6.5 Solutions

EXERCISES

6.5-1. A machine shop manufactures toggle levers. A lever is flawed if a standard nut cannot be screwed onto the threads. Let \( p \) equal the proportion of flawed toggle levers that the shop manufactures. If there were 24 flawed levers out of a sample of 642 that were selected randomly from the production line,

(a) Give a point estimate of \( p \).
(b) Use Equation 6.5-2 to find an approximate 95% confidence interval for \( p \).
(c) Use Equation 6.5-4 to find an approximate 95% confidence interval for \( p \).
(d) Use Equation 6.5-5 to find an approximate 95% confidence interval for \( p \).
(e) Find a one-sided 95% confidence interval for \( p \) that provides an upper bound for \( p \).

6.5-2. Let \( p \) equal the proportion of letters mailed in the Netherlands that are delivered the next day. Suppose that \( y = 142 \) out of a random sample of \( n = 200 \) letters were delivered the day after they were mailed.

(a) Give a point estimate of \( p \).
(b) Use Equation 6.5-2 to find an approximate 95% confidence interval for \( p \).
(c) Use Equation 6.5-4 to find an approximate 95% confidence interval for \( p \).
(d) Use Equation 6.5-5 to find an approximate 95% confidence interval for \( p \).
(e) Find a one-sided 95% confidence interval for \( p \) that provides a lower bound for \( p \).

6.5-3. Let \( p \) equal the proportion of adult Americans who favor a law requiring a teenager to have her parents' consent before having an abortion. In a survey of 1000 adult Americans (conducted by Time/CNN and reported in Time on July 9, 1990), 690 said they favored such a law.

(a) Give a point estimate of \( p \).
(b) Find an approximate 95% confidence interval for \( p \).

6.5-4. Let \( p \) equal the proportion of Americans who favor the death penalty. If a random sample of \( n = 1234 \) Americans yielded \( y = 864 \) who favored the death penalty, find an approximate 95% confidence interval for \( p \).

6.5-5. Let \( p \) equal the proportion of triathletes who suffered a training-related overuse injury during the past year. Out of 330 triathletes who responded to a survey, 167 indicated that they had suffered such an injury during the past year.

(a) Use these data to give a point estimate of \( p \).
(b) Use these data to find an approximate 90% confidence interval for \( p \).
(c) Do you think that the 330 triathletes who responded to the survey may be considered a random sample from the population of triathletes?

6.5-6. Let \( p \) equal the proportion of Americans who select jogging as one of their recreational activities. If 1497 out of a random sample of 5757 selected jogging, find an approximate 98% confidence interval for \( p \).

6.5-7. In order to estimate the proportion, \( p \), of a large class of college freshmen that had high school GPAs from 3.2 to 3.6, inclusive, a sample of \( n = 50 \) students was taken. It was found that \( y = 9 \) students fell into this interval.

(a) Give a point estimate of \( p \).
(b) Use Equation 6.5-2 to find an approximate 95% confidence interval for \( p \).
(c) Use Equation 6.5-4 to find an approximate 95% confidence interval for \( p \).
(d) Use Equation 6.5-5 to find an approximate 95% confidence interval for \( p \).

6.5-8. A proportion, \( p \), that many public opinion polls estimate is the number of Americans who would say yes to the question, "If something were to happen to the President of the United States, do you think that the Vice President would be qualified to take over as President?" In one such random sample of 1022 adults, 388 said yes.

(a) On the basis of the given data, find a point estimate of \( p \).
(b) Find an approximate 90% confidence interval for \( p \).
(c) Give updated answers to this question if new poll results are available.

6.5-9. To obtain an estimate of the proportion, \( p \), of New York City residents who feel that the quality of life in New York City has become worse in the past few years, a telephone poll by Time/CNN on August 2--5, 1990, revealed that 686 out of 1009 residents said that life has become worse.

(a) Give a point estimate of \( p \).
(b) Find an approximate 98% confidence interval for \( p \).

6.5-10. The January 17, 1994, issue of Time magazine reported that 58% of adult Americans said yes to the question "If you or your spouse were
pregnant, would you want the unborn child tested for genetic defects?" These results were based on a telephone poll of 500 adult Americans. Let \( p \) equal the proportion of all adult Americans who would say yes to this question.

(a) Give the endpoints for a 90% confidence interval for \( p \).

(b) The poll takers claimed that their sampling error was 4.5%. What is their confidence coefficient?

6.5.11. The January 29, 1996, issue of *Time* magazine reported that 48% of adult Americans "like the principle of a flat tax." It further claimed that this estimate had a sampling error of \( \pm 3\% \). Let \( p \) equal the proportion of all adult Americans who like the principle of a flat tax.

(a) Give the endpoints for a 95% confidence interval for \( p \), given that the sample size was \( n = 800 \).

(b) Given that the reported sampling error was \( \pm 3\% \) with \( n = 800 \), what is *Time*’s confidence coefficient?

6.5.12. The March 29, 1993, issue of *Time* magazine reported the proportions of adult Americans who favor "strict gun-control laws." A telephone poll of 800 adult Americans, of whom 374 were gun owners and 426 did not own guns, showed that 206 gun owners and 338 non-gun owners favored stricter gun-control laws. Let \( p_1 \) and \( p_2 \) be the respective proportions of gun owners and non-gun owners who favor stricter gun-control laws.

(a) Give point estimates of \( p_1 \) and \( p_2 \).

(b) Find a 95% confidence interval for \( p_1 - p_2 \).

6.5.13. In developing countries in Africa and the Americas, let \( p_1 \) and \( p_2 \) be the respective proportions of women with nutritional anemia. Find an approximate 90% confidence interval for \( p_1 - p_2 \), given that a random sample of \( n_1 = 2100 \) African women yielded \( y_1 = 840 \) with nutritional anemia and a random sample of \( n_2 = 1900 \) women from the Americas yielded \( y_2 = 323 \) women with nutritional anemia.

6.5.14. A candy manufacturer selects mints at random from the production line and weighs them. For one week, the day shift weighed \( n_1 = 194 \) mints and the night shift weighed \( n_2 = 162 \) mints. The numbers of these mints that weighed at most 21 grams was \( y_1 = 28 \) for the day shift and \( y_2 = 11 \) for the night shift. Let \( p_1 \) and \( p_2 \) denote the proportions of mints that weigh at most 21 grams for the day and night shifts, respectively.

(a) Give a point estimate of \( p_1 \).

(b) Give the endpoints for a 95% confidence interval for \( p_1 \).

(c) Give a point estimate of \( p_1 - p_2 \).

(d) Find a one-sided 95% confidence interval that gives a lower bound for \( p_1 - p_2 \).

6.5.15. Consider the following two groups of women: Group 1 consists of women who spend less than $500 annually on clothes, group 2 comprises women who spend over $1000 annually on clothes. Let \( p_1 \) and \( p_2 \) equal the proportions of women in these two groups, respectively, who believe that clothes are too expensive. If 1009 out of a random sample of 1230 women from group 1 and 207 out of a random sample 340 from group 2 believe that clothes are too expensive.

(a) Give a point estimate of \( p_1 - p_2 \).

(b) Find an approximate 95% confidence interval for \( p_1 - p_2 \).

6.5.16. For developing countries in Asia (excluding China) and Africa, let \( p_1 \) and \( p_2 \) be the respective proportions of preschool children with chronic malnutrition (stunting). If respective random samples of \( n_1 = 1300 \) and \( n_2 = 1100 \) yielded \( y_1 = 520 \) and \( y_2 = 385 \) children with chronic malnutrition, find an approximate 95% confidence interval for \( p_1 - p_2 \).

6.5.17. The following question was asked in a *Newsweek* poll: "Would you prefer to live in a neighborhood with mostly whites, with mostly blacks, or in a neighborhood mixed half and half?" Let \( p_1 \) and \( p_2 \) equal the proportion of black and white adult respondents, respectively, who prefer "half and half." If 207 out of 305 black adults and 291 out of 632 white adults prefer "half and half,"

(a) Give a point estimate of \( p_1 - p_2 \).

(b) Find an approximate one-sided 90% confidence interval that gives a lower bound for \( p_1 - p_2 \).

6.5.18. An environmental survey contained a question asking what respondents thought was the major cause of air pollution in this country, giving the choices "automobiles," "factories," and "incinerators." Two versions of the test, A and B, were used. Let \( p_A \) and \( p_B \) be the respective proportions of people using forms A and B who select "factories." If 170 out of 460 people who used version A chose "factories" and 141 out of 440 people who used version B chose "factories,"

(a) Find a 95% confidence interval for \( p_A - p_B \).

(b) Do the versions seem to be consistent concerning this answer? Why or why not?
2. Do only (a), (b) ignore c, d, e.

(a) \( \hat{p} = \frac{142}{200} = 0.71 \)

(b) \( \hat{p} \pm \sqrt{\frac{\hat{p}(1-\hat{p})}{200}} \gtrapprox 0.05 \)

\[ 0.71 \pm 0.032 \times 1.645 \]

\[ [0.6572, 0.76278] \]

65.7% - 76.2%

9. (a) \( \frac{686}{1009} = \hat{p} = 0.6798 \approx 0.68 \)

(b) \( \hat{p} \pm \sqrt{\frac{\hat{p}(1-\hat{p})}{1009}} \gtrapprox 0.014687 \)

\[ 0.68 \pm 0.034 \]

2.326

3.4% margin of error
6.5 - 11

(a) \( \hat{p} = 0.48 \)

\[ \hat{p} \pm \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \cdot 2 \cdot 0.025 \]

\[ \frac{0.017664}{1.96} \]

Margin of error

0.034 = 3.4%

\[ [0.48 \pm 0.034] = [0.445, 0.514] \]

not both are under 50%  
the e.i. does not guarantee  
\( p < 50\% \)

(b) Margin of error = 0.017664 \( \cdot z = 0.03 \)

\( z = 1.648 \)

\( \Phi(z) = 0.9554 \)

\( \frac{\alpha}{2} = 1 - 0.9554 = 0.0446 \)

\( \alpha = 9.1\% \)
\[ \hat{p}_1 - \hat{p}_2 \] has a confidence interval

\[
\hat{p}_1 - \hat{p}_2 \pm \sqrt{\frac{\hat{p}_1 (1-\hat{p}_1)}{2100} + \frac{\hat{p}_2 (1-\hat{p}_2)}{1900}} \approx 1.645 \\
\left( \frac{Z_\alpha}{2} \right)
\]

\[
\hat{p}_1 = \frac{840}{2100} = 0.40 \\
\hat{p}_2 = \frac{323}{1900} = 0.17
\]

\[
\frac{\hat{p}_1 (1-\hat{p}_1)}{2100} = 11.4 \cdot 10^{-5} \\
\frac{\hat{p}_2 (1-\hat{p}_2)}{1900} = 7.42 \cdot 10^{-5}
\]

\[
\sqrt{\text{Sum}} = 0.01373
\]

\[ p_1 - p_2 \in \left[ 0.23 \pm (0.01373)(1.645) \right] \\
\left[ 0.2074, 0.2525 \right]
\]