margin of error for a one-sample t confidence interval is calculated as:

a) $t_{\alpha/2} \cdot s$
b) $t_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$
c) $z_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$
d) $\bar{x} \pm t_{\alpha/2}$

Answer: B

Problem 8

Which factor does NOT affect the width of the margin of error in a one-sample t-test confidence interval?
a) The sample mean ($\bar{x}$)
b) The sample size (n)
c) The sample standard deviation (s)
d) The confidence level

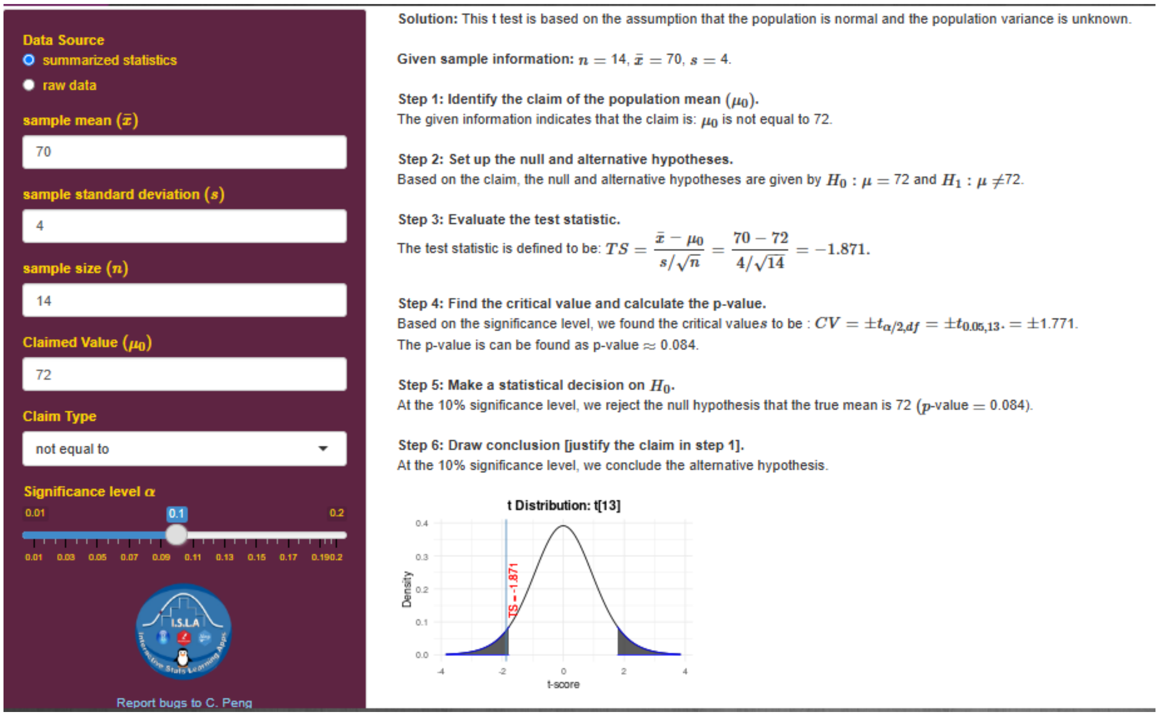
Answer: A

Problem 9

A seed packet claims that the average height of a certain sunflower variety is 72 inches. A gardener plants 14 seeds, and the average height at maturity is 70 inches with a standard deviation of 4 inches. She tests if the mean is different from the claim using α=0.10. What is the decision?

a) Fail to reject H_0. The average height is not significantly different from 72 inches.
b) Reject H_0. The average height is significantly different from 72 inches.
c) Reject H_0. The average height is exactly 72 inches.
d) Fail to reject H_0. The seeds grew taller than claimed.

Answer: B



Problem 10

For a left-tailed test (H_a: $\mu < \mu_0$) with α=0.01 and df=22, the critical value is -2.508. If the calculated t-statistic is -1.85, the decision is:

a) Reject H_0, as -1.85 < -2.508.
b) Fail to reject H_0, as -1.85 > -2.508.
c) Reject H_0, as -1.85 is negative.
d) Fail to reject H_0, as -1.85 is not less than -2.508.

Answer: B

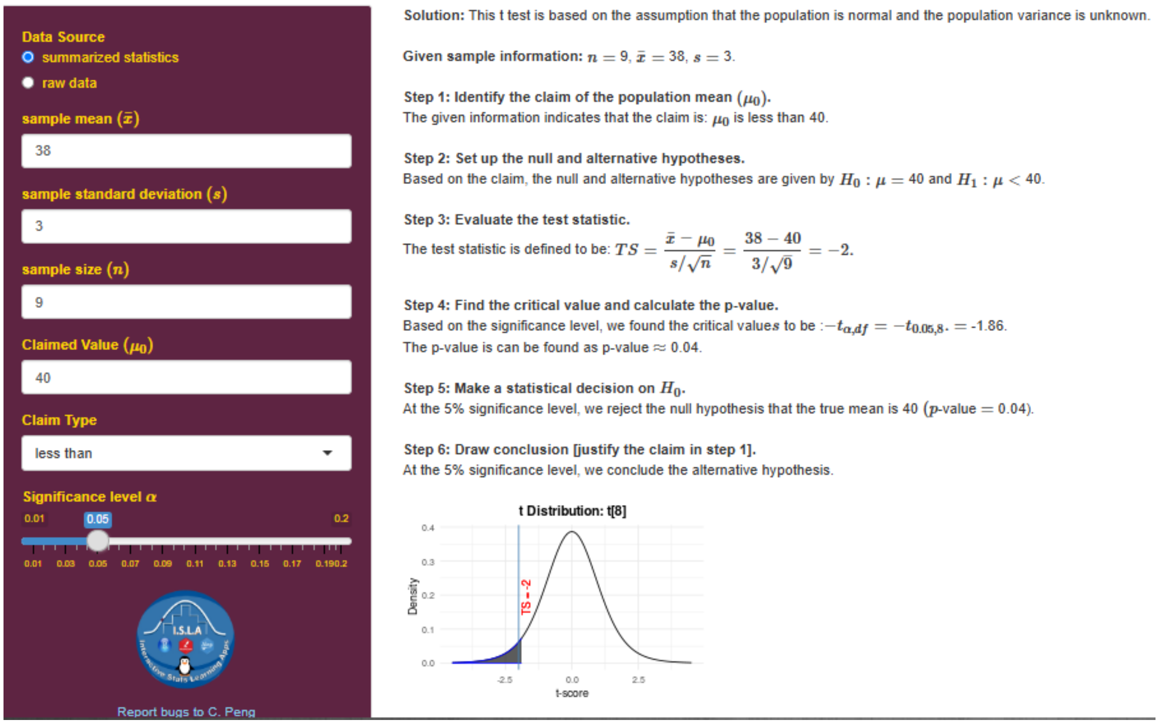
Problem 11

A car company claims its new model gets 40 MPG. A consumer group tests 9 cars and finds a mean of 38 MPG with a standard deviation of 3 MPG. They want to test if the true average is less than 40 MPG (α=0.05, critical value = -1.860). The calculated t-statistic is -2.0. What should they conclude?

a) Reject H_0. There is sufficient evidence that the average MPG is less than 40.

b) Fail to reject H_0. There is not sufficient evidence that the average MPG is less than 40.
c) Reject H_0. There is sufficient evidence that the average MPG is 40.
d) Fail to reject H_0. There is sufficient evidence that the average MPG is 40.

Answer: A



Problem 12

A smartphone manufacturer claims its battery lasts 15 hours on a full charge. A tech reviewer tests 22 phones and finds a mean battery life of 14.5 hours with a standard deviation of 1.2 hours. He conducts a left-tailed test at α=0.05. The critical t-value is -1.721. What is the calculated t-statistic?
a) -0.42
b) -1.96
c) -2.05
d) -1.72

Answer: B

$$\frac{14.5-15}{1.2/\sqrt{22}} = \frac{-0.5}{0.2558} \approx -1.955.$$

Problem 13

A piano tuner knows that middle C should have a frequency of 261.6 Hz. He checks the tuning of 8 pianos in a concert hall and finds the average frequency for middle C is 262.1 Hz with a standard deviation of 0.5 Hz. He performs a two-tailed test to see if the pianos are out of tune (α=0.05, critical values = ±2.365). What is the value of the test statistic?

a) 0.63
b) 1.00
c) 2.53
d) 2.83

Answer: D

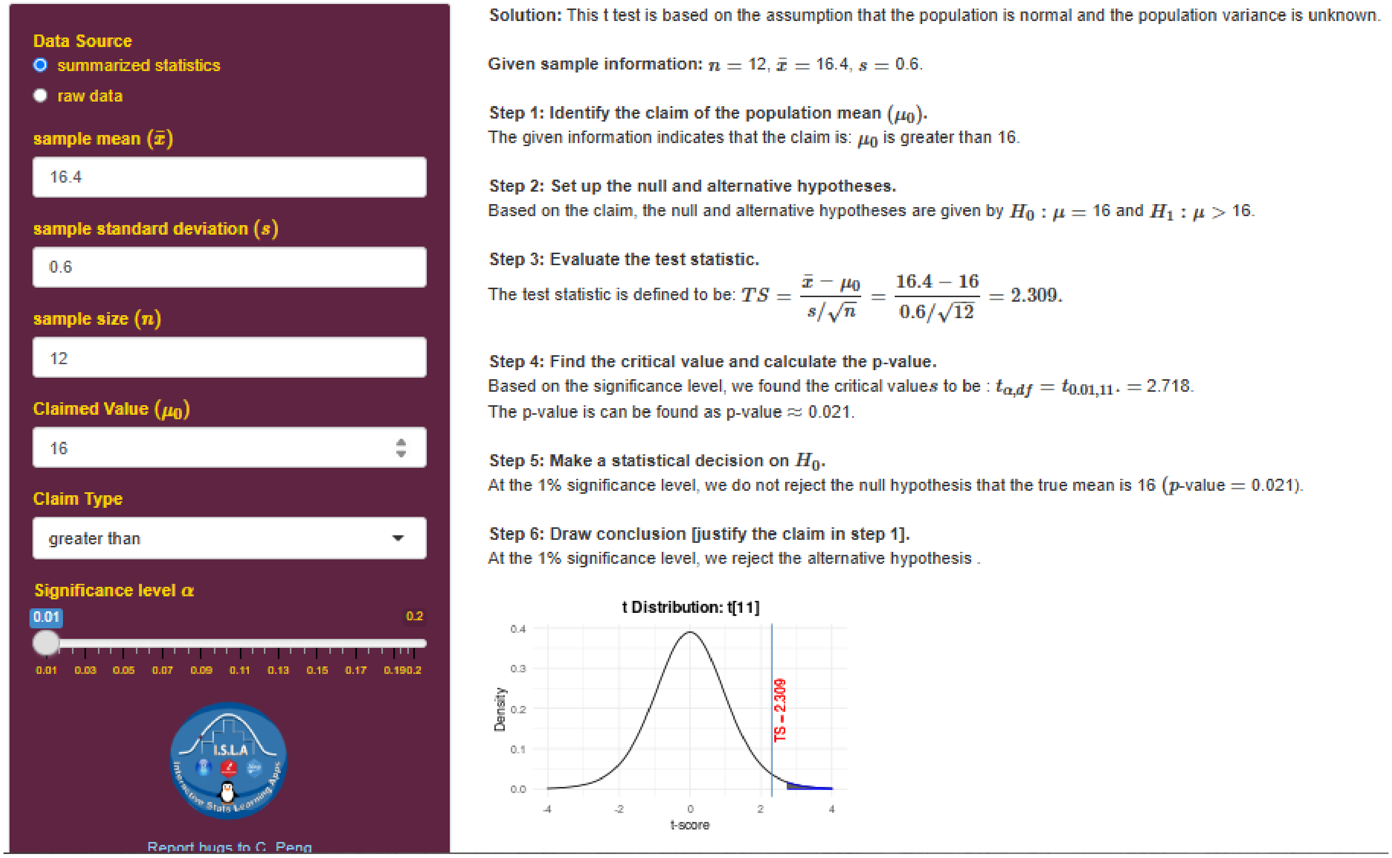
$$\frac{262.1-261.6}{0.5/\sqrt{8}} = \frac{0.5}{0.1768} \approx 2.83$$

Problem 14

A coffee shop's menu states that its large coffee contains 16 oz. An employee thinks the machine is dispensing more and secretly measures 12 cups, finding a mean of 16.4 oz with a standard deviation of 0.6 oz. She runs a right-tailed test at α=0.01. What is the conclusion?

a) Reject H_0. There is significant evidence that the mean volume is greater than 16 oz.
b) Fail to reject H_0. There is not significant evidence that the mean volume is greater than 16 oz.
c) Reject H_0. The machine is dispensing exactly 16 oz.
d) Fail to reject H_0. The machine is under-filling the cups.

Answer: B

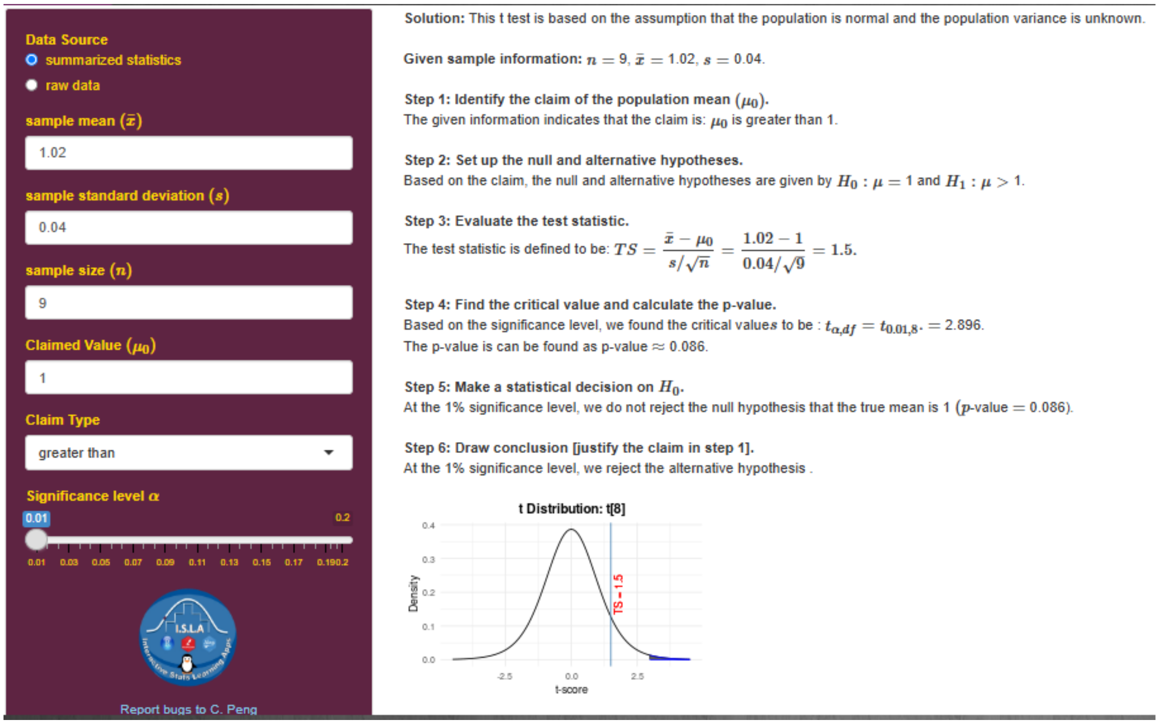


Problem 15

A mint produces gold coins that should weigh 1 ounce. A collector weighs 9 coins and finds a mean weight of 1.02 ounces with a standard deviation of 0.04 ounces. To test if the coins are overweight (a right-tailed test) at $\alpha=0.01$. What is the correct decision?

a) Reject H_0. There is evidence the coins are overweight.
b) Fail to reject H_0. There is no evidence the coins are overweight.
c) Reject H_0. The coins are underweight.
d) Fail to reject H_0. The coins weigh exactly 1 ounce.

Answer: B



Summary of the Weekly Assignment

The boxplot is a geometric representation of the five-number summary. The boxplot of the given data set is given below.