

STATISTICS

Multiple choices

1. For A and B below, select the statements that accurately describe how we use p-values to come to statistical decisions. There are multiple correct answers for each problem; select all that apply.

A.

- ☐ If $p > 0.05$, the difference is statistically significant. ☐
- *If $p > 0.05$, the difference is not statistically significant.* ☐
- If $p < 0.05$, the difference is not statistically significant. ☐
- *If $p < 0.05$, the difference is statistically significant.*
-

B.

- ☐ *If $p > 0.05$, we FTR H_0*
- ☐ If $p < 0.05$, we FTR H_0 ☐
- *If $p < 0.05$, we reject H_0* ☐
- If $p > 0.05$, we reject H_0

2. Suppose we are comparing average scores on a test for two groups that used different study techniques. The null hypothesis is that $\mu_1 - \mu_2 = 0$

A. If $\mu_1 = 84$ and $\mu_2 = 80$, which of the following are true (select all that apply)?

- ☐ If we fail to reject H_0 , we are making the correct decision ☐
- If we fail to reject H_0 , we are committing a Type I error
- ☐ *If we fail to reject H_0 , we are committing a Type II error* ☐
- *If we reject H_0 , we making the correct decision* ☐
- If we reject H_0 , we are committing a Type I error ☐
- If we reject H_0 , we are committing a Type II error

If $\mu_1 = 76$ and $\mu_2 = 76$, which of the following are true (select all that apply)?

- ☐ *If we fail to reject H_0 , we are making the correct decision*
- If we fail to reject H_0 , we are committing a Type I error ☐
- If we fail to reject H_0 , we are committing a Type II error ☐
- If we reject H_0 , we making the correct decision ☐
- *If we reject H_0 , we are committing a Type I error* ☐
- If we reject H_0 , we are committing a Type II error

3. Which statements accurately describe the relationship between a two-sided hypothesis test using $\alpha = 0.05$, and a 95% confidence interval? Select all that apply.

- ☐ *The 95% CI contains all the possible hypothesized values that we would fail to reject.* ☐
- *The 95% CI excludes all the possible hypothesized values that we would reject.* ☐
- The 95% CI contains all the possible hypothesized values that we would reject. ☐
- The 95% CI excludes all the possible hypothesized values that we would fail to reject.
- ☐ *If we FTR H_0 , the hypothesized value will be inside the 95% CI* ☐
- If we FTR H_0 , the hypothesized value will be outside the 95% CI ☐

○ If we reject H_0 , the hypothesized value will be inside the 95% CI ☐

○ *If we reject H_0 , the hypothesized value will be outside the 95% CI*

4. Find the p-value for each of these situations. Be sure to take into account whether the test is left sided, right sided, or two sided.

Note that when testing the value of a single population mean (rather than a difference in means), degrees of freedom are $df = n - 1$.

Round all answers to three decimal places

a. $H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 > 0$

$df = 29$

t-statistic = 1.73

p-value = _____

solution

This is a right sided test, using technology at $\alpha = 0.05$

The P-Value is 0.047

b. $H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 < 0$

$df = 72$

t-statistic = -1.61

p-value = _____

solution

This is a left sided test, using technology at $\alpha = 0.05$

The P-Value is 0.056

c. $H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 \neq 0.$

$df = 7$

t-statistic = 2.21

p-value =

solution

This is a two sided test, using technology at $\alpha = 0.05$

The P-Value is = 0.063

d. $H_0: \mu = 797$

$H_A: \mu > 797$

$n = 140$

t-statistic = 1.95

p-value =

solution

This is a right sided test, using technology at $\alpha = 0.05$, $df = 139$

The P-Value is = 0.027

e. $H_0: \mu = 2550$

$H_A: \mu < 2550$

$n = 65$

t-statistic = -1.67

p-value =

solution

This is a left sided test, using technology at $\alpha = 0.05$, $df = 64$

The P-Value is ≈ 0.050

f. $H_0: \mu = 3800$

$H_A: \mu \neq 3800.$

$n = 20$

t-statistic = -2.49

p-value =

solution

This is a two sided test, using technology at $\alpha = 0.05$, $df = 19$

The P-Value is 0.022

6. In a pilot study for testing the "truth" to the theory that, on average, U.S. adults gain weight between Thanksgiving and January, a research team looked at responses from 8 randomly selected U.S. adults. The subjects were weighed (lb) on the day before Thanksgiving and again on January 3rd. The raw data are found in Table 1. Let $\alpha = 0.01$

Table 1: Weights (lb) before Thanksgiving and on Jan. 3rd for 8 U.S. adults

Pre- Than ksgivi ng	155.0	159.9	161.0	153.8	154.5	153.0	160.1	154.5
Jan. 3 rd	156.9	163.1	160.6	159.6	159.6	161.4	156.7	159.7
Diff								

Since the researchers believe that adults, on average, gain weight you should compute the differences as Jan. 3 - PreThanksgiving and expect positive numbers.

- a. Fill in the missing table cells for the weight differences per the directions outlined in the bottom caption.

Pre-Thanksgiving	155	159.9	161	153.8	154.5	153	160.1	154.5
Jan. 3 rd	156.9	163.1	160.6	159.6	159.6	161.4	156.7	159.7
Diff (Jan. 3 (minus) - PreThanksgiving)	1.9	3.2	-0.4	5.8	5.1	8.4	-3.4	5.2

- b. The researchers want to know if the data provide strong evidence that, on average, U.S. adults gain weight between Thanksgiving and January.

The appropriate null/alternative hypothesis pair for this study is:

- ☐ $H_0: \mu_1 - \mu_2 = 0 ; H_A: \mu_1 - \mu_2 \neq 0$ ☐
- ☐ $H_0: \mu_1 - \mu_2 = 0 ; H_A: \mu_1 - \mu_2 > 0$ ☐
- ☒ $H_0: \mu_d = 0 ; H_A: \mu_d > 0$ ☐
- ☐ $H_0: \mu_1 - \mu_2 = 0 ; H_A: \mu_1 - \mu_2 < 0$ ☐
- ☐ $H_0: \mu_d = 0 ; H_A: \mu_d < 0$ ☐
- ☐ $H_0: \mu_d = 0 ; H_A: \mu_d \neq 0$

c. The test statistic for this data set is:

Note: Round your answer to the nearest hundredth.

$$t = \frac{(x_2 - x_1) - \mu d}{s_d / \sqrt{n}}$$
$$t = \frac{3.225}{3.772 / \sqrt{8}}$$
$$= 2.418$$

d. The p-value for this study is:

Note: round your answer to 4 decimal precision

solution

it's a right tail test, p value at $df = 7$, and $\alpha = 0.01$

p value = 0.023

e. Based on this we: Select...

- ☐ Reject H_0 because the p-value is less than the significance level ☐
- ☐ Reject H_0 because the p-value is greater than the significance level ☐
- ☐ FTR H_0 because the p-value is less than the significance level ☐

- FTR H_0 because the p-value is greater than the significance level ☐
- Reject H_A because the p-value is greater than the significance level ☐
- FTR H_A because the p-value is greater than the significance level ☐

7. A "sleep habits" survey answered by 27 randomly selected New Yorkers contained the question "How much sleep do you get per night?" The sample average was 7.75 hours, with a corresponding sample standard deviation of 0.8 hours. Conduct a hypothesis test to see if there is evidence that New Yorkers (who live, after all, in "the city that never sleeps") on average get less than 8 hours of sleep per night, using $\alpha=0.05$.

a. The t test statistic is: _____

Round your answer to 3 decimal places

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

$$t = \frac{7.75 - 8}{0.8/\sqrt{27}}$$

$$t = -1.624$$

b. What is probability that we would obtain a test statistic at least this extreme if the population mean sleep time for New Yorkers was *not* less than 8 hours per night? _____

Hint: the phrasing of this question is based on the definition of a particular statistic. Round your answer to 3 decimal places

solution

this is the p value when using $\alpha=0.05$, with $df=(27-1)=26$,

t-stat=-1.624

using technology , p value = 0.058

c. Using a level of significance of 0.05, the data (“select” between provides statistically significant or does not provide statistically significant) evidence to suggest that New Yorkers on average get less than 8 hours of sleep per night.

You have one attempt for this question, so you should verify that your answer to part b. is correct before submitting an answer to this.

Does NOT provide statistically significant

8. Each question below has multiple correct answers, and you must select all correct answers and no incorrect answers for full credit.

a. Suppose we are testing $H_0: \mu_1 - \mu_2 = 0$, and we commit a Type II error. Which of the following statements are true, assuming we use $\alpha = 0.05$? Select all that apply.

- ☐ We reject H_0 ☐
- ☐ *We FTR H_c* ☐
- ☐ *The p-value is greater than 0.05* ☐
- ☐ The p-value is less than 0.05 ☐
- ☐ $\mu_1 = \mu_2$ ☐
- ☐ $\mu_1 \neq \mu_2$ ☐
- ☐ The difference in sample means is statistically significant ☐
- ☐ *The difference in sample means is not statistically significant*

b. Suppose we are planning to test $H_0: \mu_1 - \mu_2 = 0$, and in truth $\mu_1 = \mu_2$. Which of the following statements are true, assuming we have not yet collected the data and we plan to use $\alpha = 0.05$? Select all that apply.

- ☒ *H_0 is true*
- ☐ H_0 is false ☐
- ☒ *There is a 95% chance that the 95% CI for $\mu_1 - \mu_2$ will contain zero* ☐
- ☐ There is a 5% chance that the 95% CI for $\mu_1 - \mu_2$ will contain zero ☐
- ☐ There is a 95% chance that the p-value will be less than 0.05 ☐
- ☒ *There is a 5% chance that the p-value will be less than 0.05* ☐
- ☒ *If we reject H_0 , we will be committing a Type I error* ☐
- ☐ If we FTR H_0 , we will be committing a Type II error

c. Suppose we are testing $H_0: \mu_1 - \mu_2 = 0$, and we get a test statistic of $t = -1.15$. Which of the following statements are true, given this result and assuming we use $\alpha = 0.05$? Select all that apply

- ☐ ☐ *The p-value is greater than 0.05* ☐
- ☐ The p-value is less than 0.05 ☐

- The difference in sample means is statistically significant ☐
- *The difference in sample means is not statistically significant* ☐
- We reject H_0 ☐
- *We FTR H_0* ☐
- *The corresponding 95% CI should contain zero* ☐
- The corresponding 95% CI should not contain zero ☐
- It is possible we have committed a Type I error
- ☐ *It is possible we have committed a Type II error*

9. Which of the following statements are true regarding one sided and two sided hypothesis tests? There are two correct answers; you must select both correctly.

Note: you should assume that a one sided test is not being performed on the 'wrong' side. For example, if the test statistic is positive, then assume the test is right sided and not left sided.

Hint: you should consider what happens to the p-value when going from a one sided to a two sided test, or from a two sided to a one sided test.

- ☐ Rejecting H_0 for a one sided test implies that you would also reject H_0 for the corresponding two sided test at the same significance level ☐
- *Failing to reject H_0 for a one sided test implies that you would fail to reject H_0 for the corresponding two sided test at the same significance level* ☐

- *Rejecting H_0 for a two sided test implies that you would also reject H_0 for the corresponding one sided test at the same significance level* ☐
- Failing to reject H_0 for a two sided test means that you will reject H_0 for the corresponding one sided test at the same significance level ☐
- Failing to reject H_0 for a two sided test implies that you would also fail to reject H_0 for the corresponding one sided test at the same significance level ☐
- Rejecting H_0 for a one sided test implies that you would fail to reject H_0 for the corresponding two sided test at the same significance level