1. An opinion poll asks a simple random sample of 100 college seniors how they view their job prospects. In all, 53 say “good.” Does the poll give reason to conclude that more than half of all seniors think their job prospects are good? The hypotheses for a test to answer this question are
   A. $H_0: p = 0.5$, $H_a: p > 0.5$.  
   B. $H_0: p = 0.5$, $H_a: p < 0.5$.  
   C. $H_0: p = 0.5$, $H_a: p \neq 0.5$.  
   D. $H_0: p = 0.5$, $H_a: p < 0.5$.  
   E. $H_0: p \neq 0.5$, $H_a: p > 0.5$.

2. A medical experiment compared the herb Echinacea with a placebo for preventing colds. One response variable was “volume of nasal secretions” (if you have a cold, you blow your nose a lot). Take the average volume of nasal secretions in people without colds to be $\mu = 1$. An increase to $\mu = 3$ indicates a cold. The significance level of a test of $H_0: \mu = 1$ versus $H_a: \mu > 1$ is
   A. the probability that the test rejects $H_0$ when $\mu = 1$ is true.  
   B. the probability that the test rejects $H_0$ when $\mu = 3$ is true.  
   C. the probability that the test fails to reject $H_0$ when $\mu = 3$ is true.  
   D. the probability that the test fails to reject $H_0$ when $\mu = 1$ is true.  
   E. none of the above.

3. In a test $H_0: \mu = 5$ against $H_a: \mu > 5$, a sample size of 50 produces a sample mean of 5.2 and a $P$-value of 0.09. Thus at the 0.05 level of significance
   A. there is sufficient evidence to conclude that $\mu > 5$.  
   B. there is sufficient evidence to conclude that $\mu = 5$.  
   C. there is insufficient evidence to conclude that $\mu = 5$.  
   D. there is insufficient evidence to conclude that $\mu > 5$.  
   E. there is sufficient evidence to conclude that $\mu = 5.2$.

4. A significance test gives a $P$-value of 0.04. From this we can
   A. reject $H_0$ at the 1% significance level.  
   B. reject $H_0$ at the 5% significance level.  
   C. say that the probability that $H_0$ is false is 0.04.  
   D. say that the probability that $H_0$ is true is 0.04.  
   E. none of the above. The answer is ________________

5. Resting pulse rate is an important measure of the fitness of a person's cardiovascular system, with a lower rate indicative of greater fitness. The mean pulse rate for all adult males is approximately 72 beats per minute. A random sample of 25 male students currently enrolled in the Faculty of Agriculture was selected and the mean resting pulse rate was found to be 80 beats per minute with a standard deviation of 20 beats per minute. The experimenter wishes to test if the students are less fit, on average, than the general population.
   The null and alternative hypotheses are:
   A. $H_0: \mu = 72$; $H_a: \mu < 72$  
   B. $H_0: \bar{x} = 72$; $H_a: \bar{x} < 72$  
   C. $H_0: \mu = 80$; $H_a: \mu = 72$  
   D. $H_0: \bar{x} = 80$; $H_a: \bar{x} > 72$  
   E. $H_0: \mu = 72$; $H_a: \mu > 72$.

6. A tire manufacturer claims that a new design of radial tires will last at least 50,000 miles. A consumer affairs representative believes the tires will get less than 50,000 miles. Which of the following is the correct pair of hypotheses to test?
   A. $H_0: \mu < 50,000$ vs. $H_a: \mu \neq 50,000$.  
   B. $H_0: \mu < 50,000$ vs. $H_a: \mu > 50,000$.  
   C. $H_0: \mu \leq 50,000$ vs. $H_a: \mu > 50,000$.  
   D. $H_0: \mu < 50,000$ vs. $H_a: \mu = 50,000$.  
   E. $H_0: \mu = 50,000$ vs. $H_a: \mu < 50,000$.  

7. Cooks at a student cafeteria claim that the mean amount of sodium in each meal is 450 mg. The district nutritionist says that amount is not correct. Which of the following is the correct pair of hypotheses to test?

A) \( H_0: \mu = 450 \) vs. \( H_a: \mu \neq 450 \).
B) \( H_0: \mu < 450 \) vs. \( H_a: \mu > 450 \).
C) \( H_0: \mu \leq 450 \) vs. \( H_a: \mu > 450 \).
D) \( H_0: \mu 
eq 450 \) vs. \( H_a: \mu = 450 \).
E) \( H_0: \mu \geq 450 \) vs. \( H_a: \mu < 450 \).

8. The heights (in inches) of males in the United States are believed to be normally distributed with mean \( \mu \). The average height of a random sample of 25 American adult males is found to be \( \bar{x} = 69.72 \) inches, and the standard deviation of the 25 heights is found to be \( s = 4.15 \) inches. The standard error of \( \bar{x} \) is

A) \( 0.17 \).
B) \( 0.41 \).
C) \( 0.69 \).
D) \( 0.83 \).
E) \( 2.04 \).

Use the following to answer questions 12 through 15:

An SRS of 100 postal employees found that the average amount of time these employees had worked for the U.S. Postal Service was \( \bar{x} = 7 \) years, with a standard deviation of \( s = 2 \) years. Assume the distribution of the time the population of all postal employees has worked for the Postal Service is approximately normal with mean \( \mu \). Do the observed data represent evidence that \( \mu \) has changed from its value of 7.5 years of 20 years ago? To determine this, we test the hypotheses \( H_0: \mu = 7.5 \) vs. \( H_a: \mu \neq 7.5 \) using the one-sample \( t \) test.

12. The appropriate degrees of freedom for this test are

A) 9.
B) 10.
C) 19.
D) 99.
E) 100.

13. The \( P \)-value for the one-sample \( t \) test is

A) larger than 0.10.
B) between 0.05 and 0.10.
C) between 0.01 and 0.05.
D) below 0.01.
E) impossible to determine, since the standard deviation of the study conducted 20 years ago is not given.
14. A 95% confidence interval for the mean number of years \( \mu \) that a current Postal Service employee has spent with the Postal Service is
   
   A) 7 ± 2.  B) 7 ± 1.984.  C) 7 ± 0.4.  D) 7 ± 0.3.  E) 7 ± 0.2.

15. Suppose the mean and standard deviation we obtained were based on a sample of 25 postal workers, rather than 100. The \( P \)-value would be
   
   A) larger.  B) smaller.  C) unchanged, since the difference between \( \bar{x} \) and the hypothesized value \( \mu = 7.5 \) is unchanged.  D) unchanged, since both groups of workers have the same type of job.  E) unchanged, since the variability measured by the standard deviation stays the same.

16. The one sample \( t \)-statistic from a sample of \( n = 19 \) observations for the two-sided test of
   
   \( H_0: \mu = 6, H_1: \mu \neq 6 \) has the value \( t = 1.93 \). Based on this information, which of the following would be true?
   
   A) We would reject the null hypothesis at \( \alpha = 0.10 \).  B) \( 0.025 < P \)-value < 0.05.  C) We would reject the null hypothesis at \( \alpha = 0.05 \).  D) Both B and C are correct.  E) We would not reject the null hypothesis in a two-sided test, but would reject it in a one-sided test at \( \alpha = 0.10 \).

17. A medical school claims that more than 28\% of its students plan to go into general practice. It is found that among a random sample of 130 of the school’s students, 32.3\% of them plan to go into general practice. Find the \( P \)-value for a test of the school’s claim.
   
   a) 0.1635  b) 0.3078  c) 0.1370  d) 0.3461

18. Suppose that on a hypothesis test for a single population mean, \( H_0: \mu < 10 \). Assume that \( H_0 \) is true. For a fixed sample size and significance level \( \alpha \), the power of the test will be greatest if the actual mean is which of the following:
   
   a) 8  b) 9  c) 10  d) 11  e) 13

19. If the calculated \( z \)-value for testing \( H_0: \mu = 5 \) in a one sample \( z \)-test of sig level .05 is 1.92 then
   
   a. The \( P \)-value is .0548 and \( H_0 \) should be rejected.  b. The \( P \)-value is .0548 and \( H_0 \) should not be rejected.  c. The \( P \)-value is .0274 and \( H_0 \) should be rejected.  d. The \( P \)-value is .0274 and \( H_0 \) should not be rejected.  e. None of the above responses are true.

20. True or false: In a hypothesis test, an increase in \( \alpha \) will cause a decrease in the power of the test provided the sample size is kept fixed.
   
   a) True  b) False

21. Sedans average 28 miles/gallon in the city. Carter Motor Company claims that its new sedan, the Libra, is more fuel efficient, thus will average better than 28 miles/gallon in the city and hire a statistician (you) to test the claim. Identify the type I error.
   
   a) You conclude that the Libra is more fuel efficient, when in fact is not more fuel efficient.  b) You conclude that the Libra is more fuel efficient, when in fact is more fuel efficient.  c) You conclude that the Libra is not more fuel efficient, when in fact is more fuel efficient.

22. In some mining operations, a by-product of the processing is mildly radioactive. Of prime concern is the possibility that release of these by-products into the environment may contaminate the freshwater supply. There are strict regulations for the maximum allowable radioactivity in supplies of drinking water, namely an average of 4 picocuries per liter (pCi/l) or less. However, it is well known that even safe water has occasional hot spots that eventually get diluted, so samples of water are assumed safe unless there is evidence to the contrary. What is a type I error?
   
   a) Researchers conclude that the water is safe, when in fact the water is unsafe.  b) Researchers conclude that the water is unsafe, when in fact the water is unsafe.  c) Researchers conclude that the water is unsafe, when in fact the water is safe.

23. An article states that 62\% of voters favor gun control. A researcher believes this proportion to be incorrect. Identify the type II error for the test.
   
   a) The researcher concludes that the proportion of voters that favor gun control is different than 62\%, when in fact really is.  b) The researcher concludes that the proportion of voters that favor gun control is 62\%, when in fact it is different than 62\%.  c) The researcher concludes that the proportion of voters that favor gun control is 62\%, when in fact it is.
Identify the null hypothesis $H_0$ and the alternative hypothesis $H_A$.

24. An entomologist writes an article in a scientific journal which claims that fewer than 16 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Use the parameter $p$, the true proportion of fireflies unable to produce light.

   a) $H_0$: $p > 0.0016$
   b) $H_0$: $p < 0.0016$
   c) $H_0$: $p < 0.0016$
   d) $H_0$: $p < 0.0016$

   $H_A$: $p < 0.0016$
   $H_A$: $p > 0.0016$

25. A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO, $p$, is less than 5 in every one thousand.

   a) $H_0$: $p < 0.005$
   b) $H_0$: $p > 0.005$
   c) $H_0$: $p > 0.005$
   d) $H_0$: $p < 0.005$

   $H_A$: $p > 0.005$
   $H_A$: $p < 0.005$

26. In a hypothesis test, which of the following will cause a decrease in $\beta$, the probability of making a type II error?

   A: Increasing $\alpha$ while keeping the sample size $n$, fixed
   B: Increasing the sample size $n$, while keeping $\alpha$ fixed
   C: Decreasing $\alpha$ while keeping the sample size $n$, fixed
   D: Decreasing the sample size $n$, while keeping $\alpha$ fixed
   E. Both A and B are correct.

Use the following to answer questions 27 and 28:

Bags of a certain brand of tortilla chips are claimed to have a net weight of 14 ounces. Net weights actually vary slightly from bag to bag and are normally distributed with mean $\mu$. A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised and so intends to test the hypotheses $H_0: \mu = 14$, $H_A: \mu < 14$.

To do this, he selects 16 bags of this brand at random and determines the net weight of each. He finds the sample mean to be $\bar{x} = 13.88$ ounces and the sample standard deviation to be $s = 0.24$ ounces.

27. Based on the data above,
   A) we would reject $H_0$ at significance level 0.10 but not at level 0.05.
   B) we would reject $H_0$ at significance level 0.05 but not at level 0.025.
   C) we would reject $H_0$ at significance level 0.025 but not at level 0.01.
   D) we would reject $H_0$ at significance level 0.01 but not at level 0.001.
   E) we would reject $H_0$ at significance level 0.001.

28. Referring to the information above, suppose we were not sure if the distribution of net weights was normal. In which of the following circumstances would it not be safe to use a $t$ procedure in this problem?
   A) The mean and median of the data are nearly equal.
   B) A stemplot of the data is roughly bell-shaped.
   C) A stemplot of the data displays a large outlier.
   D) The sample standard deviation is large.
   E) A histogram of the data displays moderate skewness.

29. Looking online (for example, at espn.go.com) you find the salaries of all 22 players for the Chicago Cubs as of opening day of the 2005 baseball season. The club total was $87$ million, eighth in the major leagues. Which inference procedure would you use to estimate the average salary of all MLB players?

   A) one-proportion $z$ interval
   B) one-sample $t$ interval
   C) one-sample $t$ test
   D) one-proportion $z$ test
   E) none of these

30. A random sample of 100 voters in a community produced 59 voters in favor of Candidate A. The observed value of the test statistic for testing the null hypothesis $H_0: p = 0.5$ versus the alternative hypothesis $H_A: p > 0.5$ is

   A) $z = \left( \frac{0.59 - 0.5}{\sqrt{(0.5)(0.41)/100}} \right)$
   B) $z = \left( \frac{(0.59 - 0.5)}{\sqrt{(0.5)(0.5)/100}} \right)$
   C) $t = \left( \frac{(0.59 - 0.5)}{\sqrt{(0.59)(0.41)/100}} \right)$
   D) $t = \left( \frac{(0.59 - 0.5)}{\sqrt{(0.5)(0.5)/100}} \right)$
   E) None of these
31. A sociologist is studying the effect of having children within the first two years of marriage on the divorce rate. Using hospital birth records, she selects a random sample of 200 couples who had a child within the first two years of marriage. Following up on these couples, she finds that 120 couples are divorced within five years.

To determine if the majority of marriages that have children within the first two years of marriage ends in divorce we should test:
A hypotheses $H_0: p = 0.50, H_a: p \neq 0.50.$  
B hypotheses $H_0: p = 0.50, H_a: p > 0.50.$  
C hypotheses $H_0: p = 0.50, H_a: p < 0.50.$  
D hypotheses $H_0: p = 0.60, H_a: p > 0.60.$  
E none of the above

32. A noted psychic was tested for ESP. The psychic was presented with 200 cards face down and asked to determine if the card was one of five symbols: a star, cross, circle, square, or three wavy lines. The psychic was correct in 50 cases. Let $p$ represent the probability that the psychic correctly identifies the symbol on the card in a random trial. Assume the 200 trials can be treated as an SRS from the population of all guesses the psychic would make in his lifetime. Which inference procedure would you use to determine whether the psychic is doing better than just guessing?
A one-proportion $z$ interval  
B one-sample $t$ interval  
C one-sample $t$ test  
D one-proportion $z$ test  
E none of these

Confidence Interval Review:

33. Assume that a computer was used to generate the given confidence interval for the population mean, $\mu$ . (145, 157).
Find the sample mean, $\bar{x}$ .
a) 151.0  
b) 150.5  
c) 145  
d) 152.5

34. To estimate the mean salary $\mu$ of full professors at American colleges and universities, you obtain the salaries of a random sample of 400 full professors. The sample mean is $\bar{x} = 73,220$ and the sample standard deviation is $s = 4400$. A 99% confidence interval for $\mu$ is
A) $73,220 \pm 11,440.$  
B) $73,220 \pm 569.$  
C) $73,220 \pm 5567.$  
D) $73,220 \pm 431.$  
E) $73,220 \pm 28.6.$

35. The heights (in inches) of adult males in the United States are believed to be normally distributed with mean $\mu$. The average height of a random sample of 25 American adult males is found to be $\bar{x} = 69.72$ inches, and the standard deviation of the 25 heights is found to be $s = 4.15$ inches. A 90% confidence interval for $\mu$ is
A) $69.72 \pm 0.70.$  
B) $69.72 \pm 1.09.$  
C) $69.72 \pm 1.37.$  
D) $69.72 \pm 1.42.$  
E) $69.72 \pm 4.15.$

Use the following to answer questions 36 and 37:
The college newspaper of a large Midwestern university periodically conducts a survey of students on campus to determine the attitude on campus concerning issues of interest. Pictures of the students interviewed, along with quotes of their responses, are printed in the paper. Students are interviewed by a reporter “roaming” the campus who selects students to interview “haphazardly.” On a particular day the reporter interviews five students and asks them if they feel there is adequate student parking on campus. Four of the students say no. The sample proportion $\hat{p}$ that respond “no” is thus 0.8.

36. Referring to the information above, the standard error of $\hat{p}$ is
A) 0.8.  
B) 0.64.  
C) 0.4.  
D) 0.18.  
E) 0.032.

37. Referring to the information above, which of the following assumptions for inference about a proportion using a confidence interval are violated in this example?
A) $n$ is so large that both $n\hat{p}$ and $n(1 - \hat{p})$ are at least 10.  
B) The population is at least 10 times as large as the sample.  
C) We are interested in inference about a proportion.  
D) The data are an SRS from the population of interest.  
E) More than one assumption is violated.
Use the following to answer questions 38 and 39:

A newspaper conducted a statewide survey concerning the 2010 race for state senator. The newspaper took a random sample (assume it is an SRS) of 1200 registered voters and found that 620 would vote for the Republican candidate. Let \( p \) represent the proportion of registered voters in the state that would vote for the Republican candidate.

38. Referring to the information above, a 90% confidence interval for \( p \) is
   A) 0.517 ± 0.014.  B) 0.517 ± 0.022.  C) 0.517 ± 0.024.  D) 0.517 ± 0.028.  E) 0.517 ± 0.249.

39. Referring to the information above, what sample size would you need in order to estimate \( p \) with margin of error 0.01 with 95% confidence? Use the estimate \( p = 0.5 \) as the value for \( p \).

40. Suppose a 95% confidence interval is computed for \( \mu \) resulting in the interval (112.4, 121.6). Then a definition of **95% confidence** is...
   a. In the long run, about 95% of the time the true mean \( \mu \) falls within the interval (112.4, 121.6).
   b. In the long run, there is a 95% chance that \( \mu \) falls within the interval (112.4, 121.6)
   c. In repeated sampling, approximately 95% of all of the possible values of \( \mu \) fall within the interval (112.4, 121.6)
   d. In repeated sampling, approximately 95% of all of the possible samples produce intervals that contain \( \mu \)
   e. None of the above.

41. Which of the following does **not** influence the width of a large sample confidence interval for \( \mu \)?
   a. \( \bar{x} \)
   b. The standard deviation of the population.
   c. The confidence level
   d. The sample size.
   e. a, b, c and d all influence the width.

42. A 99% confidence interval (in inches) for the mean height of a population is 65.5 < \( \mu \) < 66.9. This result is based on a sample size of 144. Construct the 95% confidence interval. (Hint: you will first need to find the sample mean and sample standard deviation.)
   a) 65.3 in < \( \mu \) < 67.1 in         b) 65.6 in < \( \mu \) < 66.8 in         c) 65.5 in < \( \mu \) < 66.9 in         d) 65.7 in < \( \mu \) < 66.7 in

Answers: