Exercise 1. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

It is believed that 70% of males pass their drivers test in the first attempt, while 65% of females pass the test in the first attempt. Of interest is whether the proportions are in fact equal.

Solution two proportions

Exercise 2. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A new laundry detergent is tested on consumers. Of interest is the proportion of consumers who prefer the new brand over the leading competitor. A study is done to test this.

Solution single proportion

Exercise 3. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
A new windshield treatment claims to repel water more effectively. Ten windshields are tested by simulating rain without the new treatment. The same windshields are then treated, and the experiment is run again. A hypothesis test is conducted.

**Solution**

matched or paired samples

**Exercise 4.** Indicate if the hypothesis test is for

a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

The known standard deviation in salary for all mid-level professionals in the financial industry is $11,000. Company A and Company B are in the financial industry. Suppose samples are taken of mid-level professionals from Company A and from Company B. The sample mean salary for mid-level professionals in Company A is $80,000. The sample mean salary for mid-level professionals in Company B is $96,000. Company A and Company B management want to know if their mid-level professionals are paid differently, on average.

**Solution**

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

**Exercise 5.** Indicate if the hypothesis test is for

a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

The average worker in Germany gets eight weeks of paid vacation.

**Solution**

single mean

**Exercise 6.** Indicate if the hypothesis test is for
According to a television commercial, 80% of dentists agree that Ultrafresh toothpaste is the best on the market.

Solution

Exercise 7. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

It is believed that the average grade on an English essay in a particular school system for females is higher than for males. A random sample of 31 females had a mean score of 82 with a standard deviation of three, and a random sample of 25 males had a mean score of 76 with a standard deviation of four.

Solution

Exercise 8. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

The league mean batting average is 0.280 with a known standard deviation of 0.06. The Rattlers and the Vikings belong to the league. The mean batting average for a sample of eight Rattlers is 0.210, and the mean batting average for a sample of eight Vikings is 0.260. There are 24 players on the Rattlers and 19 players on the Vikings. Are the batting averages of the Rattlers and Vikings statistically
different?

Exercise 9. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

In a random sample of 100 forests in the United States, 56 were coniferous or contained conifers. In a random sample of 80 forests in Mexico, 40 were coniferous or contained conifers. Is the proportion of conifers in the United States statistically more than the proportion of conifers in Mexico?

Solution two proportions

Exercise 10. Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A new medicine is said to help improve sleep. Eight subjects are picked at random and given the medicine. The means hours slept for each person were recorded before starting the medication and after.

Solution matched or paired samples

Exercise 11. Indicate if the hypothesis test is for
• independent group means, population standard deviations, and/or variances known
  a. independent group means, population standard deviations, and/or variances known
  b. independent group means, population standard deviations, and/or variances unknown
  c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

It is thought that teenagers sleep more than adults on average. A study is done to verify this. A sample of 16 teenagers has a mean of 8.9 hours slept and a standard deviation of 1.2. A sample of 12 adults has a mean of 6.9 hours slept and a standard deviation of 0.6.

Solution

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

Exercise 12. Indicate if the hypothesis test is for

a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

Varsity athletes practice five times a week, on average.

Solution

single mean

Exercise 13. Indicate if the hypothesis test is for

a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A sample of 12 in-state graduate school programs at school A has a mean tuition of $64,000 with a standard deviation of $8,000. At school B, a sample of 16 in-state graduate programs has a mean of $80,000 with a standard deviation of $6,000. On average, are the mean tuitions different?

Solution

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

Exercise 14. Indicate if the hypothesis test is for

a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A new WiFi range booster is being offered to consumers. A researcher tests the native range of 12 different routers under the same conditions. The ranges are recorded. Then the researcher uses the new WiFi range booster and records the new ranges. Does the new WiFi range booster do a better job?

Solution: matched or paired samples

Exercise 15.

Indicate if the hypothesis test is for
a. independent group means, population standard deviations, and/or variances known
b. independent group means, population standard deviations, and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A high school principal claims that 30% of student athletes drive themselves to school, while 4% of non-athletes drive themselves to school. In a sample of 20 student athletes, 45% drive themselves to school. In a sample of 35 non-athlete students, 6% drive themselves to school. Is the percent of student athletes who drive themselves to school more than the percent of nonathletes?

Solution: two proportions

Exercise 16.

A study is done to determine which of two soft drinks has more sugar. There are 13 cans of Beverage A in a sample and six cans of Beverage B. The mean amount of sugar in Beverage A is 36 grams with a standard deviation of 0.6 grams. The mean amount of sugar in Beverage B is 38 grams with a standard deviation of 0.8 grams. The researchers believe that Beverage B has more sugar than Beverage A, on average. Both populations have normal distributions. Are both population standard deviations known or unknown?

Solution: Both population standard deviations are unknown.

Exercise 17.

A study is done to determine which of two soft drinks has more sugar. There are 13 cans of Beverage A in a sample and six cans of Beverage B. The mean amount of sugar in Beverage A is 36 grams with a standard deviation of 0.6 grams. The mean amount of sugar in Beverage B is 38 grams with a standard deviation of 0.8 grams.
grams. The researchers believe that Beverage B has more sugar than Beverage A, on average. Both populations have normal distributions.

What is the random variable?

Solution

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

Exercise 18.

A study is done to determine which of two soft drinks has more sugar. There are 13 cans of Beverage A in a sample and six cans of Beverage B. The mean amount of sugar in Beverage A is 36 grams with a standard deviation of 0.6 grams. The mean amount of sugar in Beverage B is 38 grams with a standard deviation of 0.8 grams. The researchers believe that Beverage B has more sugar than Beverage A, on average. Both populations have normal distributions. Is this a one-tailed or two-tailed test?

Solution

This is a one-tailed test.

Exercise 19.

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites. Is this a test of means or proportions?

Solution

means

Exercise 20.

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites. State the null and alternative hypotheses.

a. $H_0:$

b. $H_a:$

Solution

a. $H_0: \mu_W = \mu_{NW}$

b. $H_a: \mu_W \neq \mu_{NW}$

Exercise 21.

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the
124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites. Is this a right-tailed, left-tailed, or two-tailed test?

Solution: two-tailed

Exercise 22. The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

In symbols, what is the random variable of interest for this test?

Solution: \( \bar{X}_W - \bar{X}_{NW} \)

Exercise 23. The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

In words, define the random variable of interest for this test.

Solution: the difference between the mean life spans of whites and nonwhites

Exercise 24. The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

Which distribution (normal or Student’s t) would you use for this hypothesis test?

Solution: Student’s t

Exercise 25. The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the
124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

**Exercise 10.24**

Explain why you chose the distribution you did for the Exercise 10.24 question.

**Solution**

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

**Exercise 26.**

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

**Solution**

Calculate the test statistic and *p*-value.

**Solution**

test statistic: 5.42  
*p*-value: 0

**Exercise 27.**

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

**Solution**

Sketch a graph of the situation. Label the horizontal axis. Mark the hypothesized difference and the sample difference. Shade the area corresponding to the *p*-value.

**Solution**

Check student’s solution.

**Exercise 28.**

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites.

**Solution**

Find the *p*-value:

**Solution**

zero

**Exercise 29.**

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6
years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites. At a pre-conceived $\alpha = 0.05$, what is your:

a. Decision:

b. Reason for the decision:

c. Conclusion (write out in a complete sentence):

Solution 

a. Reject the null hypothesis

b. $p$-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 whites and nonwhites.

Exercise 30. 

The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for whites born in 1900 and 33.0 years for nonwhites. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 whites, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 nonwhites, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for whites and nonwhites. Does it appear that the means are the same? Why or why not?

Solution 

From the hypothesis test, we can say that the means are not different.

Exercise 31. 

The mean speeds of fastball pitches from two different baseball pitchers are to be compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. Table 10.18 shows the result. Scouters believe that Rodriguez pitches a speedier fastball.

<table>
<thead>
<tr>
<th>Pitcher</th>
<th>Sample Mean Speed of Pitches (mph)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wesley</td>
<td>86</td>
<td>3</td>
</tr>
<tr>
<td>Rodriguez</td>
<td>91</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.18

What is the random variable?

Solution 

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

Exercise 32. 

The mean speeds of fastball pitches from two different baseball pitchers are to be
compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. Table 10.18 shows the result. Scouters believe that Rodriguez pitches a speedier fastball.

<table>
<thead>
<tr>
<th>Pitcher</th>
<th>Sample Mean Speed of Pitches (mph)</th>
<th>Population Standard Deviation</th>
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</thead>
<tbody>
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<td>86</td>
<td>3</td>
</tr>
<tr>
<td>Rodriguez</td>
<td>91</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.18

State the null and alternative hypotheses.

Solution

1: Wesley, 2: Rodriguez

\[ H_0: \mu_1 \geq \mu_2 \]

\[ H_a: \mu_1 < \mu_2 \]

Exercise 33. The mean speeds of fastball pitches from two different baseball pitchers are to be compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. Table 10.18 shows the result. Scouters believe that Rodriguez pitches a speedier fastball.

<table>
<thead>
<tr>
<th>Pitcher Sample</th>
<th>Sample Mean Speed of Pitches (mph)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wesley</td>
<td>86</td>
<td>3</td>
</tr>
<tr>
<td>Rodriguez</td>
<td>91</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.18

What is the test statistic?

Solution

\[ -2.46 \]

Exercise 34. The mean speeds of fastball pitches from two different baseball pitchers are to be compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. Table 1.18 shows the result. Scouters believe that Rodriguez pitches a speedier fastball.

<table>
<thead>
<tr>
<th>Pitcher</th>
<th>Sample Mean Speed of Pitches (mph)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wesley</td>
<td>86</td>
<td>3</td>
</tr>
<tr>
<td>Rodriguez</td>
<td>91</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.18

What is the \( p \)-value?

Solution

\[ 0.0070 \]
Exercise 35. The mean speeds of fastball pitches from two different baseball pitchers are to be compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. Table 10.18 shows the result. Scouters believe that Rodriguez pitches a speedier fastball.

<table>
<thead>
<tr>
<th>Pitcher</th>
<th>Sample Mean Speed of Pitches (mph)</th>
<th>Population Standard Deviation</th>
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<td>3</td>
</tr>
<tr>
<td>Rodriguez</td>
<td>91</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.18

At the 1% significance level, what is your conclusion?

Solution

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.

Exercise 36. A researcher is testing the effects of plant food on plant growth. Nine plants have been given the plant food. Another nine plants have not been given the plant food. The heights of the plants are recorded after eight weeks. The populations have normal distributions. The following table is the result. The researcher thinks the food makes the plants grow taller.

<table>
<thead>
<tr>
<th>Plant Group</th>
<th>Sample Mean Height of Plants (inches)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>16</td>
<td>2.5</td>
</tr>
<tr>
<td>No food</td>
<td>14</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 10.19

Is the population standard deviation known or unknown?

Solution

The population standard deviation is known.

Exercise 37. A researcher is testing the effects of plant food on plant growth. Nine plants have been given the plant food. Another nine plants have not been given the plant food. The heights of the plants are recorded after eight weeks. The populations have normal distributions. The following table is the result. The researcher thinks the food makes the plants grow taller.

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</tr>
<tr>
<td>No food</td>
<td>14</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Table 10.19

State the null and alternative hypotheses.

Solution

Subscripts: 1 = Food, 2 = No Food

$H_0: \mu_1 \leq \mu_2$

$H_a: \mu_1 > \mu_2$

Exercise 38. A researcher is testing the effects of plant food on plant growth. Nine plants have been given the plant food. Another nine plants have not been given the plant food. The heights of the plants are recorded after eight weeks. The populations have normal distributions. The following table is the result. The researcher thinks the food makes the plants grow taller.

<table>
<thead>
<tr>
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<td>2.5</td>
</tr>
<tr>
<td>No food</td>
<td>14</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 10.19

What is the $p$-value?

Solution

0.0198

Exercise 39. A researcher is testing the effects of plant food on plant growth. Nine plants have been given the plant food. Another nine plants have not been given the plant food. The heights of the plants are recorded after eight weeks. The populations have normal distributions. The following table is the result. The researcher thinks the food makes the plants grow taller.

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<thead>
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<tr>
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<td>14</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 10.19

Draw the graph of the $p$-value.
Solution

Exercise 40. A researcher is testing the effects of plant food on plant growth. Nine plants have been given the plant food. Another nine plants have not been given the plant food. The heights of the plants are recorded after eight weeks. The populations have normal distributions. The following table is the result. The researcher thinks the food makes the plants grow taller.

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<thead>
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<td>2.5</td>
</tr>
<tr>
<td>No food</td>
<td>14</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 10.19

At the 1% significance level, what is your conclusion?

Solution

There is not sufficient evidence from the sample data to conclude that the plant food increases the plants’ heights more than not feeding the plants.

Exercise 41. Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Sample Mean Melting Temperatures (°F)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy Gamma</td>
<td>800</td>
<td>95</td>
</tr>
<tr>
<td>Alloy Zeta</td>
<td>900</td>
<td>105</td>
</tr>
</tbody>
</table>

Table 10.20

State the null and alternative hypotheses.

Solution

Subscripts: 1 = Gamma, 2 = Zeta

\[ H_0: \mu_1 = \mu_2 \]

\[ H_a: \mu_1 \neq \mu_2 \]

Exercise 42. Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are
being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

<table>
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</tr>
<tr>
<td>Alloy Zeta</td>
<td>900</td>
<td>105</td>
</tr>
</tbody>
</table>

Table 10.20

Is this a right-, left-, or two-tailed test?

Solution

This is a two-tailed test.

Exercise 43.

Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

<table>
<thead>
<tr>
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<th>Sample Mean Melting Temperatures (°F)</th>
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</tr>
<tr>
<td>Alloy Zeta</td>
<td>900</td>
<td>105</td>
</tr>
</tbody>
</table>

Table 10.20

What is the $p$-value?

Solution

0.0062

Exercise 44.

Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Sample Mean Melting Temperatures (°F)</th>
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<tbody>
<tr>
<td>Alloy Gamma</td>
<td>800</td>
<td>95</td>
</tr>
<tr>
<td>Alloy Zeta</td>
<td>900</td>
<td>105</td>
</tr>
</tbody>
</table>

Table 10.20

Draw the graph of the $p$-value.
Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

<table>
<thead>
<tr>
<th>Alloy</th>
<th>Sample Mean Melting Temperatures (°F)</th>
<th>Population Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alloy Gamma</td>
<td>800</td>
<td>95</td>
</tr>
<tr>
<td>Alloy Zeta</td>
<td>900</td>
<td>105</td>
</tr>
</tbody>
</table>

**Table 10.20**

At the 1% significance level, what is your conclusion?

**Solution**

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.

Exercise 46. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS1 had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS2 had system failures within the first eight hours of operation. OS2 is believed to be more stable (have fewer crashes) than OS1. Is this a test of means or proportions?

**Solution**

This is a test of proportions.

Exercise 47. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS1 had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS2 had system failures within the first eight hours of operation. OS2 is believed to be more stable (have fewer crashes) than OS1. What is the random variable?

**Solution**

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

Exercise 48. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS₁ had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS₂ had system failures within the first eight hours of operation. OS₂ is believed to be more stable (have fewer crashes) than OS₁. State the null and alternative hypotheses.

Solution

\( H_0 : p_{OS1} = p_{OS2} \)
\( H_a : p_{OS1} > p_{OS2} \)

Exercise 49. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS₁ had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS₂ had system failures within the first eight hours of operation. OS₂ is believed to be more stable (have fewer crashes) than OS₁. What is the p-value?

Solution

0.1018

Exercise 50. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS₁ had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS₂ had system failures within the first eight hours of operation. OS₂ is believed to be more stable (have fewer crashes) than OS₁. What can you conclude about the two operating systems?

Solution

There is not sufficient evidence to reject the null hypothesis, so the data do not show that OS₂ has fewer system failures than OS₁.

Exercise 51. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota. Is this a test of means or proportions?

Solution

proportions
Exercise 52. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

State the null and alternative hypotheses.

a. $H_0$:_____

b. $H_a$:_____

Solution

Subscripts: 1 = Nevada, 2 = North Dakota

a. $H_0: p_1 \leq p_2$

b. $H_a: p_1 > p_2$

Exercise 53. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Is this a right-tailed, left-tailed, or two-tailed test? How do you know?

Solution

right-tailed

Exercise 54. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

What is the random variable of interest for this test?

Solution

Subscripts: 1 = Nevada, 2 = North Dakota $P'_1 - P'_2$

Exercise 55. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out
of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

In words, define the random variable for this test.

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

Exercise 56. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Which distribution (normal or Student’s t) would you use for this hypothesis test?

Solution normal

Exercise 57. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Which distribution (normal or Student’s t) would you use for this hypothesis test?

Which distribution would you use for the Exercise 10.56.

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

Exercise 58. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Calculate the test statistic.
Exercise 59. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Sketch a graph of the situation. Mark the hypothesized difference and the sample difference. Shade the area corresponding to the p-value.

Solution

Check student’s solution.

Exercise 60. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

Find the p-value.

Solution 0.0002

Exercise 61. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

At a pre-conceived \( \alpha = 0.05 \), what is your:

a. Decision:

b. Reason for the decision:

c. Conclusion (write out in a complete sentence):

Solution

a. Reject the null hypothesis.

b. p-value < alpha

c. At the 5% significance level, there is sufficient evidence to conclude that the
Exercise 62.  \textit{In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota. Does it appear that the proportion of Nevadans who are two or more races is higher than the proportion of North Dakotans? Why or why not?}

Solution  Yes. There is sufficient evidence to draw this conclusion.

Exercise 63.  \textit{A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 10.21. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1\% significance level.}

<table>
<thead>
<tr>
<th>Installation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>After</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 10.21
What is the random variable?

Solution the mean difference of the system failures

Exercise 64.  \textit{A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 10.21. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1\% significance level.}

<table>
<thead>
<tr>
<th>Installation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>After</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 10.21
State the null and alternative hypotheses.

Solution \( H_0: \mu_d \geq 0 \quad H_a: \mu_d < 0 \)
Exercise 65. A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 10.21. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Installation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>After</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 10.21
What is the p-value?

Solution
0.0067

Exercise 66. A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 10.21. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Installation</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>After</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 10.21
Draw the graph of the p-value.

Solution

Exercise 67. A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 10.21. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1% significance level.
What conclusion can you draw about the software patch?

**Solution**

With a p-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.

**Exercise 68.**

A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>After</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.22

State the null and alternative hypotheses.

**Solution**

$H_0: \mu_d \leq 0$

$H_a: \mu_d > 0$

**Exercise 69.**

A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>After</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.22

What is the p-value?

**Solution**

0.0021

**Exercise 70.**

A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in
the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>After</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.22

What is the sample mean difference?

Solution

1.67

Exercise 71. A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>After</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.22

Draw the graph of the p-value.

Solution

Exercise 72. A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>After</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10.22

Comment [a3]: AA: Replace this figure with the updated figure titled, “CNX_Stats_C10_M05_item002anno”
What conclusion can you draw about the juggling class?

Solution

With a p-value 0.0021, we can reject the null hypothesis. There is enough evidence to support that the juggling class improves the number of balls each subject can juggle.

Exercise 73.

A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>161</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>166</td>
<td>171</td>
</tr>
<tr>
<td>After</td>
<td>158</td>
<td>159</td>
<td>166</td>
<td>160</td>
<td>167</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 10.23

State the null and alternative hypotheses.

Solution

$H_0: \mu_d \geq 0$ $H_a: \mu_d < 0$

Exercise 74.

A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>161</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>166</td>
<td>171</td>
</tr>
<tr>
<td>After</td>
<td>158</td>
<td>159</td>
<td>166</td>
<td>160</td>
<td>167</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 10.23

What is the test statistic?

Solution

$-1.7541$

Exercise 75.

A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>161</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>166</td>
<td>171</td>
</tr>
<tr>
<td>After</td>
<td>158</td>
<td>159</td>
<td>166</td>
<td>160</td>
<td>167</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 10.23
What is the p-value?

Solution

0.0699

Exercise 76. A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>161</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>166</td>
<td>171</td>
</tr>
<tr>
<td>After</td>
<td>158</td>
<td>159</td>
<td>166</td>
<td>160</td>
<td>167</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 10.23

What is the sample mean difference?

Solution

–1.33

Exercise 77. A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>161</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>166</td>
<td>171</td>
</tr>
<tr>
<td>After</td>
<td>158</td>
<td>159</td>
<td>166</td>
<td>160</td>
<td>167</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 10.23

What is the conclusion?

Solution

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

Exercise 78. The mean number of English courses taken in a two–year time period by male and female college students is believed to be about the same. An experiment is conducted and data are collected from 29 males and 16 females. The males took an average of three English courses with a standard deviation of 0.8. The females took an average of four English courses with a standard deviation of 1.0. Are the means statistically the same?

Solution

a. \( H_0: \mu_M = \mu_F \)
b. \( H_0: \mu_M \neq \mu_F \)
c. \( \bar{x}_M - \bar{x}_F \) the difference between the mean number of English courses taken by
males and females.
d. Student’s t (2-sample t-test, variances not pooled)
e. test statistics: –3.4387
f. p-value: 0.0020
g. Use the previous information to sketch a picture of this situation. Clearly label
and scale the horizontal axis, and shade the graph the region(s) corresponding to
the p-value.
h. 
  i. Alpha: 0.05
  ii. Decision: Reject the null hypothesis.
  iii. p-value < alpha
  iv. At the 5% significance level, there is sufficient evidence to conclude that
      the mean number of college English courses that males and females take is
different.

**Exercise 79**

A student at a four-year college claims that mean enrollment at four-year colleges
is higher than at two-year colleges in the United States. Two surveys are
conducted. Of the 35 two-year colleges surveyed, the mean enrollment was 5,068
with a standard deviation of 4,777. Of the 35 four-year colleges surveyed, the
mean enrollment was 5,466 with a standard deviation of 8,191.

**Solution**

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

a. \( H_0: \mu_1 \geq \mu_2 \)
b. \( H_a: \mu_1 < \mu_2 \)
c. \( \bar{x}_1 - \bar{x}_2 \) is the difference between the mean enrollments of the two-year
   colleges and the four-year colleges.
d. Student’s t
e. test statistic: –0.2480
f. p-value: 0.4019
g. Check student’s solution.
h. 
  i. Alpha: 0.05
  ii. Decision: Do not reject
  iii. Reason for Decision: p-value > alpha
  iv. 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.

**Exercise 80**

At Rachel’s 11th birthday party, eight girls were timed to see how long (in seconds)
they could hold their breath in a relaxed position. After a two-minute rest, they
timed themselves while jumping. The girls thought that the mean difference
between their jumping and relaxed times would be zero. Test their hypothesis.
<table>
<thead>
<tr>
<th>Relaxed time (seconds)</th>
<th>Jumping time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>29</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 10.24

Solution
a. $H_0: \mu_d = 0$
b. $H_a: \mu_d \neq 0$
c. The random variable $X_d$ is the average difference between jumping and relaxed times.
d. $t_7$
e. test statistic: $-1.51$
f. $p$-value: 0.1755
g. Check student’s solution
h. i. Alpha: 0.05
ii. Decision: Do not reject the null hypothesis.
iii. Reason for Decision: $p$-value > alpha
iv. Conclusion: At the 5% level of significance, there is insufficient evidence to conclude that the average difference is not zero.

Exercise 81
Mean entry-level salaries for college graduates with mechanical engineering degrees and electrical engineering degrees are believed to be approximately the same. A recruiting office thinks that the mean mechanical engineering salary is actually lower than the mean electrical engineering salary. The recruiting office randomly surveys 50 entry level mechanical engineers and 60 entry level electrical engineers. Their mean salaries were $46,100 and $46,700, respectively. Their standard deviations were $3,450 and $4,210, respectively. Conduct a hypothesis test to determine if you agree that the mean entry-level mechanical engineering salary is lower than the mean entry-level electrical engineering salary.

Solution
Subscripts: 1: mechanical engineering; 2: electrical engineering
a. $H_0: \mu_1 \geq \mu_2$
b. $H_a: \mu_1 < \mu_2$
c. $\bar{X}_1 - \bar{X}_2$ is the difference between the mean entry level salaries of mechanical engineers and electrical engineers.
Exercise 82
Marketing companies have collected data implying that teenage girls use more ring tones on their cellular phones than teenage boys do. In one particular study of 40 randomly chosen teenage girls and boys (20 of each) with cellular phones, the mean number of ring tones for the girls was 3.2 with a standard deviation of 1.5. The mean for the boys was 1.7 with a standard deviation of 0.8. Conduct a hypothesis test to determine if the means are approximately the same or if the girls’ mean is higher than the boys’ mean.

Solution

a. $H_0: \mu_G = \mu_B$
b. $H_a: \mu_G > \mu_B$
c. $X_1 - X_2$ is the difference between the mean number of ringtones for girls and boys.
d. Student’s $t$
e. test statistic: 3.9460
f. $p$-value: 0.0002
g. Check student’s solution.
h.
  i. Alpha: 0.05
  ii. Decision: Reject 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 number of ringtones for girls is higher than that for boys.

Exercise 83
Use the information from Terri Vogel’s log book (http://staging2.cnx.org/content/m17132/latest/) to answer this exercise. Using the data from Lap 1 only, conduct a hypothesis test to determine if the mean time for completing a lap in races is the same as it is in practices.

Solution

a. $H_0: \mu_1 = \mu_2$
b. $H_a: \mu_1 \neq \mu_2$
c. $X_1 - X_2$ is the difference between the mean times for completing a lap in races
and in practices.
d. $t_{20.32}$
e. test statistic: $-4.70$
f. $p$-value: 0.0001
g. Check student’s solution.
h. 
  i. Alpha: 0.05
  ii. Decision: Reject 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 time for completing a lap in races is different from that in practices.

Exercise 84

Use the information from Terri Vogel’s log book (http://staging2.cnx.org/content/m17132/latest/) to answer this exercise. Repeat the test in Exercise 10.83, but use Lap 5 data this time.

Solution

a. $H_0: \mu_1 = \mu_2$
b. $H_a: \mu_1 \neq \mu_2$
c. $\bar{X}_1 - \bar{X}_2$ is the difference between the mean times for completing a lap in races and in practices.
d. Student’s t
e. test statistic: $-5.6548$
f. $p$-value: 0
  i. Alpha: 0.05
  ii. Decision: Reject 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 time for completing a lap in races is different from that in practices.

Exercise 85

Use the information from Terri Vogel’s log book (http://staging2.cnx.org/content/m17132/latest/) to answer this exercise. Repeat the test in Exercise 10.83, but this time combine the data from Laps 1 and 5.

Solution

a. $H_0: \mu_1 = \mu_2$
b. $H_a: \mu_1 \neq \mu_2$
c. is the difference between the mean times for completing a lap in races and in practices.
d. $t_{40.94}$
e. test statistic: −5.08
f. \( p \)-value: zero
g. Check student’s solution.
h. 
  i. Alpha: 0.05
  ii. Decision: Reject 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 time for completing a lap in races is different from that in practices.

Exercise 86

Use the information from [Terri Vogel’s log book](http://staging2.cnx.org/content/m17132/latest/) to answer this exercise.

In two to three complete sentences, explain in detail how you might use Terri Vogel’s data to answer the following question.

“Does Terri Vogel drive faster in races than she does in practices?”

Solution

As Terri completed her practice laps, many superseded the amount of time in her actual races. If you compare the first two laps, in her practice runs, she excelled over the amount of time of race laps by 5 seconds. Although, she completed more race laps then practice laps, her times were lower in racing. Many factors can weigh against her, such as adrenaline rush, technical issues with the car, and the like.

Exercise 87

The Eastern and Western Major League Soccer conferences have a new Reserve Division that allows new players to develop their skills. Data for a randomly picked date showed the following annual goals.

<table>
<thead>
<tr>
<th>Western</th>
<th>Eastern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>D.C. United</td>
</tr>
<tr>
<td>FC Dallas</td>
<td>Chicago</td>
</tr>
<tr>
<td>Chivas USA</td>
<td>Columbus</td>
</tr>
<tr>
<td>Real Salt Lake</td>
<td>New England</td>
</tr>
<tr>
<td>Colorado</td>
<td>MetroStars</td>
</tr>
<tr>
<td>San Jose</td>
<td>Kansas City</td>
</tr>
</tbody>
</table>

**Table 1.25**

The exact distribution for the hypothesis test is:

a. the normal distribution
b. the Student’s \( t \)-distribution
c. the uniform distribution
d. the exponential distribution

Solution

b
Exercise 88

If the level of significance is 0.05, the conclusion is:

a. There is sufficient evidence to conclude that the W Division teams score fewer goals, on average, than the E teams.
b. There is insufficient evidence to conclude that the W Division teams score more goals, on average, than the E teams.
c. There is insufficient evidence to conclude that the W teams score fewer goals, on average, than the E teams score.
d. Unable to determine

Solution
c

Exercise 89

Suppose a statistics instructor believes that there is no significant difference between the mean class scores of statistics day students on Exam 2 and statistics night students on Exam 2. She takes random samples from each of the populations. The mean and standard deviation for 35 statistics day students were 75.86 and 16.91. The mean and standard deviation for 37 statistics night students were 75.41 and 19.73. The “day” subscript refers to the statistics day students. The “night” subscript refers to the statistics night students. A concluding statement is:

a. There is sufficient evidence to conclude that statistics night students' mean on Exam 2 is better than the statistics day students' mean on Exam 2.
b. There is insufficient evidence to conclude that the statistics day students' mean on Exam 2 is better than the statistics night students' mean on Exam 2.
c. There is insufficient evidence to conclude that there is a significant difference between the means of the statistics day students and night students on Exam 2.
d. There is sufficient evidence to conclude that there is a significant difference between the means of the statistics day students and night students on Exam 2.

Solution
c

Exercise 90

Researchers interviewed street prostitutes in Canada and the United States. The mean age of the 100 Canadian prostitutes upon entering prostitution was 18 with a standard deviation of six. The mean age of the 130 United States prostitutes upon entering prostitution was 20 with a standard deviation of eight. Is the mean age of entering prostitution in Canada lower than the mean age in the United States? Test at a 1% significance level.

Solution

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: Do not 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.

Exercise 91

A powder diet is tested on 49 people, and a liquid diet is tested on 36 different people. Of interest is whether the liquid diet yields a higher mean weight loss than the powder diet. The powder diet group had a mean weight loss of 42 pounds with a standard deviation of 12 pounds. The liquid diet group had a mean weight loss of 45 pounds with a standard deviation of 14 pounds.

Solution

Subscript: 1 = liquid diet, 2 = powder diet

a. \( H_0: \mu_1 \leq \mu_2 \)

b. \( H_a: \mu_1 > \mu_2 \)

c. The random variable is the difference between the mean weight loss of the liquid and powder diets

d. Student’s \( t \)

e. test statistic: 1.0607

f. \( p \)-value: 0.1460

g. h.

i. Alpha: 0.05

ii. Decision: Do not reject null hypothesis.

iii. Reason for decision: \( p \)-value > alpha

iv. Conclusion: At the 5% significance level, there is insufficient evidence to conclude that the liquid diet yields a higher weight loss than the powder diet.

Exercise 92

Suppose a statistics instructor believes that there is no significant difference between the mean class scores of statistics day students on Exam 2 and statistics night students on Exam 2. She takes random samples from each of the
populations. The mean and standard deviation for 35 statistics day students were 75.86 and 16.91, respectively. The mean and standard deviation for 37 statistics night students were 75.41 and 19.73. The “day” subscript refers to the statistics day students. The “night” subscript refers to the statistics night students. An appropriate alternative hypothesis for the hypothesis test is:

a. \( \mu_{\text{day}} > \mu_{\text{night}} \)
b. \( \mu_{\text{day}} < \mu_{\text{night}} \)
c. \( \mu_{\text{day}} = \mu_{\text{night}} \)
d. \( \mu_{\text{day}} \neq \mu_{\text{night}} \)

Solution

Exercise 93

A study is done to determine if students in the California state university system take longer to graduate, on average, than students enrolled in private universities. One hundred students from both the California state university system and private universities are surveyed. Suppose that from years of research, it is known that the population standard deviations are 1.5811 years and 1 year, respectively. The following data are collected. The California state university system students took on average 4.5 years with a standard deviation of 0.8. The private university students took on average 4.1 years with a standard deviation of 0.3.

Solution

Subscripts: 1 = California state universities, 2 = private universities

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 times it takes to graduate from the California state university system and private universities.
d. normal
e. test statistic: \( z = 2.14 \)
f. \( p \)-value: 0.0163
g. Check student’s solution.
h. i. Alpha: 0.05
   ii. Decision: Reject null when \( \alpha = 0.05 \); Do not reject null when \( \alpha = 0.01 \)
   iii. Reason for decision: \( p \)-value < alpha
   iv. Conclusion: At the 5% significance level, there is sufficient evidence to conclude that the mean time it takes to graduate from California state universities is longer than that of private universities.

Exercise 94

Parents of teenage boys often complain that auto insurance costs more, on average, for teenage boys than for teenage girls. A group of concerned parents examines a random sample of insurance bills. The mean annual cost for 36 teenage boys was $679. For 23 teenage girls, it was $559. From past years, it is known that the population standard deviation for each group is $180. Determine whether or not you believe that the mean cost for auto insurance for teenage boys
is greater than that for teenage girls.

Solution

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: 0.0063
g. Check student’s solution.
h.
   i. Alpha: 0.05
   ii. Decision: Reject 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.

Exercise 95

A group of transfer bound students wondered if they will spend the same mean amount on texts and supplies each year at their four-year university as they have at their community college. They conducted a random survey of 54 students at their community college and 66 students at their local four-year university. The sample means were $947 and $1,011, respectively. The population standard deviations are known to be $254 and $87, respectively. Conduct a hypothesis test to determine if the means are statistically the same.

Solution

Subscripts: 1 = community college, 2 = four-year university

a. \( H_0: \mu_1 = \mu_2 \)
b. \( H_a: \mu_1 \neq \mu_2 \)
c. The random variable is the difference between the mean costs of texts and supplies each year at community colleges and four-year universities.
d. normal
e. test statistic: \(-1.76\)
f. \( p \)-value: 0.0770
g. Check student’s solution.
h.
   i. Alpha: 0.05
   ii. Decision: Do not 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 mean costs of texts and supplies at community colleges and four-year universities is different.
Exercise 96  
Some manufacturers claim that non-hybrid sedan cars have a lower mean miles-per-gallon (mpg) than hybrid ones. Suppose that consumers test 21 hybrid sedans and get a mean of 31 mpg with a standard deviation of seven mpg. Thirty one non-hybrid sedans get a mean of 22 mpg with a standard deviation of four mpg. Suppose that the population standard deviations are known to be six and three, respectively. Conduct a hypothesis test to evaluate the manufacturers claim.

Solution  
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: Reject 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.

Exercise 97  
A baseball fan wanted to know if there is a difference between the number of games played in a World Series when the American League won the series versus when the National League won the series. From 1922 to 2012, the population standard deviation of games won by the American League was 1.14, and the population standard deviation of games won by the National League was 1.11. Of 19 randomly selected World Series games won by the American League, the mean number of games won was 5.76. The mean number of 17 randomly selected games won by the National League was 5.42. Conduct a hypothesis test.

Solution  
Test: two independent sample means, population standard deviation known.  
Random variable: $X_1 - X_2$  
Distribution: $H_0: \mu_1 = \mu_2$ $H_a: \mu_1 \neq \mu_2$ The mean number of games in the World Series won by the American League is different from that of the National League. Graph: two-tailed  
$p$-value: 0.3650  
Decision: Do not reject the $H_0$. 
Conclusion: At the 5% level of significance, from the sample data, there is not sufficient evidence to conclude that the mean number of games in the World Series won by the American League is different than that of the National League.

Exercise 98

One of the questions in a study of marital satisfaction of dual-career couples was to rate the statement “I’m pleased with the way we divide the responsibilities for childcare.” The ratings went from one (strongly agree) to five (strongly disagree). Table 1.26 contains ten of the paired responses for husbands and wives. Conduct a hypothesis test to see if the mean difference in the husband’s versus the wife’s satisfaction level is negative (meaning that, within the partnership, the husband is happier than the wife).

Solution

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: Reject 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.

Exercise 99

A recent drug survey showed an increase in the use of drugs and alcohol among local high school seniors as compared to the national percent. Suppose that a survey of 100 local seniors and 100 national seniors is conducted to see if the proportion of drug and alcohol use is higher locally than nationally. Locally, 65 seniors reported using drugs or alcohol within the past month, while 60 national seniors reported using them.

Solution

Subscripts: 1 = local, 2 = national
Exercise 100

We are interested in whether the proportions of female suicide victims for ages 15 to 24 are the same for the whites and the blacks races in the United States. We randomly pick one year, 1992, to compare the races. The number of suicides estimated in the United States in 1992 for white females is 4,930. Five hundred eighty were aged 15 to 24. The estimate for black females is 330. Forty were aged 15 to 24. We will let female suicide victims be our population.

Solution

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: 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 proportions of white and black female suicide victims, aged 15 to 24, are different.

Exercise 101

Elizabeth Mjelde, an art history professor, was interested in whether the value from the Golden Ratio formula, \( \frac{\text{larger + smaller dimension}}{\text{larger dimension}} \) was the same in the Whitney Exhibit for works from 1900 to 1919 as for works from 1920 to 1942. Thirty-seven early works were sampled, averaging 1.74 with a standard deviation
Sixty-five of the later works were sampled, averaging 1.746 with a standard deviation of 0.1064. Do you think that there is a significant difference in the Golden Ratio calculation?

Solution

Subscripts: 1 = 1900 to 1919, 2 = 1920 to 1942
a. \( H_0: \mu_1 = \mu_2 \)
b. \( H_a: \mu_1 \neq \mu_2 \)
c. The random variable is the difference between the means of the golden ratio formula for Whitney Exhibit works from 1900 to 1919 and for works from 1920 to 1942.
d. Student’s t
e. test statistic: -0.2680 
f. \( p \)-value: 0

g. Check student’s solution.
h. 
  i. Alpha: 0.05
  ii. Decision: Do not 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 means of the golden ratio formula for Whitney Exhibit works from 1900 to 1919 and for works from 1920 to 1942 are different.

Exercise 102

A recent year was randomly picked from 1985 to the present. In that year, there were 2,051 Hispanic students at Cabrillo College out of a total of 12,328 students. At Lake Tahoe College, there were 321 Hispanic students out of a total of 2,441 students. In general, do you think that the percent of Hispanic students at the two colleges is basically the same or different?

Solution

Subscripts: 1 = Cabrillo College, 2 = Lake Tahoe College
a. \( H_0: p_1 = p_2 \)
b. \( H_a: p_1 \neq p_2 \)
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: Reject 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.
Neuroinvasive West Nile virus is a severe disease that affects a person’s nervous system. It is spread by the Culex species of mosquito. In the United States in 2010 there were 629 reported cases of neuroinvasive West Nile virus out of a total of 1,021 reported cases and there were 486 neuroinvasive reported cases out of a total of 712 cases reported in 2011. Is the 2011 proportion of neuroinvasive West Nile virus cases more than the 2010 proportion of neuroinvasive West Nile virus cases? Using a 1% level of significance, conduct an appropriate hypothesis test.

- “2010” subscript: 2010 group

This is:
- a test of two proportions
- a test of two independent means
- a test of a single mean
- a test of matched pairs.

**Solution**

Neuroinvasive West Nile virus is a severe disease that affects a person’s nervous system. It is spread by the Culex species of mosquito. In the United States in 2010 there were 629 reported cases of neuroinvasive West Nile virus out of a total of 1,021 reported cases and there were 486 neuroinvasive reported cases out of a total of 712 cases reported in 2011. Is the 2011 proportion of neuroinvasive West Nile virus cases more than the 2010 proportion of neuroinvasive West Nile virus cases? Using a 1% level of significance, conduct an appropriate hypothesis test.

- “2010” subscript: 2010 group

An appropriate null hypothesis is:

- $p_{2011} \leq p_{2010}$
- $p_{2011} \geq p_{2010}$
- $\mu_{2011} \leq \mu_{2010}$
- $p_{2011} > p_{2010}$

**Solution**

The $p$-value is 0.0022. At a 1% level of significance, the appropriate conclusion is

- a. There is sufficient evidence to conclude that the proportion of people in the United States in 2011 who contracted neuroinvasive West Nile disease is less than the proportion of people in the United States in 2010 who contracted neuroinvasive West Nile disease.
- b. There is insufficient evidence to conclude that the proportion of people in the United States in 2011 who contracted neuroinvasive West Nile disease is more than the proportion of people in the United States in 2010 who contracted neuroinvasive West Nile disease.
- c. There is insufficient evidence to conclude that the proportion of people in the
United States in 2011 who contracted neuroinvasive West Nile disease is less than the proportion of people in the United States in 2010 who contracted neuroinvasive West Nile disease.

d. There is sufficient evidence to conclude that the proportion of people in the United States in 2011 who contracted neuroinvasive West Nile disease is more than the proportion of people in the United States in 2010 who contracted neuroinvasive West Nile disease.

Solution
d

Exercise 106

Researchers conducted a study to find out if there is a difference in the use of eReaders by different age groups. Randomly selected participants were divided into two age groups. In the 16- to 29-year-old group, 7% of the 628 surveyed use eReaders, while 11% of the 2,309 participants 30 years old and older use eReaders.

Solution

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

$p$-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.

Exercise 107

Adults aged 18 years old and older were randomly selected for a survey on obesity. Adults are considered obese if their body mass index (BMI) is at least 30. The researchers wanted to determine if the proportion of women who are obese in the south is less than the proportion of southern men who are obese. The results are shown in Table 10.27. Test at the 1% level of significance.

<table>
<thead>
<tr>
<th></th>
<th>Number who are obese</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>42,769</td>
<td>155,525</td>
</tr>
<tr>
<td>Women</td>
<td>67,169</td>
<td>248,775</td>
</tr>
</tbody>
</table>

Table 10.27
Solution

Subscripts; 1 = southern women, 2 = southern men
Test: two independent sample proportions.
Random Variable: \( p'_{1} - p'_{2} \)
Distribution: Put in the distribution

\( H_{0}: p_{1} = p_{2} \)
\( H_{a}: p_{1} < p_{2} \)
The proportion of women who are obese in the south is less than the proportion of southern men who are obese.

Graph: left-tailed

\[ p-value = 0.0003 \]

Decision: Reject \( H_{0} \). Conclusion: At the 1% level of significance, from the sample data, there is sufficient evidence to conclude that the proportion of women who are obese in the south is less than the proportion of southern men who are obese.

Exercise 108

Two computer users were discussing tablet computers. A higher proportion of people ages 16 to 29 use tablets than the proportion of people age 30 and older. Table 10.28 details the number of tablet owners for each age group. Test at the 1% level of significance.

<table>
<thead>
<tr>
<th>Own a Tablet</th>
<th>16–29 year olds</th>
<th>30 years old and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>69</td>
<td>231</td>
</tr>
</tbody>
</table>

Table 10.28

Solution

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

\[ p-value = 0.2354 \]

Decision: Do not reject \( H_{0} \). 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.

Exercise 109

A group of friends debated whether more men use smartphones than women. They consulted a research study of smartphone use among adults. The results of
the survey indicate that of the 973 men randomly sampled, 379 use smartphones. For women, 404 of the 1,304 who were randomly sampled use smartphones. Test at the 5% level of significance.

Solution

subscripts: 1 = men, 2 = women
Test: two independent sample proportions.
Random Variable: \( p_1' - p_2' \)
Distribution: \( H_0: p_1 = p_2 \)
\( H_0: p_1 > p_2 \) A higher proportion of men than women use smartphones. Graph: right-tailed

Exercise 110

While her husband spent 2½ hours picking out new speakers, a statistician decided to determine whether the percent of men who enjoy shopping for electronic equipment is higher than the percent of women who enjoy shopping for electronic equipment. The population was Saturday afternoon shoppers. Out of 67 men, 24 said they enjoyed the activity. Eight of the 24 women surveyed claimed to enjoy the activity. Interpret the results of the survey.

Solution

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: Do not 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.

Exercise 111

We are interested in whether children’s educational computer software costs less, on average, than children’s entertainment software. Thirty-six educational software titles were randomly picked from a catalog. The mean cost was $31.14 with a standard deviation of $4.69. Thirty-five entertainment software titles were
randomly picked from the same catalog. The mean cost was $33.86 with a standard deviation of $10.87. Decide whether children’s educational software costs less, on average, than children’s entertainment software.

Solution

Subscripts: 1: children’s educational software; 2: children’s entertainment computer software

a. \( H_0: \mu_1 \geq \mu_2 \)
b. \( H_a: \mu_1 < \mu_2 \)
c. \( \bar{X}_1 - \bar{X}_2 \) is the difference between the mean costs of children’s educational computer software and children’s entertainment software.
d. Student’s t
e. test statistic: -1.3622
f. \( p \)-value: 0.0899
g. Check student’s solution.
h.

i. Alpha: 0.05
ii. Decision: Do not 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 mean cost of children’s educational computer software is less than the mean cost of children’s entertainment software.

Exercise 112

Joan Nguyen recently claimed that the proportion of college-age males with at least one pierced ear is as high as the proportion of college-age females. She conducted a survey in her classes. Out of 107 males, 20 had at least one pierced ear. Out of 92 females, 47 had at least one pierced ear. Do you believe that the proportion of males has reached the proportion of females?

Solution

a. \( H_0: \pi_1 = \pi_2 \)
b. \( H_a: \pi_1 \neq \pi_2 \)
c. \( \pi'_1 - \pi'_2 \) 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: Reject 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
Use the data sets found in Terri Vogel's log book (http://staging2.cnx.org/content/m17132/latest/) to answer this exercise. Is the proportion of race laps Terri completes slower than 130 seconds less than the proportion of practice laps she completes slower than 135 seconds?

Subscripts: 1: laps Terri completes slower than 130 secs; 2: laps Terri completes slower than 135 secs.

a. $H_0: p_1 \geq p_2$

b. $H_a: p_1 < p_2$

c. $P' \_1 - P' \_2$ is the difference between the proportions for completing race laps slower than 130 seconds and for completing practice laps slower than 135 seconds.

d. Student's t
e. Test statistic: –0.9223

f. $p$-value: 0.1782

g. Check student’s solution.

h.

i. Alpha: 0.05

ii. Decision: Do not reject the null hypothesis.

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

iv. Conclusion: At the 5% significance level, there is not sufficient evidence to conclude that the proportion for completing race laps slower than 130 seconds is less than the proportion for completing practice laps slower than 135 seconds.

"To Breakfast or Not to Breakfast?" by Richard Ayore

In the American society, birthdays are one of those days that everyone looks forward to. People of different ages and peer groups gather to mark the 18th, 20th, ..., birthdays. During this time, one looks back to see what he or she has achieved for the past year and also focuses ahead for more to come.

If, by any chance, I am invited to one of these parties, my experience is always different. Instead of dancing around with my friends while the music is booming, I get carried away by memories of my family back home in Kenya. I remember the good times I had with my brothers and sister while we did our daily routine.

Every morning, I remember we went to the shamba (garden) to weed our crops. I remember one day arguing with my brother as to why he always remained behind just to join us an hour later. In his defense, he said that he preferred waiting for breakfast before he came to weed. He said, "This is why I always work more hours than you guys!"

And so, to prove him wrong or right, we decided to give it a try. One day we went to work as usual without breakfast, and recorded the time we could work before getting tired and stopping. On the next day, we all ate breakfast before going to
work. We recorded how long we worked again before getting tired and stopping. Of interest was our mean increase in work time. Though not sure, my brother insisted that it was more than two hours. Using the data in Table 1.29, solve our problem.

<table>
<thead>
<tr>
<th>Work hours with breakfast</th>
<th>Work hours without breakfast</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 10.29

Solution

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: 5.1612
f. $p$-value: 0.0003
g. Check student’s solution.
h. i. Alpha: 0.05
   ii. Decision: Reject 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.

Exercise 115

Ten individuals went on a low-fat diet for 12 weeks to lower their cholesterol. The data are recorded in Table 1.30. Do you think that their cholesterol levels were significantly lowered?

<table>
<thead>
<tr>
<th>Starting cholesterol level</th>
<th>Ending cholesterol level</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>220</td>
<td>230</td>
</tr>
</tbody>
</table>
Exercise 116

A new AIDS prevention drug was tried on a group of 224 HIV positive patients. Forty-five patients developed AIDS after four years. In a control group of 224 HIV positive patients, 68 developed AIDS after four years. We want to test whether the method of treatment reduces the proportion of patients that develop AIDS after four years or if the proportions of the treated group and the untreated group stay the same. Let the subscript t = treated patient and ut = untreated patient.

The appropriate hypotheses are:

a. \( H_0: p_t < p_{ut} \) and \( H_a: p_t \geq p_{ut} \)

b. \( H_0: p_t \leq p_{ut} \) and \( H_a: p_t > p_{ut} \)

c. \( H_0: p_t = p_{ut} \) and \( H_a: p_t \neq p_{ut} \)

d. \( H_0: p_t = p_{ut} \) and \( H_a: p_t < p_{ut} \)

Solution

d

Exercise 117

A new AIDS prevention drug was tried on a group of 224 HIV positive patients. Forty-five patients developed AIDS after four years. In a control group of 224 HIV positive patients, 68 developed AIDS after four years. We want to test whether the method of treatment reduces the proportion of patients that develop AIDS after four years or if the proportions of the treated group and the untreated group stay the same. Let the subscript t = treated patient and ut = untreated patient.

If the p-value is 0.0062 what is the conclusion (use \( \alpha = 0.05 \))?

a. The method has no effect.

b. There is sufficient evidence to conclude that the method reduces the proportion of HIV positive patients who develop AIDS after four years.

c. There is sufficient evidence to conclude that the method increases the proportion of HIV positive patients who develop AIDS after four years.

d. There is insufficient evidence to conclude that the method reduces the proportion of HIV positive patients who develop AIDS after four years.
Exercise 118
An experiment is conducted to show that blood pressure can be consciously reduced in people trained in a “biofeedback exercise program.” Six subjects were randomly selected and blood pressure measurements were recorded before and after the training. The difference between blood pressures was calculated (after - before) producing the following results: $\bar{x}_d = -10.2$ $s_d = 8.4$. Using the data, test the hypothesis that the blood pressure has decreased after the training. The distribution for the test is:

a. $t_5$

b. $t_6$

c. $N(-10.2, 8.4)$

d. $N\left(-10.2, \frac{8.4}{\sqrt{6}}\right)$

Exercise 119
An experiment is conducted to show that blood pressure can be consciously reduced in people trained in a “biofeedback exercise program.” Six subjects were randomly selected and blood pressure measurements were recorded before and after the training. The difference between blood pressures was calculated (after - before) producing the following results: $\bar{x}_d = -10.2$ $s_d = 8.4$. Using the data, test the hypothesis that the blood pressure has decreased after the training. If $\alpha = 0.05$, the p-value and the conclusion are

a. 0.0014; There is sufficient evidence to conclude that the blood pressure decreased after the training.

b. 0.0014; There is sufficient evidence to conclude that the blood pressure increased after the training.

c. 0.0155; There is sufficient evidence to conclude that the blood pressure decreased after the training.

d. 0.0155; There is sufficient evidence to conclude that the blood pressure increased after the training.

Exercise 120
A golf instructor is interested in determining if her new technique for improving players’ golf scores is effective. She takes four new students. She records their 18-hole scores before learning the technique and then after having taken her class. She conducts a hypothesis test. The data are as follows.

<table>
<thead>
<tr>
<th>Player</th>
<th>Player 2</th>
<th>Player 3</th>
<th>Player 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean score before class</td>
<td>83</td>
<td>78</td>
<td>93</td>
</tr>
<tr>
<td>Mean score after class</td>
<td>80</td>
<td>80</td>
<td>86</td>
</tr>
<tr>
<td>------------------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

Table 10.31
The correct decision is:
a. Reject $H_0$.
b. Do not reject the $H_0$.

Solution

b

Exercise 121

A local cancer support group believes that the estimate for new female breast cancer cases in the south is higher in 2013 than in 2012. The group compared the estimates of new female breast cancer cases by southern state in 2012 and in 2013. The results are in Table 1.32.

<table>
<thead>
<tr>
<th>Southern States</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>3,450</td>
<td>3,720</td>
</tr>
<tr>
<td>Arkansas</td>
<td>2,150</td>
<td>2,280</td>
</tr>
<tr>
<td>Florida</td>
<td>15,540</td>
<td>15,710</td>
</tr>
<tr>
<td>Georgia</td>
<td>6,970</td>
<td>7,310</td>
</tr>
<tr>
<td>Kentucky</td>
<td>3,160</td>
<td>3,300</td>
</tr>
<tr>
<td>Louisiana</td>
<td>3,320</td>
<td>3,630</td>
</tr>
<tr>
<td>Mississippi</td>
<td>1,990</td>
<td>2,080</td>
</tr>
<tr>
<td>North Carolina</td>
<td>7,090</td>
<td>7,430</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>2,630</td>
<td>2,690</td>
</tr>
<tr>
<td>South Carolina</td>
<td>3,570</td>
<td>3,580</td>
</tr>
<tr>
<td>Tennessee</td>
<td>4,680</td>
<td>5,070</td>
</tr>
<tr>
<td>Texas</td>
<td>15,050</td>
<td>14,980</td>
</tr>
<tr>
<td>Virginia</td>
<td>6,190</td>
<td>6,280</td>
</tr>
</tbody>
</table>

Table 10.32

Solution

Test: two matched pairs or paired samples (t-test) Random variable: $\bar{X}_d$
Distribution: $t_{12}; \mu_d = 0$ $H_0: \mu_d > 0$ 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: 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 2013 than in 2012.

Exercise 122

A traveler wanted to know if the prices of hotels are different in the ten cities that he visits the most often. The list of the cities with the corresponding hotel prices for his two favorite hotel chains is in Table 1.33. Test at the 1% level of significance.

<table>
<thead>
<tr>
<th>Cities</th>
<th>Hyatt Regency prices in dollars</th>
<th>Hilton prices in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta</td>
<td>107</td>
<td>169</td>
</tr>
<tr>
<td>Boston</td>
<td>358</td>
<td>289</td>
</tr>
<tr>
<td>Chicago</td>
<td>209</td>
<td>299</td>
</tr>
<tr>
<td>Dallas</td>
<td>209</td>
<td>198</td>
</tr>
<tr>
<td>Denver</td>
<td>167</td>
<td>169</td>
</tr>
<tr>
<td>Indianapolis</td>
<td>179</td>
<td>214</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>179</td>
<td>169</td>
</tr>
<tr>
<td>New York City</td>
<td>625</td>
<td>459</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>179</td>
<td>159</td>
</tr>
<tr>
<td>Washington, DC</td>
<td>245</td>
<td>239</td>
</tr>
</tbody>
</table>

Table 10.33

Solution

Test: matched pairs or paired samples (t-test) Random variable: $\tau_d$ Distribution: $t_9$ $H_0$: $\mu_d = 0$ $H_a$: $\mu_d \neq 0$ The mean of the differences of prices at the Hyatt Regency and Hilton hotels is not equal to zero. The prices of hotels (Hyatt Regency and Hilton) are different in the ten cities that the traveler visits the most often. Graph: two-tailed

\[
\frac{1}{2} \text{(p-value)} = 0.3441
\]
Exercise 123

A politician asked his staff to determine whether the underemployment rate in the northeast decreased from 2011 to 2012. The results are in Table 1.34.

<table>
<thead>
<tr>
<th>Northeastern States</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>17.3</td>
<td>16.4</td>
</tr>
<tr>
<td>Delaware</td>
<td>17.4</td>
<td>13.7</td>
</tr>
<tr>
<td>Maine</td>
<td>19.3</td>
<td>16.1</td>
</tr>
<tr>
<td>Maryland</td>
<td>16.0</td>
<td>15.5</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>17.6</td>
<td>18.2</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>15.4</td>
<td>13.5</td>
</tr>
<tr>
<td>New Jersey</td>
<td>19.2</td>
<td>18.7</td>
</tr>
<tr>
<td>New York</td>
<td>18.5</td>
<td>18.7</td>
</tr>
<tr>
<td>Ohio</td>
<td>18.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>16.5</td>
<td>16.9</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>20.7</td>
<td>22.4</td>
</tr>
<tr>
<td>Vermont</td>
<td>14.7</td>
<td>12.3</td>
</tr>
<tr>
<td>West Virginia</td>
<td>15.5</td>
<td>17.3</td>
</tr>
</tbody>
</table>

Table 10.34

Solution

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: \(X_d\) 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

\[ p\text{-value: 0.1207} \]

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 2011 to 2012.
Exercise 124

Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A powder diet is tested on 49 people, and a liquid diet is tested on 36 different people. The population standard deviations are two pounds and three pounds, respectively. Of interest is whether the liquid diet yields a higher mean weight loss than the powder diet.

Solution

a

Exercise 125

Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A new chocolate bar is taste-tested on consumers. Of interest is whether the proportion of children who like the new chocolate bar is greater than the proportion of adults who like it.

Solution

e

Exercise 126

Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

The mean number of English courses taken in a two–year time period by male and
female college students is believed to be about the same. An experiment is conducted and data are collected from nine males and 16 females.

Solution
b

Exercise 127
Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A football league reported that the mean number of touchdowns per game was five. A study is done to determine if the mean number of touchdowns has decreased.

Solution
d

Exercise 128
Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A study is done to determine if students in the California state university system take longer to graduate than students enrolled in private universities. One hundred students from both the California state university system and private universities are surveyed. From years of research, it is known that the population standard deviations are 1.5811 years and one year, respectively.

Solution
a

Exercise 129
Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
According to a YWCA Rape Crisis Center newsletter, 75% of rape victims know their attackers. A study is done to verify this.

Solution  
f

Exercise 130  Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

According to a recent study, U.S. companies have a mean maternity-leave of six weeks.

Solution  d

Exercise 131  Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known
b. independent group means, population standard deviations and/or variances unknown
c. matched or paired samples
d. single mean
e. two proportions
f. single proportion

A recent drug survey showed an increase in use of drugs and alcohol among local high school students as compared to the national percent. Suppose that a survey of 100 local youths and 100 national youths is conducted to see if the proportion of drug and alcohol use is higher locally than nationally.

Solution  e

Exercise 132  Indicate which of the following choices best identifies the hypothesis test.
A new SAT study course is tested on 12 individuals. Pre-course and post-course scores are recorded. Of interest is the mean increase in SAT scores. The following data are collected:

<table>
<thead>
<tr>
<th>Pre-course score</th>
<th>Post-course score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>960</td>
<td>920</td>
</tr>
<tr>
<td>1010</td>
<td>1100</td>
</tr>
<tr>
<td>840</td>
<td>880</td>
</tr>
<tr>
<td>1100</td>
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</tr>
<tr>
<td>1250</td>
<td>1320</td>
</tr>
<tr>
<td>860</td>
<td>860</td>
</tr>
<tr>
<td>1330</td>
<td>1370</td>
</tr>
<tr>
<td>790</td>
<td>770</td>
</tr>
<tr>
<td>990</td>
<td>1040</td>
</tr>
<tr>
<td>1110</td>
<td>1200</td>
</tr>
<tr>
<td>740</td>
<td>850</td>
</tr>
</tbody>
</table>

Table 10.35  

Solution  
e  

Exercise 133  

Indicate which of the following choices best identifies the hypothesis test.

a. independent group means, population standard deviations and/or variances known  
b. independent group means, population standard deviations and/or variances unknown  
c. matched or paired samples  
d. single mean  
e. two proportions  
f. single proportion  

University of Michigan researchers reported in the Journal of the National Cancer Institute that quitting smoking is especially beneficial for those under age 49. In
this American Cancer Society study, the risk (probability) of dying of lung cancer was about the same as for those who had never smoked.

Solution

Exercise 134

Lesley E. Tan investigated the relationship between left-handedness vs. right-handedness and motor competence in preschool children. Random samples of 41 left-handed preschool children and 41 right-handed preschool children were given several tests of motor skills to determine if there is evidence of a difference between the children based on this experiment. The experiment produced the means and standard deviations shown Table 10.36. Determine the appropriate test and best distribution to use for that test.

<table>
<thead>
<tr>
<th></th>
<th>Left-handed</th>
<th>Right-handed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Sample mean</td>
<td>97.5</td>
<td>98.1</td>
</tr>
<tr>
<td>Sample standard deviation</td>
<td>17.5</td>
<td>19.2</td>
</tr>
</tbody>
</table>

Table 10.36

a. Two independent means, normal distribution
b. Two independent means, Student’s-t distribution
c. Matched or paired samples, Student’s-t distribution
d. Two population proportions, normal distribution

Solution

Exercise 135

A golf instructor is interested in determining if her new technique for improving players’ golf scores is effective. She takes four (4) new students. She records their 18-hole scores before learning the technique and then after having taken her class. She conducts a hypothesis test. The data are as Table 10.37.

<table>
<thead>
<tr>
<th></th>
<th>Player 1</th>
<th>Player 2</th>
<th>Player 3</th>
<th>Player 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean score</td>
<td>83</td>
<td>78</td>
<td>93</td>
<td>87</td>
</tr>
<tr>
<td>before class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean score</td>
<td>80</td>
<td>80</td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>after class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10.37

This is:

a. a test of two independent means.

Solution

A