8.5: Chapter 8 Exercises

Chapter 8 Exercises

1. The plant-breeding department at a major university developed a new hybrid boysenberry plant called Stumptown Berry. Based on research data, the claim is made that from the time shoots are planted 90 days on average are required to obtain the first berry. A corporation that is interested in marketing the product tests 60 shoots by planting them and recording the number of days before each plant produces its first berry. The sample mean is 92.3 days. The corporation wants to know if the mean number of days is different from the 90 days claimed. Which one is the correct set of hypotheses?

a) H_0: p = 90% H_1: p ≠ 90%

b) H_0: μ = 90 H_1: μ ≠ 90

c) H_0: p = 92.3% H_1: p ≠ 92.3%

d) H_0: μ = 92.3 H_1: μ ≠ 92.3

e) H_0: μ ≠ 90 H_1: μ = 90

2. Match the symbol with the correct phrase.

$<$	More than
$>$	At most
$\leq$	Reduced
$\geq$	Different from
$\neq$	At least

3. According to the February 2008 Federal Trade Commission report on consumer fraud and identity theft, 23% of all complaints in 2007 were for identity theft. In that year, Alaska had 321 complaints of identity theft out of 1,432 consumer complaints. Does this data provide enough evidence to show that Alaska had a lower proportion of identity theft than 23%? Which one is the correct set of hypotheses?

Federal Trade Commission, (2008). *Consumer fraud and identity theft complaint data: January-December 2007*. Retrieved from website: http://www.ftc.gov/opa/2008/02/fraud.pdf.

a) H_0: p = 23% H_1: p < 23%

b) H_0: μ = 23 H_1: μ < 23

c) H_0: p < 23% H_1: p ≥ 23%

d) H_0: p = 0.224 H_1: p < 0.224

e) H_0: μ < 0.224 H_1: μ ≥ 0.224

4. Compute the z critical value for a right-tailed test when α = 0.01.

5. Compute the z critical value for a two-tailed test when α = 0.01.

6. Compute the z critical value for a left-tailed test when α = 0.05.

7. Compute the z critical value for a two-tailed test when α = 0.05.

8. As of 2018, the Centers for Disease Control and Protection's (CDC) national estimate that 1 in 68 $\approx$ 0.0147 children have been diagnosed with autism spectrum disorder (ASD). A researcher believes that the proportion of children in their county is different from the CDC estimate. Which one is the correct set of hypotheses?

a) H_0: p = 0.0147 H_1: p ≠ 0.0147

b) H_0: μ = 0.0147 H_1: μ ≠ 0.0147

c) H_0: p ≠ 0.0147 H_1: p = 0.0147

d) H_0: μ = 68 H_1: μ ≠ 68

e) H_0: = 0.0147 H_1: ≠ 0.0147

9. Match the phrase with the correct symbol.

a. Sample Size i. α

b. Population Mean ii. n

c. Sample Variance iii. σ^2

d. Sample Mean iv. s^2

e. Population Standard Deviation v. s

f. P(Type I Error) vi. $\bar{x}$

g. Sample Standard Deviation vii. σ

h. Population Variance viii. μ

10. The Food & Drug Administration (FDA) regulates that fresh albacore tuna fish contains at most 0.82 ppm of mercury. A scientist at the FDA believes the mean amount of mercury in tuna fish for a new company exceeds the ppm of mercury. Which one is the correct set of hypotheses?

a) H_0: $p = 82\%$ H_1: $p > 82\%$

b) H_0: $\mu = 0.82$ H_1: $\mu > 0.82$

c) H_0: $p > 82\%$ H_1: $p \leq 82\%$

d) H_0: $\mu = 0.82$ H_1: $\mu \neq 0.82$

e) H_0: $\mu > 0.82$ H_1: $\mu \leq 0.82$

11. Match the symbol with the correct phrase.

$100(1-\alpha)\%$	Parameter
$1-\beta$	P(Type II Error)
β	Power
μ	Significance Level
α	Confidence Level

12. The plant-breeding department at a major university developed a new hybrid boysenberry plant called Stumptown Berry. Based on research data, the claim is made that from the time shoots are planted 90 days on average are required to obtain the first berry. A corporation that is interested in marketing the product tests 60 shoots by planting them and recording the number of days before each plant produces its first berry. The sample mean is 92.3 days. The corporation will not market the product if the mean number of days is more than the 90 days claimed. The hypotheses are H_0: $\mu = 90$ H_1: $\mu > 90$. Which answer is the correct type I error in the context of this problem?

a) The corporation will not market the Stumptown Berry even though the berry does produce fruit within the 90 days.

b) The corporation will market the Stumptown Berry even though the berry does produce fruit within the 90 days.

c) The corporation will not market the Stumptown Berry even though the berry does produce fruit in more than 90 days.

d) The corporation will market the Stumptown Berry even though the berry does produce fruit in more than 90 days.

13. The Food & Drug Administration (FDA) regulates that fresh albacore tuna fish contains at most 0.82 ppm of mercury. A scientist at the FDA believes the mean amount of mercury in tuna fish for a new company exceeds the ppm of mercury. The hypotheses are H_0: $\mu = 0.82$ H_1: $\mu > 0.82$. Which answer is the correct type II error in the context of this problem?

a) The fish is rejected by the FDA when in fact it had less than 0.82 ppm of mercury.

b) The fish is accepted by the FDA when in fact it had less than 0.82 ppm of mercury.

c) The fish is rejected by the FDA when in fact it had more than 0.82 ppm of mercury.

d) The fish is accepted by the FDA when in fact it had more than 0.82 ppm of mercury.

14. A two-tailed z-test found a test statistic of $z = 2.153$. At a 1% level of significance, which would the correct decision?

a) Do not reject H_0

b) Reject H_0

c) Accept H_0

d) Reject H_1

e) Do not reject H_1

15. A left-tailed z-test found a test statistic of z = -1.99. At a 5% level of significance, what would the correct decision be?

a) Do not reject H0

b) Reject H0

c) Accept H0

d) Reject H1

e) Do not reject H1

16. A right-tailed z-test found a test statistic of z = 0.05. At a 5% level of significance, what would the correct decision be?

a) Reject H_0

b) Accept H_0

c) Reject H_1

d) Do not reject H_0

e) Do not reject H_1

17. A two-tailed z-test found a test statistic of z = -2.19. At a 1% level of significance, which would the correct decision?

a) Do not reject H0

b) Reject H0

c) Accept H0

d) Reject H1

e) Do not reject H1

18. According to the February 2008 Federal Trade Commission report on consumer fraud and identity theft, 23% of all complaints in 2007 were for identity theft. In that year, Alaska had 321 complaints of identity theft out of 1,432 consumer complaints. Does this data provide enough evidence to show that Alaska had a lower proportion of identity theft than 23%? The hypotheses are H0: p = 23% H1: p < 23%. Which answer is the correct type I error in the context of this problem?

Federal Trade Commission, (2008). *Consumer fraud and identity theft complaint data: January-December 2007*. Retrieved from website: http://www.ftc.gov/opa/2008/02/fraud.pdf.

a) It is believed that less than 23% of Alaskans had identity theft and there really was 23% or less that experienced identity theft.

b) It is believed that more than 23% of Alaskans had identity theft and there really was 23% or more that experience identity theft.

c) It is believed that less than 23% of Alaskans had identity theft even though there really was 23% or more that experienced identity theft.

d) It is believed that more than 23% of Alaskans had identity theft even though there really was less than 23% that experienced identity theft

19. A hypothesis test was conducted during a clinical trial to see if a new COVID-19 vaccination reduces the risk of contracting the virus. What is the Type I and II errors in terms of approving the vaccine for use?

20. A manufacturer of rechargeable laptop batteries claims its batteries have, on average, 500 charges. A consumer group decides to test this claim by assessing the number of times 30 of their laptop batteries can be recharged and finds a p-value is 0.1111; thus, the null hypothesis is not rejected. What is the Type II error for this situation?

21. A commonly cited standard for one-way length (duration) of school bus rides for elementary school children is 30 minutes. A local government office in a rural area conducts a study to determine if elementary schoolers in their district have a longer average one-way commute time. If they determine that the average commute time of students in their district is significantly higher than the commonly cited standard they will invest in increasing the number of school buses to help shorten commute time. What would a Type II error mean in this context?

22. The Centers for Disease Control and Prevention (CDC) 2018 national estimate that 1 in 68 $\approx$ 0.0147 children have been diagnosed with autism spectrum disorder (ASD). A researcher believes that the proportion of children in their county is different from the CDC estimate. The hypotheses are H_0: p = 0.0147 H_1: p ≠ 0.0147. Which answer is the correct type II error in the context of this problem?

a) The proportion of children diagnosed with ASD in the researcher's county is believed to be different from the national estimate, even though the proportion is the same.

b) The proportion of children diagnosed with ASD in the researcher's county is believed to be different from the national estimate and the proportion is different.

c) The proportion of children diagnosed with ASD in the researcher's county is believed to be the same as the national estimate, even though the proportion is different.

d) The proportion of children diagnosed with ASD in the researcher's county is believed to be the same as the national estimate and the proportion is the same.

23. The Food & Drug Administration (FDA) regulates that fresh albacore tuna fish contains at most 0.82 ppm of mercury. A scientist at the FDA believes the mean amount of mercury in tuna fish for a new company exceeds the ppm of mercury. A test statistic was found to be 2.576 and a critical value was found to be 1.645, what is the correct decision and summary?

a) Reject H_0, there is enough evidence to support the claim that the amount of mercury in the new company's tuna fish exceeds the FDA limit of 0.82 ppm.

b) Accept H_0, there is not enough evidence to reject the claim that the amount of mercury in the new company's tuna fish exceeds the FDA limit of 0.82 ppm.

c) Reject H_1, there is not enough evidence to reject the claim that the amount of mercury in the new company's tuna fish exceeds the FDA limit of 0.82 ppm.

d) Reject H_0, there is not enough evidence to support the claim that the amount of mercury in the new company's tuna fish exceeds the FDA limit of 0.82 ppm.

e) Do not reject H_0, there is not enough evidence to support the claim that the amount of mercury in the new company's tuna fish exceeds the FDA limit of 0.82 ppm.

24. The plant-breeding department at a major university developed a new hybrid boysenberry plant called Stumptown Berry. Based on research data, the claim is made that from the time shoots are planted 90 days on average are required to obtain the first berry. A corporation that is interested in marketing the product tests 60 shoots by planting them and recording the number of days before each plant produces its first berry. The corporation wants to know if the mean number of days is different from the 90 days claimed. A random sample was taken and the following test statistic was z = -2.15 and critical values of z = ±1.96 was found. What is the correct decision and summary?

a) Do not reject H_0, there is not enough evidence to support the corporation's claim that the mean number of days until a berry is produced is different from the 90 days claimed by the university.

b) Reject H_0, there is enough evidence to support the corporation's claim that the mean number of days until a berry is produced is different from the 90 days claimed by the university.

c) Accept H_0, there is enough evidence to support the corporation's claim that the mean number of days until a berry is produced is different from the 90 days claimed by the university.

d) Reject H_1, there is not enough evidence to reject the corporation's claim that the mean number of days until a berry is produced is different from the 90 days claimed by the university.

e) Reject H_0, there is not enough evidence to support the corporation's claim that the mean number of days until a berry is produced is different from the 90 days claimed by the university.

25. You are conducting a study to see if the accuracy rate for fingerprint identification is significantly different from 0.34. Thus, you are performing a two-tailed test. Your sample data produce the test statistic z = 2.504. Use your calculator to find the p-value and state the correct decision and summary.

26. The SAT exam in previous years is normally distributed with an average score of 1,000 points and a standard deviation of 150 points. The test writers for this upcoming year want to make sure that the new test does not have a significantly different mean score. They have a random sample of 20 students take the SAT and their mean score was 1,050 points.

a) Test to see if the mean time has significantly changed using a 5% level of significance. Show all your steps using the critical value method.

b) What is a type I error for this problem?

c) What is a type II error for this problem?

27. A sample of 45 body temperatures of athletes had a mean of 98.8˚F. Assume the population standard deviation is known to be 0.62˚F. Test the claim that the mean body temperature for all athletes is more than 98.6˚F. Use a 1% level of significance. Show all your steps using the p-value method.

28. Compute the t critical value for a left-tailed test when α = 0.10 and *df* = 10.

29. Compute the t critical value for a two-tailed test when α = 0.05 with a sample size of 18.

30. Using a t-distribution with *df* = 25, find the P(t ≥ 2.185).

31. A student is interested in becoming an actuary. They know that becoming an actuary takes a lot of schooling and they will have to take out student loans. They want to make sure the starting salary will be higher than $55,000/year. They randomly sample 30 starting salaries for actuaries and find a p-value of 0.0392. Use α = 0.05.

a) Choose the correct hypotheses.

i. H_0: μ = 55,000 H_1: μ < 55,000

ii. H_0: μ > 55,000 H_1: μ ≤ 55,000

iii. H_0: μ = 55,000 H_1: μ > 55,000

iv. H_0: μ < 55,000 H_1: μ ≥ 55,000

v. H_0: μ = 55,000 H_1: μ ≠ 55,000

b) Should the student pursue an actuary career?

i. Yes, since we reject the null hypothesis.

ii. Yes, since we reject the claim.

iii. No, since we reject the claim.

iv. No, since we reject the null hypothesis.

32. The workweek for adults in the United States work full-time is normally distributed with a mean of 47 hours. A newly hired engineer at a start-up company believes that employees at start-up companies work more on average then working adults in the U.S. She asks 12 engineering friends at start-ups for the lengths in hours of their workweek. Their responses are shown in the table below. Test the claim using a 5% level of significance. Show all 5 steps using the p-value method.

Hours	46	42	54	52	48	45	49	49	50	46	55	55

33. The average number of calories from a fast food meal for adults in the United States is 842 calories. A nutritionist believes that the average is higher than reported. They sample 11 meals that adults ordered and measure the calories for each meal shown below. Test the claim using a 5% level of significance. Assume that fast food calories are normally distributed. Show all 5 steps using the p-value method.

Calories	855	854	785	854	952	860	853	760	862	851	919

34. Honda advertises the 2018 Honda Civic as getting 32 mpg for city driving. A skeptical consumer about to purchase this model believes the mpg is less than the advertised amount and randomly selects 35 2018 Honda Civic owners and asks them

what their car's mpg is. Use a 1% significance level. They find a p-value of 0.0436.

a) Choose the correct hypotheses.

i. H_0: μ = 32 H_1: μ < 32

ii. H_0: μ < 32 H_1: μ ≥ 32

iii. H_0: μ = 32 H_1: μ > 32

iv. H_0: μ = 35 H_1: μ ≠ 35

v. H_0: μ = 32 H_1: μ ≠ 32

b) Choose the correct decision based off the reported p-value.

i. Reject H_0

ii. Do not reject H_0

iii. Do not reject H_1

iv. Reject H_1

For exercises 35-40, show all 5 steps for hypothesis testing:

a) State the hypotheses.

b) Compute the test statistic.

c) Compute the critical value or p-value.

d) State the decision.

e) Write a summary.

35. The total of individual pounds of garbage discarded by 17 households in one week is shown below. The current waste removal system company has a weekly maximum weight policy of 36 pounds. Test the claim that the average weekly household garbage weight is less than the company's weekly maximum. Use a 5% level of significance.

Weight				
34.5	32.9	42.9	32.9	31.8
40	33.8	35.8	35.4	30.5
31.4	39.2	26.8	30.6	34.5
34.7	32.8			

36. The world's smallest mammal is the bumblebee bat (also known as Kitti's hog-nosed bat or Craseonycteris thonglongyai). Such bats are roughly the size of a large bumblebee. A sample of 10 bats weighed in grams are shown below. Test the claim that mean weight for all bumblebee bats is not equal to 2.1 g using a 1% level of significance. Assume that the bat weights are normally distributed.

Weight	2.22	1.6	1.78	1.52	1.61	1.98	1.56	2.24	1.55	2.28

37. The average age of an adult's first vacation without a parent or guardian was reported to be 23 years old. A travel agent believes that the average age is different from what was reported. They sample 28 adults and they asked their age in years when they first vacationed as an adult without a parent or guardian, data shown below. Test the claim using a 10% level of significance.

Age						
21	22	25	26	24	27	22
23	24	27	20	18	24	22
22	28	26	25	26	22	23
24	27	25	22	21	24	22

38. Test the claim that the proportion of people who own dogs is less than 32%. A random sample of 1,000 people found that 28% owned dogs. Do the sample data provide convincing evidence to support the claim? Test the relevant hypotheses using a 10% level of significance.

39. The National Institute of Mental Health published an article stating that in any one-year period, approximately 9.3% of American adults suffer from depression or a depressive illness. Suppose that in a survey of 2,000 people in a certain city, 11.1% of them suffered from depression or a depressive illness. Conduct a hypothesis test to determine if the true proportion of people in that city suffering from depression or a depressive illness is more than the 9.3% in the general adult American population. Test the relevant hypotheses using a 5% level of significance.

40. The United States Department of Energy reported that 48% of homes were heated by natural gas. A random sample of 333 homes in Oregon found that 149 were heated by natural gas. Test the claim that the proportion of homes in Oregon that were heated by natural gas is different from what was reported. Use a 1% significance level.

41. A 2019 survey by the Bureau of Labor Statistics reported that 92% of Americans working in large companies have paid leave. In January 2021, a random survey of workers showed that 89% had paid leave. The resulting p-value is 0.009; thus, the null hypothesis is rejected. It is concluded that there has been a decrease in the proportion of people, who have paid leave from 2019 to January 2021. What type of error is possible in this situation?

a) Type I Error

b) Type II Error

c) Standard Error

d) Margin of Error

e) No error was made.

For exercises 42-44, show all 5 steps for hypothesis testing:

a) State the hypotheses.

b) Compute the test statistic.

c) Compute the critical value or p-value.

d) State the decision.

e) Write a summary.

42. Nationwide 40.1% of employed teachers are union members. A random sample of 250 Oregon teachers showed that 110 belonged to a union. At α = 0.10, is there sufficient evidence to conclude that the proportion of union membership for Oregon teachers is higher than the national proportion?

43. You are conducting a study to see if the proportion of men over the age of 50 who regularly have their prostate examined is significantly less than 0.31. A random sample of 735 men over the age of 50 found that 208 have their prostate regularly examined. Do the sample data provide convincing evidence to support the claim? Test the relevant hypotheses using a 5% level of significance.

44. Nationally the percentage of adults that have their teeth cleaned by a dentist yearly is 64%. A dentist in Portland, Oregon believes that regionally the percent is higher. A sample of 2,000 Portlanders found that 1,312 had their teeth cleaned by a dentist in the last year. Test the relevant hypotheses using a 10% level of significance.

Answer to Odd Numbered Exercises

1) b

3) a

5) ±2.5758

7) ±1.96

9) a) ii. b) viii. c) iv. d) vi. e) vii. f) i. g) v. h) iii.

11) $100(1 – \alpha)\%$ = Confidence Level $1 – \beta$ = Power β = P(Type II Error) μ = Parameter α = Significance Level

13) d

15) b

17) a

19) The implication of a Type I error from the clinical trial is that the vaccination will be approved when it indeed does not reduce the risk of contracting the virus. The implication of a Type II error from the clinical trial is that the vaccination will not be approved when it indeed does reduce the risk of contracting the virus.

21) The local government decides that the data do not provide convincing evidence of an average commute time higher than 30 minutes, when the true average commute time is in fact higher than 30 minutes.

23) a

25) 0.0123

27) H_0: $\mu = 98.6$; H_1: $\mu > 98.6$; $z = 2.1639$; p-value = 0.0152; Do not reject H_0. There is not enough evidence to support the claim that the mean body temperature for all athletes is more than 98.6˚F.

29) ±2.1098

31) a) iii. b) i.

33) H_0: $\mu = 842$; H_1: $\mu > 842$; $t = 0.8218$; p-value = 0.2152; Do not reject H_0. We do not have evidence to support the claim the average calories from a fast food meal is higher than reported.

35) H_0: $\mu = 36$; H_1: $\mu < 36$; $t = -1.9758$; p-value = 0.0438; Reject H_0. There is enough evidence to support the claim the average weekly household garbage weight is less than the company's weekly 36 lb. maximum.

37) H_0: $\mu = 23$; H_1: $\mu \neq 23$; $t = 1.4224$; p-value = 0.1664; Do not reject H_0. We do not have enough evidence to support the claim that the mean age adults travel without a parent or guardian differs from 23.

39) H_0: $p = 0.093$; H_1: $p > 0.093$; $t = 2.7116$; p-value = 0.0027; Reject H_0. There is enough evidence to support the claim the population proportion of American adults that suffer from depression or a depressive illness is more than 9.3%.

41) a

43) H_0: $p = 0.31$; H_1: $p < 0.31$; $t = -1.5831$; p-value = 0.0567; Do not reject H_0. There is not enough evidence to support the claim the population proportion of men over the age of 50 who regularly have their prostate examined is significantly less than 0.31