MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) Which statement best describes a parameter?
   A) A parameter is an unbiased estimate of a statistic found by experimentation or polling.
   B) A parameter is a numerical measure of a population that is almost always unknown and must
      be estimated.
   C) A parameter is a level of confidence associated with an interval about a sample mean or
      proportion.
   D) A parameter is a sample size that guarantees the error in estimation is within acceptable
      limits.

2) A study was conducted to determine what proportion of all college students considered themselves
   as full-time students. A random sample of 300 college students was selected and 210 of the
   students responded that they considered themselves full-time students. Which of the following
   would represent the target parameter of interest?
   A) p
   B) \( \mu \)

3) What is \( z_{\alpha/2} \) when \( \alpha = 0.02 \)?
   A) 2.575
   B) 2.33
   C) 1.645
   D) 1.96

4) A 90% confidence interval for the mean percentage of airline reservations being canceled on the
   day of the flight is (1.1%, 3.2%). What is the point estimator of the mean percentage of reservations
   that are canceled on the day of the flight?
   A) 1.60%
   B) 2.1%
   C) 1.05%
   D) 2.15%

5) Parking at a large university can be extremely difficult at times. One particular university is trying
   to determine the location of a new parking garage. As part of their research, officials are interested
   in estimating the average parking time of students from within the various colleges on campus. A
   survey of 338 College of Business (COBA) students yields the following descriptive information
   regarding the length of time (in minutes) it took them to find a parking spot. Note that the "Lo 95%"
   and "Up 95%" refer to the endpoints of the desired confidence interval.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Lo 95% CI</th>
<th>Mean</th>
<th>Up 95% CI</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Time</td>
<td>338</td>
<td>9.1944</td>
<td>10.466</td>
<td>11.738</td>
<td>11.885</td>
</tr>
</tbody>
</table>

   University officials have determined that the confidence interval would be more useful if the
   interval were narrower. Which of the following changes in the confidence level would result in a
   narrower interval?
   A) The university could increase their confidence level.
   B) The university could decrease their confidence level.
6) A retired statistician was interested in determining the average cost of a $200,000.00 term life insurance policy for a 60-year-old male non-smoker. He randomly sampled 65 subjects (60-year-old male non-smokers) and constructed the following 95 percent confidence interval for the mean cost of the term life insurance: ($850.00, $1050.00). What value of alpha was used to create this confidence interval?

A) 0.05  B) 0.01  C) 0.10  D) 0.025

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) Suppose (1,000, 2,100) is a 95% confidence interval for μ. To make more useful inferences from the data, it is desired to reduce the width of the confidence interval. Explain why an increase in sample size will lead to a narrower interval of the estimate of μ.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) Determine the confidence level for the given confidence interval for μ.

\[ \bar{x} \pm 1.88 \left( \frac{s}{\sqrt{n}} \right) \]

A) 97%  B) 98.5%  C) 94%  D) 3%

9) A random sample of 250 students at a university finds that these students take a mean of 14.3 credit hours per quarter with a standard deviation of 1.7 credit hours. The 95% confidence interval for the mean is 14.3 ±0.211. Interpret the interval.

A) 95% of the students take between 14.089 to 14.511 credit hours per quarter.
B) We are 95% confident that the average number of credit hours per quarter of students at the university falls in the interval 14.089 to 14.511 hours.
C) The probability that a student takes 14.089 to 14.511 credit hours in a quarter is 0.95.
D) We are 95% confident that the average number of credit hours per quarter of the sampled students falls in the interval 14.089 to 14.511 hours.

10) A random sample of 250 students at a university finds that these students take a mean of 15.8 credit hours per quarter with a standard deviation of 1.7 credit hours. The 95% confidence interval for the mean is 15.8 ±0.211. Interpret the interval.

A) We are 95% confident that the average number of credit hours per quarter of the sampled students falls in the interval 15.589 to 16.011 hours.
B) The probability that a student takes 15.589 to 16.011 credit hours in a quarter is 0.95.
C) 95% of the students take between 15.589 to 16.011 credit hours per quarter.
D) We are 95% confident that the average number of credit hours per quarter of students at the university falls in the interval 15.589 to 16.011 hours.

11) Suppose a large labor union wishes to estimate the mean number of hours per month a union member is absent from work. The union decides to sample 348 of its members at random and monitor the working time of each of them for 1 month. At the end of the month, the total number of hours absent from work is recorded for each employee. If the mean and standard deviation of the sample are \( \bar{x} = 7.5 \) hours and \( s = 3.5 \) hours, find a 99% confidence interval for the true mean number of hours a union member is absent per month. Round to the nearest thousandth.

A) 7.5 ± 0.026  B) 7.5 ± 0.483  C) 7.5 ± 0.186  D) 7.5 ± 0.258
12) Parking at a large university can be extremely difficult at times. One particular university is trying to determine the location of a new parking garage. As part of their research, officials are interested in estimating the average parking time of students from within the various colleges on campus. A survey of 338 College of Business (COBA) students yields the following descriptive information regarding the length of time (in minutes) it took them to find a parking spot. Note that the "Lo 95%" and "Up 95%" refer to the endpoints of the desired confidence interval.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Lo 95% CI</th>
<th>Mean</th>
<th>Up 95% CI</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Time</td>
<td>338</td>
<td>9.1944</td>
<td>10.466</td>
<td>11.738</td>
<td>11.885</td>
</tr>
</tbody>
</table>

Explain what the phrase "95% confident" means when working with a 95% confidence interval.
A) 95% of the observations in the population will fall within the endpoints of the interval.
B) In repeated sampling, 95% of the sample means will fall within the interval created.
C) In repeated sampling, 95% of the population means will fall within the interval created.
D) In repeated sampling, 95% of the intervals created will contain the population mean.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) How much money does the average professional football fan spend on food at a single football game? That question was posed to 43 randomly selected football fans. The sample results provided a sample mean and standard deviation of $16.00 and $2.85, respectively. Use this information to create a 95 percent confidence interval for the population mean.

\[
\text{Sample Mean} = 16.00, \quad \text{Sample Standard Deviation} = 2.85
\]

Find and interpret a 99% confidence interval for \( \mu \).

14) Find the value of \( t_0 \) such that the following statement is true: \( P(-t_0 \leq t \leq t_0) = .99 \) where \( df = 9 \).

A) 2.2821 \quad B) 2.262 \quad C) 1.833 \quad D) 3.250

15) Let \( t_0 \) be a particular value of \( t \). Find a value of \( t_0 \) such that \( P(t \leq t_0 \text{ or } t \geq t_0) = .1 \) where \( df = 14 \).

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) Private colleges and universities rely on money contributed by individuals and corporations for their operating expenses. Much of this money is invested in a fund called an endowment, and the college spends only the interest earned by the fund. A recent survey of eight private colleges in the United States revealed the following endowments (in millions of dollars): 77.8, 45.1, 243.4, 489.5, 113.9, 187.6, 102.4, and 210.2. What value will be used as the point estimate for the mean endowment of all private colleges in the United States?

A) 183.738 \quad B) 209.986 \quad C) 1469.9 \quad D) 8

17) How much money does the average professional football fan spend on food at a single football game? That question was posed to ten randomly selected football fans. The sampled results show that the sample mean and sample standard deviation were $70.00 and $17.50, respectively. Use this information to create a 95 percent confidence interval for the population mean.

\[
\text{Sample Mean} = 70.00, \quad \text{Sample Standard Deviation} = 17.50, \quad \text{Sample Size} = 10
\]

A) 70 ±1.960 \left( \frac{17.50}{\sqrt{60}} \right) \quad B) 70 ±1.833 \left( \frac{17.50}{\sqrt{60}} \right)

C) 70 ±2.228 \left( \frac{17.50}{\sqrt{60}} \right) \quad D) 70 ±2.262 \left( \frac{17.50}{\sqrt{60}} \right)
18) How much money does the average professional football fan spend on food at a single football game? That question was posed to 10 randomly selected football fans. The sample results provided a sample mean and standard deviation of $14.00 and $2.50, respectively. Use this information to construct a 90% confidence interval for the mean.

A) $14 \pm 1.796(2.50\sqrt{10})$
B) $14 \pm 1.383(2.50\sqrt{10})$
C) $14 \pm 1.812(2.50\sqrt{10})$
D) $14 \pm 1.833(2.50\sqrt{10})$

19) You are interested in purchasing a new car. One of the many points you wish to consider is the resale value of the car after 5 years. Since you are particularly interested in a certain foreign sedan, you decide to estimate the resale value of this car with a 90% confidence interval. You manage to obtain data on 17 recently resold 5-year-old foreign sedans of the same model. These 17 cars were resold at an average price of $12,630 with a standard deviation of $800. Suppose that the interval is calculated to be ($12,291.23, $12,968.77). How could we alter the sample size and the confidence coefficient in order to guarantee a decrease in the width of the interval?

A) Increase the sample size and increase the confidence coefficient.
B) Keep the sample size the same but increase the confidence coefficient.
C) Increase the sample size but decrease the confidence coefficient.
D) Decrease the sample size but increase the confidence coefficient.

20) To help consumers assess the risks they are taking, the Food and Drug Administration (FDA) publishes the amount of nicotine found in all commercial brands of cigarettes. A new cigarette has recently been marketed. The FDA tests on this cigarette yielded mean nicotine content of 27.3 milligrams and standard deviation of 2.1 milligrams for a sample of $n = 9$ cigarettes. Construct a 95% confidence interval for the mean nicotine content of this brand of cigarette.

A) 27.3 ± 1.712
B) 27.3 ± 1.679
C) 27.3 ± 1.614
D) 27.3 ± 1.583

21) An educator wanted to look at the study habits of university students. As part of the research, data was collected for three variables - the amount of time (in hours per week) spent studying, the amount of time (in hours per week) spent playing video games and the GPA - for a sample of 20 male university students. As part of the research, a 95% confidence interval for the average GPA of all male university students was calculated to be: (2.95, 3.10). The researcher claimed that the average GPA of all male students exceeded 2.94. Using the confidence interval supplied above, how do you respond to this claim?

A) We are 100% confident that the researcher is incorrect.
B) We cannot make any statement regarding the average GPA of male university students at the 95% confidence level.
C) We are 95% confident that the researcher is incorrect.
D) We are 95% confident that the researcher is correct.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

22) The following sample of 16 measurements was selected from a population that is approximately normally distributed.

61 85 92 77 83 81 75 78
95 87 69 74 76 84 80 83

Construct a 90% confidence interval for the population mean.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

23) A marketing research company is estimating which of two soft drinks college students prefer. A random sample of 329 college students produced the following 95% confidence interval for the proportion of college students who prefer one of the colas: (0.329, 0.474). What additional assumptions are necessary for the interval to be valid?
   A) The population proportion has an approximately normal distribution.
   B) No additional assumptions are necessary.
   C) The sample proportion equals the population proportion.
   D) The sample was randomly selected from an approximately normal population.

24) A study was conducted to determine what proportion of all college students considered themselves as full-time students. A random sample of 300 college students was selected and 210 of the students responded that they considered themselves full-time students. A computer program was used to generate the following 95% confidence interval for the population proportion: (0.64814, 0.75186). The sample size that was used in this problem is considered a large sample. What criteria should be used to determine if n is large?
   A) If n > 25, then n is considered large.
   B) Both np ≥ 15 and nq ≥ 15.
   C) When working with proportions, any n is considered large.
   D) If n ≥ 30, then n is considered large.

25) What type of car is more popular among college students, American or foreign? One hundred fifty-nine college students were randomly sampled and each was asked which type of car he or she prefers. A computer package was used to generate the printout below for the proportion of college students who prefer American automobiles.

   SAMPLE PROPORTION = .383277
   SAMPLE SIZE = 159

   UPPER LIMIT = .464240
   LOWER LIMIT = .331153

   What proportion of the sampled students prefer foreign automobiles?
   A) .616723    B) .464240    C) .331153    D) .383277

26) A newspaper reported on the topics that teenagers most want to discuss with their parents. The findings, the results of a poll, showed that 46% would like more discussion about the family’s financial situation, 37% would like to talk about school, and 30% would like to talk about religion. These and other percentages were based on a national sampling of 508 teenagers. Estimate the proportion of all teenagers who want more family discussions about school. Use a 99% confidence level.
   A) .37 ± .002    B) .63 ± .002    C) .37 ± .055    D) .63 ± .055
27) A newspaper reported on the topics that teenagers most want to discuss with their parents. The findings, the results of a poll, showed that 46% would like more discussion about the family's financial situation, 37% would like to talk about school, and 30% would like to talk about religion. These and other percentages were based on a national sampling of 549 teenagers. Using 99% reliability, can we say that more than 30% of all teenagers want to discuss school with their parents?
   A) Yes, since the value .30 falls inside the 99% confidence interval.
   B) Yes, since the values inside the 99% confidence interval are greater than .30.
   C) No, since the value .30 is not contained in the 99% confidence interval.
   D) No, since the value .30 is not contained in the 99% confidence interval.

28) A university dean is interested in determining the proportion of students who receive some sort of financial aid. Rather than examine the records for all students, the dean randomly selects 200 students and finds that 118 of them are receiving financial aid. Use a 95% confidence interval to estimate the true proportion of students who receive financial aid.
   A) .59 ± .474  B) .59 ± .068  C) .59 ± .005  D) .59 ± .002

29) A confidence interval was used to estimate the proportion of statistics students who are female. A random sample of 72 statistics students generated the following confidence interval: (.438, .642). Using the information above, what sample size would be necessary if we wanted to estimate the true proportion to within 3% using 99% reliability?
   A) 1842  B) 1831  C) 1916  D) 1769

30) A local men's clothing store is being sold. The buyers are trying to estimate the percentage of items that are outdated. They will choose a random sample from the 100,000 items in the store's inventory in order to determine the proportion of merchandise that is outdated. The current owners have never determined the percentage of outdated merchandise and cannot help the buyers. How large a sample do the buyers need in order to be 95% confident that the margin of error of their estimate is about 5%?
   A) 385  B) 1537  C) 769  D) 196

31) It is desired to estimate the average time it takes Statistics students to finish a computer project to within two hours at 90% reliability. It is estimated that the standard deviation of the times is 14 hours. How large a sample should be taken to get the desired interval?
   A) n = 231  B) n = 133  C) n = 189  D) n = 325

32) A local eat- in pizza restaurant wants to investigate the possibility of starting to deliver pizzas. The owner of the store has determined that home delivery will be successful only if the average time spent on a delivery does not exceed 37 minutes. The owner has randomly selected 15 customers and delivered pizzas to their homes. What hypotheses should the owner test to demonstrate that the pizza delivery will not be successful?
   A) H₀: μ = 37 vs. Hₐ: μ < 37
   B) H₀: μ = 37 vs. Hₐ: μ ≠ 37
   C) H₀: μ < 37 vs. Hₐ: μ = 37
   D) H₀: μ = 37 vs. Hₐ: μ > 37
33) A consumer product magazine recently ran a story concerning the increasing prices of digital cameras. The story stated that digital camera prices dipped a couple of years ago, but are now beginning to increase in price because of added features. According to the story, the average price of all digital cameras a couple of years ago was $215.00. A random sample of cameras was recently taken and entered into a spreadsheet. It was desired to test to determine if that average price of all digital cameras is now more than $215.00. What null and alternative hypothesis should be tested?

A) $H_0: \mu \geq 215$ vs. $H_A: \mu < 215$
B) $H_0: \mu = 215$ vs. $H_A: \mu \neq 215$
C) $H_0: \mu = 215$ vs. $H_A: \mu > 215$
D) $H_0: \mu = 215$ vs. $H_A: \mu < 215$

Answer the question True or False.

34) The alternative hypothesis is accepted as true unless there is overwhelming evidence that it is false.

A) True
B) False

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

35) According to an advertisement, a strain of soybeans planted on soil prepared with a specified fertilizer treatment has a mean yield of 556 bushels per acre. Twenty-five farmers who belong to a cooperative plant the soybeans in soil prepared as specified. Each uses a 40-acre plot and records the mean yield per acre. The mean and variance for the sample of 25 farms are $\bar{x} = 517$ and $s^2 = 9580$. Specify the null and alternative hypotheses used to determine if the mean yield for the soybeans is different than advertised.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

36) An insurance company sets up a statistical test with a null hypothesis that the average time for processing a claim is 7 days, and an alternative hypothesis that the average time for processing a claim is greater than 7 days. After completing the statistical test, it is concluded that the average time exceeds 7 days. However, it is eventually learned that the mean process time is really 7 days. What type of error occurred in the statistical test?

A) Type I error
B) No error occurred in the statistical sense.
C) Type II error
D) Type III error

37) Suppose we wish to test $H_0: \mu = 40$ vs. $H_A: \mu > 40$. What will result if we conclude that the mean is greater than 40 when its true value is really 47?

A) a Type II error
B) a Type I error
C) a correct decision
D) none of the above

38) A significance level for a hypothesis test is given as $\alpha = 0.01$. Interpret this value.

A) The probability of making a Type II error is 0.99.
B) The probability of making a Type I error is 0.01.
C) There is a 1% chance that the sample will be biased.
D) The smallest value of $\alpha$ that you can use and still reject $H_0$ is 0.01.

39) We never conclude "Accept $H_0$" in a test of hypothesis. This is because:

A) $\alpha = \beta$ (Type I error) is not known.
B) $\beta = \alpha$ (Type II error) is not known.
C) We want $H_0$ to be false.
D) $H_0$ is never true.
Find the rejection region for the specified hypothesis test.

40) Consider a test of \( H_0: \mu = 6 \). For the following case, give the rejection region for the test in terms of the \( z \)-statistic: \( H_a: \mu \neq 6, \alpha = 0.10 \).

A) \( z > 1.28 \)  
B) \( |z| > 1.28 \)  
C) \( z > 1.645 \)  
D) \( |z| > 1.645 \)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

For the given rejection region, sketch the sampling distribution for \( z \) and indicate the location of the rejection region.

41) \( z > 2.575 \)

42) \( z < -1.28 \)

43) \( z < -2.33 \) or \( z > 2.33 \)

44) \( z < -1.96 \) or \( z > 1.96 \)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For the given value of \( \alpha \) and observed significance level (p-value), indicate whether the null hypothesis would be rejected.

45) \( \alpha = 0.1, p\text{-value} = 0.04 \)
   A) Reject \( H_0 \)  
   B) Fail to reject \( H_0 \)  

46) \( \alpha = 0.01, p\text{-value} = 0.05 \)
   A) Reject \( H_0 \)  
   B) Fail to reject \( H_0 \)  

Solve the problem.

47) Given \( H_0: \mu = 25, H_a: \mu \neq 25 \), and \( p = 0.029 \). Do you reject or fail to reject \( H_0 \) at the .01 level of significance?
   A) fail to reject \( H_0 \)  
   B) reject \( H_0 \)  
   C) not sufficient information to decide
48) A consumer product magazine recently ran a story concerning the increasing prices of digital cameras. The story stated that digital camera prices dipped a couple of years ago, but now are beginning to increase in price because of added features. According to the story, the average price of all digital cameras a couple of years ago was $215.00. A random sample of cameras was recently taken and entered into a spreadsheet. It was desired to test to determine if that average price of all digital cameras is now more than $215.00. The information was entered into a spreadsheet and the following printout was obtained:

One-Sample T Test

Null Hypothesis: \( \mu = 215 \)
Alternative Hyp: \( \mu > 215 \)

95% Conf Interval

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SE</th>
<th>Lower</th>
<th>Upper</th>
<th>T</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera Price</td>
<td>245.23</td>
<td>15.620</td>
<td>212.740</td>
<td>277.720</td>
<td>1.94</td>
<td>21</td>
<td>0.0333</td>
</tr>
</tbody>
</table>

Cases Included 22

Use the \( p \)-value given above to determine which of the following conclusions is correct.

A) At \( \alpha = 0.10 \), there is insufficient evidence to indicate that the mean price of all digital cameras exceeds $215.00
B) At \( \alpha = 0.01 \), there is sufficient evidence to indicate that the mean price of all digital cameras exceeds $215.00
C) At \( \alpha = 0.03 \), there is insufficient evidence to indicate that the mean price of all digital cameras exceeds $215.00
D) At \( \alpha = 0.05 \), there is insufficient evidence to indicate that the mean price of all digital cameras exceeds $215.00

49) A national organization has been working with utilities throughout the nation to find sites for large wind machines that generate electricity. Wind speeds must average more than 16 miles per hour (mph) for a site to be acceptable. Recently, the organization conducted wind speed tests at a particular site. To determine whether the site meets the organization’s requirements, consider the test, \( H_0: \mu = 16 \) vs. \( H_3: \mu > 16 \), where \( \mu \) is the true mean wind speed at the site and \( \alpha = .01 \). Suppose the observed significance level (\( p \)-value) of the test is calculated to be \( p = 0.3571 \). Interpret this result.

A) The probability of rejecting the null hypothesis is 0.3571.
B) Since the \( p \)-value greatly exceeds \( \alpha = .01 \), there is strong evidence to reject the null hypothesis.
C) We are 64.29% confident that \( \mu = 16 \).
D) Since the \( p \)-value exceeds \( \alpha = .01 \), there is insufficient evidence to reject the null hypothesis.

50) The smaller the \( p \)-value in a test of hypothesis, the more significant the results are.

A) True  
B) False
Solve the problem.

51) How many tissues should a package of tissues contain? Researchers have determined that a person uses an average of 61 tissues during a cold. Suppose a random sample of 2500 people yielded the following data on the number of tissues used during a cold: \( \bar{x} = 51, s = 25 \). Suppose the corresponding test statistic falls in the rejection region at \( \alpha = .05 \). What is the correct conclusion?

A) At \( \alpha = .10 \), reject \( H_0 \).  
B) At \( \alpha = .10 \), reject \( H_A \).  
C) At \( \alpha = .05 \), reject \( H_0 \).  
D) At \( \alpha = .05 \), accept \( H_0 \).

52) A large university is interested in learning about the average time it takes students to drive to campus. The university sampled 238 students and asked each to provide the amount of time they spent traveling to campus. This variable, travel time, was then used conduct a test of hypothesis. The goal was to determine if the average travel time of all the university’s students differed from 20 minutes. Find the large-sample rejection region for the test of interest to the college when using a level of significance of 0.05.

A) Reject \( H_0 \) if \( z < -1.96 \).  
B) Reject \( H_0 \) if \( z > 1.645 \).  
C) Reject \( H_0 \) if \( z < -1.96 \) or \( z > 1.96 \).  
D) Reject \( H_0 \) if \( z < -1.645 \) or \( z > 1.645 \).

53) A large university is interested in learning about the average time it takes students to drive to campus. The university sampled 238 students and asked each to provide the amount of time they spent traveling to campus. This variable, travel time, was then used conduct a test of hypothesis. The goal was to determine if the average travel time of all the university’s students differed from 20 minutes. Suppose the sample mean and sample standard deviation were calculated to be 23.2 and 20.26 minutes, respectively. Calculate the value of the test statistic to be used in the test.

A) \( z = 2.551 \)  
B) \( z = 37.59 \)  
C) \( z = 2.437 \)  
D) \( z = 0.173 \)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

54) State University uses thousands of fluorescent light bulbs each year. The brand of bulb it currently uses has a mean life of 760 hours. A competitor claims that its bulbs, which cost the same as the brand the university currently uses, have a mean life of more than 760 hours. The university has decided to purchase the new brand if, when tested, the evidence supports the manufacturer’s claim at the .01 significance level. Suppose 92 bulbs were tested with the following results: \( \bar{x} = 778 \) hours, \( s = 91 \). Find the rejection region for the test of interest to the State University.

55) State University uses thousands of fluorescent light bulbs each year. The brand of bulb it currently uses has a mean life of 800 hours. A competitor claims that its bulbs, which cost the same as the brand the university currently uses, have a mean life of more than 800 hours. The university has decided to purchase the new brand if, when tested, the evidence supports the manufacturer’s claim at the .05 significance level. Suppose 121 bulbs were tested with the following results: \( \bar{x} = 830 \) hours, \( s = 110 \). Conduct the test using \( \alpha = .05 \).
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

56) A local eat-in pizza restaurant wants to investigate the possibility of starting to deliver pizzas. The owner of the store has determined that home delivery will be successful only if the average time spent on a delivery does not exceed 36 minutes. The owner has randomly selected 21 customers and delivered pizzas to their homes in order to test whether the mean delivery time actually exceeds 36 minutes. What assumption is necessary for this test to be valid?

A) None. The Central Limit Theorem makes any assumptions unnecessary.
B) The population variance must equal the population mean.
C) The sample mean delivery time must equal the population mean delivery time.
D) The population of delivery times must have a normal distribution.

57) An industrial supplier has shipped a truckload of teflon lubricant cartridges to an aerospace customer. The customer has been assured that the mean weight of these cartridges is in excess of 10 ounces printed on each cartridge. To check this claim, a sample of n = 10 cartridges are randomly selected from the shipment and carefully weighed. Summary statistics for the sample are: \( \bar{x} = 10.11 \) ounces, \( z = .30 \) ounce. To determine whether the supplier’s claim is true, consider the test, \( H_0: \mu = 10 \) vs. \( H_A: \mu > 10 \), where \( \mu \) is the true mean weight of the cartridges. Find the rejection region for the test using \( \alpha = .01 \).

A) \(|z| > 2.58\)  
B) \( t > 2.821 \), where \( t \) depends on 9 df  
C) \( z > 2.33 \)  
D) \( t > 3.25 \), where \( t \) depends on 9 df

58) A bottling company produces bottles that hold 12 ounces of liquid. Periodically, the company gets complaints that their bottles are not holding enough liquid. To test this claim, the bottling company randomly samples 25 bottles and finds the average amount of liquid held by the bottles is 11.8 ounces with a standard deviation of .4 ounce. Which of the following is the set of hypotheses the company wishes to test?

A) \( H_0: \mu = 12 \) vs. \( H_A: \mu > 12 \)  
B) \( H_0: \mu = 12 \) vs. \( H_A: \mu < 12 \)  
C) \( H_0: \mu = 12 \) vs. \( H_A: \mu \neq 12 \)  
D) \( H_0: \mu < 12 \) vs. \( H_A: \mu = 12 \)

59) A consumer product magazine recently ran a story concerning the increasing prices of digital cameras. The story stated that digital camera prices dipped a couple of years ago, but now are beginning to increase in price because of added features. According to the story, the average price of all digital cameras a couple of years ago was $215.00. A random sample of n = 22 cameras was recently taken and entered into a spreadsheet. It was desired to test to determine if that average price of all digital cameras is now more than $215.00. Find a rejection region appropriate for this test if we are using \( \alpha = 0.05 \).

A) Reject \( H_0 \) if \( t > 1.721 \)  
B) Reject \( H_0 \) if \( t > 1.717 \)  
C) Reject \( H_0 \) if \( t > 1.725 \)  
D) Reject \( H_0 \) if \( t > 2.080 \) or \( t < -2.080 \)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

60) A recipe submitted to a magazine by one of its subscribers states that the mean baking time for a cheesecake is 55 minutes. A test kitchen preparing the recipe before it is published in the magazine makes the cheesecake 10 times at different times of the day in different ovens. The following baking times (in minutes) are observed.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>5</td>
</tr>
<tr>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>58</td>
<td>5</td>
</tr>
<tr>
<td>59</td>
<td>5</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>62</td>
<td>1</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
</tr>
</tbody>
</table>

Assume that the baking times belong to a normal population. Test the null hypothesis that the mean baking time is 55 minutes against the alternative hypothesis \( \mu > 55 \). Use \( \alpha = .05 \).
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For the given binomial sample size and null-hypothesized value of \( p_0 \), determine whether the sample size is large enough to use the normal approximation methodology to conduct a test of the null hypothesis \( H_0: p = p_0 \).

61) \( n = 80, p_0 = 0.4 \)
   - A) Yes
   - B) No

62) \( n = 600, p_0 = 0.01 \)
   - A) Yes
   - B) No

63) \( n = 1100, p_0 = 0.99 \)
   - A) Yes
   - B) No

Solve the problem.

64) The business college computing center wants to determine the proportion of business students who have laptop computers. If the proportion exceeds 25%, then the lab will scale back a proposed enlargement of its facilities. Suppose 200 business students were randomly sampled and 65 have laptops. Find the rejection region for the corresponding test using \( \alpha = 0.01 \).
   - A) Reject \( H_0 \) if \( z > 2.33 \).
   - B) Reject \( H_0 \) if \( z > 2.575 \) or \( z < -2.575 \).
   - C) Reject \( H_0 \) if \( z = 2.33 \).
   - D) Reject \( H_0 \) if \( z < -2.33 \).

65) The business college computing center wants to determine the proportion of business students who have laptop computers. If the proportion differs from 25%, then the lab will modify a proposed enlargement of its facilities. Suppose a hypothesis test is conducted and the test statistic is 2.4. Find the \( p \)-value for a two-tailed test of hypothesis.
   - A) .0164
   - B) .4836
   - C) .0082
   - D) .4918

66) A small private college is interested in determining the percentage of its students who live off campus and drive to class. Specifically, it was desired to determine if less than 20% of their current students live off campus and drive to class. Find the large-sample rejection region for the test of interest to the college when using a level of significance of 0.01.
   - A) Reject \( H_0 \) if \( z < -1.96 \).
   - B) Reject \( H_0 \) if \( z < -2.33 \) or \( z > 2.33 \).
   - C) Reject \( H_0 \) if \( z < -2.33 \).
   - D) Reject \( H_0 \) if \( z < -1.28 \).

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

67) A method currently used by doctors to screen women for possible breast cancer fails to detect cancer in 15% of women who actually have the disease. A new method has been developed that researchers hope will be able to detect cancer more accurately. A random sample of 70 women known to have breast cancer were screened using the new method. Of these, the new method failed to detect cancer in 8. Calculate the test statistic used by the researchers for the corresponding test of hypothesis.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

68) Which of the following represents the difference in two population means?
   - A) \( \mu_1 + \mu_2 \)
   - B) \( p_1 + p_2 \)
   - C) \( p_1 - p_2 \)
   - D) \( \mu_1 - \mu_2 \)
69) Which of the following represents the difference in two population proportions?

A) \( \frac{\sigma_1^2}{\sigma_2^2} \)  
B) \( p_1 - p_2 \)  
C) \( \mu_1 - \mu_2 \)  
D) \( p_1 + p_2 \)

70) When blood levels are low at an area hospital, a call goes out to local residents to give blood. The blood center is interested in determining which sex - males or females - is more likely to respond. Random, independent samples of 60 females and 100 males were each asked if they would be willing to give blood when called by a local hospital. A success is defined as a person who responds to the call and donates blood. The goal is to compare the percentage of the successes between the male and female responses. What type of analysis should be used?

A) An independent samples comparison of population means.
B) A paired difference comparison of population means.
C) A test of a single population proportion.
D) An independent samples comparison of population proportions.

71) A marketing study was conducted to compare the mean age of male and female purchasers of a certain product. Random and independent samples were selected for both male and female purchasers of the product. What type of analysis should be used to compare the mean age of male and female purchasers?

A) A test of a single population mean.
B) An independent samples comparison of population means.
C) A paired difference comparison of population means.
D) An independent samples comparison of population proportions.

72) Calculate the degrees of freedom associated with a small-sample test of hypothesis for \( \mu_1 - \mu_2 \), assuming \( \sigma_1^2 = \sigma_2^2 \) and \( n_1 = n_2 = 16 \).

A) 33  
B) 30  
C) 31  
D) 15

73) Consider the following set of salary data:

<table>
<thead>
<tr>
<th></th>
<th>Men (1)</th>
<th>Women (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Mean</td>
<td>$12,850</td>
<td>$13,000</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>$345</td>
<td>$500</td>
</tr>
</tbody>
</table>

What assumptions are necessary to perform a test for the difference in population means?

A) The two samples were independently selected from the populations of men and women.
B) The population variances of salaries for men and women are equal.
C) Both of the target populations have approximately normal distributions.
D) All of the above are necessary.
74) A marketing study was conducted to compare the mean age of male and female purchasers of a certain product. Random and independent samples were selected for both male and female purchasers of the product. It was desired to test to determine if the mean age of all female purchasers exceeds the mean age of all male purchasers. The sample data is shown here:

Female:  \( n = 10, \)  sample mean \( = 50.30, \)  sample standard deviation \( = 13.215 \)
Male:  \( n = 10, \)  sample mean \( = 39.80, \)  sample standard deviation \( = 10.040 \)

Which of the following assumptions must be true in order for the pooled test of hypothesis to be valid?
I.  Both the male and female populations of ages must possess approximately normal probability distributions.
II.  Both the male and female populations of ages must possess population variances that are equal.
III.  Both samples of ages must have been randomly and independently selected from their respective populations.
A)  II only  
B)  I, II, and III  
C)  I only  
D)  III only

75) A confidence interval for \( (\mu_1 - \mu_2) \) is \((-5, 8)\). Which of the following inferences is correct?
A)  \( \mu_1 = \mu_2 \)  
B)  \( \mu_1 > \mu_2 \)  
C)  \( \mu_1 < \mu_2 \)  
D)  no significant difference between means

76) In a controlled laboratory environment, a random sample of 10 adults and a random sample of 10 children were tested by a psychologist to determine the room temperature that each person finds most comfortable. The data are summarized below:

<table>
<thead>
<tr>
<th></th>
<th>Sample Mean</th>
<th>Sample Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults (1)</td>
<td>77.5°F</td>
<td>4.5</td>
</tr>
<tr>
<td>Children (2)</td>
<td>74.5°F</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Suppose that the psychologist decides to construct a 99% confidence interval for the difference in mean comfortable room temperatures instead of proceeding with a test of hypothesis. The 99% confidence interval turns out to be \((-2.9, 3.1)\). Select the correct statement.
A)  It can be concluded at the 99% confidence level that the true mean comfortable room temperature is between -2.9 and 3.1.
B)  It cannot be concluded at the 99% confidence level that there is actually a difference between the true mean comfortable room temperatures for the two groups.
C)  It can be concluded at the 99% confidence level that the true mean comfortable room temperature for children exceeds that for adults.
D)  It can be concluded at the 99% confidence level that the true mean room temperature for adults exceeds that for children.
77) University administrators are trying to decide where to build a new parking garage on campus. The state legislature has budgeted just enough money for one parking structure on campus. The administrators have determined that the parking garage will be built either by the college of engineering or by the college of business. To help make the final decision, the university has randomly and independently asked students from each of the two colleges to estimate how long they usually take to find a parking spot on campus (in minutes). Suppose that the sample sizes selected by the university for the two samples were both \( n_e = n_g = 15 \). What critical value should be used by the university in the calculations for the 95% confidence interval for \( \mu_e - \mu_g \)? Assume that the university used the pooled estimate of the population variances in the calculation of the confidence interval.

A) \( t = 2.048 \)  
B) \( z = 1.96 \)  
C) \( t = 2.042 \)  
D) \( z = 1.645 \)  
E) \( t = 1.701 \)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

78) In order to compare the means of two populations, independent random samples of 144 observations are selected from each population with the following results.

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \bar{x}_1 = 7,123 )</td>
<td>( \bar{x}_2 = 6,957 )</td>
</tr>
<tr>
<td>( s_1 = 175 )</td>
<td>( s_2 = 225 )</td>
</tr>
</tbody>
</table>

Use a 95% confidence interval to estimate the difference between the population means \( (\mu_1 - \mu_2) \). Interpret the confidence interval.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

79) The owners of an industrial plant want to determine which of two types of fuel (gas or electricity) will produce more useful energy at a lower cost. The cost is measured by plant investment per delivered quad ($ invested / quadrillion BTUs). The smaller this number, the less the industrial plant pays for delivered energy. Suppose we wish to determine if there is a difference in the average investment/quad between using electricity and using gas. Our null and alternative hypotheses would be:

A) \( H_0: (\mu_e - \mu_g) = 0 \) vs. \( H_a: (\mu_e - \mu_g) > 0 \)  
B) \( H_0: (\mu_e - \mu_g) = 0 \) vs. \( H_a: (\mu_e - \mu_g) = 0 \)  
C) \( H_0: (\mu_e - \mu_g) = 0 \) vs. \( H_a: (\mu_e - \mu_g) < 0 \)  
D) \( H_0: (\mu_e - \mu_g) = 0 \) vs. \( H_a: (\mu_e - \mu_g) \neq 0 \)

80) The owners of an industrial plant want to determine which of two types of fuel (gas or electricity) will produce more useful energy at a lower cost. The cost is measured by plant investment per delivered quad ($ invested / quadrillion BTUs). The smaller this number, the less the industrial plant pays for delivered energy. Random samples of 11 similar plants using electricity and 16 similar plants using gas were taken, and the plant investment/quad was calculated for each. In an analysis of the difference of means of the two samples, the owners were able to reject \( H_0 \) in the test \( H_0: (\mu_E - \mu_G) = 0 \) vs. \( H_a: (\mu_E - \mu_G) > 0 \). What is our best interpretation of the result?

A) The mean investment/quad for electricity is different from the mean investment/quad for gas.  
B) The mean investment/quad for electricity is not different from the mean investment/quad for gas.  
C) The mean investment/quad for electricity is greater than the mean investment/quad for gas.  
D) The mean investment/quad for electricity is less than the mean investment/quad for gas.
A marketing study was conducted to compare the mean age of male and female purchasers of a certain product. Random and independent samples were selected for both male and female purchasers of the product. It was desired to test to determine if the mean age of all female purchasers exceeds the mean age of all male purchasers. The sample data is shown here:

Female:  
n = 10, sample mean = 50.30, sample standard deviation = 13.215
Male:  
n = 10, sample mean = 39.80, sample standard deviation = 10.040

Find the rejection region to state the correct conclusion when testing at alpha = 0.01.

A) Reject H₀ if t > 1.330  
B) Reject H₀ if t > 2.878  
C) Reject H₀ if t > 2.552  
D) Reject H₀ if t > 2.528

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Assume that  \( \sigma_1^2 = \sigma_2^2 = \sigma^2 \). Calculate the pooled estimator of \( \sigma^2 \) for  \( s_1^2 = 50 \),  \( s_2^2 = 57 \), and  \( n_1 = n_2 = 18 \).

83) Independent random samples selected from two normal populations produced the following sample means and standard deviations.

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n_1 = 14 )</td>
<td>( n_2 = 11 )</td>
</tr>
<tr>
<td>( \bar{x}_1 = 7.1 )</td>
<td>( \bar{x}_2 = 8.4 )</td>
</tr>
<tr>
<td>( s_1 = 2.3 )</td>
<td>( s_2 = 2.9 )</td>
</tr>
</tbody>
</table>

Conduct the test  \( H_0: (\mu_1 - \mu_2) = 0 \) against  \( H_a: (\mu_1 - \mu_2) \neq 0 \). Use  \( \alpha = .05 \).

84) Independent random samples from normal populations produced the results shown below.

| Sample 1: 5.8, 5.1, 3.9, 4.5, 5.4 |
| Sample 2: 4.4, 6.1, 5.2, 5.7 |

a. Calculate the pooled estimator of \( \sigma^2 \).

b. Test  \( \mu_1 < \mu_2 \) using  \( \alpha = .10 \).

C. Find a 90% confidence interval for  \( (\mu_1 - \mu_2) \).
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

85) Which supermarket has the lowest prices in town? All claim to be cheaper, but an independent agency recently was asked to investigate this question. The agency randomly selected 100 items common to each of two supermarkets (labeled A and B) and recorded the prices charged by each supermarket. The summary results are provided below:

\[
\bar{x}_A = 2.09 \quad \bar{x}_B = 1.99 \quad \bar{d} = .10 \\
\sigma_A = 0.22 \quad \sigma_B = 0.19 \quad \sigma_d = .03
\]

Assuming a matched pairs design, which of the following assumptions is necessary for a confidence interval for the mean difference to be valid?

A) The samples are randomly and independently selected.
B) The population variances must be equal.
C) None of these assumptions are necessary.
D) The population of paired differences has an approximate normal distribution.

86) A researcher is investigating which of two newly developed automobile engine oils is better at prolonging the life of an engine. Since there are a variety of automobile engines, 20 different engine types were randomly selected and were tested using each of the two engine oils. The number of hours of continuous use before engine breakdown was recorded for each engine oil. Based on the information provided, what type of analysis will yield the most useful information?

A) Independent samples comparison of population proportions.
B) Independent samples comparison of population means.
C) Matched pairs comparison of population proportions.
D) Matched pairs comparison of population means.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

87) The data for a random sample of six paired observations are shown below.

<table>
<thead>
<tr>
<th>Pair</th>
<th>Observation 1</th>
<th>Observation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

a. Calculate the difference between each pair of observations by subtracting observation 2 from observation 1. Use the differences to calculate \( sd^2 \).
b. Calculate the standard deviations \( s_1^2 \) and \( s_2^2 \) of each column of observations. Then find pooled estimate of the variance \( sp^2 \).
c. Comparing \( sd^2 \) and \( sp^2 \), explain the benefit of a paired difference experiment.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

88) Which supermarket has the lowest prices in town? All claim to be cheaper, but an independent agency recently was asked to investigate this question. The agency randomly selected 100 items common to each of two supermarkets (labeled A and B) and recorded the prices charged by each supermarket. The summary results are provided below:

\[
\begin{align*}
\bar{x}_A &= 2.09 & \bar{x}_B &= 1.99 & d &= 0.10 \\
s_A &= 0.22 & s_B &= 0.19 & s_d &= 0.03 \\
\end{align*}
\]

Assuming the data represent a matched pairs design, calculate the confidence interval for comparing mean prices using a 95% confidence level.

A) \(0.10 \pm 0.056975\)  
B) \(0.10 \pm 0.004935\)  
C) \(0.10 \pm 0.1255\)  
D) \(0.10 \pm 0.00588\)

89) A researcher is investigating which of two newly developed automobile engine oils is better at prolonging the life of an engine. Since there are a variety of automobile engines, 20 different engine types were randomly selected and were tested using each of the two engine oils. The number of hours of continuous use before engine breakdown was recorded for each engine oil. Suppose the following 95% confidence interval for \(\mu_A - \mu_B\) was calculated: (100, 2500). Which of the following inferences is correct?

A) We are 95% confident that an engine using oil B has a higher mean number of hours of continuous use before breakdown than does an engine using oil A.
B) We are 95% confident that no significant differences exists in the mean number of hours of continuous use before breakdown of engines using oils A and B.
C) We are 95% confident that the mean number of hours of continuous use of an engine using oil A is between 100 and 2500 hours.
D) We are 95% confident that an engine using oil A has a higher mean number of hours of continuous use before breakdown than does an engine using oil B.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

90) The data for a random sample of five paired observations are shown below.

<table>
<thead>
<tr>
<th>Pair</th>
<th>Observation 1</th>
<th>Observation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

a. Calculate the difference between each pair of observations by subtracting observation 2 from observation 1. Use the differences to calculate \(\bar{d}\) and \(s_d\).
b. Calculate the means \(\bar{x}_1\) and \(\bar{x}_2\) of each column of observations. Show that \(\bar{d} = \bar{x}_1 - \bar{x}_2\).
c. Form a 90% confidence interval for \(\mu_D\).
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

91) An inventor has developed a new spray coating that is designed to improve the wear of bicycle tires. To test the new coating, the inventor randomly selects one of the two tires on each of 50 bicycles to be coated with the new spray. The bicycle is then driven for 100 miles and the amount of the depth of the tread left on the two bicycle tires is measured (in millimeters). It is desired to determine whether the new spray coating improves the wear of the bicycle tires. The data and summary information is shown below:

<table>
<thead>
<tr>
<th>Bicycle</th>
<th>Coated Tire (C)</th>
<th>Non-Coated Tire (N)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.452</td>
<td>0.785</td>
<td>0.666</td>
</tr>
<tr>
<td></td>
<td>1.634</td>
<td>0.844</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>1.211</td>
<td>0.954</td>
<td>0.257</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mean = 0.53, std dev = 0.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sample size = 50</td>
</tr>
</tbody>
</table>

Identify the correct null and alternative hypothesis for testing whether the new spray coating improves the mean wear of the bicycle tires (which would result in a larger amount of tread left on the tire).

A) $H_0: \mu_d = 0$ vs. $H_a: \mu_d > 0$
B) $H_0: \mu_d = 0$ vs. $H_a: \mu_d \neq 0$
C) $H_0: \mu_d = 0$ vs. $H_a: \mu_d < 0$

92) A paired difference experiment yielded $n_d$ pairs of observations. For the given case, what is the rejection region for testing $H_0: \mu_d = 15$ against $H_a: \mu_d < 15$?

$n_d = 21, \alpha = 0.05$
A) $t < -1.721$
B) $t < -1.725$
C) $t < 1.725$
D) $t < 2.086$

93) We sampled 100 men and 100 women and asked: "Do you think the environment is a major concern?" Of those sampled, 67 women and 53 men responded that they believed it is. For the confidence interval procedure to work properly, what additional assumptions must be satisfied?

A) The population variances are equal.
B) Both populations have approximate normal distributions.
C) Both samples were randomly and independently selected from their respective populations.
D) All of the above are necessary.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

94) Determine whether the sample sizes are large enough to conclude that the sampling distributions are approximately normal.

$n_1 = 45, n_2 = 52, \hat{p}_1 = 0.3, \hat{p}_2 = 0.6$

95) Construct a 90% confidence interval for $(p_1 - p_2)$ when $n_1 = 400, n_2 = 550, \hat{p}_1 = 0.42, \text{and } \hat{p}_2 = 0.63$. 

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

96) When blood levels are low at an area hospital, a call goes out to local residents to give blood. The blood center is interested in determining which sex - males or females - is more likely to respond. Random, independent samples of 60 females and 100 males were each asked if they would be willing to give blood when called by a local hospital. A success is defined as a person who responds to the call and donates blood. The goal is to compare the percentage of the successes of the male and female responses. Find the rejection region that would be used if it is desired to test to determine if a difference exists between the proportion of the females and males who responds to the call to donate blood. Use $\alpha = 0.10$.

A) Reject $H_0$ if $z < -1.96$.  
B) Reject $H_0$ if $z > 1.645$.  
C) Reject $H_0$ if $z < -1.645$ or $z > 1.645$.  
D) Reject $H_0$ if $z < -1.96$ or $z > 1.96$.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

97) One indication of how strong the real estate market is performing is the proportion of properties that sell in less than 30 days after being listed. Of the condominiums in a Florida beach community that sold in the first six months of 2006, 75 of the 115 sampled had been on the market less than 30 days. For the first six months of 2007, 25 of the 85 sampled had been on the market less than 30 days. Test the hypothesis that the proportion of condominiums that sold within 30 days decreased from 2006 to 2007. Use $\alpha = 0.01$.

98) In an exit poll, 42 of 75 men sampled supported a ballot initiative to raise the local sales tax to build a new football stadium. In the same poll, 41 of 85 women sampled supported the initiative. Find and interpret the $p$-value for the test of hypothesis that the proportions of men and women who support the initiative are different.

99) A government housing agency is comparing home ownership rates among several immigrant groups. In a sample of 235 families who emigrated to the U.S. from Eastern Europe five years ago, 165 now own homes. In a sample of 195 families who emigrated to the U.S. from Pacific islands five years ago, 125 now own homes. Write a 95% confidence interval for the difference in home ownership rates between the two groups. Based on the confidence interval, can you conclude that there is a significant difference in home ownership rates in the two groups of immigrants?
In a comprehensive road test for new car models, one variable measured is the time it takes the car to accelerate from 0 to 60 miles per hour. To model acceleration time, a regression analysis is conducted on a random sample of 129 new cars.

TIME60: \( y = \) Elapsed time (in seconds) from 0 mph to 60 mph
MAX: \( x = \) Maximum speed attained (miles per hour)

The simple linear model \( E(y) = \beta_0 + \beta_1 x \) was fit to the data. Computer printouts for the analysis are given below:

NWEIGHTED LEAST SQUARES LINEAR REGRESSION OF TIME60

<table>
<thead>
<tr>
<th>PREDICTOR VARIABLES</th>
<th>COEFFICIENT</th>
<th>STD ERROR</th>
<th>STUDENT’S T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>18.7171</td>
<td>0.63708</td>
<td>29.38</td>
<td>0.0000</td>
</tr>
<tr>
<td>MAX</td>
<td>-0.08365</td>
<td>0.00491</td>
<td>-17.05</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-SQUARED 0.6960 RESID. MEAN SQUARE (MSE) 1.28695
ADJUSTED R-SQUARED 0.6937 STANDARD DEVIATION 1.13444

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGRESSION</td>
<td>1</td>
<td>374.285</td>
<td>374.285</td>
<td>290.83</td>
<td>0.0000</td>
</tr>
<tr>
<td>RESIDUAL</td>
<td>127</td>
<td>163.443</td>
<td>1.28695</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>128</td>
<td>537.728</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CASES INCLUDED 129  MISSING CASES 0

Find and interpret the estimate \( \hat{\beta}_1 \) in the printout above.
1) B  
2) A  
3) B  
4) D  
5) B  
6) A  
7) An increase in the sample size reduces the sampling variation of the point estimate as it is calculated as \( \sigma \sqrt{n} \). The larger the sample size, the smaller this variation which leads to narrower intervals. 
8) C  
9) B  
10) D  
11) B  
12) D  
13) For confidence coefficient .99, \( 1 - a = 0.99 \). 
\[ \Rightarrow a/2 = 0.005 = \frac{z_{0.005}}{2} = 2.575. \] The confidence interval is: 
\[ \bar{x} \pm z_{0.005}/2 \left( \frac{s}{\sqrt{n}} \right) = 16.00 \pm 2.575 \left( \frac{2.85}{\sqrt{43}} \right) = 16.00 \pm 1.119 = ($14.88, $17.12) \] 

We are 99% confident that the average amount a fan spends on food at a single professional football game is between $14.88 and $17.12.  
14) D  
15) \( t_0 = 1.761 \); Use table for \( t_{0.05} \) with 14 degrees of freedom. 
16) A  
17) D  
18) D  
19) C  
20) C  
21) D  
22) \( \bar{x} = 80; s = 8.367 \); \( \bar{x} \pm t_{0.025}/2 \left( \frac{s}{\sqrt{n}} \right) = 80 \pm 1.753 \left( \frac{8.367}{\sqrt{16}} \right) = 80 \pm 3.667 \)  
23) B  
24) B  
25) A  
26) C  
27) B  
28) B  
29) B  
30) A  
31) B  
32) D  
33) C  
34) B  
35) To determine if the mean yield for the soybeans differs from 556 bushels per acre, we test: 
\[ H_0: \mu = 556 \text{ vs. } H_1: \mu \neq 556 \]  
36) A  
37) C
38) B
39) B
40) D
41)

42)
43)

![Graph showing the decision region for rejecting or not rejecting the null hypothesis.]

44)

![Graph showing the decision region for rejecting or not rejecting the null hypothesis.]

45) A
46) B
47) A
48) C
49) D
50) A
51) C
52) C
53) C
54) To determine if the mean exceeds 760 hours, we test:

\[ H_0: \mu = 760 \text{ vs. } H_a: \mu > 760 \]

The rejection region requires \( \alpha = .01 \) in the upper tail of the \( z \) distribution. From a \( z \) table, we find \( z_{.01} = 2.33 \). The rejection region is \( z > 2.33 \).

55) To determine if the mean life exceeds 800 hours, we test:

\[ H_0: \mu = 800 \text{ vs. } H_a: \mu > 800 \]

The test statistic is \( z = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{830 - 800}{110/\sqrt{121}} = 3 \).

Since the test is greater than 1.645, \( H_0 \) can be rejected. There is sufficient evidence to indicate the average life of the new bulbs exceeds 800 hours when testing at \( \alpha = .05 \).

56) D
57) B
58) B
59) A

60) \( \bar{x} = 59.4, s = 3.24 \); The test statistic is \( t = \frac{59.4 - 55}{3.24 / \sqrt{10}} \approx 4.29 \). The rejection region is \( t > 1.833 \). Since the test statistic falls in the rejection region, we reject the null hypothesis in favor of the alternative hypothesis. We conclude that the true mean baking time is actually greater than 55 minutes.

61) A
62) B
63) B
64) A
65) A
66) C

67) The test statistic is \( z = \frac{\hat{p} - p_0}{\sqrt{p0q0/\hat{n}}} \) where \( \hat{p} = \frac{8}{70} = .1143 \).

The test statistic is \( z = \frac{.1143 -.15}{.15(.85)/70} = -.84 \).

68) D
69) B
70) D
71) B
72) B
73) A
74) B
75) D
76) B
77) A
78) \( (7,123 - 6,957) \pm 1.96 \sqrt{\frac{1752}{144} + \frac{2252}{144}} = 166 \pm 46.56 \)

79) D
80) C
81) C

82) \[ s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)} = \frac{(18 - 1)50 + (18 - 1)57}{(18 - 1) + (18 - 1)} = 53.5 \]

83) The observed level of significance is .223, which is not less than .05. There is no significant difference between the means.

84) \( \bar{x}_1 = 4.94, \ s_1 = .75, \ n_1 = 5, \bar{x}_2 = 5.35, \ s_2 = .73, \ n_2 = 4 \)

   a. \[ s_p^2 = \frac{(5 - 1)75^2 + (4 - 1)73^2}{(5 - 1) + (4 - 1)} \approx .550 \]

   b. The test statistic is \[ t = \frac{4.94 - 5.35}{.73 \sqrt{\frac{1}{5} + \frac{1}{4}}} \approx - .82. \]

   There are 7 degrees of freedom, so the rejection region for \( \alpha = .10 \) is \( t < 1.415. \)

   Since the test statistic does not fall within the rejection region, we have insufficient evidence to conclude that \( \mu_1 \neq \mu_2. \)

   c. \[ (4.94 - 5.35) \pm 1.895 \sqrt{.550 \left( \frac{1}{5} + \frac{1}{4} \right)} \approx .41 \pm 943. \]

85) C
86) D

87) a. The differences are all -2, so \( s_d^2 = 0. \)

   b. \( s_1^2 = s_2^2 = 3.5; \ s_p^2 = \frac{5(3.5) + 5(3.5)}{10} = 3.5 \)

   c. For the paired difference experiment, the variance is much smaller.

88) D
89) D

90) a. The differences are 2, 0, 1, 3, and 1; \( \bar{d} = -1.14; \ s_d = 1.14 \)

   b. \( \bar{x}_1 = 3.4, \ \bar{x}_2 = 4.8, \ \bar{x}_1 - \bar{x}_2 = 3.4 - 4.8 = -1.4 = \bar{d} \)

   c. \( -1.4 \pm 2.132 \sqrt{\frac{1.14}{5}} \approx -1.4 \pm 1.09 \)

91) A
92) B
93) C

94) Since \( n_1p_1 = 45(3) = 13.5 < 15, \) the sample size is not large enough.

95) \( (.42 - .63) \pm 1.645 \sqrt{\frac{.42(.58)}{400} + \frac{.63(.37)}{550}} \approx -.21 \pm 0.053. \)

96) C
97) \( \hat{p}_1 = .65 \) and \( \hat{p}_2 = .29 \); The test statistic is \( z = \frac{(\hat{p}_1 - \hat{p}_2) - 0}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}} \approx 5.43 \).

The rejection region is \( z > 2.33 \). Since the test statistic falls in the rejection region, we reject the null hypothesis in favor of the alternative hypothesis that \((\hat{p}_1 - \hat{p}_2) > 0\). We conclude that the proportion of condominiums that sold within 30 days was greater in the first half of 2006 than in the first half of 2007.

98) \( \hat{p}_1 = .56 \) and \( \hat{p}_2 = .48 \); The test statistic is \( z = \frac{(\hat{p}_1 - \hat{p}_2) - 0}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}} \approx 1.01 \).

The \( p \)-value is \( p = 2(\hat{p} \cdot .3438) = .3124 \). The probability of observing a value of \( z \) more contradictory to the null hypothesis is .3124.

99) \( \hat{p}_1 = .70 \) and \( \hat{p}_2 = .64 \); The confidence interval is \( (.70 - .64) \pm 1.96 \sqrt{\frac{.70(1-.70)}{235} + \frac{.64(1-.64)}{195}} \approx .06 \pm .089 \).

Since the confidence interval includes 0, we cannot conclude that there is a difference in home ownership rates.

100) \( \hat{\beta}_1 = -.08365 \). For every 1 mile per hour increase in the maximum speed attained, we estimate the elapsed 0- to- 60 acceleration time to decrease by .08365 second.