Ch09 - Ch 9 prep questions

Analytical Methods for Business (University of Arizona)

ch09

Student: ____

1. The null hypothesis typically corresponds to a presumed default state of nature.
   True False

2. The alternative hypothesis typically agrees with the status quo.
   True False

3. On the basis of sample information, we either "accept the null hypothesis" or "reject the null hypothesis."
   True False

4. As a general guideline, we use the alternative hypothesis as a vehicle to establish something new, or contest the status quo, for which a corrective action may be required.
   True False

5. In a one-tailed test, the rejection region is located under one tail (left or right) of the corresponding probability distribution, while in a two-tailed test this region is located under both tails.
   True False

6. A Type I error is committed when we reject the null hypothesis which is actually true.
   True False

7. A Type II error is made when we reject the null hypothesis and the null hypothesis is actually false.
   True False

8. For a given sample size, any attempt to reduce the likelihood of making one type of error (Type I or Type II) will increase the likelihood of the other error.
   True False

9. A hypothesis test regarding the population mean μ is based on the sampling distribution of the sample mean $\bar{X}$.
   True False

10. Under the assumption that the null hypothesis is true as an equality, the p-value is the likelihood of observing a sample mean that is at least as extreme as the one derived from the given sample.
    True False

11. The critical value approach specifies a range of values, also called the rejection region, such that if the value of the test statistic falls into this range, we do not reject the null hypothesis.
    True False

12. The null hypothesis in a hypothesis test refers to _____________.
    A. The desired outcome
    B. The default state of nature
    C. The altered state of nature
    D. The desired state of nature

13. In general, the null and alternative hypotheses are __________.
    A. Additive
    B. Correlated
    C. Multiplicative
    D. Mutually exclusive

14. The alternative hypothesis typically ___________.
A. Corresponds to the presumed default state of nature
B. Contests the status quo for which a corrective action may be required
C. States the probability of rejecting the null hypothesis when it is false
D. States the probability of rejecting the null hypothesis when it is true

15. Which of the following types of tests may be performed?
A. Right-tailed and two-tailed tests
B. Left-tailed and two-tailed tests
C. Right-tailed and left-tailed tests
D. Right-tailed, left-tailed, and two-tailed tests

16. The national average for an 8th grade reading comprehension test is 73. A school district claims that its eighth-graders outperform the national average. In testing the school district's claim, how does one define the population parameter of interest?
A. The mean score on the 8th grade reading comprehension test.
B. The number of 8th graders that took the reading comprehension test.
C. The standard deviation of the score on the 8th grade reading comprehension test.
D. The proportion of 8th graders that scored above 73 on the reading comprehension test.

17. A local courier service advertises that its average delivery time is less than 6 hours for local deliveries. When testing the two hypotheses, $H_0: \mu \geq 6$ and $H_A: \mu < 6$, μ stands for _____________.
A. The mean delivery time
B. The standard deviation of the delivery time
C. The number of deliveries that took less than 6 hours
D. The proportion of deliveries that took less than 6 hours

18. It is generally believed that no more than 0.50 of all babies in a town in Texas are born out of wedlock. A politician claims that the proportion of babies that are born out of wedlock is increasing. In testing the politician's claim, how does one define the population parameter of interest?
A. The current proportion of babies born out of wedlock
B. The mean number of babies born out of wedlock
C. The number of babies born out of wedlock
D. The general belief that the proportion of babies born out of wedlock is no more than 0.50

19. It is generally believed that no more than 0.50 of all babies in a town in Texas are born out of wedlock. A politician claims that the proportion of babies that are born out of wedlock is increasing. When testing the two hypotheses, H_0: $p \leq 0.50$ and H_A: $p > 0.50$, p stands for _____________.
A. The current proportion of babies born out of wedlock
B. The mean number of babies born out of wedlock
C. The number of babies born out of wedlock
D. The general belief that the proportion of babies born out of wedlock is no more than 0.50

20. It is generally believed that no more than 0.50 of all babies in a town in Texas are born out of wedlock. A politician claims that the proportion of babies that are born out of wedlock is increasing. Identify the correct null and alternative hypotheses to test the politician's claim.
A. $H_0: p = 0.50$ and $H_A: p \neq 0.50$
B.
C.
D.

21. Many cities around the United States are installing LED streetlights, in part to combat crime by improving visibility after dusk. An urban police department claims that the proportion of crimes committed after dusk will fall below the current level of 0.84 if LED streetlights are installed. Specify the null and alternative hypotheses to test the police department's claim.
    A. $H_0: p = 0.84$ and $H_A: p \neq 0.84$
    B. $H_0: p < 0.84$ and $H_A: p \geq 0.84$
    C.
    D.

22. A professional sports organization is going to implement a test for steroids. The test gives a positive reaction in 94% of the people who have taken the steroid. However, it erroneously gives a positive reaction in 4% of the people who have not taken the steroid. What is the probability of a Type I and Type II error using the null hypothesis "the individual has not taken steroids."
    A. Type I: 4%, Type II: 6%
    B. Type I: 6%, Type II: 4%
    C. Type I: 94%, Type II: 4%
    D. Type I: 4%, Type II: 94%

23. A statistics professor works tirelessly to catch students cheating on his exams. He has particular routes for his teaching assistants to patrol, an elevated chair to ensure an unobstructed view of all students, and even a video recording of the exam in case additional evidence needs to be collected. He estimates that he catches 95% of students who cheat in his class, but 1% of the time he accuses a student of cheating and he is actually incorrect. Consider the null hypothesis, "the student is not cheating." What is the probability of a Type I error?
    A. 1%
    B. 5%
    C. 95%
    D. 99%

24. A Type I error occurs when we ___________.
    A. Reject the null hypothesis when it is actually true
    B. Reject the null hypothesis when it is actually false
    C. Do not reject the null hypothesis when it is actually true
    D. Do not reject the null hypothesis when it is actually false

25. A Type II error occurs when we ___________.
    A. Reject the null hypothesis when it is actually true
    B. Reject the null hypothesis when it is actually false
    C. Do not reject the null hypothesis when it is actually true
    D. Do not reject the null hypothesis when it is actually false

26. When we reject the null hypothesis when it is actually false we have committed _________.
    A. No error
    B. A Type I error
    C. A Type II error
    D. A Type I error and a Type II error

27. For a given sample size n, ________________.
    A. Decreasing the probability of a Type I error α will increase the probability of a Type II error β
    B. Decreasing the probability of a Type I error α will decrease the probability of a Type II error β
    C. Changing the probability of a Type I error α will have no impact on the probability of a Type II error β
    D. Increasing the probability of a Type I error α will increase the probability of a Type II error β as long as σ is known

28. Consider the following hypotheses that relate to the medical field:

H_0 : A person is free of disease

H_A : A person has disease

In this instance, a Type I error is often referred to as ___________.

A. A false positive
B. A false negative
C. A negative result
D. The power of the test

29. Consider the following hypotheses that relate to the medical field:

H_0 : A person is free of disease

H_A : A person has disease

In this instance, a Type II error is often referred to as ___________.

A. A false positive
B. A false negative
C. A negative result
D. The power of the test

30. A fast-food franchise is considering building a restaurant at a busy intersection. A financial advisor determines that the site is acceptable only if, on average, more than 300 automobiles pass the location per hour. The advisor tests the following hypotheses:

$H_0: \mu \leq 300$

$H_A: \mu > 300$

The consequences of committing a Type I error would be that _______________.

A. The franchiser builds on an acceptable site
B. The franchiser builds on an unacceptable site
C. The franchiser does not build on an acceptable site
D. The franchiser does not build on an unacceptable site

31. A fast-food franchise is considering building a restaurant at a busy intersection. A financial advisor determines that the site is acceptable only if, on average, more than 300 automobiles pass the location per hour. The advisor tests the following hypotheses:

$H_0: \mu \leq 300$

$H_A: \mu > 300$

The consequences of committing a Type II error would be that _______________.

A. The franchiser builds on an acceptable site
B. The franchiser builds on an unacceptable site
C. The franchiser does not build on an acceptable site
D. The franchiser does not build on an unacceptable site

32. A fast-food franchise is considering building a restaurant at a busy intersection. A financial advisor determines that the site is acceptable only if, on average, more than 300 automobiles pass the location per hour. If the advisor tests the hypotheses $H_0: \mu \leq 300$ versus $H_A: \mu > 300$, μ stands for ____________.

A. The average number of automobiles that pass the intersection per hour
B. The number of automobiles that pass the intersection per hour
C. The proportion of automobiles that pass the intersection per hour
D. The standard deviation of the number of automobiles that pass the intersection per hour

33. Which of the following answers represents the objective of a hypothesis test?
    A. Rejecting the null hypothesis when it is true
    B. Rejecting the null hypothesis when it is false
    C. Not rejecting the null hypothesis when it is true
    D. B and C

34. When conducting a hypothesis test, which of the following decisions represents an error?
    A. Rejecting the null hypothesis when it is true
    B. Rejecting the null hypothesis when it is false
    C. Not rejecting the null hypothesis when it is true
    D. B and C

35. A hypothesis test regarding the population mean is based on _____________.
    A. The sampling distribution of the sample mean
    B. The sampling distribution of the sample variance
    C. The sampling distribution of the sample proportion
    D. The sampling distribution of the sample standard deviation

36. When conducting a hypothesis test concerning the population mean, and the population standard deviation is known, the value of the test statistic is calculated as _________.
    A. $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$
    B. $t_{df} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$
    C. $z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$
    D. $t_{df} = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$

37. When conducting a hypothesis test concerning the population mean, and the population standard deviation is unknown, the value of the test statistic is calculated as __________.
    A. $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$
    B. $t_{df} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$
    C. $z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$
    D. $t_{df} = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$

38. When conducting a hypothesis test concerning the population proportion, the value of the test statistic is calculated as ____________.
A. $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$
B. $t_{df} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$
C. $z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$
D. $t_{df} = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$

39. Which of the following represents an appropriate set of hypotheses?
A. $H_0 : \bar{X} = 0, H_A : \bar{X} \neq 0$
B. $H_0 : \bar{X} < 0, H_A : \bar{X} > 0$
C. $H_0 : \mu < 0, H_A : \mu > 0$
D. $H_0 : \mu = 0, H_A : \mu \neq 0$

40. If the chosen significance level is $\alpha = 0.05$, then ______________.
A. There is a 5% probability of rejecting a true null hypothesis
B. There is a 5% probability of accepting a true null hypothesis
C. There is a 5% probability of rejecting a false null hypothesis
D. There is a 5% probability of accepting a false null hypothesis

41. When conducting a hypothesis test for a given sample size, if α is increased from 0.05 to 0.10, then __________________.
A. The probability of incorrectly rejecting the null increases
B. The probability of incorrectly failing to reject the null decreases
C. The probability of Type II error decreases
D. All of the above are correct

42. When conducting a hypothesis test for a given sample size, if the probability of a Type I error decreases, then the _____________.
A. Probability of Type II error decreases
B. Probability of incorrectly rejecting the null increases
C. Probability of incorrectly accepting the null increases
D. Probability of incorrectly accepting the null decreases

43. Which of the following are one-tailed tests?
A. $H_0 : \mu \leq 10$ versus $H_A : \mu > 10$
B. $H_0 : \mu = 10$ versus $H_A : \mu \neq 10$
C. $H_0 : \mu \geq 400$ versus $H_A : \mu < 400$
D. Both A and C

44. Which of the following are two-tailed tests?
A.
B.
C. $H_0 : \mu \geq 400$ versus $H_A : \mu < 400$
D. Both A and C

45. If the p-value for a hypothesis test is 0.027 and the chosen level of significance is $\alpha = 0.05$, then the correct conclusion is to ________________.
A. Reject the null hypothesis
B. Not reject the null hypothesis
C. Reject the null hypothesis if $\sigma = 10$
D. Not reject the null hypothesis if $\sigma = 10$

46. If the p-value for a hypothesis test is 0.07 and the chosen level of significance is $\alpha = 0.05$, then the correct conclusion is to ____________________.
A. Reject the null hypothesis
B. Not reject the null hypothesis
C. Reject the null hypothesis if $\sigma = 10$
D. Not reject the null hypothesis if $\sigma = 10$

47. If the null hypothesis is rejected at a 1% significance level, then _____________.
A. The null hypothesis will be rejected at a 5% significance level
B. The alternative hypothesis will be rejected at a 5% significance level
C. The null hypothesis will not be rejected at a 5% significance level
D. The alternative hypothesis will not be rejected at a 5% significance level

48. What is the decision rule when using the p-value approach to hypothesis testing?
A. Reject H_0 if the p-value > α.
B. Reject H_0 if the p-value < α.
C. Do not reject H_0 if the p-value < 1 - α.
D. Do not reject H_0 if the p-value > 1 - α.

49. A two-tailed hypothesis test of the population mean or population proportion has ________.
A. Only one critical value
B. Two critical values, both positive
C. Two critical values, both negative
D. Two critical values, one positive and one negative

50. A one-tailed hypothesis test of the population mean has ______________.
A. Only one critical value
B. Two critical values, both positive
C. Two critical values, both negative
D. Two critical values, one positive and one negative

51. Consider the following competing hypotheses: $H_0: \mu = 0$ and $H_A: \mu \neq 0$. The value of the test statistic is z = -1.38. If we choose a 5% significance level, then we ______________.
A. Reject the null hypothesis and conclude that the population mean is significantly different from zero
B. Reject the null hypothesis and conclude that the population mean is not significantly different from zero
C. Do not reject the null hypothesis and conclude that the population mean is significantly different from zero
D. Do not reject the null hypothesis and conclude that the population mean is not significantly different from zero

52. **Exhibit 9-1.** A university is interested in promoting graduates of its honors program by establishing that the mean GPA of these graduates exceeds 3.50. A sample of 36 honors students is taken and is found to have a mean GPA equal to 3.60. The population standard deviation is assumed to equal 0.40.

Refer to Exhibit 9-1. The parameter to be tested is ____________.
A. The mean GPA of all university students
B. The mean GPA of the university honors students
C. The mean GPA of 3.60 for the 36 selected honors students
D. The proportion of honors students with a GPA exceeding 3.50

53. **Exhibit 9-1.** A university is interested in promoting graduates of its honors program by establishing that the mean GPA of these graduates exceeds 3.50. A sample of 36 honors students is taken and is found to have a mean GPA equal to 3.60. The population standard deviation is assumed to equal 0.40.

Refer to Exhibit 9-1. In order to establish whether the mean GPA exceeds 3.50, the appropriate hypotheses are ______________.
A.
B.
C.
D.

54. **Exhibit 9-1.** A university is interested in promoting graduates of its honors program by establishing that the mean GPA of these graduates exceeds 3.50. A sample of 36 honors students is taken and is found to have a mean GPA equal to 3.60. The population standard deviation is assumed to equal 0.40.

Refer to Exhibit 9-1. The value of the test statistic is ____________.
A. $z = -1.50$
B. $t_{35} = -1.50$
C. $z = 1.50$
D. $t_{35} = 1.50$

55. **Exhibit 9-1.** A university is interested in promoting graduates of its honors program by establishing that the mean GPA of these graduates exceeds 3.50. A sample of 36 honors students is taken and is found to have a mean GPA equal to 3.60. The population standard deviation is assumed to equal 0.40.

Refer to Exhibit 9-1. At a 5% significance level, the critical value(s) is (are) ________.
A. 1.645
B. 1.690
C. -1.96 and 1.96
D. -2.030 and 2.030

56. **Exhibit 9-1.** A university is interested in promoting graduates of its honors program by establishing that the mean GPA of these graduates exceeds 3.50. A sample of 36 honors students is taken and is found to have a mean GPA equal to 3.60. The population standard deviation is assumed to equal 0.40.

Refer to Exhibit 9-1. At a 5% significance level, the decision is to _____________.
A. Reject H_0; we can conclude that the mean GPA is significantly greater than 3.50
B. Reject H_0; we cannot conclude that the mean GPA is significantly greater than 3.50
C. Do not reject H_0; we can conclude that the mean GPA is significantly greater than 3.50
D. Do not reject H_0; we cannot conclude that the mean GPA is significantly greater than 3.50

57. **Exhibit 9-2.** The owner of a large car dealership believes that the financial crisis decreased the number of customers visiting her dealership. The dealership has historically had 800 customers per day. The owner takes a sample of 100 days and finds the average number of customers visiting the dealership per day was 750. Assume that the population standard deviation is 350.

Refer to Exhibit 9-2. The population parameter to be tested is ___________.
A. The average number of 750 customers per day
B. The proportion of customers visiting the dealership per day
C. The mean number of customers visiting the dealership per day
D. The standard deviation of the number of customers visiting the dealership per day

58. **Exhibit 9-2.** The owner of a large car dealership believes that the financial crisis decreased the number of customers visiting her dealership. The dealership has historically had 800 customers per day. The owner takes a sample of 100 days and finds the average number of customers visiting the dealership per day was 750. Assume that the population standard deviation is 350.

Refer to Exhibit 9-2. In order to determine whether there has been a decrease in the average number of customers visiting the dealership daily, the appropriate hypotheses are _________.
A. $H_0: \mu \leq 800$ and $H_A: \mu > 800$
B. $H_0: \bar{X} \leq 800$ and $H_A: \bar{X} > 800$
C. $H_0: \mu \geq 800$ and $H_A: \mu < 800$
D. $H_0: \bar{X} \geq 800$ and $H_A: \bar{X} < 800$

59. **Exhibit 9-2.** The owner of a large car dealership believes that the financial crisis decreased the number of customers visiting her dealership. The dealership has historically had 800 customers per day. The owner takes a sample of 100 days and finds the average number of customers visiting the dealership per day was 750. Assume that the population standard deviation is 350.

Refer to Exhibit 9-2. The value of the test statistic is ____________.
A. $z = -1.429$
B. $t_{99} = -1.429$
C. $z = 1.429$
D. $t_{99} = 1.429$

60. **Exhibit 9-2.** The owner of a large car dealership believes that the financial crisis decreased the number of customers visiting her dealership. The dealership has historically had 800 customers per day. The owner takes a sample of 100 days and finds the average number of customers visiting the dealership per day was 750. Assume that the population standard deviation is 350.

Refer to Exhibit 9-2. At a 5% significance level, the critical value(s) is (are) ___________.
A. 1.645
B. -1.645
C. -1.96 and 1.96
D. -2.030 and 2.030

61. **Exhibit 9-2.** The owner of a large car dealership believes that the financial crisis decreased the number of customers visiting her dealership. The dealership has historically had 800 customers per day. The owner takes a sample of 100 days and finds the average number of customers visiting the dealership per day was 750. Assume that the population standard deviation is 350.

Refer to Exhibit 9-2. At the 5% significance level, the decision is to ___________.
A. Reject H_0; we can conclude that the mean number of customers visiting the dealership is significantly less than 800
B. Reject H_0; we cannot conclude that the mean number of customers visiting the dealership is significantly less than 800
C. Do not reject H_0; we can conclude that the mean number of customers visiting the dealership is significantly less than 800
D. Do not reject H_0; we cannot conclude that the mean number of customers visiting the dealership is significantly less than 800

62. **Exhibit 9-3.** The Boston public school district has had difficulty maintaining on-time bus service for its students ("A Year Later, School Buses Still Late," Boston Globe, October 5, 2011). Suppose the district develops a new bus schedule to help combat chronic lateness on a particularly woeful route. Historically, the bus service on the route has been, on average, 12 minutes late. After the schedule adjustment, the first 36 runs were an average of 8 minutes late. As a result, the Boston public school district claimed that the schedule adjustment was an improvement—students were not as late. Assume a population standard deviation for bus arrival time of 12 minutes.

Refer to Exhibit 9-3. Develop the null and alternative hypotheses to determine whether the schedule adjustment reduced the average lateness time of 12 minutes.

A. $H_0: \mu = 8$ and $H_A: \mu \neq 8$
B. $H_0: \mu < 12$ and $H_A: \mu \geq 12$
C. $H_0: \mu \geq 12$ and $H_A: \mu < 12$
D. $H_0: \bar{X} \geq 8$ and $H_A: \bar{X} < 8$

63. **Exhibit 9-3.** The Boston public school district has had difficulty maintaining on-time bus service for its students ("A Year Later, School Buses Still Late," Boston Globe, October 5, 2011). Suppose the district develops a new bus schedule to help combat chronic lateness on a particularly woeful route. Historically, the bus service on the route has been, on average, 12 minutes late. After the schedule adjustment, the first 36 runs were an average of 8 minutes late. As a result, the Boston public school district claimed that the schedule adjustment was an improvement—students were not as late. Assume a population standard deviation for bus arrival time of 12 minutes.

Refer to Exhibit 9-3. Calculate the value of the test statistic.

A. $t_{35} = -2.00$
B. $z = -2.00$
C. $t_{35} = -0.33$
D. $z = -0.33$

64. **Exhibit 9-3.** The Boston public school district has had difficulty maintaining on-time bus service for its students ("A Year Later, School Buses Still Late," Boston Globe, October 5, 2011). Suppose the district develops a new bus schedule to help combat chronic lateness on a particularly woeful route. Historically, the bus service on the route has been, on average, 12 minutes late. After the schedule adjustment, the first 36 runs were an average of 8 minutes late. As a result, the Boston public school district claimed that the schedule adjustment was an improvement—students were not as late. Assume a population standard deviation for bus arrival time of 12 minutes.

Refer to Exhibit 9-3. At the 5% significance level, does the evidence support the Boston public school district's claim?

A. No, since the p-value is less than α.
B. Yes, since the p-value is less than α.
C. No, since the value of the test statistic is greater than the critical value.
D. Yes, since the value of the test statistic is greater than the critical value.

65. **Exhibit 9-3.** The Boston public school district has had difficulty maintaining on-time bus service for its students ("A Year Later, School Buses Still Late," Boston Globe, October 5, 2011). Suppose the district develops a new bus schedule to help combat chronic lateness on a particularly woeful route. Historically, the bus service on the route has been, on average, 12 minutes late. After the schedule adjustment, the first 36 runs were an average of 8 minutes late. As a result, the Boston public school district claimed that the schedule adjustment was an improvement—students were not as late. Assume a population standard deviation for bus arrival time of 12 minutes.

Refer to Exhibit 9-3. At the 1% significance level, does the evidence support the Boston Public Schools' claim?

A. No, since the p-value is greater than α.
B. Yes, since the p-value is greater than α.
C. No, since the value of the test statistic is less than the critical value.
D. Yes, since the value of the test statistic is less than the critical value.

66. An analyst conducts a hypothesis test to check whether the mean return for a particular fund differs from 10%. He assumes that returns are normally distributed and sets up the following competing hypotheses:

$$H_0: \mu = 10$$
$$H_A: \mu \neq 10$$

Over the past 10 years the fund has had an average annual return of 13.4% with a standard deviation of 2.6%. The value of the test statistic is 4.14 and the critical values at the 5% significance level are -2.262 and 2.262. The correct decision is to __________.

A. Reject H_0; we can conclude that the mean differs from 10%
B. Reject H_0; we cannot conclude that the mean differs from 10%
C. Do not reject H_0; we can conclude that the mean differs from 10%
D. Do not reject H_0; we cannot conclude that the mean differs from 10%

67. A 99% confidence interval for the population mean yields the following results: [-3.79, 5.86]. At the 1% significance level, what decision should be made regarding a hypothesis test with hypotheses $H_0: \mu = 0$ and $H_A: \mu \neq 0$?

A. Reject H_0; we can conclude that the mean differs from zero.
B. Reject H_0; we cannot conclude that the mean differs from zero.
C. Do not reject H_0; we can conclude that the mean differs from zero.
D. Do not reject H_0; we cannot conclude that the mean differs from zero.

68. In order to test if the mean IQ of employees in an organization is greater than 100, a sample of 30 employees is taken and the value of the test statistic is computed as $t_{29} = 2.42$. If we choose a 5% significance level, we _____________.

A. Reject the null hypothesis and conclude that the mean IQ is greater than 100
B. Reject the null hypothesis and conclude that the mean IQ is not greater than 100
C. Do not reject the null hypothesis and conclude that the mean IQ is greater than 100
D. Do not reject the null hypothesis and conclude that the mean IQ is not greater than 100

69. In order to test if the mean returns on a major index have changed from the historic monthly average of 1.2%, a sample of 36 recent monthly returns is used to calculate the value of the relevant t_{df} test statistic. At the 5% level of significance, we reject the null hypothesis if this value is ____________.

A. Greater than 1.69
B. Greater than 1.645
C. Greater than 1.96 or less than -1.96
D. Greater than 2.03 or less than -2.03

70. A recent report claimed that Americans are retiring later in life (U.S. News & World Report, August 17, 2011). An economist wishes to determine if the mean retirement age has increased from 62. To conduct the relevant test, she takes a random sample of 38 Americans who have recently retired and computes the value of the test statistic as $t_{37} = 1.92$. With a = 0.05, she ___________________.

A. Rejects the null hypothesis and concludes that the mean retirement age has increased
B. Rejects the null hypothesis and concludes that the mean retirement age has not increased
C. Does not reject the null hypothesis and does not conclude that the mean retirement age has changed
D. Does not reject the null hypothesis and does not conclude that the mean retirement age has increased

71. **Exhibit 9-4.** A school teacher is worried that the concentration of dangerous, cancer-causing radon gas in her classroom is greater than the safe level of 4pCi/L. The school samples the air for 36 days and finds an average concentration of 4.4pCi/L with a standard deviation of 1pCi/L.

Refer to Exhibit 9-4. In order to test whether the average level of radon gas is greater than the safe level, the appropriate hypotheses are ____________.

A. $H_0: \mu \le 4.0$ and $H_A: \mu > 4.0$
B. $H_0: \mu = 4.0; H_A: \mu \ne 4.0$
C. $H_0: \mu \ge 4.4$ and $H_A: \mu < 4.4$
D. $H_0: \bar{X} = 4.4; H_A: \bar{X} \ne 4.4$

72. **Exhibit 9-4.** A school teacher is worried that the concentration of dangerous, cancer-causing radon gas in her classroom is greater than the safe level of 4pCi/L. The school samples the air for 36 days and finds an average concentration of 4.4pCi/L with a standard deviation of 1pCi/L.

Refer to Exhibit 9-4. The value of the test statistic is ___________.

A. $z = -2.40$
B. $t_{35} = -2.40$
C. $z = 2.40$
D. $t_{35} = 2.40$

73. **Exhibit 9-4.** A school teacher is worried that the concentration of dangerous, cancer-causing radon gas in her classroom is greater than the safe level of 4pCi/L. The school samples the air for 36 days and finds an average concentration of 4.4pCi/L with a standard deviation of 1pCi/L.

Refer to Exhibit 9-4. At a 5% significance level, the critical value(s) is (are) _______.

A. -1.690
B. 1.690
C. -1.96 and 1.96
D. -2.030 and 2.030

74. **Exhibit 9-4.** A school teacher is worried that the concentration of dangerous, cancer-causing radon gas in her classroom is greater than the safe level of 4pCi/L. The school samples the air for 36 days and finds an average concentration of 4.4pCi/L with a standard deviation of 1pCi/L.

Refer to Exhibit 9-4. At a 5% significance level, the decision is to ___________.

A. Reject H_0; we can conclude that the mean concentration of radon gas is greater than the safe level
B. Reject H_0; we cannot conclude that the mean concentration of radon gas is greater than the safe level
C. Do not reject H_0; we can conclude that the mean concentration of radon gas is greater than the safe level
D. Do not reject H_0; we cannot conclude that the mean concentration of radon gas is greater than the safe level

75. A car dealer who sells only late-model luxury cars recently hired a new salesman and believes that this salesman is selling at lower markups. He knows that the long-run average markup in his lot is $5600. He takes a random sample of 16 of the new salesman's sales and finds an average markup of $5000 and a standard deviation of $800. Assume the markups are normally distributed. What is the value of an appropriate test statistic for the car dealer to use to test his claim?
A. $t_{15} = -3.00$
B. $z = -3.00$
C. $t_{15} = -0.75$
D. $z = -0.75$

76. A temp agency feels that one of its recruiters has unorthodox methods and claims that the wages the recruiter secures for its temps differs from the agency's average wage of $12 per hour. The agency takes a random sample of 49 recent contracts the recruiter secured and finds an average wage of $11.25 per hour and a standard deviation of $2.25 per hour. Does the evidence support the agency's claim at the 5% significance level?
A. Yes, since the p-value is greater than α, the claim is supported.
B. No, since the p-value is not greater than α, the claim is not supported.
C. Yes, since the value of the test statistic is less than the critical value, the claim is supported.
D. No, since the value of the test statistic is greater than the critical value, the claim is not supported.

77. A newly hired basketball coach promised a high-paced attack that will put more points on the board than the team's previously tepid offense historically managed. After a few months, the team owner looks at the data to test the coach's claim. He takes a sample of 36 of the team's games under the new coach and finds that they score an average of 101 points with a standard deviation of 6 points. Over the past 10 years, the team had averaged 99 points. What is (are) the appropriate critical value(s) to test the new coach's claim at the 1% significance level?
A. -2.438
B. -2.438 and 2.438
C. 2.326
D. 2.438

78. A newly hired basketball coach promised a high-paced attack that will put more points on the board than the team's previously tepid offense historically managed. After a few months, the team owner looks at the data to test the coach's claim. He takes a sample of 36 of the team's games under the new coach and finds that they score an average of 101 points with a standard deviation of 6 points. Over the past 10 years, the team had averaged 99 points. What is the value of the appropriate test statistic to test the new coach's claim at the 1% significance level?
A. $t_{35} = 0.33$
B. $z = 0.33$
C. $t_{35} = 2.00$
D. $z = 2.00$

79. What type of data would necessitate using a hypothesis test of the population proportion rather than a test of the population mean?
A. Ratio
B. Interval
C. Qualitative
D. Quantitative

80. You want to test if more than 20% of homes in a neighborhood have recently been sold through a short sale, at a foreclosure auction, or by the bank following an unsuccessful foreclosure auction. You take a sample of 60 homes from this neighborhood and find that 14 fit your criteria. The appropriate null and alternative hypotheses are ___________.
A.
B.
C. $H_0: p \leq 0.20; H_A: p > 0.20$
D. $H_0: p = 0.20; H_A: p \neq 0.20$

81. **Exhibit 9-5.** A university interested in tracking their honors program believes that the proportion of graduates with a GPA of 3.00 or below is less than 0.20. In a sample of 200 graduates, 30 students have a GPA of 3.00 or below.

Refer to Exhibit 9-5. In testing the university's belief, how does one define the population parameter of interest?
A. It's the proportion of honors graduates with a GPA of 3.00 or below.
B. It's the mean number of honors graduates with a GPA of 3.00 or below.
C. It's the number of honors graduates with a GPA of 3.00 or below.
D. It's the standard deviation of the number of honors graduates with a GPA of 3.00 or below.

82. **Exhibit 9-5.** A university interested in tracking their honors program believes that the proportion of graduates with a GPA of 3.00 or below is less than 0.20. In a sample of 200 graduates, 30 students have a GPA of 3.00 or below.

Refer to Exhibit 9-5. In testing the university's belief, the appropriate hypotheses are __________.
A. $H_0: p = 0.15$ and $H_A: p \neq 0.15$
B.
C.
D.

83. **Exhibit 9-5.** A university interested in tracking their honors program believes that the proportion of graduates with a GPA of 3.00 or below is less than 0.20. In a sample of 200 graduates, 30 students have a GPA of 3.00 or below.

Refer to Exhibit 9-5. The value of the test statistic and its associated p-value are ___________.

	Test Statistic Value	p-value
A.	$z = -1.77$	0.0384
B.	$t_{199} = -1.77$	0.0384
C.	$z = 1.77$	0.0768
D.	$t_{199} = 1.77$	0.0768

A. Option A
B. Option B
C. Option C
D. Option D

84. **Exhibit 9-5.** A university interested in tracking their honors program believes that the proportion of graduates with a GPA of 3.00 or below is less than 0.20. In a sample of 200 graduates, 30 students have a GPA of 3.00 or below.

Refer to Exhibit 9-5. At a 5% significance level, the decision is to ___________.
A. Reject H_0; we can conclude that the proportion of graduates with a GPA of 3.00 or below is significantly less than 0.20.
B. Reject H_0; we cannot conclude that the proportion of graduates with a GPA of 3.00 or below is significantly less than 0.20.
C. Do not reject H_0; we can conclude that the proportion of graduates with a GPA of 3.00 or below is significantly less than 0.20.
D. Do not reject H_0; we cannot conclude that the proportion of graduates with a GPA of 3.00 or below is significantly less than 0.20.

85. **Exhibit 9-6.** The Institute of Education Sciences measures the high school dropout rate as the percentage of 16- through 24-year-olds who are not enrolled in school and have not earned a high school credential. In 2009, the high school dropout rate was 8.1%. A polling company recently took a survey of 1000 people between the ages of 16 and 24 and found 6.5% of them are high school dropouts. The polling company would like to determine whether the dropout rate has decreased.

Refer to Exhibit 9-6. When testing whether the dropout rate has decreased, the appropriate hypotheses are _____________.

A. $H_0: p \leq 0.065$ and $H_A: p > 0.065$
B.
C.
D. $H_0: p = 0.081$ and $H_A: p \neq 0.081$

86. **Exhibit 9-6.** The Institute of Education Sciences measures the high school dropout rate as the percentage of 16- through 24-year-olds who are not enrolled in school and have not earned a high school credential. In 2009, the high school dropout rate was 8.1%. A polling company recently took a survey of 1000 people between the ages of 16 and 24 and found 6.5% of them are high school dropouts. The polling company would like to determine whether the dropout rate has decreased.

Refer to Exhibit 9-6. The value of the test statistic is ____________.

A. $z = -2.052$
B. $z = -1.854$
C. $z = 1.854$
D. $z = 2.052$

87. **Exhibit 9-6.** The Institute of Education Sciences measures the high school dropout rate as the percentage of 16- through 24-year-olds who are not enrolled in school and have not earned a high school credential. In 2009, the high school dropout rate was 8.1%. A polling company recently took a survey of 1000 people between the ages of 16 and 24 and found 6.5% of them are high school dropouts. The polling company would like to determine whether the dropout rate has decreased.

Refer to Exhibit 9-6. At a 5% significance level, the p-value and α are _____________.

A.
B.
C.
D.

88. **Exhibit 9-6.** The Institute of Education Sciences measures the high school dropout rate as the percentage of 16- through 24-year-olds who are not enrolled in school and have not earned a high school credential. In 2009, the high school dropout rate was 8.1%. A polling company recently took a survey of 1000 people between the ages of 16 and 24 and found 6.5% of them are high school dropouts. The polling company would like to determine whether the dropout rate has decreased.

Refer to Exhibit 9-6. At a 5% significance level, the decision is to ____________.

A. Reject H_0; we can conclude that the high school dropout rate has decreased
B. Reject H_0; we cannot conclude that the high school dropout rate has decreased
C. Do not reject H_0; we can conclude that the high school dropout rate has decreased
D. Do not reject H_0; we cannot conclude that the high school dropout rate has decreased

89. **Exhibit 9-7.** Vermont-based Green Mountain Coffee Roasters dominates the market for single-serve coffee in the United States, with its subsidiary Keurig accounting for approximately 70% of sales ("Rivals Try to Loosen Keurig's Grip on Single-Serve Coffee Market," Chicago Tribune, February 26, 2011). But Keurig's patent on K-cups, the plastic pods used to brew the coffee, is expected to expire in 2012, allowing other companies to better compete. Suppose a potential competitor has been conducting blind taste tests on its blend and finds that 47% of consumers strongly prefer its French Roast to that of Green Mountain Coffee Roasters. After tweaking its recipe, the competitor conducts a test with 144 tasters, of which 72 prefer its blend. The competitor claims that its new blend is preferred by more than 47% of consumers to Green Mountain Coffee Roasters' French Roast.

Refer to Exhibit 9-7. Which of the following should be used to develop the null and alternative hypotheses to test this claim?
A.
B.
C.
D. $H_0: \mu \geq 72$ and $H_A: \mu < 72$

90. **Exhibit 9-7.** Vermont-based Green Mountain Coffee Roasters dominates the market for single-serve coffee in the United States, with its subsidiary Keurig accounting for approximately 70% of sales ("Rivals Try to Loosen Keurig's Grip on Single-Serve Coffee Market," Chicago Tribune, February 26, 2011). But Keurig's patent on K-cups, the plastic pods used to brew the coffee, is expected to expire in 2012, allowing other companies to better compete. Suppose a potential competitor has been conducting blind taste tests on its blend and finds that 47% of consumers strongly prefer its French Roast to that of Green Mountain Coffee Roasters. After tweaking its recipe, the competitor conducts a test with 144 tasters, of which 72 prefer its blend. The competitor claims that its new blend is preferred by more than 47% of consumers to Green Mountain Coffee Roasters' French Roast.

Refer to Exhibit 9-7. What is the value of the appropriate test statistic to test this claim?
A. $t_{143} = 0.721$
B. $z = 0.721$
C. $t_{143} = 1.96$
D. $z = 1.96$

91. **Exhibit 9-7.** Vermont-based Green Mountain Coffee Roasters dominates the market for single-serve coffee in the United States, with its subsidiary Keurig accounting for approximately 70% of sales ("Rivals Try to Loosen Keurig's Grip on Single-Serve Coffee Market," Chicago Tribune, February 26, 2011). But Keurig's patent on K-cups, the plastic pods used to brew the coffee, is expected to expire in 2012, allowing other companies to better compete. Suppose a potential competitor has been conducting blind taste tests on its blend and finds that 47% of consumers strongly prefer its French Roast to that of Green Mountain Coffee Roasters. After tweaking its recipe, the competitor conducts a test with 144 tasters, of which 72 prefer its blend. The competitor claims that its new blend is preferred by more than 47% of consumers to Green Mountain Coffee Roasters' French Roast.

Refer to Exhibit 9-7. What critical value should be used to test this claim at the 1% significance level?

A. 2.326
B. 2.353
C. 2.576
D. 2.610

92. **Exhibit 9-7.** Vermont-based Green Mountain Coffee Roasters dominates the market for single-serve coffee in the United States, with its subsidiary Keurig accounting for approximately 70% of sales ("Rivals Try to Loosen Keurig's Grip on Single-Serve Coffee Market," Chicago Tribune, February 26, 2011). But Keurig's patent on K-cups, the plastic pods used to brew the coffee, is expected to expire in 2012, allowing other companies to better compete. Suppose a potential competitor has been conducting blind taste tests on its blend and finds that 47% of consumers strongly prefer its French Roast to that of Green Mountain Coffee Roasters. After tweaking its recipe, the competitor conducts a test with 144 tasters, of which 72 prefer its blend. The competitor claims that its new blend is preferred by more than 47% of consumers to Green Mountain Coffee Roasters' French Roast.

Refer to Exhibit 9-7. At the 1% significance level, does the evidence support the claim?
A. No, since the value of the test statistic is less than the critical value.
B. Yes, since the value of the test statistic is less than the critical value.
C. No, since the value of the test statistic is greater than the critical value.
D. Yes, since the value of the test statistic is greater than the critical value.

93. Construct a null and alternative hypothesis for the following claims.

a. "The school's mean GPA differs from 2.50 GPA."
b. "The school's mean GPA is less than 2.50 GPA."

94. Massachusetts Institute of Technology grants pirate certificates to those students who successfully complete courses in archery, fencing, sailing, and pistol shooting ("MIT Awards Pirate Certificates to Undergraduates," Boston Globe, March 3, 2012). Sheila claims that those students who go on to earn pirate certificates are able to hit a higher proportion of bull's-eyes during the archery final exam than the course average of 0.15. Specify the null and alternative hypotheses to test her claim.

95. An engineer is designing an experiment to test if airplane engines are faulty and unsafe to fly. The engineer expects 0.0001% of engines to be unsafe. The null hypothesis is that the probability of an unsafe engine is less than or equal to 0.0001% and the alternative hypothesis is that the probability the engine is unsafe is greater than 0.0001%.

a. Describe the consequences of a Type I and Type II error.
b. Should the engineer design the test with a higher alpha or a higher beta? Explain.

96. George W. Bush famously claimed in the 2003 State of the Union Address that the U.S. had uncovered evidence that Iraq had developed weapons of mass destruction under Saddam Hussein. Consider the null hypothesis, "Iraq does not possess weapons of mass destruction." After deciding that Iraq did possess weapons of mass destruction and invading this country, the U.S. found no evidence of said weapons. Is this a Type I or a Type II error on the part of the U.S.? Explain.

97. A philanthropic organization helped a town in Africa dig several wells to gain access to clean water. Before the wells were in place, an average of 120 infants contracted typhoid each month. After the wells were installed, the philanthropic organization surveyed for nine months and found an average of 90 infants contracted typhoid per month. Assume that the population standard deviation is 40 and the number of infants that contract typhoid is normally distributed.

a. Specify the null and alternative hypotheses to determine whether the average number of infants that contract typhoid has decreased since the wells were put in place.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, can you conclude that the number of babies falling ill due to typhoid has decreased? Explain.

98. Billy wants to test whether the average speed of his favorite pitcher's fastball differs from the league average of 92 miles per hour. He takes a sample of 36 of the pitcher's fastballs and computes a sample mean of 94 miles per hour. Assume that the standard deviation of the population is 4 miles per hour.

a. Specify the null and alternative hypotheses to test Billy's claim.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, can you conclude that Billy's favorite pitcher's fastball differs in speed from the league average?
d. At the 1% significance level, can you conclude that Billy's favorite pitcher's fastball differs in speed from the league average?

99. An engineer wants to know if the average amount of energy used in his factory per day has changed since 2005. The factory used an average of 2000 megawatt hours (mwh) per day prior to 2005. Since 2005, the engineer surveyed 400 days and found the average energy use was 2040 mwh per day. Assume that the population standard deviation is 425 mwh per day.

a. Specify the null and alternative hypotheses to determine whether the factory's energy use has changed.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, can you conclude that the energy usage has changed? Explain.

100. A university wants to know if the average salary of its graduates has increased since 2010. The average salary of graduates prior to 2010 was $48,000. Since 2010, the university surveyed 256 graduates and found an average salary of $48,750. Assume that the standard deviation of all graduates' salaries is $7,000.

a. Specify the null and alternative hypotheses to determine whether the average salary of graduates has increased.
b. Calculate the value of the test statistic and the critical value at a 5% significance level.
c. At the 5% significance level, can you conclude that salaries have increased? Explain.

101. Students who graduated from college in 2010 with student loans owed an average of $25,250 (The New York Times, November 2, 2011). An economist wants to determine if the average debt has increased since 2010. She takes a sample of 40 recent graduates and finds that their average debt was $28,275. Assume that the population standard deviation is $7,250.

a. Specify the competing hypotheses to determine whether the average undergraduate debt has increased since 2001.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, can you conclude that the average undergraduate debt has increased? Explain.

102. A professional baseball player changed his throwing motion to increase the velocity of his fastball. Before the change, the player threw his fastball at an average of 91 miles per hour. After the change in his throwing motion, the team watched him throw 64 fastballs with an average speed of 91.75 miles per hour and a standard deviation of 3 miles per hour.

a. Specify the null and alternative hypotheses to determine whether the baseball player increased the speed of his fastball.
b. Calculate the value of the test statistic and approximate the p-value.
c. At the 1% significance level, can you conclude that the baseball player has increased the speed of his fastball? Explain.

103. A company that manufactures helmets wants to test their helmets to make sure they pass SNELL certification. One of the tests the helmets are required to undergo is a test that simulates real-world impacts. During the test, crash dummies must, on average, experience a force of nearly 300 g in order to pass. The company tests 36 helmets and finds the dummy experienced an average of 298 g with a standard deviation of 8 g.

a. Specify the null and alternative hypotheses to determine whether the company's helmets experience, on average, less than 300 g during the SNELL test.
b. Calculate the value of the test statistic, and find the critical value at a 10% significance level.
c. At the 10% significance level, can you conclude that the company's helmets experience less than 300 g during the SNELL test? Explain.

104. A city is considering widening a busy intersection in town. Last year, the city reported 16,000 cars passed through the intersection per day. The city conducted a survey for 49 days this year and found an average of 17,000 cars passed through the intersection, with a standard deviation of 5000.

a. Specify the null and alternative hypotheses to determine whether the intersection has seen an increase in traffic.
b. Calculate the value of the test statistic and approximate the p-value.
c. The city is going to widen the intersection if it believes traffic has increased. At the 5% significance level, can you conclude that the intersection has seen an increase in traffic? Should the city widen the intersection?

105. A hairdresser believes that she is more profitable on Tuesdays, her lucky day of the week. She knows that, on average, she has a daily revenue of $250. She randomly samples the revenue from eight Tuesdays and finds she takes in $260, $245, $270, $260, $295, $235, $270, and $265. Assume that daily revenue is normally distributed.

a. Specify the population parameter to be tested.
b. Specify the null and alternative hypotheses to test the hairdresser's claim.
c. Calculate the sample mean revenue and the sample standard deviation.
d. Compute the value of the appropriate test statistic.
e. At the 10% significance level, specify the critical value(s).
f. At the 10% significance level, is the hairdresser's claim supported by the data?

106. A portfolio manager claims that the mean annual return on one of the mutual funds he manages exceeds 8%. In order to substantiate his claim, he states that over the past 10 years, the mean annual return for the mutual fund has been 9.5% with a sample standard deviation of 1.5%. Assume annual returns are normally distributed.

a. Specify the competing hypotheses to test the portfolio manager's claim.
b. Calculate the value of the test statistic.
c. At the 5% significance level, use the critical value approach to state the decision rule.
d. Is the portfolio manager's claim substantiated by the data? Explain.

107. According to a 2009 Lawyers.com survey, only 35% of adult Americans had a will (The Wall Street Journal, December 12, 2011). Suppose a recent survey of 250 adult Americans found 100 adults with wills.

a. Specify the competing hypotheses to determine whether the proportion of adult Americans that have a will differs from the proportion reported for 2009.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, is the proportion different? Explain.

108. A real estate investor thinks the real estate market has bottomed out. One of the variables he examined to arrive at this conclusion was the proportion of houses sold at or above the asking price. In 2010, the proportion of houses sold at or above the asking price was 14%. The real estate investor takes a random sample of 40 recently sold houses and finds that 9 of them are selling at or above the asking price.

a. Specify the population parameter to be tested.
b. Specify the null and alternative hypotheses to determine whether the proportion of houses sold at or above the asking price has increased.
c. Calculate the value of the test statistic and the p-value.
d. At the 10% significance level, can you conclude that the proportion of houses sold at or above the asking price has increased?

109. A doctor thinks he has found a miraculous cure for rheumatoid arthritis. He thinks it will cure more than 50% of all cases within a year of first taking the drug. To test his drug, he runs a clinical trial on 400 patients with rheumatoid arthritis. He finds that 208 of the patients are symptom-free within a year.

a. Specify the null and alternative hypotheses to determine whether the proportion of patients that are cured by the drug exceeds 50%.
b. Calculate the value of the test statistic, and find the critical value at a 5% significance level.
c. At the 5% significance level, can you conclude that the percentage of patients who are cured by the drug exceeds 50%?

110. The percentage of complete passes is an important measure for a quarterback in the NFL. A particular quarterback has a career completion percentage of 55%. The quarterback got a new coach and then played a few games where he completed 48 of 100 passes.

a. Specify the null and alternative hypotheses to determine whether the proportion of completed passes has decreased with the new coach.
b. Calculate the value of the test statistic and the p-value.
c. At the 5% significance level, can you conclude that the quarterback's completion percentage has decreased?

111. A Massachusetts state police officer measured the speed of 100 motorists on the Massachusetts Turnpike and found that 70 exceeded the posted speed limit by more than 10 miles per hour. The police officer claims that more than 60% of motorists drive at least 10 miles per hour more than the posted speed on the Turnpike.

a. Specify the null and alternative hypotheses to test the officer's claim.
b. Calculate the value of the test statistic.
c. At the 5% significance level, what is (are) the critical value(s) to test the officer's claim?
d. At the 5% significance level, does the evidence support the officer's claim?

ch09 Key

1. TRUE

2. FALSE

3. FALSE

4. TRUE

5. TRUE

6. TRUE

7. FALSE

8. TRUE

9. TRUE

10. TRUE

11. FALSE

12. B

13. D

14. B

15. D

16. A

17. A

18. A

19. A

20. B

21. D

22. A

23. A

24. A

25. D

26. A

27. A

28. A

29. B

30. B

31. C

32. A

33. D

34. A

35. A

36. A

37. B
38. C
39. D
40. A
41. D
42. C
43. D
44. B
45. A
46. B
47. A
48. B
49. D
50. A
51. D
52. B
53. A
54. C
55. A
56. D
57. C
58. C
59. C
60. B
61. D
62. C
63. B
64. B
65. A
66. A
67. D
68. A
69. D
70. A
71. A
72. D
73. B
74. A

75. A

76. C

77. D

78. C

79. C

80. C

81. A

82. D

83. A

84. A

85. C

86. B

87. B

88. A

89. C

90. B

91. A

92. A

93. a. $H_0: \mu = 2.50$ and $H_A: \mu \neq 2.50$ b. $H_0: \mu \geq 2.50$ and $H_A: \mu < 2.50$

Feedback: The competing hypotheses represent a right-tailed test concerning the population proportion.
94. $H_0: p \leq 0.15; H_A: p > 0.15$

b. The engineer should design a test with a higher alpha and a smaller beta. This will reduce dangerous Type II errors explained earlier.
Feedback: a. A Type I error means the null hypothesis is true and the probability of faulty engines is less than 0.0001%, but the engineer decided to reject the null hypothesis. This means the engineer is more likely to ground planes that are safe to fly. A Type II error means the null hypothesis is false and the probability of faulty engines is greater than 0.0001% but the engineer fails to reject the null hypothesis. This means the engineer is more likely to let planes fly that are actually unsafe. This is very dangerous and should be avoided.
95. Type I error-ground planes that are safe; Type II error-fly planes that are unsafe.

Feedback: A Type I error occurs when we erroneously reject the null hypothesis.
96. Type I, the U.S. appeared to have erroneously rejected the null hypothesis.

Feedback: The competing hypotheses are $H_0: \mu \geq 120$ and $H_A: \mu < 120$. Given $\bar{x} = 90$, $\sigma = 40$, and $n = 9$, the value of the test statistic is $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{90 - 120}{40 / \sqrt{9}} = -2.250$. For a left-tailed test, the p-value is computed as P(Z ≤ -2.250) = 0.0122. With $\alpha = 0.05$, we reject H_0 since 0.0122 < 0.05. At the 5% significance level, we can conclude the number of babies falling ill because of typhoid has decreased.
97. a. $H_0: \mu \geq 120$ and $H_A: \mu < 120$; b. $z = -2.250$, p-value = 0.0122, c. Yes, reject H_0, since 0.0122 < 0.05.

d. Since the p-value = 0.0026 is less than $\alpha = 0.01$, we reject the null hypothesis and the claim is supported.
c. Since the p-value = 0.0026 is less than $\alpha = 0.05$, we reject the null hypothesis and the claim is supported.

b. The value of the test statistic is $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{94 - 92}{4 / \sqrt{36}} = 3.00$, and the p-value is 2P(Z ≥ 3.00) = 0.0026.

Feedback: a. The competing hypotheses are $H_0 : \mu = 92$; $H_A : \mu \neq 92$.

98. a. $H_0 : \mu = 92$; $H_A : \mu \neq 92$; b. z = 3.00, p-value = 0.0026; c. Yes; d. Yes

Feedback: The competing hypotheses are $H_0 : \mu = 2000; H_A : \mu \neq 2000$. Given $\bar{x} = 2040$, $\sigma = 425$, and $n = 400$, the value of the test statistic is $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{2040 - 2000}{425 / \sqrt{400}} = 1.882$. For a two-tailed test, the p-value is computed as 2P(Z ≥ 1.882) = 0.0622. With $\alpha = 0.05$, we fail to reject H_0 since 0.0602 > 0.05. At the 5% significance level, we cannot conclude the electricity usage has changed.

99. a. $H_0 : \mu = 2000; H_A : \mu \neq 2000$; b. $z = 1.882$, p-value = 0.0602; c. No, fail to reject H_0, since 0.0602 > 0.05.

Feedback: The competing hypotheses are $H_0 : \mu \leq 48,000; H_A : \mu > 48,000$. Given $\bar{x} = 48,750$, $\sigma = 7000$, and $n = 256$, the value of the test statistic is $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{48,750 - 48,000}{7000 / \sqrt{256}} = 1.714$. For a right-tailed test, the critical value is $z_\alpha = z_{0.05} = 1.645$. With $\alpha = 0.05$, we reject H_0 since 1.714 > 1.645. At the 5% significance level, average salaries have increased.

100. a. $H_0 : \mu \leq 48,000; H_A : \mu > 48,000$; b. $z = 1.714$, Critical Value = 1.645, c. Yes, reject H_0, since 1.714 > 1.645.

Feedback: The competing hypotheses are $H_0 : \mu \leq 25,250$ and $H_A : \mu > 25,250$. Given $\bar{x} = 28,275$, $\sigma = 7,250$, $n = 40$ and, the value of the test statistic is $z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} = \frac{28,275 - 25,250}{7,250 / \sqrt{40}} = 2.64$. For a right-tailed test, the p-value is computed as P(Z ≥ 2.64) = 0.0041. With $\alpha = 0.05$, we reject H_0 since 0.0041 < 0.05. At the 5% significance level, average undergraduate debt has increased.

101. a. $H_0 : \mu \leq 25,250$ and $H_A : \mu > 25,250$; b. $z = 2.64$, p-value = 0.0041; c. Yes, reject H_0, since 0.0041 < 0.05.

Feedback: The competing hypotheses are $H_0 : \mu \leq 91; H_A : \mu > 91$. Since the population standard deviation is not known, we use the t_{df} distribution with $df = n - 1 = 63$. Given $\bar{x} = 91.75$, $s = 3$, and $n = 64$, the value of the test statistic is $t_{63} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} = \frac{91.75 - 91}{3 / \sqrt{64}} = 2.00$. For a right-tailed test, the p-value is approximated using the t table with 60 degrees of freedom as $P(T_{63} \geq 2) \approx 0.025$. With $\alpha = 0.01$, we fail to reject H_0 since 0.025 > 0.01. At the 1% significance level, we cannot conclude the speed of the player's fastball has increased.

102. a. $H_0 : \mu \leq 91; H_A : \mu > 91$; b. $t_{63} = 2.00$, p-value ≈ 0.025; c. No, fail to reject H_0, since 0.0249 > 0.01.

Feedback: The competing hypotheses are $H_0: \mu \geq 300 \text{ and } H_A: \mu < 300$. Since the population standard deviation is not known, we use the t_{df} distribution with $df = n-1 = 35$. Given $\bar{x} = 298$, $s = 8$, and $n = 36$, the value of the test statistic is $t_{35} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{298-300}{8/\sqrt{36}} = -1.50$. For a left-tailed test, the critical value is $-t_{0.10,35} = -1.306$. With $\alpha = 0.10$, we reject H_0 since -1.5 < -1.306. At the 10% significance level, we can conclude the company's helmets, on average, experience less than 300 g during the SNELL test.

103. a. $H_0: \mu \geq 300 \text{ and } H_A: \mu < 300$; b. $t_{35} = -1.50$, critical value = -1.306; c. Yes, reject H_0, since -1.50 < -1.3060.

Feedback: The competing hypotheses are $H_0: \mu \leq 16{,}000; H_A: \mu > 16{,}000$. Since the population standard deviation is not known, we use the t_{df} distribution with $df = n-1 = 48$. Given $\bar{x} = 17{,}000$, $s = 5000$, and $n = 49$, the value of the test statistic is $t_{48} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{17{,}000 - 16{,}000}{5{,}000/\sqrt{49}} = 1.40$. For a one-tailed test, the p-value is approximated using the t table as $0.05 < p\text{-value} < 0.10$. With $\alpha = 0.05$, we fail to reject H_0 since the p-value > 0.05. At the 5% significance level, we cannot conclude the intersection has seen an increase in traffic.

104. a. $H_0: \mu \leq 16{,}000; H_A: \mu > 16{,}000$; b. $t_{48} = 1.40$, $0.05 < p\text{-value} < 0.10$; c. No, fail to reject H_0, since 0.084 > 0.05.

f. Since the value of the test statistic is greater than the critical value, we reject the null hypothesis and the claim is supported.

e. The appropriate critical value for the right-tailed test is $t_{0.10,7} = 1.415$.

d. The value of the test statistic is $t_7 = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{262.5 - 250}{17.9284/\sqrt{8}} = 1.972$.

c. The sample mean is $\bar{x} = \frac{2100}{8} = 262.5$ The sample standard deviation is $s = \sqrt{\frac{2250}{7}} = 17.9284$.

Feedback: a. See above; b. The competing hypotheses are $H_0: \mu \leq 250; H_A: \mu > 250$.

105. a. The mean revenue on Tuesdays; b. $H_0: \mu \leq 250; H_A: \mu > 250$; c. $\bar{x} = 262.5; s = 17.9284$; d. $t_7 = 1.972$; e. 1.415; f. Yes

Feedback: The competing hypotheses are $H_0: \mu \leq 8$ and $H_A: \mu > 8$. Given $\bar{x} = 9.5$, $s = 1.5$, and $n = 10$, the value of the test statistic is $t_{df} = t_9 = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{9.5 - 8}{1.5/\sqrt{10}} = 3.16$. Referencing the t table with $\alpha = 0.05$ and $df = 10 - 1 = 9$, the critical value for a right-tailed test is $t_{0.05,9} = 1.833$. We reject H_0 if $t_{df} = t_9$ is greater than 1.833. Since $t_9 = 3.16 > 1.833 = t_{0.05,9}$, we reject H_0; the portfolio manager's claim is substantiated by the data.

106. a. $H_0: \mu \leq 8$ and $H_A: \mu > 8$; b. $t_9 = 3.16$; c. Reject H_0 if $t_9 > 1.833$; d. Reject H_0, yes.

Feedback: The competing hypotheses are $H_0: p = 0.35$ and $H_A: p \neq 0.35$ We first calculate $\bar{p} = 100/250 = 0.40$; then, the value of the test statistic is $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.40 - 0.35}{\sqrt{0.35(1-0.35)/250}} = 1.66$. The p-value is 2P(Z ≥ 1.66) = 0.097. Since the p-value = 0.097 > 0.05, we do not reject H_0; the proportion of adult Americans that have a will does not significantly differ from 0.35.

107. a. $H_0: p = 0.35$ and $H_A: p \neq 0.35$; b. $z = 1.66$, p-value = 0.097; c. Reject H_0 p-value < α if; d. Do not reject H_0, no.

Feedback: a. See above. b. The competing hypotheses are $H_0: p \leq 0.14; H_A: p > 0.14$. c. We first calculate $\bar{p} = 9/40 = 0.225$; then the value of the test statistic is $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.225 - 0.14}{\sqrt{0.14(1-0.14)/40}} = 1.549$. The p-value is P(Z ≥ 1.549) = 0.0607. Since the p-value = 0.0607 < 0.10, we reject H_0; we can conclude that the proportion of houses sold at or above the asking price has increased.

108. a. The current proportion of houses sold at or above the asking price; b. $H_0: p \leq 0.14; H_A: p > 0.14$; c. $z = 1.549$, p-value = 0.0607; d. Yes, reject H_0, since 0.0607 < 0.10.

Feedback: The competing hypotheses are $H_0: p \leq 0.50; H_A: p > 0.50$. We first calculate $\bar{p} = 208/400 = 0.52$; then the value of the test statistic is $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.52 - 0.50}{\sqrt{0.50(1-0.50)/400}} = 0.80$. The critical value is $z_\alpha = z_{0.05} = 1.645$. Since 0.80 < 1.645, we do not reject H_0; we cannot conclude that the percentage of patients cured by the drug exceeds 50%.

109. a. $H_0: p \leq 0.50; H_A: p > 0.50$; b. $z = 0.80$, $z_{0.05} = 1.645$; c. No, do not reject H_0, since 0.80 < 1.645.

Feedback: The competing hypotheses are $H_0: p \geq 0.55; H_A: p < 0.55$. We first calculate $\bar{p} = 48/100 = 0.48$; then the value of the test statistic is $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.48 - 0.55}{\sqrt{0.55(1-0.55)/100}} = -1.407$. The p-value is P(Z ≤ -1.407) = 0.0797. Since 0.0797 > 0.05, we fail to reject H_0; we cannot conclude that the quarterback's completion percentage has decreased.

110. a. $H_0: p \geq 0.55; H_A: p < 0.55$; b. $z = -1.407$, p-value = 0.0797; c. No, fail to reject H_0, since 0.0797 > 0.05.

d. Since the value of the test statistic is greater than the critical value, we reject the null hypothesis and the claim is supported.

c. The critical value for this right-tailed test with $\alpha = 0.05$ is $z_{0.05} = 1.645$.

b. The value of the test statistic is $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.70 - 0.60}{\sqrt{0.60(1-0.60)/100}} = 2.04$.

Feedback: a. The competing hypotheses are $H_0: p \leq 0.60; H_A: p > 0.60$.

111. a. $H_0: p \leq 0.60$; $H_A: p > 0.60$; b. z = 2.041; c. 1.645; d. No

ch09 Summary

Category	# of Questions
AACSB: Analytic	111
Blooms: Analyze	13
Blooms: Apply	39
Blooms: Remember	13
Blooms: Understand	46
Difficulty: 1 Easy	26
Difficulty: 2 Medium	76
Difficulty: 3 Hard	9
Jaggia - Chapter 09	111
Learning Objective: 09-01 Define the null hypothesis and the alternative hypothesis.	31
Learning Objective: 09-02 Distinguish between Type I and Type II errors.	17
Learning Objective: 09-03 Explain the steps of a hypothesis test using the p-value approach.	23
Learning Objective: 09-04 Explain the steps of a hypothesis test using the critical value approach.	14
Learning Objective: 09-05 Differentiate between the test statistics for the population mean.	13
Learning Objective: 09-06 Specify the test statistic for the population proportion.	13
Topic: Define the Null Hypothesis and the Alternative Hypothesis	2
Topic: Distinguish between Type I and Type II Errors	2
Topic: Hypothesis Test of the Population Mean When σ Is Known	24
Topic: Hypothesis Test of the Population Mean When σ Is Known and Hypothesis Test of the Population Mean When σ Is Unknown	3
Topic: Hypothesis Test of the Population Mean When σ Is Known, Hypothesis Test of the Population Mean When σ Is Unknown, Hypothesis Test of the Population Proportion	5
Topic: Hypothesis Test of the Population Mean When σ Is Unknown	17
Topic: Hypothesis Test of the Population Proportion	19
Topic: Introduction to Hypothesis Testing	39