

10.15: Solutions

1.

two proportions

3.

matched or paired samples

5.

single mean

7.

independent group means, population standard deviations and/or variances unknown

9.

two proportions

11.

independent group means, population standard deviations and/or variances unknown

13.

independent group means, population standard deviations and/or variances unknown

15.

two proportions

17.

The random variable is the difference between the mean amounts of sugar in the two soft drinks.

19.

means

21.

two-tailed

23.

the difference between the mean life spans of White and non-White people

25.

This is a comparison of two population means with unknown population standard deviations.

27.

Answers may vary.

29.

1. Reject the null hypothesis

2. $p\text{-value} < 0.05$

3. There is not enough evidence at the 5% level of significance to support the claim that life expectancy in the 1900s is different between White and non-White people.

31.

The difference in mean speeds of the fastball pitches of the two pitchers

33.

-2.46

35.

At the 1% significance level, we can reject the null hypothesis. There is sufficient data to conclude that the mean speed of Rodriguez's fastball is faster than Wesley's.

37.

Subscripts: 1 = Food, 2 = No Food

$H_0: \mu_1 \leq \mu_2$

$H_a: \mu_1 > \mu_2$

39.

 This is a normal distribution curve with mean equal to zero. The values 0 and 0.1 are labeled on the horizontal axis. A vertical line extends from 0.1 to the curve. The region under the curve to the right of the line is shaded to represent $p\text{-value} = 0.0198$.

Figure 10.18

41.

Subscripts: 1 = Gamma, 2 = Zeta

$H_0: \mu_1 = \mu_2$

$H_a: \mu_1 \neq \mu_2$

43.

0.0062

45.

There is sufficient evidence to reject the null hypothesis. The data support that the melting point for Alloy Zeta is different from the melting point of Alloy Gamma.

47.

$P_{OS1} - P_{OS2}$ = difference in the proportions of phones that had system failures within the first eight hours of operation with OS₁ and OS₂.

49.

0.1018

51.

proportions

53.

right-tailed

55.

The random variable is the difference in proportions (percents) of the populations that are of two or more races in Nevada and North Dakota.

57.

Our sample sizes are much greater than five each, so we use the normal for two proportions distribution for this hypothesis test.

59.

Answers may vary.

61.

1. Reject the null hypothesis.
2. $p\text{-value} < \alpha$
3. At the 5% significance level, there is sufficient evidence to conclude that the proportion (percent) of the population that is of two or more races in Nevada is statistically higher than that in North Dakota.

63.

the mean difference of the system failures

65.

0.0067

67.

With a $p\text{-value}$ 0.0067, we can reject the null hypothesis. There is enough evidence to support that the software patch is effective in reducing the number of system failures.

69.

0.0021

71.

 This is a normal distribution curve with mean equal to zero. The values 0 and 1.67 are labeled on the horizontal axis. A vertical line extends from 1.67 to the curve. The region under the curve to the right of the line is shaded to represent $p\text{-value} = 0.0021$.

Figure 10.19

73.

$H_0: \mu_d \geq 0$

$H_a: \mu_d < 0$

75.

0.0699

77.

We decline to reject the null hypothesis. There is not sufficient evidence to support that the medication is effective.

79.

Subscripts: 1: two-year colleges; 2: four-year colleges

1. $H_0: \mu_1 \geq \mu_2$
2. $H_a: \mu_1 < \mu_2$
3. $\bar{X}_1 - \bar{X}_2$ is the difference between the mean enrollments of the two-year colleges and the four-year colleges.
4. Student's t
5. test statistic: -0.2480
6. $p\text{-value}$: 0.4019
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Do not reject
3. Reason for Decision: $p\text{-value} > \alpha$
4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean enrollment at four-year colleges is higher than at two-year colleges.

81.

Subscripts: 1: mechanical engineering; 2: electrical engineering

1. $H_0: \mu_1 \geq \mu_2$
2. $H_a: \mu_1 < \mu_2$
3. $\bar{X}_1 - \bar{X}_2$ is the difference between the mean entry level salaries of mechanical engineers and electrical engineers.
4. t_{108}
5. test statistic: $t = -0.82$
6. $p\text{-value}$: 0.2061
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Do not reject the null hypothesis.
3. Reason for Decision: $p\text{-value} > \alpha$
4. Conclusion: At the 5% significance level, there is insufficient evidence to conclude that the mean entry-level salaries of mechanical engineers is lower than that of electrical engineers.

83.

1. $H_0: \mu_1 = \mu_2$
2. $H_a: \mu_1 \neq \mu_2$
3. $\bar{X}_1 - \bar{X}_2$ is the difference between the mean times for completing a lap in races and in practices.
4. $t_{20,32}$
5. test statistic: -4.70
6. $p\text{-value}$: 0.0001
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Reject the null hypothesis.
3. Reason for Decision: $p\text{-value} < \alpha$

4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean time for completing a lap in races is different from that in practices.

85.

1. $H_0: \mu_1 = \mu_2$
2. $H_a: \mu_1 \neq \mu_2$
3. is the difference between the mean times for completing a lap in races and in practices.
4. $t_{40,94}$
5. test statistic: -5.08
6. p -value: zero
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis.
 3. Reason for Decision: p -value $<$ alpha
 4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean time for completing a lap in races is different from that in practices.

88.

c

90.

Test: two independent sample means, population standard deviations unknown.

μ_1 = the mean price of a sociology text on the selected site.

μ_2 = the mean price of a math/science text on the selected site.

Random variable: $\bar{X}_1 - \bar{X}_2$ = the difference in the sample mean textbook price between sociology texts and math/science texts.

Hypotheses:

$H_0: \mu_1 - \mu_2 = 0$, $H_a: \mu_1 - \mu_2 < 0$ which can be expressed as
 $H_0: \mu_1 - \mu_2 = 0$, $H_a: \mu_1 - \mu_2 < 0$

Distribution for the test: Use t_{df} because each sample has more than 30 observations,
 $df = n_1 + n_2 - 2 = 33 + 33 - 2 = 64$

Estimate the critical value on the t -table using the nearest available degrees of freedom, 60. The critical value, 2.660, is found in the .0005 column.

Calculate the test statistic:

$t_c = \frac{(\bar{X}_1 - \bar{X}_2) - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(74.64 - 111.56) - 0}{\sqrt{\frac{49.36233}{33} + \frac{66.90233}{33}}} = -2.55$

Using a calculator with $t_c = -2.55$ and $df = 64$, the left-tailed p -value: Decision: Reject H_0 . Conclusion: At the 1% level of significance, from the sample data, there is sufficient evidence to conclude that the mean price of sociology textbooks is less than the mean price of textbooks for math/science.

92.

d

94.

Subscripts: 1 = boys, 2 = girls

1. $H_0: \mu_1 \leq \mu_2$
2. $H_a: \mu_1 > \mu_2$
3. The random variable is the difference in the mean auto insurance costs for boys and girls.
4. normal
5. test statistic: $z = 2.50$
6. p -value: 0.0062
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis.
 3. Reason for Decision: p -value $<$ alpha
 4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean cost of auto insurance for teenage boys is greater than that for girls.

96.

Subscripts: 1 = non-hybrid sedans, 2 = hybrid sedans

1. $H_0: \mu_1 \geq \mu_2$
2. $H_a: \mu_1 < \mu_2$
3. The random variable is the difference in the mean miles per gallon of non-hybrid sedans and hybrid sedans.
4. normal
5. test statistic: 6.36
6. p -value: 0
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis.
 3. Reason for decision: p -value $<$ alpha
 4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean miles per gallon of non-hybrid sedans is less than that of hybrid sedans.

98.

1. $H_0: \mu_d = 0$
2. $H_a: \mu_d < 0$

3. The random variable X_d is the average difference between husband's and wife's satisfaction level.
4. t_9
5. test statistic: $t = -1.86$
6. p -value: 0.0479
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis, but run another test.
 3. Reason for Decision: p -value < alpha
 4. Conclusion: This is a weak test because alpha and the p -value are close. However, there is insufficient evidence to conclude that the mean difference is negative.

100.

1. $H_0: P_W = P_B$
2. $H_a: P_W \neq P_B$
3. The random variable is the difference in the proportions of White and Black people with conferred degrees in a given year, aged 21 to 24.
4. normal for two proportions
5. test statistic: -0.1944
6. p -value: 0.8458
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis.
 3. Reason for decision: p -value > alpha
 4. Conclusion: At the 5% significance level, there is insufficient evidence to conclude that the proportions of White and Black people with conferred physical science degrees, aged 21 to 24, are different.

102.

Subscripts: 1 = Cabrillo College, 2 = Lake Tahoe College

1. $H_0: p_1 = p_2$
2. $H_a: p_1 \neq p_2$
3. The random variable is the difference between the proportions of Hispanic/Latino students at Cabrillo College and Lake Tahoe College.
4. normal for two proportions
5. test statistic: 4.29
6. p -value: 0.00002
7. Answers may vary.
8.
 1. Alpha: 0.05
 2. Decision: Reject the null hypothesis.
 3. Reason for decision: p -value < alpha
 4. Conclusion: There is sufficient evidence to conclude that the proportions of Hispanic/Latino students at Cabrillo College and Lake Tahoe College are different.

104.

a

106.

Test: two independent sample proportions.

Random variable: $p'_1 - p'_2$

Distribution:

$H_0: p_1 = p_2$

$H_a: p_1 \neq p_2$

The proportion of eReader users is different for the 16- to 29-year-old users from that of the 30 and older users.

Graph: two-tailed


 This is a normal distribution curve with mean equal to zero. Both the right and left tails of the curve are shaded. Each tail represents $1/2(p\text{-value}) = 0.0017$.

Figure 10.20

p -value : 0.0033

Decision: Reject the null hypothesis.

Conclusion: At the 5% level of significance, from the sample data, there is sufficient evidence to conclude that the proportion of eReader users 16 to 29 years old is different from the proportion of eReader users 30 and older.

108.

Test: two independent sample proportions

Random variable: $p'_1 - p'_2$

Distribution:

$H_0: p_1 = p_2$

$H_a: p_1 > p_2$

A higher proportion of tablet owners are aged 16 to 29 years old than are 30 years old and older.

Graph: right-tailed


 This is a normal distribution curve with mean equal to zero. A vertical line near the tail of the curve to the right of zero extends from the axis to the curve. The region under the curve to the right of the line is shaded representing $p\text{-value} = 0.2354$.

Figure 10.21

p -value: 0.2354

Decision: Do not reject the H_0 .

Conclusion: At the 1% level of significance, from the sample data, there is not sufficient evidence to conclude that a higher proportion of tablet owners are aged 16 to 29 years old than are 30 years old and older.

110.

Subscripts: 1: men; 2: women

1. $H_0: p_1 \leq p_2$
2. $H_a: p_1 > p_2$
3. $P'_{11} - P'_{12} - P'_{21} - P'_{22}$ is the difference between the proportions of men and women who enjoy shopping for electronic equipment.
4. normal for two proportions
5. test statistic: 0.22
6. p -value: 0.4133
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Do not reject the null hypothesis.
3. Reason for Decision: p -value $>$ alpha
4. Conclusion: At the 5% significance level, there is insufficient evidence to conclude that the proportion of men who enjoy shopping for electronic equipment is more than the proportion of women.

112.

1. $H_0: p_1 = p_2$
2. $H_a: p_1 \neq p_2$
3. $P'_{11} - P'_{12} - P'_{21} - P'_{22}$ is the difference between the proportions of men and women that have at least one pierced ear.
4. normal for two proportions
5. test statistic: -4.82
6. p -value: zero
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Reject the null hypothesis.
3. Reason for Decision: p -value $<$ alpha
4. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the proportions of men and women with at least one pierced ear is different.

114.

1. $H_0: \mu_d = 0$
2. $H_a: \mu_d > 0$
3. The random variable X_d is the mean difference in work times on days when eating breakfast and on days when not eating breakfast.
4. t_9
5. test statistic: 4.8963
6. p -value: 0.0004
7. Answers may vary.
8. 1. Alpha: 0.05
2. Decision: Reject the null hypothesis.
3. Reason for Decision: p -value $<$ alpha
4. Conclusion: At the 5% level of significance, there is sufficient evidence to conclude that the mean difference in work times on days when eating breakfast and on days when not eating breakfast has increased.

115.

p -value = 0.1494

At the 5% significance level, there is insufficient evidence to conclude that the medication lowered cholesterol levels after 12 weeks.

117.

b

119.

c

121.

Test: two matched pairs or paired samples (t -test)

Random variable: $\bar{X}_d - \bar{X}_d$

Distribution: t_{12}

$H_0: \mu_d = 0$ $H_a: \mu_d > 0$

The mean of the differences of new female breast cancer cases in the south between Year 2 and Year 1 is greater than zero. The estimate for new female breast cancer cases in the south is higher in Year 2 than in Year 1.

Graph: right-tailed

p -value: 0.0004

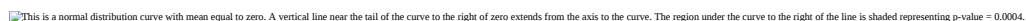


Figure 10.22

Decision: Reject H_0

Conclusion: At the 5% level of significance, from the sample data, there is sufficient evidence to conclude that there was a higher estimate of new female breast cancer cases in Year 2 than in Year 1.

123.

Test: matched or paired samples (t -test)

Difference data: $\{-0.9, -3.7, -3.2, -0.5, 0.6, -1.9, -0.5, 0.2, 0.6, 0.4, 1.7, -2.4, 1.8\}$

Random Variable: $\bar{X}_d - \bar{X}_d$

Distribution: $H_0: \mu_d = 0$ $H_a: \mu_d < 0$

The mean of the differences of the rate of underemployment in the northeastern states between Year 2 and Year 1 is less than zero. The underemployment rate went down from Year 1 to Year 2.

Graph: left-tailed.

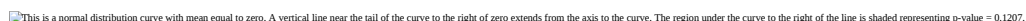


Figure 10.23

p -value: 0.1207

Decision: Do not reject H_0 .

Conclusion: At the 5% level of significance, from the sample data, there is not sufficient evidence to conclude that there was a decrease in the underemployment rates of the northeastern states from Year 1 to Year 2.

125.

e

127.

d

129.

f

131.

e

133.

f

135.

a

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