8-2 Basic Skills and Concepts

Finding Number of Successes. In Exercises 1–4, find the number of successes \( x \) suggested by the given statement.

1. From the Arizona Department of Weights and Measures: Among 37 inspections at NAPA Auto Parts stores, 81% failed.
2. From the New York Times: Among 240 vinyl gloves subjected to stress tests, 63% leaked viruses.
3. From Sociological Methods and Research: When 294 central-city residents were surveyed, 28.9% refused to respond.
4. From a Time/CNN survey: 24% of 205 single women said that they “definitely want to get married.”

Calculations for Testing Claims. In Exercises 5 and 6, assume that you plan to use a significance level of \( \alpha = 0.05 \) to test the claim that \( p_1 = p_2 \). Use the given sample sizes and numbers of successes to find (a) the pooled estimate \( \bar{p} \), (b) the \( z \) test statistic, (c) the critical \( z \) values, and (d) the \( P \)-value.

5. Workers

\[
\begin{array}{c|c}
\text{Workers} & \text{Bosses} \\
\hline
n_1 = 436 & n_2 = 121 \\
x_1 = 192 & x_2 = 40 \\
\end{array}
\]

6. Low Activity

\[
\begin{array}{c|c|c}
\text{Low Activity} & \text{High Activity} \\
\hline
n_1 = 10,239 & n_2 = 9877 \\
x_1 = 101 & x_2 = 56 \\
\end{array}
\]

7. E-Mail and Privacy  A survey of 436 workers showed that 192 of them said that it was seriously unethical to monitor employee e-mail. When 121 senior-level bosses were surveyed, 40 said that it was seriously unethical to monitor employee e-mail (based
on data from a Gallup poll). Use a 0.05 significance level to test the claim that for those saying that monitoring e-mail is seriously unethical, the proportion of employees is greater than the proportion of bosses.

8. **E-Mail and Privacy** Refer to the sample data given in Exercise 7 and construct a 90% confidence interval estimate of the difference between the two population proportions. Is there a substantial gap between the employees and bosses?

9. **Exercise and Coronary Heart Disease** In a study of women and coronary heart disease, the following sample results were obtained: Among 10,239 women with a low level of physical activity (less than 200 kcal/wk), there were 101 cases of coronary heart disease. Among 9877 women with physical activity measured between 200 and 600 kcal/wk, there were 56 cases of coronary heart disease (based on data from “Physical Activity and Coronary Heart Disease in Women” by Lee, Rexrode, et al., *Journal of the American Medical Association*, Vol. 285, No. 11). Construct a 90% confidence interval estimate for the difference between the two proportions. Does the difference appear to be substantial? Does it appear that physical activity corresponds to a lower rate of coronary heart disease?

10. **Exercise and Coronary Heart Disease** Refer to the sample data in Exercise 9 and use a 0.05 significance level to test the claim that the rate of coronary heart disease is higher for women with the lower levels of physical activity. What does the conclusion suggest?

11. **Instant Replay in Football** In the 2000 football season, 247 plays were reviewed by officials using instant video replays, and 83 of them resulted in reversal of the original call. In the 2001 football season, 258 plays were reviewed and 89 of them were reversed (based on data from “Referees Turn to Video Aid More Often” by Richard Sandomir, *New York Times*). Is there a significant difference in the two reversal rates? Does it appear that the reversal rate was the same in both years?

12. **Effectiveness of Smoking Bans** The Joint Commission on Accreditation of Healthcare Organizations mandated that hospitals ban smoking by 1994. In a study of the effects of this ban, subjects who smoke were randomly selected from two different populations. Among 843 smoking employees of hospitals with the smoking ban, 56 quit smoking one year after the ban. Among 703 smoking employees from workplaces without a smoking ban, 27 quit smoking a year after the ban (based on data from “Hospital Smoking Bans and Employee Smoking Behavior” by Longo, Brownson, et al., *Journal of the American Medical Association*, Vol. 275, No. 16). Is there a significant difference between the two proportions at a 0.05 significance level? Is there a significant difference between the two proportions at a 0.01 significance level? Does it appear that the ban had an effect on the smoking quit rate?

13. **Testing Effectiveness of Vaccine** In a *USA Today* article about an experimental nasal spray vaccine for children, the following statement was presented: “In a trial involving 1602 children only 14 (1%) of the 1070 who received the vaccine developed the flu, compared with 95 (18%) of the 532 who got a placebo.” The article also referred to a study claiming that the experimental nasal spray “cuts children’s chances of getting the flu.” Is there sufficient sample evidence to support the stated claim?

14. **Color Blindness in Men and Women** In a study of red/green color blindness, 500 men and 2100 women are randomly selected and tested. Among the men, 45 have red/green color blindness. Among the women, 6 have red/green color blindness (based on data from *USA Today*).

*continued*
Chapter 8 Inferences from Two Samples

a. Is there sufficient evidence to support the claim that men have a higher rate of red/green color blindness than women? Use a 0.01 significance level.
b. Construct the 98% confidence interval for the difference between the color blindness rates of men and women. Does there appear to be a substantial difference?
c. Why would the sample size for women be so much larger than the sample size for men?

15. Seat Belts and Hospital Time A study was made of 413 children who were hospitalized as a result of motor vehicle crashes. Among 290 children who were not using seat belts, 50 were injured severely. Among 123 children using seat belts, 16 were injured severely (based on data from “Morbidity Among Pediatric Motor Vehicle Crash Victims: The Effectiveness of Seat Belts,” by Osberg and Di Scala, American Journal of Public Health, Vol. 82, No. 3). Is there sufficient sample evidence to conclude, at the 0.05 significance level, that the rate of severe injuries is lower for children wearing seat belts? Based on these results, what action should be taken?

16. Drinking and Crime Karl Pearson, who developed many important concepts in statistics, collected crime data in 1909. Of those convicted of arson, 50 were drinkers and 43 abstained. Of those convicted of fraud, 63 were drinkers and 144 abstained. Use a 0.01 significance level to test the claim that the proportion of drinkers among convicted arsonists is greater than the proportion of drinkers among those convicted of fraud. Does it seem reasonable that drinking might have had an effect on the type of crime? Why?

17. Interpreting a Computer Display A U.S. Department of Justice report (NCJ-156831) included the claim that “in spouse murder cases, wife defendants were less likely to be convicted than husband defendants.” Sample data consisted of 277 convictions among 318 husband defendants, and 155 convictions among 222 wife defendants. Test the stated claim and identify one possible explanation for the result. The Minitab results are shown here.

<table>
<thead>
<tr>
<th>Sample</th>
<th>X</th>
<th>N</th>
<th>Sample p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>277</td>
<td>318</td>
<td>0.871069</td>
</tr>
<tr>
<td>2</td>
<td>155</td>
<td>222</td>
<td>0.698198</td>
</tr>
</tbody>
</table>

Estimate for p(1) - p(2): 0.172871
95% lower bound for p(1) - p(2): 0.113511
Test for p(1) - p(2) = 0 (vs > 0): Z = 4.94 P-value = 0.000

18. Effectiveness of Salk Vaccine for Polio In initial tests of the Salk vaccine, 33 of 200,000 vaccinated children later developed polio. Of 200,000 children vaccinated with a placebo, 115 later developed polio. The TI-83 Plus calculator display is shown here. At the 0.01 significance level, test the claim that the Salk vaccine is effective in lowering the polio rate. Does it appear that the vaccine is effective?

19. Failed Inspections When conducting tests of auto parts stores, the Arizona Department of Weights and Measures conducted 100 inspections of Autozone stores and found that 63% of those inspections failed. Among 37 inspections at NAPA Auto Parts stores, 81% failed. Use a 0.05 significance level to determine whether there is a significant difference between those two rates of failures. Does it appear that either store is a better choice for consumers?
20. **Airline Load Factor** In a recent year, Southwest Airlines had 3,131,727 aircraft seats available on all of its flights, and 2,181,604 of them were occupied by passengers. America West had 2,091,859 seats available, and 1,448,255 of them were occupied. The percentage of seats occupied is called the *load factor*, so these results show that the load factor is 69.7% (rounded) for Southwest Airlines and 69.2% (rounded) for America West. (The data are from the U.S. Department of Transportation.) Answer the following by assuming that the results are from randomly selected samples.
   a. Test the claim that both airlines have the same load factor.
   b. Given that 69.7% and 69.2% appear to be so obviously close, how do you explain the results from part (a)?
   c. Generalize the key point of this example by completing the following statement: “If two sample sizes are extremely large, even seemingly small differences in sample proportions . . .”

21. **Attitudes Toward Marriage** In a Time/CNN survey, 24% of 205 single women said that they “definitely want to get married.” In the same survey, 27% of 260 single men gave that same response. Construct a 99% confidence interval estimate of the difference between the proportions of single women and single men who definitely want to get married. Is there a gender gap on this issue?

22. **Attitudes Toward Marriage** Refer to the same sample data in Exercise 21 and use a 0.01 significance level to test the claim that there is a difference between the proportion of men and the proportion of women who definitely want to get married. Does there appear to be a difference?

23. **Violent Crime and Age Group** The newly appointed head of the state mental health agency claims that a smaller proportion of the crimes committed by persons younger than 21 years of age are violent crimes (when compared to the crimes committed by persons 21 years of age or older). Of 2750 randomly selected arrests of criminals younger than 21 years of age, 4.25% involve violent crimes. Of 2200 randomly selected arrests of criminals 21 years of age or older, 4.55% involve violent crimes (based on data from the *Uniform Crime Reports*). Construct a 95% confidence interval for the difference between the two proportions of violent crimes. Does the confidence interval indicate that there isn’t a significant difference between the two rates of violent crimes?

24. **Testing Laboratory Gloves** The *New York Times* ran an article about a study in which Professor Denise Korniewicz and other Johns Hopkins researchers subjected laboratory gloves to stress. Among 240 vinyl gloves, 63% leaked viruses. Among 240 latex gloves, 7% leaked viruses. At the 0.005 significance level, test the claim that vinyl gloves have a larger virus leak rate than latex gloves.

25. **Written Survey and Computer Survey** In a study of 1700 teens aged 15–19, half were given written surveys and half were given surveys using an anonymous computer program. Among those given the written surveys, 7.9% say that they carried a gun within the last 30 days. Among those given the computer surveys, 12.4% say that they carried a gun within the last 30 days (based on data from the Urban Institute).
   a. The sample percentages of 7.9% and 12.4% are obviously not equal, but is the difference significant? Explain.
   b. Construct a 99% confidence interval estimate of the difference between the two population percentages, and interpret the result.

26. **Adverse Drug Reactions** The drug Viagra has become quite well known, and it has had a substantial economic impact on its producer, Pfizer Pharmaceuticals. In prelim-
CHAPTER 8  Inferences from Two Samples

Ininary tests for adverse reactions, it was found that when 734 men were treated with Viagra, 16% of them experienced headaches. (There’s some real irony there.) Among 725 men in a placebo group, 4% experienced headaches (based on data from Pfizer Pharmaceuticals).

a. Using a 0.01 significance level, is there sufficient evidence to support the claim that among those men who take Viagra, headaches occur at a rate that is greater than the rate for those who do not take Viagra?

b. Construct a 99% confidence interval estimate of the difference between the rate of headaches among Viagra users and the headache rate for those who are given a placebo. What does the confidence interval suggest about the two rates?

27. Poll Refusal Rate  Professional pollsters are becoming concerned about the growing rate of refusals among potential survey subjects. In analyzing the problem, there is a need to know if the refusal rate is universal or if there is a difference between the rates for central-city residents and those not living in central cities. Specifically, it was found that when 294 central-city residents were surveyed, 28.9% refused to respond. A survey of 1015 residents not living in a central city resulted in a 17.1% refusal rate (based on data from “I Hear You Knocking But You Can’t Come In,” by Fitzgerald and Fuller, Sociological Methods and Research, Vol. 11, No. 1). At the 0.01 significance level, test the claim that the central-city refusal rate is the same as the refusal rate in other areas.

28. Home Field Advantage  When games were sampled from throughout a season, it was found that the home team won 127 of 198 professional basketball games, and the home team won 57 of 99 professional football games (based on data from “Predicting Professional Sports Game Outcomes from Intermediate Game Scores,” by Cooper et al., Chance, Vol. 5, No. 3–4). Construct a 95% confidence interval for the difference between the proportions of home wins. Does there appear to be a significant difference between the proportions of home wins? What do you conclude about the home field advantage?

29. Alcohol and Tobacco in Children’s Movies  Test the claim that the proportion of 25 of 50 randomly selected children’s movies showing some use of alcohol is significantly less than the sample proportion of 28 of 50 other such movies showing some use of tobacco. Do the results apply to Data Set 7?

30. Health Survey  Refer to Data Set 1 in Appendix B and use the sample data to test the claim that the proportion of men over the age of 30 is equal to the proportion of women over the age of 30.

8-2 Beyond the Basics

31. Interpreting Overlap of Confidence Intervals  In the article “On Judging the Significance of Differences by Examining the Overlap Between Confidence Intervals” by Schenker and Gentleman (The American Statistician, Vol. 55, No. 3), the authors consider sample data in this statement: “Independent simple random samples, each of size 200, have been drawn, and 112 people in the first sample have the attribute, whereas 88 people in the second sample have the attribute.”

a. Use the methods of this section to construct a 95% confidence interval estimate of the difference \( p_1 - p_2 \). What does the result suggest about the equality of \( p_1 \) and \( p_2 \)?

b. Use the methods of Section 6-2 to construct individual 95% confidence interval estimates for each of the two population proportions. After comparing the overlap
between the two confidence intervals, what do you conclude about the equality of \( p_1 \) and \( p_2 \)?

**c.** Use a 0.05 significance level to test the claim that the two population proportions are equal. What do you conclude?

**d.** Based on the preceding results, what should you conclude about equality of \( p_1 \) and \( p_2 \)? Which of the three preceding methods is least effective in testing for equality of \( p_1 \) and \( p_2 \)?

32. **Equivalence of Hypothesis Test and Confidence Interval** Two different simple random samples are drawn from two different populations. The first sample consists of 20 people with 10 having a common attribute. The second sample consists of 2000 people with 1404 of them having the same common attribute. Compare the results from a hypothesis test of \( p_1 = p_2 \) (with a 0.05 significance level) and a 95% confidence interval estimate of \( p_1 - p_2 \).

33. **Same Proportions with Larger Samples** This section used the sample data in Table 8-1 to test the claim that \( p_1 = p_2 \) and to construct a confidence interval estimate of \( p_1 - p_2 \). How are the results affected if the sample data in Table 8-1 are modified so that \( p_1 \) becomes 240/2000 instead of 24/200, and \( p_2 \) becomes 1470/14,000 instead of 147/1400? Note that both sample proportions remain the same, but the sample sizes are larger. Is there now sufficient evidence to support the claim that the proportion of black drivers stopped by the police is greater than the proportion of white drivers who are stopped?

34. **Testing for Constant Difference** To test the null hypothesis that the difference between two population proportions is equal to a nonzero constant \( c \), use the test statistic

\[
z = \frac{(\hat{p}_1 - \hat{p}_2) - c}{\sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}}
\]

As long as \( n_1 \) and \( n_2 \) are both large, the sampling distribution of the test statistic \( z \) will be approximately the standard normal distribution. Refer to Exercise 26 and use a 0.05 significance level to test the claim that the headache rate of Viagra users is 10 percentage points more than the percentage for those who are given a placebo.