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Assignment: HW: Chapter 9 - DUE
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1. A newspaper published an article about a study in which researchers subjected laboratory gloves to stress. Among 236 vinyl gloves, 56% leaked viruses. Among 236 latex gloves, 10% leaked viruses. Using the accompanying display of the technology results, and using a 0.01 significance level, test the claim that vinyl gloves have a greater virus leak rate than latex gloves. Let vinyl gloves be population 1.

¹ Click the icon to view the technology results.

What are the null and alternative hypotheses?

☐ A. $H_0: p_1 = p_2$
 $H_1: p_1 < p_2$

☐ B. $H_0: p_1 > p_2$
 $H_1: p_1 = p_2$

☐ C. $H_0: p_1 \neq p_2$
 $H_1: p_1 = p_2$

☒ D. $H_0: p_1 = p_2$
 $H_1: p_1 > p_2$

☐ E. $H_0: p_1 < p_2$
 $H_1: p_1 = p_2$

☐ F. $H_0: p_1 = p_2$
 $H_1: p_1 \neq p_2$

Identify the test statistic.

10.65

(Round to two decimal places as needed.)

Identify the P-value.

0.000

(Round to three decimal places as needed.)

What is the conclusion for this test?

The P-value is less than the significance level α , so reject the null hypothesis. There is sufficient evidence to support the claim that vinyl gloves have a greater virus leak rate than latex gloves.

1: Technology Results

Pooled proportion: 0.33

Test statistic, z: 10.6486

Critical z: 2.3264

P-value: 0.0000

98% Confidence interval:

$0.3739145 < p_1 - p_2 < 0.5498143$

2. Test the given claim. Identify the null hypothesis, alternative hypothesis, test statistic, P-value, and then state the conclusion about the null hypothesis, as well as the final conclusion that addresses the original claim. Among 2011 passenger cars in a particular region, 216 had only rear license plates. Among 398 commercial trucks, 58 had only rear license plates. A reasonable hypothesis is that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars. Use a 0.05 significance level to test that hypothesis.
- Test the claim using a hypothesis test.
 - Test the claim by constructing an appropriate confidence interval.

a. Identify the null and alternative hypotheses for this test. Let population 1 correspond to the passenger cars and population 2 correspond to the commercial trucks. Let a success be a vehicle that only has a rear license plate.

- ☐ A. $H_0: p_1 = p_2$
 $H_1: p_1 \neq p_2$
- ☐ B. $H_0: p_1 = p_2$
 $H_1: p_1 > p_2$
- ☐ C. $H_0: p_1 < p_2$
 $H_1: p_1 = p_2$
- ☒ D.

Identify the test statistic.

(Round to two decimal places as needed.)

Identify the P-value.

(Round to three decimal places as needed.)

State the conclusion about the null hypothesis, as well as the final conclusion that addresses the original claim.

- ☐ A. Reject H_0 . There is not sufficient evidence to support the claim that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars.
- ☒ B. Reject H_0 . There is sufficient evidence to support the claim that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars.
- ☐ C. Fail to reject H_0 . There is sufficient evidence to support the claim that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars.
- ☐ D. Fail to reject H_0 . There is not sufficient evidence to support the claim that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars.

b. Identify the confidence interval limits for the appropriate confidence interval. Let population 1 correspond to the passenger cars and population 2 correspond to the commercial trucks. Let a success be a vehicle that only has a rear license plate.

$< p_1 - p_2 <$

(Round to four decimal places as needed.)

Because the confidence interval limits do not contain 0, there is a significant difference between the two proportions. There is sufficient evidence to support the claim that commercial trucks owners violate laws requiring front license plates at a higher rate than owners of passenger cars.

3. Since an instant replay system for tennis was introduced at a major tournament, men challenged 1415 referee calls, with the result that 428 of the calls were overturned. Women challenged 753 referee calls, and 217 of the calls were overturned. Use a 0.01 significance level to test the claim that men and women have equal success in challenging calls. Complete parts (a) through (c) below.

a. Test the claim using a hypothesis test.

Consider the first sample to be the sample of male tennis players who challenged referee calls and the second sample to be the sample of female tennis players who challenged referee calls. What are the null and alternative hypotheses for the hypothesis test?

- ☐ A. $H_0: p_1 = p_2$
 $H_1: p_1 < p_2$
☐ B. $H_0: p_1 \geq p_2$
 $H_1: p_1 \neq p_2$
☐ C. $H_0: p_1 \leq p_2$
 $H_1: p_1 \neq p_2$
☐ D. $H_0: p_1 \neq p_2$
 $H_1: p_1 = p_2$
☐ E. $H_0: p_1 = p_2$
 $H_1: p_1 > p_2$
☒ F. $H_0: p_1 = p_2$
 $H_1: p_1 \neq p_2$

Identify the test statistic.

$z =$

(Round to two decimal places as needed.)

Identify the P-value.

P-value =

(Round to three decimal places as needed.)

What is the conclusion based on the hypothesis test?

The P-value is greater than the significance level of $\alpha = 0.01$, so fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that women and men have equal success in challenging calls.

b. Test the claim by constructing an appropriate confidence interval.

The 99% confidence interval is $< (p_1 - p_2) <$.

(Round to three decimal places as needed.)

What is the conclusion based on the confidence interval?

Because the confidence interval limits include 0, there does not appear to be a significant difference between the two proportions. There is not sufficient evidence to warrant rejection of the claim that men and women have equal success in challenging calls.

c. Based on the results, does it appear that men and women may have equal success in challenging calls?

- ☒ A. The confidence interval suggests that there is no significant difference between the success of men and women in challenging calls.
 ☐ B. The confidence interval suggests that there is a significant difference between the success of men and women in challenging calls. It is reasonable to speculate that men have more success.
 ☐ C. The confidence interval suggests that there is a significant difference between the success of men and women in challenging calls. It is reasonable to speculate that women have more success.
 ☐ D. There is not enough information to reach a conclusion.

4. A study was conducted to determine the proportion of people who dream in black and white instead of color. Among 292 people over the age of 55, 62 dream in black and white, and among 305 people under the age of 25, 16 dream in black and white. Use a 0.01 significance level to test the claim that the proportion of people over 55 who dream in black and white is greater than the proportion for those under 25. Complete parts (a) through (c) below.

a. Test the claim using a hypothesis test.

Consider the first sample to be the sample of people over the age of 55 and the second sample to be the sample of people under the age of 25. What are the null and alternative hypotheses for the hypothesis test?

- | | | |
|---|--|---|
| ☐ A. $H_0: p_1 = p_2$
$H_1: p_1 < p_2$ | ☐ B. $H_0: p_1 = p_2$
$H_1: p_1 \neq p_2$ | ☐ C. $H_0: p_1 \geq p_2$
$H_1: p_1 \neq p_2$ |
| ☐ D. $H_0: p_1 \leq p_2$
$H_1: p_1 \neq p_2$ | ☒ E. $H_0: p_1 = p_2$
$H_1: p_1 > p_2$ | ☐ F. $H_0: p_1 \neq p_2$
$H_1: p_1 = p_2$ |

Identify the test statistic.

$z =$

(Round to two decimal places as needed.)

Identify the P-value.

P-value =

(Round to three decimal places as needed.)

What is the conclusion based on the hypothesis test?

The P-value is less than the significance level of $\alpha = 0.01$, so reject the null hypothesis. There is sufficient evidence to support the claim that the proportion of people over 55 who dream in black and white is greater than the proportion for those under 25.

b. Test the claim by constructing an appropriate confidence interval.

The 98% confidence interval is $< (p_1 - p_2) <$.

(Round to three decimal places as needed.)

What is the conclusion based on the confidence interval?

Because the confidence interval limits do not include 0, it appears that the two proportions are not equal. Because the confidence interval limits include only positive values, it appears that the proportion of people over 55 who dream in black and white is greater than the proportion for those under 25.

c. An explanation for the results is that those over the age of 55 grew up exposed to media that was displayed in black and white. Can these results be used to verify that explanation?

- ☐ A. Yes. The results can be used to verify the given explanation because the difference in proportions is practically significant.
- ☐ B. No. The results speak to a possible difference between the proportions of people over 55 and under 25 who dream in black and white, but the results are not statistically significant enough to verify the cause of such a difference.
- ☐ C. Yes. The results can be used to verify the given explanation because the difference in proportions is statistically significant.
- ☒ D. No. The results speak to a possible difference between the proportions of people over 55 and under 25 who dream in black and white, but the results cannot be used to verify the cause of such a difference.

5. Rhino viruses typically cause common colds. In a test of the effectiveness of echinacea, 38 of the 43 subjects treated with echinacea developed rhinovirus infections. In a placebo group, 74 of the 91 subjects developed rhinovirus infections. Use a 0.05 significance level to test the claim that echinacea has an effect on rhinovirus infections. Complete parts (a) through (c) below.

a. Test the claim using a hypothesis test.

Consider the first sample to be the sample of subjects treated with echinacea and the second sample to be the sample of subjects treated with a placebo. What are the null and alternative hypotheses for the hypothesis test?

- | | | |
|---|---|---|
| ☐ A. $H_0: p_1 \geq p_2$
$H_1: p_1 \neq p_2$ | ☐ B. $H_0: p_1 = p_2$
$H_1: p_1 < p_2$ | ☐ C. $H_0: p_1 = p_2$
$H_1: p_1 > p_2$ |
| ☐ D. $H_0: p_1 \neq p_2$
$H_1: p_1 = p_2$ | ☐ E. $H_0: p_1 \leq p_2$
$H_1: p_1 \neq p_2$ | ☒ F. $H_0: p_1 = p_2$
$H_1: p_1 \neq p_2$ |

Identify the test statistic.

$z =$

(Round to two decimal places as needed.)

Identify the P-value.

P-value =

(Round to three decimal places as needed.)

What is the conclusion based on the hypothesis test?

The P-value is greater than the significance level of $\alpha = 0.05$, so fail to reject the null hypothesis. There is not sufficient evidence to support the claim that echinacea treatment has an effect.

b. Test the claim by constructing an appropriate confidence interval.

The 95% confidence interval is $< (p_1 - p_2) <$.

(Round to three decimal places as needed.)

What is the conclusion based on the confidence interval?

Because the confidence interval limits include 0, there does not appear to be a significant difference between the two proportions. There is not evidence to support the claim that echinacea treatment has an effect.

c. Based on the results, does echinacea appear to have any effect on the infection rate?

- ☒ A. Echinacea does not appear to have a significant effect on the infection rate.
- ☐ B. Echinacea does appear to have a significant effect on the infection rate. There is evidence that it lowers the infection rate.
- ☐ C. Echinacea does appear to have a significant effect on the infection rate. There is evidence that it increases the infection rate.
- ☐ D. The results are inconclusive.

6. In a random sample of males, it was found that 18 write with their left hands and 210 do not. In a random sample of females, it was found that 55 write with their left hands and 434 do not. Use a 0.01 significance level to test the claim that the rate of left-handedness among males is less than that among females. Complete parts (a) through (c) below.

a. Test the claim using a hypothesis test.

Consider the first sample to be the sample of males and the second sample to be the sample of females. What are the null and alternative hypotheses for the hypothesis test?

- ☐ A. $H_0: p_1 = p_2$
☐ B. $H_0: p_1 = p_2$
☐ C. $H_0: p_1 \neq p_2$
- ☐ D. $H_0: p_1 \geq p_2$
 $H_1: p_1 \neq p_2$
☒ E. $H_0: p_1 = p_2$
 $H_1: p_1 < p_2$
☐ F. $H_0: p_1 \leq p_2$
 $H_1: p_1 \neq p_2$

Identify the test statistic.

$$z = -1.38$$

(Round to two decimal places as needed.)

Identify the P-value.

$$P\text{-value} = 0.083$$

(Round to three decimal places as needed.)

What is the conclusion based on the hypothesis test?

The P-value is greater than the significance level of $\alpha = 0.01$, so fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the rate of left-handedness among males is less than that among females.

b. Test the claim by constructing an appropriate confidence interval.

$$\text{The 98\% confidence interval is } -0.087 < (p_1 - p_2) < 0.020.$$

(Round to three decimal places as needed.)

What is the conclusion based on the confidence interval?

Because the confidence interval limits include 0, it appears that the two rates of left-handedness are equal. There is not sufficient evidence to support the claim that the rate of left-handedness among males is less than that among females.

c. Based on the results, is the rate of left-handedness among males less than the rate of left-handedness among females?

- ☐ A. The rate of left-handedness among males does appear to be less than the rate of left-handedness among females because the results are not statistically significant.
- ☐ B. The rate of left-handedness among males does appear to be less than the rate of left-handedness among females because the results are statistically significant.
- ☒ C. The rate of left-handedness among males does not appear to be less than the rate of left-handedness among females.
- ☐ D. The results are inconclusive.

7. Data on the weights (lb) of the contents of cans of diet soda versus the contents of cans of the regular version of the soda is summarized to the right. Assume that the two samples are independent simple random samples selected from normally distributed populations, and do not assume that the population standard deviations are equal. Complete parts (a) and (b) below. Use a 0.05 significance level for both parts.

	Diet	Regular
μ	μ_1	μ_2
n	31	31
$\bar{x}$	0.79428 lb	0.81085 lb
s	0.00446 lb	0.00748 lb

a. Test the claim that the contents of cans of diet soda have weights with a mean that is less than the mean for the regular soda.

What are the null and alternative hypotheses?

- ☐ A. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$
☒ B. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 < \mu_2$
☐ C. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$
☐ D. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 < \mu_2$

The test statistic, t , is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

- ☐ A. Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the cans of diet soda have mean weights that are lower than the mean weight for the regular soda.
☐ B. Reject the null hypothesis. There is not sufficient evidence to support the claim that the cans of diet soda have mean weights that are lower than the mean weight for the regular soda.
☐ C. Fail to reject the null hypothesis. There is sufficient evidence to support the claim that the cans of diet soda have mean weights that are lower than the mean weight for the regular soda.
☒ D. Reject the null hypothesis. There is sufficient evidence to support the claim that the cans of diet soda have mean weights that are lower than the mean weight for the regular soda.

b. Construct a confidence interval appropriate for the hypothesis test in part (a).

lb $< \mu_1 - \mu_2 <$ lb

(Round to three decimal places as needed.)

Does the confidence interval support the conclusion found with the hypothesis test?

Yes, because the confidence interval contains only negative values.

8. A study was done using a treatment group and a placebo group. The results are shown in the table. Assume that the two samples are independent simple random samples selected from normally distributed populations, and do not assume that the population standard deviations are equal. Complete parts (a) and (b) below. Use a 0.01 significance level for both parts.

	Treatment	Placebo
μ	μ_1	μ_2
n	30	35
$\bar{x}$	2.36	2.62
s	0.94	0.59

a. Test the claim that the two samples are from populations with the same mean.

What are the null and alternative hypotheses?

- ☐ A. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$
☐ B. $H_0: \mu_1 < \mu_2$
 $H_1: \mu_1 \geq \mu_2$
☐ C. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 < \mu_2$
☒ D. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$

The test statistic, t , is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

- ☐ A. Reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the two samples are from populations with the same mean.
☐ B. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two samples are from populations with the same mean.
☒ C. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the two samples are from populations with the same mean.
☐ D. Fail to reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two samples are from populations with the same mean.

b. Construct a confidence interval suitable for testing the claim that the two samples are from populations with the same mean.

$< \mu_1 - \mu_2 <$

(Round to three decimal places as needed.)

9. A study was done on proctored and nonproctored tests. The results are shown in the table. Assume that the two samples are independent simple random samples selected from normally distributed populations, and do not assume that the population standard deviations are equal. Complete parts (a) and (b) below.

	Proctored	Nonproctored
μ	μ_1	μ_2
n	32	35
$\bar{x}$	77.11	82.69
s	10.44	21.71

- a. Use a 0.05 significance level to test the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.

What are the null and alternative hypotheses?

- ☐ A. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$
☐ B. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 < \mu_2$
☒ C. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 < \mu_2$
☐ D. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$

The test statistic, t , is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

- ☐ A. Reject H_0 . There is sufficient evidence to support the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.
☐ B. Fail to reject H_0 . There is sufficient evidence to support the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.
☐ C. Reject H_0 . There is not sufficient evidence to support the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.
☒ D. Fail to reject H_0 . There is not sufficient evidence to support the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.

- b. Construct a confidence interval suitable for testing the claim that students taking nonproctored tests get a higher mean score than those taking proctored tests.

$< \mu_1 - \mu_2 <$

(Round to two decimal places as needed.)

Does the confidence interval support the conclusion of the test?

Yes, because the confidence interval contains zero.

10. Researchers conducted a study to determine whether magnets are effective in treating back pain. The results are shown in the table for the treatment (with magnets) group and the sham (or placebo) group. The results are a measure of reduction in back pain. Assume that the two samples are independent simple random samples selected from normally distributed populations, and do not assume that the population standard deviations are equal. Complete parts (a) and (b) below.

	Treatment	Sham
μ	μ_1	μ_2
n	16	16
$\bar{x}$	0.54	0.44
s	0.87	1.28

- a. Use a 0.05 significance level to test the claim that those treated with magnets have a greater mean reduction in pain than those given a sham treatment.

What are the null and alternative hypotheses?

- ☐ A. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$
☐ B. $H_0: \mu_1 < \mu_2$
 $H_1: \mu_1 \geq \mu_2$
☒ C. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$
☐ D. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 < \mu_2$

The test statistic, t , is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that those treated with magnets have a greater mean reduction in pain than those given a sham treatment.

Is it valid to argue that magnets might appear to be effective if the sample sizes are larger?

Since the sample mean for those treated with magnets is greater than the sample mean for those given a sham treatment, it is valid to argue that magnets might appear to be effective if the sample sizes are larger.

- b. Construct a confidence interval suitable for testing the claim that those treated with magnets have a greater mean reduction in pain than those given a sham treatment.

$$-0.560 < \mu_1 - \mu_2 < 0.760$$

(Round to three decimal places as needed.)

11. Given in the table are the BMI statistics for random samples of men and women. Assume that the two samples are independent simple random samples selected from normally distributed populations, and do not assume that the population standard deviations are equal. Complete parts (a) and (b) below. Use a 0.05 significance level for both parts.

	Male BMI	Female BMI
μ	μ_1	μ_2
n	43	43
$\bar{x}$	27.6324	25.7704
s	7.435472	5.928074

a. Test the claim that males and females have the same mean body mass index (BMI).

What are the null and alternative hypotheses?

- ☐ A. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 < \mu_2$
☐ B. $H_0: \mu_1 \geq \mu_2$
 $H_1: \mu_1 < \mu_2$
☒ C. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$
☐ D. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$

The test statistic, t , is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

- ☒ A. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that men and women have the same mean BMI.
☐ B. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that men and women have the same mean BMI.
☐ C. Fail to reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that men and women have the same mean BMI.
☐ D. Reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that men and women have the same mean BMI.

b. Construct a confidence interval suitable for testing the claim that males and females have the same mean BMI.

$< \mu_1 - \mu_2 <$

(Round to three decimal places as needed.)

Does the confidence interval support the conclusion of the test?

Yes, because the confidence interval contains zero.

12. Listed in the data table are IQ scores for a random sample of subjects with medium lead levels in their blood. Also listed are statistics from a study done of IQ scores for a random sample of subjects with high lead levels. Assume that the two samples are independent simple random samples selected from normally distributed populations. Do not assume that the population standard deviations are equal. Complete parts (a) and (b) below.

² Click the icon to view the data table of IQ scores.

a. Use a 0.01 significance level to test the claim that the mean IQ scores for subjects with medium lead levels is higher than the mean for subjects with high lead levels.

What are the null and alternative hypotheses? Assume that population 1 consists of subjects with medium lead levels and population 2 consists of subjects with high lead levels.

- ☐ A. $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 > \mu_2$
- ☐ B. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$
- ☐ C. $H_0: \mu_1 \leq \mu_2$
 $H_1: \mu_1 > \mu_2$
- ☒ D. $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$

The test statistic is 0.46. (Round to two decimal places as needed.)

The P-value is 0.324. (Round to three decimal places as needed.)

State the conclusion for the test.

- ☒ A. Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that subjects with medium lead levels have higher IQ scores.
- ☐ B. Reject the null hypothesis. There is not sufficient evidence to support the claim that subjects with medium lead levels have higher IQ scores.
- ☐ C. Reject the null hypothesis. There is sufficient evidence to support the claim that subjects with medium lead levels have higher IQ scores.
- ☐ D. Fail to reject the null hypothesis. There is sufficient evidence to support the claim that subjects with medium lead levels have higher IQ scores.

b. Construct a confidence interval suitable for testing the claim that the mean IQ scores for subjects with medium lead levels is higher than the mean for subjects with high lead levels.

$$\underline{-9.00} < \mu_1 - \mu_2 < \underline{13.01}$$

(Round to two decimal places as needed.)

Does the confidence interval support the conclusion of the test?

Yes, because the confidence interval contains zero.

2: IQ Scores

Medium Lead Level	High Lead Level
72	$n_2 = 11$
88	
92	$\bar{x}_2 = 89.176$
85	
89	$s_2 = 10.048$
97	
83	
92	
103	
111	
91	

13. Listed below are the numbers of years that archbishops and monarchs in a certain country lived after their election or coronation. Assume that the two samples are independent simple random samples selected from normally distributed populations. Do not assume that the population standard deviations are equal. Use a 0.05 significance level to test the claim that the mean longevity for archbishops is less than the mean for monarchs after coronation. All measurements are in years.

³ Click the icon to view the table of longevities of archbishops and monarchs.

What are the null and alternative hypotheses? Assume that population 1 consists of the longevity of archbishops and population 2 consists of the longevity of monarchs.

- ☒ **A.** $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 < \mu_2$
- ☐ **B.** $H_0: \mu_1 \leq \mu_2$
 $H_1: \mu_1 > \mu_2$
- ☐ **C.** $H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 \neq \mu_2$
- ☐ **D.** $H_0: \mu_1 \neq \mu_2$
 $H_1: \mu_1 > \mu_2$

The test statistic is . (Round to two decimal places as needed.)

The P-value is . (Round to three decimal places as needed.)

State the conclusion for the test.

- ☐ **A.** Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that archbishops have lower mean longevity than monarchs.
- ☐ **B.** Reject the null hypothesis. There is not sufficient evidence to support the claim that archbishops have lower mean longevity than monarchs.
- ☐ **C.** Fail to reject the null hypothesis. There is sufficient evidence to support the claim that archbishops have lower mean longevity than monarchs.
- ☒ **D.** Reject the null hypothesis. There is sufficient evidence to support the claim that archbishops have lower mean longevity than monarchs.

3: Longevities of Archbishops and Monarchs

Archbishops	14	14	15	13	17	2	17	18	9	12	14	12
	12	13	14	11	15	18	8	14	12	2	15	17
Monarchs	15	15	13	11	16	16	20	17	12	16	17	19