5. From observing the P-value, what would you conclude?
6. By comparing the test statistic to the critical value, what would you conclude?
7. Is there a conflict in this output? Explain.
8. What has been proved in this study?

See page 469 for the answers.

Exercises 8–3

1. In what ways is the t distribution similar to the standard normal distribution? In what ways is the t distribution different from the standard normal distribution?

2. What are the degrees of freedom for the t test?

3. Find the critical value (or values) for the t test for each.

a. $n = 10$, $\alpha = 0.05$, right-tailed $+1.833$
b. $n = 18$, $\alpha = 0.10$, two-tailed ± 1.740
c. $n = 6$, $\alpha = 0.01$, left-tailed -3.365
d. $n = 9$, $\alpha = 0.025$, right-tailed $+2.306$
e. $n = 15$, $\alpha = 0.05$, two-tailed ± 2.145
f. $n = 23$, $\alpha = 0.005$, left-tailed -2.819
g. $n = 28$, $\alpha = 0.01$, two-tailed ± 2.771
h. $n = 17$, $\alpha = 0.02$, two-tailed ± 2.583

4. (ans) Using Table F, find the P-value interval for each test value.

a. $t = 2.321$, $n = 15$, right-tailed
b. $t = 1.945$, $n = 28$, two-tailed
c. $t = -1.267$, $n = 8$, left-tailed
d. $t = 1.562$, $n = 17$, two-tailed
e. $t = 3.025$, $n = 24$, right-tailed
f. $t = -1.145$, $n = 5$, left-tailed
g. $t = 2.179$, $n = 13$, two-tailed
h. $t = 0.665$, $n = 10$, right-tailed

For Exercises 5 through 18, perform each of the following steps.

a. State the hypotheses and identify the claim.
b. Find the critical value(s).
c. Find the test value.
d. Make the decision.
e. Summarize the results.

Use the traditional method of hypothesis testing unless otherwise specified.

Assume that the population is approximately normally distributed.

5. Veterinary Expenses of Cat Owners According to the American Pet Products Manufacturers Association, cat owners spend an average of \$179 annually in routine veterinary visits. A random sample of local cat owners revealed that 10 randomly selected owners spent an average of \$205 with $s = \$26$. Is there a significant statistical difference at $\alpha = 0.01$?

Source: www.hsus.org/pets

6. Park Acreage A state executive claims that the average number of acres in western Pennsylvania state parks is less than 2000 acres. A random sample of five parks is selected, and the number of acres is shown. At $\alpha = 0.01$, is there enough evidence to support the claim?

959	1187	493	6249	541

Source: *Pittsburgh Tribune-Review.*

7. Cell Phone Call Lengths The average local cell phone call length was reported to be 2.27 minutes. A random sample of 20 phone calls showed an average of 2.98 minutes in length with a standard deviation of 0.98 minute. At $\alpha = 0.05$ can it be concluded that the average differs from the population average?

Source: *World Almanac.*

8. Commute Time to Work A survey of 15 large U.S. cities finds that the average commute time one way is 25.4 minutes. A chamber of commerce executive feels that the commute in his city is less and wants to publicize this. He randomly selects 25 commuters and finds the average is 22.1 minutes with a standard deviation of 5.3 minutes. At $\alpha = 0.10$, is he correct?

Source: *New York Times Almanac.*

9. Heights of Tall Buildings A researcher estimates that the average height of the buildings of 30 or more stories in a large city is at least 700 feet. A random sample of 10 buildings is selected, and the heights in feet are shown. At $\alpha = 0.025$, is there enough evidence to reject the claim?

485	511	841	725	615
520	535	635	616	582

Source: *Pittsburgh Tribune-Review.*

10. Exercise and Reading Time Spent by Men Men spend an average of 29 minutes per day on weekends and holidays exercising and playing sports. They spend an average of 23 minutes per day reading. A random sample of 25 men resulted in a mean of 35 minutes exercising with a standard deviation of 6.9 minutes and

The formula is derived from the normal approximation to the binomial and follows the general formula

$$\text{Test value} = \frac{(\text{observed value}) - (\text{expected value})}{\text{standard error}}$$

We obtain $\hat{p}$ from the sample (i.e., observed value), p is the expected value (i.e., hypothesized population proportion), and $\sqrt{pq/n}$ is the standard error.

The formula $z = \dfrac{\hat{p} - p}{\sqrt{pq/n}}$ can be derived from the formula $z = \dfrac{X - \mu}{\sigma}$ by substituting $\mu = np$ and $\sigma = \sqrt{npq}$ and then dividing both numerator and denominator by n. Some algebra is used. See Exercise 23 in this section.

Assumptions for Testing a Proportion

1. The sample is a random sample.
2. The conditions for a binomial experiment are satisfied. (See Chapter 5.)
3. $np \geq 5$ and $nq \geq 5$.

The steps for hypothesis testing are the same as those shown in Section 8–3. Table E is used to find critical values and P-values.

Examples 8–17 to 8–19 show the traditional method of hypothesis testing. Example 8–20 shows the P-value method.

Sometimes it is necessary to find $\hat{p}$, as shown in Examples 8–17, 8–19, and 8–20, and sometimes $\hat{p}$ is given in the exercise. See Example 8–18.

Example 8–17 People Who Are Trying to Avoid Trans Fats

A dietitian claims that 60% of people are trying to avoid trans fats in their diets. She randomly selected 200 people and found that 128 people stated that they were trying to avoid trans fats in their diets. At $\alpha = 0.05$, is there enough evidence to reject the dietitian's claim?

Source: Based on a survey by the Gallup Poll.

Solution

Step 1 State the hypothesis and identify the claim.

H_0: $p = 0.60$ (claim) and H_1: $p \neq 0.60$

Step 2 Find the critical values. Since $\alpha = 0.05$ and the test value is two-tailed, the critical values are ± 1.96.

Step 3 Compute the test value. First, it is necessary to find $\hat{p}$.

$$\hat{p} = \frac{X}{n} = \frac{128}{200} = 0.64 \qquad p = 0.60 \qquad q = 1 - 0.60 = 0.40$$

Substitute in the formula.

$$Z = \frac{\hat{p} - p}{\sqrt{pq/n}} = \frac{0.64 - 0.60}{\sqrt{(0.60)(0.40)/200}} = 1.15$$

Step 4 Make the decision. Do not reject the null hypothesis since the test value falls outside the critical region, as shown in Figure 8–26.