

## 10.14: Solutions

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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 whites and nonwhites
25. This is a comparison of two population means with unknown population standard deviations.
27. Check student's solution.
28.
  - a. Cannot accept the null hypothesis
  - b.  $p\text{-value} < 0.05$
  - c. 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.  $P'_{OS1} - P'_{OS2}$  = difference in the proportions of phones that had system failures within the first eight hours of operation with  $OS_1$  and  $OS_2$ .
34. proportions
36. right-tailed
38. The random variable is the difference in proportions (percents) of the populations that are of two or more races in Nevada and North Dakota.
40. Our sample sizes are much greater than five each, so we use the normal for two proportions distribution for this hypothesis test.
42.
  - a. Cannot accept the null hypothesis.
  - b.  $p\text{-value} < \alpha$
  - c. 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.
44. The difference in mean speeds of the fastball pitches of the two pitchers
- 46–2.46
47. 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.
49. Subscripts: 1 = Food, 2 = No Food
$$H_0 : \mu_1 \leq \mu_2$$
$$H_a : \mu_1 > \mu_2$$
51. Subscripts: 1 = Gamma, 2 = Zeta

$$H_0 : \mu_1 = \mu_2$$

$$H_a : \mu_1 \neq \mu_2$$

53. There is sufficient evidence so we cannot accept the null hypothesis. The data support that the melting point for Alloy Zeta is different from the melting point of Alloy Gamma.

54. the mean difference of the system failures

56. With a  $p$ -value 0.0067, we cannot accept the null hypothesis. There is enough evidence to support that the software patch is effective in reducing the number of system failures.

60.

$$H_0 : \mu_d \geq 0$$

$$H_a : \mu_d < 0$$

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

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

67.

Subscripts: 1: mechanical engineering; 2: electrical engineering

69.

1. 71.

74.

c

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

$$\bar{X}_1 - \bar{X}_2$$

Distribution:  $H_0 : \mu_1 = \mu_2$   $H_a : \mu_1 < \mu_2$ . The mean age of entering prostitution in Canada is lower than the mean age in the United States.

Graph: left-tailed  $p$ -value : 0.0151

Decision: Cannot reject  $H_0$ .

Conclusion: At the 1% level of significance, from the sample data, there is not sufficient evidence to conclude that the mean age of entering prostitution in Canada is lower than the mean age in the United States.

78. d

80.

a.  $H_0: P_W = P_B$

b.  $H_a: P_W \neq P_B$

c. The random variable is the difference in the proportions of White and Black suicide victims, aged 15 to 24.

d. normal for two proportions

e. test statistic: -0.1944

f.  $p$ -value: 0.8458

g. Check student's solution.

h. i. Alpha: 0.05

ii. Decision: Cannot accept the null hypothesis.

iii. Reason for decision:  $p$ -value > alpha

iv. Conclusion: At the 5% significance level, there is insufficient evidence to conclude that the proportions of White and Black female suicide victims, aged 15 to 24, are different.

82.

1 = Cabrillo College, 2 = Lake Tahoe College

- a.  $H_0: p_1 = p_2$   $H_a: p_1 \neq p_2$
- b.  $H_a: p_1 \neq p_2$   $H_0: p_1 = p_2$
- c. The random variable is the difference between the proportions of Hispanic students at Cabrillo College and Lake Tahoe College.
- d. normal for two proportions
- e. test statistic: 4.29
- f.  $p$ -value: 0.00002
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis.
  - iii. Reason for decision:  $p$ -value < alpha
  - iv. Conclusion: There is sufficient evidence to conclude that the proportions of Hispanic students at Cabrillo College and Lake Tahoe College are different.

84. a

85. 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

87.

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

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.

89.

Subscripts: 1: men; 2: women

- a.  $H_0: p_1 \leq p_2$
- b.  $H_a: p_1 > p_2$
- c.  $P'_1 - P'_2$  is the difference between the proportions of men and women who enjoy shopping for electronic equipment.
- d. normal for two proportions
- e. test statistic: 0.22
- f.  $p$ -value: 0.4133
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot reject the null hypothesis.
  - iii. Reason for Decision:  $p$ -value > alpha
  - iv. 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.

91.

- a.  $H_0: p_1 = p_2$
- b.  $H_a: p_1 \neq p_2$
- c.  $P'_1 - P'_2$  is the difference between the proportions of men and women that have at least one pierced ear.

- d. normal for two proportions
- e. test statistic:  $-4.82$
- f.  $p$ -value: zero
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis.
  - iii. Reason for Decision:  $p$ -value  $<$  alpha
  - iv. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the proportions of males and females with at least one pierced ear is different.

92.

- a.  $H_0: \mu_d = 0$
- b.  $H_a: \mu_d > 0$
- c. The random variable  $X_d$  is the mean difference in work times on days when eating breakfast and on days when not eating breakfast.
- d.  $t_9$
- e. test statistic: 4.8963
- f.  $p$ -value: 0.0004
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis.
  - iii. Reason for Decision:  $p$ -value  $<$  alpha
  - iv. 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.

94.

Subscripts: 1 = boys, 2 = girls

- a.  $H_0: \mu_1 \leq \mu_2$
- b.  $H_a: \mu_1 > \mu_2$
- c. The random variable is the difference in the mean auto insurance costs for boys and girls.
- d. normal
- e. test statistic:  $z = 2.50$
- f.  $p$ -value: 0.0062
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis.
  - iii. Reason for Decision:  $p$ -value  $<$  alpha
  - iv. 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

- a.  $H_0: \mu_1 \geq \mu_2$
- b.  $H_a: \mu_1 < \mu_2$
- c. The random variable is the difference in the mean miles per gallon of non-hybrid sedans and hybrid sedans.
- d. normal
- e. test statistic: 6.36
- f.  $p$ -value: 0
- g. Check student's solution.
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis.
  - iii. Reason for decision:  $p$ -value  $<$  alpha

- iv. 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.

- a.  $H_0: \mu_d = 0$
- b.  $H_a: \mu_d < 0$
- c. The random variable  $X_d$  is the average difference between husband's and wife's satisfaction level.
- d.  $t_9$
- e. test statistic:  $t = -1.86$
- f.  $p$ -value: 0.0479
- g. Check student's solution
- h.
  - i. Alpha: 0.05
  - ii. Decision: Cannot accept the null hypothesis, but run another test.
  - iii. Reason for Decision:  $p$ -value < alpha
  - iv. 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.

99.  $p$ -value = 0.1494

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

Random variable:  $\bar{X}_d$

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 2013 and 2012 is greater than zero. The estimate for new female breast cancer cases in the south is higher in 2013 than in 2012.

Graph: right-tailed

$p$ -value: 0.0004

Decision: Cannot accept  $H_0$

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 2013 than in 2012.

105. 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:  $\bar{X}_d$

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 2012 and 2011 is less than zero. The underemployment rate went down from 2011 to 2012.

Graph: left-tailed.

Decision: Cannot 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 2011 to 2012.

107. e

109. d

111. f

113. e

115. f

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