the list of average teachers' salaries. The California yearly average is \$64,421 while teachers in New York make an average annual salary of \$62,332. Random samples of 45 teachers from each state yielded the following.

	California	New York
Sample mean	64,510	62,900
Population standard deviation	8,200	7,800

At $\alpha = 0.10$, is there a difference in means of the salaries?

Source: World Almanac.

7. Commuting Times The U.S. Census Bureau reports that the average commuting time for citizens of both Baltimore, Maryland, and Miami, Florida, is approximately 29 minutes. To see if their commuting times appear to be any different in the winter, random samples of 40 drivers were surveyed in each city and the average commuting time for the month of January was calculated for both cities. The results are shown. At the 0.05 level of significance, can it be concluded that the commuting times are different in the winter?

Miami	Baltimore
40	40
28.5 min	35.2 min
7.2 min	9.1 min
	40 28.5 min

Source: www.census.gov

8. Heights of 9-Year-Olds At age 9 the average weight (21.3 kg) and the average height (124.5 cm) for both boys and girls are exactly the same. A random sample of 9-year-olds yielded these results. At $\alpha = 0.05$, do the data support the given claim that there is a difference in heights?

	Boys	Girls
Sample size	60	50 ,
Mean height, cm	123.5	126.2
Population variance	98	120

Source: www.healthepic.com

9. Length of Hospital Stays The average length of "short hospital stays" for men is slightly longer than that for women, 5.2 days versus 4.5 days. A random sample of recent hospital stays for both men and women revealed the following. At $\alpha = 0.01$, is there sufficient evidence to conclude that the average hospital stay for men is longer than the average hospital stay for women?

ys
ys
•

Source: www.cdc.gov/nchs

10. Home Prices A real estate agent compares the selling prices of randomly selected homes in two municipalities

in southwestern Pennsylvania to see if there is a difference. The results of the study are shown. Is there enough evidence to reject the claim that the average cost of a home in both locations is the same? Use $\alpha = 0.01$

Ligonier	
$\overline{X}_2 = \$98,043*$ $\sigma_2 = \$4731$ $n_2 = 40$	

*Based on information from RealSTATs.

11. Women Science Majors In a study of randomly selected women science majors, the following data were obtained on two groups, those who left their profession within a few months after graduation (leavers) and those who remained in their profession after they graduated (stayers). Test the claim that those who stayed had a higher science grade point average than those who left. Use $\alpha = 0.05$.

Leavers	Stayers	
$\bar{X}_1 = 3.16$	$\bar{X}_2 = 3.28$	
$\sigma_1 = 0.52$	$\sigma_2 = 0.46$	
$n_1 = 103$	$n_2 = 225$	

Source: Paula Rayman and Belle Brett, "Women Science Majors: What Makes a Difference in Persistence after Graduation?" The Journal of Higher Education.

12. ACT Scores A random survey of 1000 students nationwide showed a mean ACT score of 21.4. Ohio was not used. A survey of 500 randomly selected Ohio scores showed a mean of 20.8. If the population standard deviation in each case is 3, can we conclude that Ohio is below the national average? Use $\alpha = 0.05$.

Source: Report of WFIN radio.

13. Per Capita Income The average per capita income for Wisconsin is reported to be \$37,314, and for South Dakota it is \$37,375—almost the same thing. A random sample of 50 workers from each state indicated the following sample statistics.

	Wisconsin	South Dakota
Size	50	50
Mean	\$40,275	\$38,750
Population standard deviation	\$10,500	\$12,500

At $\alpha = 0.05$, can we conclude a difference in means of the personal incomes?

Source: New York Times Almanac.

14. Monthly Social Security Benefits The average monthly Social Security benefit for a specific year for retired workers was \$954.90 and for disabled workers was \$894.10. Researchers used data from the Social Security records to test the claim that the difference in monthly benefits between the two groups was greater

than \$30. Based on the following information, can the researchers' claim be supported at the 0.05 level of significance?

	Retired	Disabled
Sample size	60	60
Mean benefit	\$960.50	\$902.89
Population standard deviation	\$98	\$101

Source: New York Times Almanac.

15. Self-Esteem Scores In the study cited in Exercise 11, the researchers collected the data shown here on a self-esteem questionnaire. At $\alpha=0.05$, can it be concluded that there is a difference in the self-esteem scores of the two groups? Use the *P*-value method.

Leavers	Stayers	
$\overline{\bar{X}}_1 = 3.05$	$\bar{X}_2 = 2.96$	
$\sigma_1 = 0.75$	$\sigma_2 = 0.75$	
$n_1 = 103$	$n_2 = 225$	

Source: Paula Rayman and Belle Brett, "Women Science Majors: What Makes a Difference in Persistence after Graduation?" *The Journal of Higher Education*.

16. Ages of College Students The dean of students wants to see whether there is a significant difference in ages of resident students and commuting students. She selects a random sample of 50 students from each group. The ages are shown here. At $\alpha = 0.05$, decide if there is enough evidence to reject the claim of no difference in the ages of the two groups. Use the *P*-value method. Assume $\sigma_1 = 3.68$ and $\sigma_2 = 4.7$.

Resident students							
22	25	27	23	26	28	26	24
25	20	26	24	27	26	18	19
18	30	26	18	18	19	32	23
19	19	18	29	19	22	18	22
26	19	19	21	23	18	20	18
22	21	19	21	21`	22	18	20
19	23						
		Co	mmute	r stude	nts		
18	20	19	18	22	25	24	35
23	18	23	22	28	25	20	24
26	30	22	22	22	21	18	20
19	26	35	19	19	18	19	32
29	23	21	19	36	27	27	20
20	21	18	19	23	20	19	19
20	25						

17. Problem-Solving Ability Two groups of students are given a problem-solving test, and the results are compared. Find the 90% confidence interval of the true difference in means.

Mathematics majors	Computer science majors
$\bar{X}_1 = 83.6$	$\bar{X}_2 = 79.2$
$\sigma_1 = 4.3$	$\sigma_2 = 3.8$
$n_1 = 36$	$n_2 = 36$

8. Credit Card Debt The average credit card debt for a recent year was \$9205. Five years earlier the average credit card debt was \$6618. Assume sample sizes of 35 were used and the population standard deviations of both samples were \$1928. Find the 95% confidence interval of the difference in means.

Source: CardWeb.com

19. Literacy Scores Adults aged 16 or older were assessed in three types of literacy: prose, document, and quantitative. The scores in document literacy were the same for 19- to 24-year-olds and for 40- to 49-year-olds. A random sample of scores from a later year showed the following statistics.

Age group	Mean score	standard deviation	Sample size	
19–24	280	56.2	40	
40-49	315	52.1	35	

Construct a 95% confidence interval for the true difference in mean scores for these two groups. What does your interval say about the claim that there is no difference in mean scores?

Source: www.nces.ed.gov

20. Battery Voltage Two brands of batteries are tested, and their voltages are compared. The summary statistics follow. Find the 95% confidence interval of the true difference in the means. Assume that both variables are normally distributed.

Brand X	Brand Y
$\overline{X}_1 = 9.2 \text{ volts}$	$\bar{X}_2 = 8.8 \text{ volts}$
$\sigma_1 = 0.3 \text{ volt}$	$\sigma_2 = 0.1 \text{ volt}$
$n_1 = 27$	$n_2 = 30$

21. Television Watching The average number of hours of television watched per week by women over age 55 is 48 hours. Men over age 55 watch an average of 43 hours of television per week. Random samples of 40 men and 40 women from a large retirement community yielded the following results. At the 0.01 level of significance, can it be concluded that women watch more television per week than men?

	Sample size	Mean	Population standard deviation
Women	40	48.2	5.6
Men	40	44.3	4.5

Source: World Almanac 2012.

22. Commuting Times for College Students The mean travel time to work for Americans is 25.3 minutes. An

Exercises 9–2

For these exercises, perform each of these steps. Assume that all variables are normally or approximately normally distributed.

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

Use the traditional method of hypothesis testing unless otherwise specified and assume the variances are unequal.

- 1. Bestseller Books The mean for the number of weeks 15 New York Times hard-cover fiction books spent on the bestseller list is 22 weeks. The standard deviation is 6.17 weeks. The mean for the number of weeks 15 New York Times hard-cover nonfiction books spent on the list is 28 weeks. The standard deviation is 13.2 weeks. At $\alpha = 0.10$, can we conclude that there is a difference in the mean times for the number of weeks the books were on the bestseller lists?
- 2. Tax-Exempt Properties A tax collector wishes to see if the mean values of the tax-exempt properties are different for two cities. The values of the tax-exempt properties for the two random samples are shown. The data are given in millions of dollars. At $\alpha = 0.05$, is there enough evidence to support the tax collector's claim that the means are different?

	City	7 A			City	7 B	
113	22	14	8	82	11	5	15
25	23	23	30	295	50	12	9
44	11	19	7	12	68	81	2
31	19	5	2	20	16	4	5

- 3. Noise Levels in Hospitals The mean noise level of 20 randomly selected areas designated as "casualty doors" was 63.1 dBA, and the sample standard deviation is 4.1 dBA. The mean noise level for 24 randomly selected areas designated as operating theaters was 56.3 dBA, and the sample standard deviation was 7.5 dBA. At $\alpha = 0.05$, can it be concluded that there is a difference in the means?
- 4. Ages of Gamblers The mean age of a random sample of 25 people who were playing the slot machines is 48.7 years, and the standard deviation is 6.8 years. The mean age of a random sample of 35 people who were playing roulette is 55.3 with a standard deviation of 3.2 years. Can it be concluded at $\alpha = 0.05$ that the mean age of those playing the slot machines is less than those playing roulette?
- 5. Carbohydrates in Candies The number of grams of carbohydrates contained in 1-ounce servings of randomly selected chocolate and nonchocolate candy is listed here. Is there sufficient evidence to conclude

that the difference in the means is statistically significant? Use $\alpha = 0.10$.

Chocolate:	 25 34	 		25	32	29
Nonchocolate:	41 55	29	30	38	39	10

Source: The Doctor's Pocket Calorie, Fat, and Carbohydrate Counter.

6. Weights of Vacuum Cleaners Upright vacuum cleaners have either a hard body type or a soft body type. Shown are the weights in pounds of a random sample of each type. At $\alpha = 0.05$, can it be concluded that the means of the weights are different?

H	ard bo	dy typ	es	S	oft boo	ly type	s
21	17	17	20	24	13	11	13
16	17	15	20	12	15		
23	16	17	17				
13	15	16	18				
18							

7. Weights of Running Shoes The weights in ounces of a sample of running shoes for men and women are shown. Test the claim that the means are different. Use the P-value method with $\alpha = 0.05$.

M	en	Women						
10.4	12.6	10.6	10.2	8.8				
11.1	14.7	9.6	9.5	9.5				
10.8	12.9	10.1	11.2	9.3				
11.7	13.3	9.4	10.3	9.5				
12.8	14.5	9.8	10.3	11.0				

- **8. Teacher Salaries** A researcher claims that the mean of the salaries of elementary school teachers is greater than the mean of the salaries of secondary school teachers in a large school district. The mean of the salaries of a random sample of 26 elementary school teachers is \$48,256, and the sample standard deviation is \$3,912.40. The mean of the salaries of a random sample of 24 secondary school teachers is \$45,633. The sample standard deviation is \$5533. At $\alpha = 0.05$, can it be concluded that the mean of the salaries of the elementary school teachers is greater than the mean of the salaries of the secondary school teachers? Use the *P*-value method.
- **9.** Find the 95% confidence interval for the difference of the means in Exercise 3 of this section.
- **10.** Find the 95% confidence interval for the difference of the means in Exercise 6 of this section.
- 11. Hours Spent Watching Television According to Nielsen Media Research, children (ages 2–11) spend an average of 21 hours 30 minutes watching television per week while teens (ages 12–17) spend an average of

516

Before	9	12	6	15	3	18	10	13	7
After	9	17	9	20	2	21	15	22	6

4. Obstacle Course Times An obstacle course was set up on a campus, and 8 randomly selected volunteers were given a chance to complete it while they were being timed. They then sampled a new energy drink and were given the opportunity to run the course again. The "before" and "after" times in seconds are shown. Is there sufficient evidence at $\alpha = 0.05$ to conclude that the students did better the second time? Discuss possible reasons for your results.

Student		1	2	3	4	5	6	7	8
Before	Ī	67	72	80	70	78	82	69	75
After		68	70	76	65	75	78	65	68

5. Sleep Report Randomly selected students in a statistics class were asked to report the number of hours they slept on weeknights and on weekends. At $\alpha = 0.05$, is there sufficient evidence that there is a difference in the mean number of hours slept?

Student	1	2	3	4	5	6	7	8
Hours, SunThurs.	8	5.5	7.5	8	7	6	6	8
Hours, Fri.–Sat.	4	7	10.5	12	11	9	6	9

6. PGA Golf Scores At a recent PGA tournament (the Honda Classic at Palm Beach Gardens, Florida) the following scores were posted for eight randomly selected golfers for two consecutive days. At $\alpha=0.05$, is there evidence of a difference in mean scores for the two days?

	Y.									
Golfer	1	2	3	4	5	6	7	8		
Thursday	67	65	68	68	68	70	69	70		
Friday	68	70	69	71	72	69	70	70		

Source: Washington Observer-Reporter.

.7. Reducing Errors in Grammar A composition teacher wishes to see whether a new grammar program will reduce the number of grammatical errors her students make when writing a two-page essay. She randomly selects six students, and the data are shown. At $\alpha = 0.025$, can it be concluded that the number of errors has been reduced?

Student	1	2	3	4	5	6
Errors before	12	9	0	5	4	3
Errors after	9	6	1	3	2	3

8. Overweight Dogs A veterinary nutritionist developed a diet for overweight dogs. The total volume of food consumed remains the same, but one-half of the dog food is

replaced with a low-calorie "filler" such as canned green beans. Six overweight dogs were randomly selected from her practice and were put on this program. Their initial weights were recorded, and they were weighed again after 4 weeks. At the 0.05 level of significance, can it be concluded that the dogs lost weight?

Before	42	53	48	65	40	52
After	39	45	40	58	42	47

9. Pulse Rates of Identical Twins A researcher wanted to compare the pulse rates of identical twins to see whether there was any difference. Eight sets of twins were randomly selected. The rates are given in the table as number of beats per minute. At $\alpha = 0.01$, is there a significant difference in the average pulse rates of twins? Use the *P*-value method. Find the 99% confidence interval for the difference of the two.

Twin A	87	92	78	83	88	90	84	93
Twin B	83	95	79	83	86	93	80	86

10. Toy Assembly Test An educational researcher devised a wooden toy assembly project to test learning in 6-year-olds. The time in seconds to assemble the project was noted, and the toy was disassembled out of the child's sight. Then the child was given the task to repeat. The researcher would conclude that learning occurred if the mean of the second assembly times was less than the mean of the first assembly times. At $\alpha = 0.01$, can it be concluded that learning took place? Use the *P*-value method, and find the 99% confidence interval of the difference in means.

Child	1	2	3	4	5	6	7
Trial 1	100	150	150	110	130	120	118
Trial 2	90	130	150	90	105	110	120

11. Golf Scores A researcher hypothesized that scores differed between the first and last rounds of major U.S. golf tournaments. Here are the paired data for randomly selected golfers from the 2012 U.S. Open. At the 0.05 level of significance, is there a difference?

Golfer	1	2	3	4	5	6	7	8
Round 1	72	73	72	72	72	70	73	70
Round 2	72	69	75	76	75	73	75	74

12. Mistakes in a Song A random sample of six music students played a short song, and the number of mistakes in music each student made was recorded. After they practiced the song 5 times, the number of mistakes each student made was recorded. The data are shown. At $\alpha = 0.05$, can it be concluded that there was a decrease in the mean number of mistakes?

Student	A	В	C	D	Е	F
Before	10	6	8	8	13	8
After	4	2	2	7	8	9

3. Find each X, given \hat{p} .

a.
$$\hat{p} = 0.16, n = 100$$

b.
$$\hat{p} = 0.08, n = 50$$

c.
$$\hat{p} = 6\%, n = 800$$

d.
$$\hat{p} = 52\%, n = 200$$

e.
$$\hat{p} = 20\%, n = 150$$

4. Find each X, given \hat{p} .

a.
$$\hat{p} = 0.24, n = 300$$

b.
$$\hat{p} = 0.09, n = 200$$

c.
$$\hat{p} = 88\%, n = 500$$

d.
$$\hat{p} = 40\%$$
, $n = 480$

e.
$$\hat{p} = 32\%, n = 700$$

5. Find \bar{p} and \bar{q} for each.

a.
$$X_1 = 60, n_1 = 100, X_2 = 40, n_2 = 100$$

b.
$$X_1 = 22$$
, $n_1 = 50$, $X_2 = 18$, $n_2 = 30$

c.
$$X_1 = 18, n_1 = 60, X_2 = 20, n_2 = 80$$

d.
$$X_1 = 5$$
, $n_1 = 32$, $X_2 = 12$, $n_2 = 48$

e.
$$X_1 = 12, n_1 = 75, X_2 = 15, n_2 = 50$$

6. Find \bar{p} and \bar{q} .

a.
$$X_1 = 6, n_1 = 15, X_2 = 9, n_2 = 15$$

b.
$$X_1 = 21, n_1 = 100, X_2 = 43, n_2 = 150$$

c.
$$X_1 = 20, n_1 = 80, X_2 = 65, n_2 = 120$$

d.
$$X_1 = 15, n_1 = 50, X_2 = 3, n_2 = 12$$

e.
$$X_1 = 24$$
, $n_1 = 40$, $X_2 = 18$, $n_2 = 36$

For Exercises 7 through 27, perform these steps.

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

Use the traditional method of hypothesis testing unless otherwise specified.

- 7. Lecture versus Computer-Assisted Instruction A survey found that 83% of the men questioned preferred computer-assisted instruction to lecture and 75% of the women preferred computer-assisted instruction to lecture. There were 100 randomly selected individuals in each sample. At $\alpha=0.05$, test the claim that there is no difference in the proportion of men and the proportion of women who favor computer-assisted instruction over lecture. Find the 95% confidence interval for the difference of the two proportions.
- 8. Leisure Time In a sample of 50 men, 44 said that they had less leisure time today than they had 10 years ago. In a random sample of 50 women, 48 women said that they had less leisure time than they had 10 years ago. At $\alpha = 0.10$, is there a difference in the proportions? Find the 90% confidence interval for the difference of the

two proportions. Does the confidence interval contain 0? Give a reason why this information would be of interest to a researcher.

Source: Based on statistics from Market Directory.

- 9. Desire to Be Rich In a random sample of 80 Americans, 44 wished that they were rich. In a random sample of 90 Europeans, 41 wished that they were rich. At $\alpha = 0.01$, is there a difference in the proportions? Find the 99% confidence interval for the difference of the two proportions.
- Animal Bites of Postal Workers In Cleveland, a random sample of 73 mail carriers showed that 10 had been bitten by an animal during one week. In Philadelphia, in a random sample of 80 mail carriers, 16 had received animal bites. Is there a significant difference in the proportions? Use $\alpha = 0.05$. Find the 95% confidence interval for the difference of the two proportions.
- 11. **Dog Ownership** A survey found that in a random sample of 75 families, 26 owned dogs. A survey done 15 years ago found that in a random sample of 60 families, 26 owned dogs. At $\alpha = 0.05$, has the proportion of dog owners changed over the 15-year period? Use the *P*-value method.

Source: Based on statistics from the American Veterinary Medical Association.

- 12. Seat Belt Use In a random sample of 200 men, 130 said they used seat belts. In a random sample of 300 women, 63 said they used seat belts. Test the claim that men are more safety-conscious than women, at $\alpha = 0.01$. Use the *P*-value method.
- 13. Survey on Inevitability of War A random sample of 200 teenagers shows that 50 believe that war is inevitable, and a random sample of 300 people over age 60 shows that 93 believe war is inevitable. Is the proportion of teenagers who believe war is inevitable different from the proportion of people over age 60 who do? Use $\alpha = 0.01$. Find the 99% confidence interval for the difference of the two proportions.
- 14. Hypertension It has been found that 26% of men 20 years and older suffer from hypertension (high blood pressure) and 31.5% of women are hypertensive. A random sample of 150 of each gender was selected from recent hospital records, and the following results were obtained. Can you conclude that a higher percentage of women have high blood pressure? Use α = 0.05.

Men 43 patients had high blood pressure Women 52 patients had high blood pressure

Source: www.nchs.gov

15. Partisan Support of Salary Increase Bill Find the 99% confidence interval for the difference in the population proportions for the data of a study in which 80% of the 150 randomly selected Republicans surveyed favored the bill for a salary increase and 60% of the

200 randomly selected Democrats surveyed favored the bill for a salary increase.

16. Smoking Survey National statistics show that 23% of men smoke and 18.5% of women smoke. A random sample of 180 men indicated that 50 were smokers, and a random sample of 150 women surveyed indicated that 39 smoked. Construct a 98% confidence interval for the true difference in proportions of male and female smokers. Comment on your interval—does it support the claim that there is a difference?

Source: www.nchs.gov

17. Senior Workers It seems that people are choosing or finding it necessary to work later in life. Random samples of 200 men and 200 women age 65 or older were selected, and 80 men and 59 women were found to be working. At $\alpha = 0.01$, can it be concluded that the proportions are different?

Source: Based on www.census.gov

18. Airlines On-Time Arrivals The percentages of ontime arrivals for major U.S. airlines range from 68.6 to 91.1. Two regional airlines were surveyed with the following results. At $\alpha = 0.01$, is there a difference in proportions?

	Airline A	Airline B
No. of flights	300	250
No. of on-time flights	213	185

Source: New York Times Almanac

19. College Education The percentages of adults 25 years of age and older who have completed 4 or more years of college are 23.6% for females and 27.8% for males. A random sample of women and men who were 25 years old or older was surveyed with these results. Estimate the true difference in proportions with 95% confidence, and compare your interval with the *Almanac* statistics.

	Women	Men
Sample size	350	400
No. who completed 4 or more years	100	115

Source: New York Times Almanac.

20. Married People In a specific year 53.7% of men in the United States were married and 50.3% of women were married. Random samples of 300 men and 300 women found that 178 men and 139 women were married (not necessarily to each other). At the 0.05 level of significance, can it be concluded that the proportion of men who were married is greater than the proportion of women who were married?

Source: New York Times Almanac

21. Undergraduate Financial Aid A study is conducted to determine if the percent of women who receive financial aid in undergraduate school is different from the percent of men who receive financial aid in undergraduate

school. A random sample of undergraduates revealed these results. At $\alpha = 0.01$, is there significant evidence to reject the null hypothesis?

	Women	Men
Sample size	250	300
Number receiving aid	200	180

Source: U.S. Department of Education, National Center for Education Statistics

22. High School Graduation Rates The overall U.S. public high school graduation rate is 73.4%. For Pennsylvania it is 83.5% and for Idaho 80.5%—a difference of 3%. Random samples of 1200 students from each state indicated that 980 graduated in Pennsylvania and 940 graduated in Idaho. At the 0.05 level of significance, can it be concluded that there is a difference in the proportions of graduating students between the states?

Source: World Almanac.

23. Interview Errors It has been found that many first-time interviewees commit errors that could very well affect the outcome of the interview. An astounding 77% are guilty of using their cell phones or texting during the interview! A researcher wanted to see if the proportion of male offenders differed from the proportion of female ones. Out of 120 males, 72 used their cell phone and 80 of 150 females did so. At the 0.01 level of significance is there a difference?

Source: Careerbuilder.com

- Medical Supply Sales According to the U.S. Bureau of Labor Statistics, approximately equal numbers of men and women are engaged in sales and related occupations. Although that may be true for total numbers, perhaps the proportions differ by industry. A random sample of 200 salespersons from the industrial sector indicated that 114 were men, and in the medical supply sector, 80 of 200 were men. At the 0.05 level of significance, can we conclude that the proportion of men in industrial sales differs from the proportion of men in medical supply sales?
- **25.** Coupon Use In today's economy, everyone has become savings savvy. It is still believed, though, that a higher percentage of women than men clip coupons. A random survey of 180 female shoppers indicated that 132 clipped coupons while 56 out of 100 men did so. At $\alpha = 0.01$, is there sufficient evidence that the proportion of couponing women is higher than the proportion of couponing men? Use the *P*-value method.
- 26. Never Married People The percentage of males 18 years and older who have never married is 30.4. For females the percentage is 23.6. Looking at the records in a particular populous county, a random sample of 250 men showed that 78 had never married and 58 of 200 women had never married. At the 0.05 level of significance, is the proportion of men greater than the proportion of women? Use the *P*-value method.

9-40

11. Calories in Ice Cream The numbers of calories contained in ½-cup servings of randomly selected flavors of ice cream from two national brands are listed. At the 0.05 level of significance, is there sufficient evidence to conclude that the variance in the number of calories differs between the two brands?

Bra	nd A	Bra	nd B
330	300	280	310
310	350	300	370
270	380	250	300
310	300	290	310

Source: The Doctor's Pocket Calorie, Fat and Carbohydrate Counter,

12. Winter Temperatures A random sample of daily high temperatures in January and February is listed. At $\alpha = 0.05$, can it be concluded that there is a difference in variances in high temperature between the two months?

Jan.	31	31	38	24	24	42	22	43	35	42
Feb.	31	29	24	30	28	24	27	34	27	

13. Population and Area Cities were randomly selected from the list of the 50 largest cities in the United States (based on population). The areas of each in square miles are shown. Is there sufficient evidence to conclude that the variance in area is greater for eastern cities than for western cities at $\alpha = 0.05$? At $\alpha = 0.01$?

Eastern		Western				
Atlanta, GA	132	Albuquerque, NM	181			
Columbus, OH	210	Denver, CO	155			
Louisville, KY	385	Fresno, CA	104			
New York, NY	303	Las Vegas, NV	113			
Philadelphia, PA	135	Portland, OR	134			
Washington, DC	61	Seattle, WA	84			
Charlotte, NC	242					

Source: New York Times Almanac.

Carbohydrates in Candy The number of grams of carbohydrates contained in 1-ounce servings of randomly selected chocolate and nonchocolate candy is shown. Is there sufficient evidence to conclude that there is a difference between the variation in carbohydrate content for chocolate and nonchocolate candy? Use $\alpha = 0.10$.

Chocolate	29	25	17	36	41	25	32	29
	38	34	24	27	29			
Nonchocolate	41	41	37	29	30	38	39	10
	29	55	29					

Source: The Doctor's Pocket Calorie, Fat and Carbohydrate Counter.

15. Tuition Costs for Medical School The yearly tuition costs in dollars for random samples of medical schools that specialize in research and in primary care are listed. At $\alpha = 0.05$, can it be concluded that

a difference between the variances of the two groups exists?

	Research	l	Primary care			
30,897 34,294 20,618 21,274	34,280 31,275 20,500	,	34,208	21,044 20,877 33,065	30,897 29,691 35,000	

Source: U.S. News & World Report Best Graduate Schools.

16. County Size in Indiana and Iowa A researcher wishes to see if the variance of the areas in square miles for counties in Indiana is less than the variance of the areas for counties in Iowa. A random sample of counties is selected, and the data are shown. At $\alpha = 0.01$, can it be concluded that the variance of the areas for counties in Indiana is less than the variance of the areas for counties in Iowa?

Indiana				Iowa			
406	393	396	485	640	580	431	416
431	430	369	408	443	569	779	381
305	215	489	293	717	568	714	731
373	148	306	509	571	577	503	501
560	384	320	407	568	434	615	402

Source: The World Almanac and Book of Facts.

17. Heights of Tall Buildings Test the claim that the variance of heights of randomly selected tall buildings in Denver is equal to the variance in heights of randomly selected tall buildings in Detroit at $\alpha = 0.10$. The data are given in feet.

	Denver	•	Detroit			
714	698	544	620	472	430	
504	438	408	562	448	420	
404			534	436		

Source: The World Almanac and Book of Facts.

- 18. Reading Program Summer reading programs are very popular with children. At the Citizens Library, Team Ramona read an average of 23.2 books with a standard deviation of 6.1. There were 21 members on this team. Team Beezus read an average of 26.1 books with a standard deviation of 2.3. There were 23 members on this team. Did the variances of the two teams differ? Use $\alpha = 0.05$.
- 19. Weights of Running Shoes The weights in ounces of a random sample of running shoes for men and women are shown. Calculate the variances for each sample, and test the claim that the variances are equal at $\alpha = 0.05$. Use the *P*-value method.

	Men			Women	
11.9	10.4	12.6	10.6	10.2	8.8
12.3	11.1	14.7	9.6	9.5	9.5
9.2	10.8	12.9	10.1	11.2	9.3
11.2	11.7	13.3	9.4	10.3	9.5
13.8	12.8	14.5	9.8	10.3	11.0

20. School Teachers' Salaries A researcher claims that the variation in the salaries of elementary school teachers is