

Chapter 7 Review Exercises

1. $76.1\% < p < 82.0\%$. There is 95% confidence that the limits of 76.1% and 82.0% contain the true value of the percentage of all adults who believe that it is morally wrong to not report all income on tax returns.
2. 4145 (Tech: 4147)
3. 21,976 (Tech: 21,991). The sample size is too large to be practical, unless the data can be processed automatically.
4. $2.492 \text{ g} < \mu < 2.506 \text{ g}$. The confidence interval does contain the required mean value of 2.5 g, so the manufacturing process appears to be OK.
5. $368.4 < \mu < 969.2$
6. $145.0 < \sigma < 695.6$ (Tech: $145.0 < \sigma < 695.3$)
7. a. 0.890 b. $0.871 < p < 0.910$
c. Yes. Because there is 95% confidence that the limits of 0.871 and 0.910 contain the true value of the population proportion, it appears that there is strong evidence that the population proportion is greater than 0.5.
8. a. 601 b. 1383 c. 1383
9. a. 3.840 lb b. $1.786 \text{ lb} < \mu < 5.894 \text{ lb}$
c. $1.686 \text{ lb} < \mu < 5.994 \text{ lb}$
10. a. $1.624 \text{ lb} < \sigma < 5.000 \text{ lb}$
b. $2.639 \text{ lb}^2 < \sigma^2 < 25.002 \text{ lb}^2$ (Tech: $2.639 \text{ lb}^2 < \sigma^2 < 25.004 \text{ lb}^2$)

Chapter 7 Cumulative Review Exercises

1. 11.8 lb, 21.0 lb, 9.2 lb
2. 11.8 lb
3. $11.8 \text{ lb} < \mu < 21.0 \text{ lb}$
4. 11.8 lb

Review Exercises

1. Reporting Income In a Pew Research Center poll of 745 randomly selected adults, 589 said that it is morally wrong to not report all income on tax returns. Construct a 95% confidence interval estimate of the percentage of all adults who have that belief, and then write a statement interpreting the confidence interval.

2. Determining Sample Size See the survey described in Exercise 1. Assume that you must conduct a new poll to determine the percentage of adults who believe that it is morally wrong to not report all income on tax returns. How many randomly selected adults must you survey if you want 99% confidence that the margin of error is two percentage points? Assume that nothing is known about the percentage that you are trying to estimate.

3. Determining Sample Size See the survey described in Exercise 1. Assume that you must conduct a survey to determine the mean income reported on tax returns, and you have access to actual tax returns. How many randomly selected tax returns must you survey if you want to be 99% confident that the mean of the sample is within \$500 of the true population mean?

Assume that reported incomes have a standard deviation of \$28,785 (based on data from the U.S. Census Bureau). Is the sample size practical?

4. Penny Weights A simple random sample of 37 weights of pennies made after 1983 has a mean of 2.4991 g and a standard deviation of 0.0165 g (based on Data Set 20 in Appendix B). Construct a 99% confidence interval estimate of the mean weight of all such pennies. Design specifications require a population mean of 2.5 g. What does the confidence interval suggest about the manufacturing process?

5. Crash Test Results The National Transportation Safety Administration conducted crash test experiments on five subcompact cars. The head injury data (in hic) recorded from crash test dummies in the driver's seat are as follows: 681, 428, 917, 898, 420. Use these sample results to construct a 95% confidence interval for the mean of head injury measurements from all subcompact cars.

6. Confidence Interval for σ New car design specifications are being considered to control the variation of the head injury measurements. Use the same sample data from Exercise 5 to construct a 95% confidence interval estimate of σ .

7. Cloning Survey A Gallup poll consisted of 1012 randomly selected adults who were asked whether "cloning of humans should or should not be allowed." Results showed that 901 adults surveyed indicated that cloning should not be allowed.

a. Find the best point estimate of the proportion of adults believing that cloning of humans should not be allowed.

b. Construct a 95% confidence interval estimate of the proportion of adults believing that cloning of humans should not be allowed.

c. A news reporter wants to determine whether these survey results constitute strong evidence that the majority (more than 50%) of people are opposed to such cloning. Based on the results, is there strong evidence supporting the claim that the majority is opposed to such cloning? Why or why not?

8. Sample Size You have been hired by a consortium of local car dealers to conduct a survey about the purchases of new and used cars.

a. If you want to estimate the percentage of car owners in your state who purchased new cars (not used), how many adults must you survey if you want 95% confidence that your sample percentage is in error by no more than four percentage points?

b. If you want to estimate the mean amount of money spent by car owners on their last car purchase, how many car owners must you survey if you want 95% confidence that your sample mean is in error by no more than \$750? (Based on results from a pilot study, assume that the standard deviation of amounts spent on car purchases is \$14,227.)

c. If you plan to obtain the estimates described in parts (a) and (b) with a single survey having several questions, how many people must be surveyed?

9. Discarded Glass Listed below are weights (in pounds) of glass discarded in one week by randomly selected households (based on data from the Garbage Project at the University of Arizona).

a. What is the best point estimate of the mean weight of glass discarded by all households in one week?

b. Construct a 95% confidence interval estimate of the mean weight of glass discarded by all households.

c. Repeat part (b) assuming that the population is normally distributed with a standard deviation known to be 3.108 lb.

3.52 8.87 3.99 3.61 2.33 3.21 0.25 4.94

10. Confidence Intervals for σ and σ^2

a. Use the sample data from Exercise 9 to construct a 95% confidence interval estimate of the population standard deviation.

b. Use the sample data from Exercise 9 to construct a 95% confidence interval estimate of the population variance.

1. Rate of Smoking A simple random sample of 1088 adults between the ages of 18 and 44 is conducted. It is found that 261 of the 1088 adults smoke (based on data from the National Health Interview Survey). Use a 0.05 significance level to test the claim that less than $1/4$ of such adults smoke.

2. Graduation Rate A simple random sample is conducted of 1486 college students who are seeking bachelor's degrees, and it includes 802 who earned bachelor's degrees within five years. Use a 0.01 significance level to test the claim that most college students earn bachelor's degrees within five years.

3. Weights of Cars When planning for construction of a parkway, engineers must consider the weights of cars to be sure that the road surface is strong enough. A simple random sample of 32 cars yields a mean of 3605.3 lb and a standard deviation of 501.7 lb (based on Data Set 16 in Appendix B). Use a 0.01 significance level to test the claim that the mean weight of cars is less than 3700 lb. When considering weights of cars for the purpose of constructing a road that is strong enough, is it the mean that is most relevant? If not, what weight is most relevant?

4. Weights of Cars Repeat Exercise 3 by assuming that weights of cars have a standard deviation known to be 520 lb.

5. Herb Consumption Among 30,617 randomly selected adults, 5787 consumed herbs within the past 12 months (based on data from "Use of Herbs Among Adults Based on Evidence-Based Indications: Findings From the National Health Survey," by Bardia, et al., *Mayo Clinic Proceedings*, Vol. 82, No. 5). Use a 0.01 significance level to test the claim that fewer than 20% of adults consumed herbs within the past 12 months.

6. Are Thinner Aluminum Cans Weaker? The axial load of an aluminum can is the maximum weight that the sides can support before collapsing. The axial load is an important measure, because the top lids are pressed onto the sides with pressures that vary between 158 lb and 165 lb. Pepsi experimented with thinner aluminum cans, and a random sample of 175 of the thinner cans has axial loads with a mean of 267.1 lb and a standard deviation of 22.1 lb. Use a 0.01 significance level to test the claim that the thinner cans have a mean axial load that is less than 281.8 lb, which is the mean axial load of the thicker cans that were then in use. Do the thinner cans appear to be strong enough so that they are not crushed when the top lids are pressed onto the sides?

Cumulative Review Exercises

7. Random Generation of Data The TI-83/84 Plus calculator can be used to generate random data from a normally distributed population. The command `randNorm(74, 12.5, 100)` generates 100 values from a normally distributed population with $\mu = 74$ and $\sigma = 12.5$ (for pulse rates of women). One such generated sample of 100 values has a mean of 74.4 and a standard deviation of 11.7. Assume that σ is known to be 12.5 and use a 0.05 significance level to test the claim that the sample actually does come from a population with a mean equal to 74. Based on the results, does it appear that the calculator's random number generator is working correctly?

8. Random Generation of Data Repeat Exercise 7 without making the assumption that the population standard deviation is known.

9. Random Generation of Data Use the sample results from Exercise 7 to test the claim that the generated values are from a population with a standard deviation equal to 12.5. Use a 0.05 significance level.

10. Weights of Cars A simple random sample of 32 cars yields a mean weight of 3605.3 lb, a standard deviation of 501.7 lb, and the sample weights appear to be from a normally distributed population (based on Data Set 16 in Appendix B). Use a 0.01 significance level to test the claim that the standard deviation of the weights of cars is less than 520 lb.

Fail to reject H_0 . There is not sufficient evidence to support the claim that the standard deviation of the weights of cars is less than 520 lb.

1. $H_0: p = 0.5$. $H_1: p < 0.5$. Test statistic: $z = -0.77$. Critical value: $z = -1.645$. P -value: 0.2206. Fail to reject H_0 . There is not sufficient evidence to support the claim that less than 1/4 of adults between the ages of 18 and 44 smoke.
3. $H_0: p = 0.5$. $H_1: p > 0.5$. Test statistic: $z = 3.06$. Critical value: $z = 2.33$. P -value: 0.0011. Reject H_0 . There is sufficient evidence to support the claim that among college students seeking bachelor's degrees, most earn that degree within five years.
3. $H_0: \mu = 3700$ lb. $H_1: \mu < 3700$ lb. Test statistic: $t = -1.068$. Critical value: $t = -2.453$. P -value > 0.10 (Tech: 0.1469). Fail to reject H_0 . There is not sufficient evidence to support the claim that the mean weight of cars is less than 3700 lb. When considering weights of cars for the purpose of constructing a road that is strong enough, the weight of the heaviest car is more relevant than the mean weight of all cars.
9. There is not sufficient evidence to support the claim that the population proportion is greater than 0.25.
10. Fail to reject H_0 .

Chapter 8 Review Exercises

1. $H_0: p = 1/4$. $H_1: p < 1/4$. Test statistic: $z = -0.77$. Critical value: $z = -1.645$. P -value: 0.2206. Fail to reject H_0 . There is not sufficient evidence to support the claim that less than 1/4 of adults between the ages of 18 and 44 smoke.
2. $H_0: p = 0.5$. $H_1: p > 0.5$. Test statistic: $z = 3.06$. Critical value: $z = 2.33$. P -value: 0.0011. Reject H_0 . There is sufficient evidence to support the claim that among college students seeking bachelor's degrees, most earn that degree within five years.
3. $H_0: \mu = 3700$ lb. $H_1: \mu < 3700$ lb. Test statistic: $t = -1.068$. Critical value: $t = -2.453$. P -value > 0.10 (Tech: 0.1469). Fail to reject H_0 . There is not sufficient evidence to support the claim that the mean weight of cars is less than 3700 lb. When considering weights of cars for the purpose of constructing a road that is strong enough, the weight of the heaviest car is more relevant than the mean weight of all cars.
4. $H_0: \mu = 3700$ lb. $H_1: \mu < 3700$ lb. Test statistic: $z = -1.03$. Critical value: $z = -2.33$. P -value = 0.1515. Fail to reject H_0 . There is not sufficient evidence to support the claim that the mean weight of cars is less than 3700 lb.
5. $H_0: p = 0.20$. $H_1: p < 0.20$. Test statistic: $z = -4.81$. Critical value: $z = -2.33$. P -value: 0.0001 (Tech: 0.0000). Reject H_0 . There is sufficient evidence to support the claim that fewer than 20% of adults consumed herbs within the past 12 months.
6. $H_0: \mu = 281.8$ lb. $H_1: \mu < 281.8$ lb. Test statistic: $t = -8.799$. Critical value: $t = -2.345$ (approximately). P -value < 0.005 (Tech: 0.0000). Reject H_0 . There is sufficient evidence to support the claim that the thinner cans have a mean axial load less than 281.8 lb. Given the values of the sample mean and standard deviation, the thinner cans appear to have axial loads that can easily withstand the top pressure of 158 lb to 165 lb.
7. $H_0: \mu = 74$. $H_1: \mu \neq 74$. Test statistic: $z = 0.32$. Critical values: $z = \pm 1.96$. P -value: 0.7490. Fail to reject H_0 . There is not sufficient evidence to warrant rejection of the claim that the mean is equal to 74. The calculator appears to be working correctly.
8. $H_0: \mu = 74$. $H_1: \mu \neq 74$. Test statistic: $t = 0.342$. Critical values: $t = \pm 1.984$ (approximately). P -value > 0.20 (Tech: 0.7332). Fail to reject H_0 . There is not sufficient evidence to warrant rejection of the claim that the mean is equal to 74. The calculator appears to be working correctly.
9. $H_0: \sigma = 12.5$. $H_1: \sigma \neq 12.5$. Test statistics: $\chi^2 = 86.734$. Critical values: $\chi^2 = 74.222$ and 129.561 (approximately). P -value: 0.3883. Fail to reject H_0 . There is not sufficient evidence to warrant rejection of the claim that the standard deviation of such generated values is equal to 12.5.
10. $H_0: \sigma = 520$ lb. $H_1: \sigma < 520$ lb. Test statistic: $\chi^2 = 28.856$. Critical value: $\chi^2 = 14.954$ (approximately). P -value: 0.4233.

CH 9

1. Carpal Tunnel Syndrome Treatments Carpal tunnel syndrome is a common wrist complaint resulting from a compressed nerve, and it is often caused by repetitive wrist movements. In a randomized controlled trial, among 73 patients treated with surgery and evaluated one year later, 67 were found to have successful treatments. Among 83 patients treated with splints and evaluated one year later, 60 were found to have successful treatments (based on data from "Splinting vs Surgery in the Treatment of Carpal Tunnel Syndrome," by Gerritsen, et al., *Journal of the American Medical Association*, Vol. 288, No. 10). In a journal article about the trial, authors claimed that "treatment with open carpal tunnel release surgery resulted in better outcomes than treatment with wrist splinting for patients with CTS (carpal tunnel syndrome)." Use a 0.01 significance level to test that claim. What treatment strategy is suggested by the results?

2. Effects of Cocaine on Children Researchers conducted a study to assess the effects that occur when children are exposed to cocaine before birth. Children were tested at age 4 for object assembly skill, which was described as "a task requiring visual-spatial skills related to mathematical competence." The 190 children born to cocaine users had a mean of 7.3 and a standard deviation of 3.0. The 186 children not exposed to cocaine had a mean score

of 8.2 with a standard deviation of 3.0. (The data are based on "Cognitive Outcomes of Preschool Children with Prenatal Cocaine Exposure," by Singer, et al., *Journal of the American Medical Association*, Vol. 291, No. 20.) Use a 0.05 significance level to test the claim that prenatal cocaine exposure is associated with lower scores of four-year-old children on the test of object assembly.

3. Historical Data Set In 1908, "Student" (William Gosset) published the article "The Probable Error of a Mean" (*Biometrika*, Vol. 6, No. 1). He included the data listed below for two different types of straw seed (regular and kiln dried) that were used on adjacent plots of land. The listed values are the yields of straw in cwt per acre, and the yields are paired by the plot of land that they share.

- Using a 0.05 significance level, test the claim that there is no difference between the yields from the two types of seed.
- Construct a 95% confidence interval estimate of the mean difference between the yields from the two types of seed.
- Does it appear that either type of seed is better?

Regular	19.25	22.75	23	23	22.5	19.75	24.5	15.5	18	14.25	17
Kiln dried	25	24	24	28	22.5	19.5	22.25	16	17.25	15.75	17.25

4. Effect of Blinding Among 13,200 submitted abstracts that were blindly evaluated (with authors and institutions not identified), 26.7% were accepted for publication. Among 13,433 abstracts that were not blindly evaluated, 29.0% were accepted (based on data from "Effect of Blinded Peer Review on Abstract Acceptance," by Ross, et al., *Journal of the American Medical Association*, Vol. 295, No. 14). Use a 0.01 significance level to test the claim that the acceptance rate is the same with or without blinding. How might the results be explained?

5. Comparing Readability of J. K. Rowling and Leo Tolstoy Listed below are Flesch Reading Ease scores taken from randomly selected pages in J. K. Rowling's *Harry Potter and the Sorcerer's Stone* and Leo Tolstoy's *War and Peace*. (Higher scores indicate writing that is easier to read.) Use a 0.05 significance level to test the claim that *Harry Potter and the Sorcerer's Stone* is easier to read than *War and Peace*. Is the result as expected?

Rowling:	85.3	84.3	79.5	82.5	80.2	84.6	79.2	70.9	78.6	86.2	74.0	83.7
Tolstoy:	68.5	68.5	71.1	71.6	68.5	61.9	72.2	74.4	52.8	58.4	65.4	73.6

...ing effects. Captopril is a drug designed to lower systolic blood pressure. Patients were tested with this drug, their systolic blood pressure readings (in mm Hg) were measured before and after drug treatment, with the results given in the following table (based on data from "Essential Hypertension: Effect of an Oral Inhibitor of Angiotensin-Converting Enzyme," by MacGregor, et al., *British Medical Journal*, Vol. 2).

- Use the sample data to construct a 99% confidence interval for the mean difference between the before and after readings.
- Is there sufficient evidence to support the claim that captopril is effective in lowering systolic blood pressure?

Subject	A	B	C	D	E	F	G	H	I	J	K	L
Before	200	174	198	170	179	182	193	209	185	155	169	210
After	191	170	177	167	159	151	176	183	159	145	146	177

7. Smoking and Gender A simple random sample of 280 men included 71 who smoke, and a simple random sample of 340 women included 68 who smoke (based on data from the National Health and Nutrition Examination Survey). Use a 0.05 significance level to test the claim that the proportion of men who smoke is greater than the proportion of women who smoke.

8. Income and Education A simple random sample of 80 workers with high school diplomas is obtained, and the annual incomes have a mean of \$37,622 and a standard deviation of \$14,115. Another simple random sample of 39 workers with bachelor's degrees is obtained, and the annual incomes have a mean of \$77,689, with a standard deviation of \$24,227. Use a 0.01 significance level to test the claim that workers with a high school diploma have a lower mean annual income than workers with a bachelor's degree. Does solving this exercise contribute to a higher income?

Chapter 9 Review Exercises

- $H_0: p_1 = p_2$. $H_1: p_1 > p_2$. Test statistic: $z = 3.12$. Critical value: $z = 2.33$. P -value: 0.0009. Reject H_0 . There is sufficient evidence to support a claim that the proportion of successes with surgery is greater than the proportion of successes with splinting. When treating carpal tunnel syndrome, surgery should generally be recommended instead of splinting.
- $H_0: \mu_1 = \mu_2$. $H_1: \mu_1 < \mu_2$. Test statistic: $t = -2.908$. Critical value: $t = -1.653$ (approximately). P -value: < 0.005 (Tech: 0.0019). Reject H_0 . There is sufficient evidence to support the claim that the children exposed to cocaine have a lower mean score.
- $H_0: \mu_d = 0$. $H_1: \mu_d \neq 0$. Test statistic: $t = -1.532$. Critical values: $t = \pm 2.228$. P -value is between 0.10 and 0.20 (Tech: 0.1565). Fail to reject H_0 . There is not sufficient evidence to warrant rejection of the claim that there is no difference. There does not appear to be a difference.
 - $-2.7 < \mu_d < 0.5$
 - No, there is not a significant difference.
- $H_0: p_1 = p_2$. $H_1: p_1 \neq p_2$. Test statistic: $z = -4.20$. Critical values: $z = \pm 2.575$. P -value: 0.0002 (Tech: 0.000). Reject H_0 . There is sufficient evidence to warrant rejection of the claim that the acceptance rate is the same with or without blinding. Without blinding, reviewers know the names and institutions of the abstract authors, and they might be influenced by that knowledge.
- $H_0: \mu_1 = \mu_2$. $H_1: \mu_1 > \mu_2$. Test statistic: $t = 5.529$. Critical value: $t = 1.796$. P -value: < 0.005 (Tech: 0.0000). Reject H_0 . There is sufficient evidence to support the claim that *Harry Potter* is easier to read than *War and Peace*. The result is as expected, because *Harry Potter* was written for children, but *War and Peace* was written for adults.

6. a. $9.5 < \mu_d < 27.6$

- $H_0: \mu_d = 0$. $H_1: \mu_d > 0$. Test statistic: $t = 6.371$. Critical value: $t = 2.718$ (assuming a 0.01 significance level). P -value: < 0.005 (Tech: 0.0000). Reject H_0 . There is sufficient evidence to support the claim that the blood pressure levels are lower after taking captopril.

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- $H_0: p_1 = p_2$. $H_1: p_1 > p_2$. Test statistic: $z = 1.59$. Critical value: $z = 1.645$. P -value: 0.0559 (Tech: 0.0557). Fail to reject H_0 . There is not sufficient evidence to support the claim that the proportion of men who smoke is greater than the proportion of women who smoke.
- $H_0: \mu_1 = \mu_2$. $H_1: \mu_1 < \mu_2$. Test statistic: $t = -9.567$. Critical value: $t = -2.429$. P -value: < 0.005 (Tech: 0.0000). Reject H_0 . There is sufficient evidence to support the claim that workers with a high school diploma have a lower mean annual income than workers with a bachelor's degree. Solving this exercise contributes to a bachelor's degree and to a higher income.

Chapter 9 Review Exercises

Assume that the number of words spoken by a person is normally distributed with a mean of 15,000 words and a standard deviation of 6,000 words. Find the probability that he speaks more than 17,000 words.