1. We have calculated a confidence interval based on a sample size of \( n = 100 \). Now we want to get a better estimate with a margin of error that is only one-fourth as large. How large does our new sample need to be?

   a) 25       
   b) 50       
   c) 200      
   d) 400      
   e) 1600

2. Which statement is not true about confidence intervals?
   a) A confidence interval is an interval of values computed from sample data that is likely to include the true population value.
   b) An approximate formula for a 95% confidence interval is the sample estimate ± margin of error.
   c) A confidence interval between 20% and 40% means that the population proportion lies between 20% and 40%.
   d) A 99% confidence interval procedure has a higher probability of producing intervals that will include the population parameter than a 95% confidence interval procedure.

3. In a random sample of 50 men, 40% said they preferred to walk up stairs rather than take the elevator. In a random sample of 40 women, 50% said they preferred the stairs. The difference between the two sample proportions (men-women) is to be calculated. Which of the following choices correctly denotes the difference between the two sample proportions that is desired?

   a) \( \hat{p}_m - \hat{p}_w = .10 \)       
   b) \( \hat{p}_m - \hat{p}_w = .10 \)       
   c) \( \hat{p}_m - \hat{p}_w = -.10 \)      
   d) \( p_m - p_w = -.10 \)

4. Five hundred random samples of size \( n = 900 \) are taken from a large population in which 10% are left handed. The proportion of the sample that is left handed is found for each sample and a histogram of these 500 proportions is drawn. Which interval covers the range into which 68% of the values in the histogram will fall?

   a) \( .1 \pm .010 \)       
   b) \( .1 \pm .0134 \)      
   c) \( .1 \pm .0167 \)      
   d) \( .1 \pm .030 \)

5. A randomly selected sample of 400 students at a university with 15-week semesters was asked whether or not they think the semester should be shortened to 14 weeks (with longer classes). Forty-six percent (46%) of the 400 students surveyed answered “yes”. Which one of the following statements about the number 46% is correct?

   a) It is a sample statistic.       
   b) It is a population parameter. 
   c) It is a margin of error.       
   d) It is a standard error.

6. You are going to create a 95% confidence interval for a population proportion and want the margin of error to be no more than .05. Historical data indicate that the population proportion has remained constant at about .7. What is the minimum sample size you need to construct this interval?

   a) 385       
   b) 322      
   c) 274      
   d) 275      
   e) 323

7. The corn rootworm is a pest that can cause significant damage to corn, resulting in a reduction in yield and thus in farm income. A farmer will examine a random sample of plants from a field in order to decide whether or not the number of corn rootworms in the whole field is at a dangerous level. If the farmer concludes that it is, the field will be treated. The farmer is testing the null hypothesis that the number of corn rootworms is not at a dangerous level against the alternative hypothesis that the number is at a dangerous level. Suppose that the number of corn rootworms in the whole field actually is at a dangerous level. Which of the following is equal to the power of the test?

   a) The probability that the farmer will decide to treat the field.
   b) The probability that the farmer will decide not to treat the field.
   c) The probability that the farmer will fail to reject the null hypothesis.
   d) The probability that the farmer will reject the alternative hypothesis.
   e) The probability that the farmer will not get a statistically significant result.
8. Under a null hypothesis, a sample value yields a p-value of .015. Which of the following statements is (are) true?
   I. This finding is statistically significant at the .05 level of significance.
   II. This finding is statistically significant at the .01 level of significance.
   III. The probability of getting a sample value or more extreme as the one obtained by chance alone if the null hypothesis is true is .015.
   a) I and III only  
   b) I only  
   c) III only  
   d) II and III only  
   e) I, II, and III

9. A 95% confidence interval for the difference between two population proportions is found to be (.07, .19). Which of the following statements is (are) true?
   I. We are 95% confident that the true difference between the population proportions is between .07 and .19.
   II. The probability is .95 that the true difference between the population proportions is between .07 and .19.
   III. It is unlikely that the two populations have the same proportions.
   a) I only  
   b) II only  
   c) I and II only  
   d) I and III only  
   e) II and III only

10. In a test of the null hypothesis $H_0: p = .35$ with $\alpha = .01$, against the alternative hypothesis $H_a: p < .35$, a large random sample produced a z-score of -2.05. Based on this, which of the following conclusions can be drawn?
   a) $p = .35$  
   b) $p = .35$ only 2% of the time  
   c) If the z-score were positive instead of negative, we would be able to reject the null hypothesis.  
   d) We do not have sufficient evidence to reject the null hypothesis.  
   e) 1% of the time we will reject the alternative hypothesis in error.

11. The mayor of a large city will run for governor if he believes that more than 30 percent of the voters in the state already support him. He will have a survey firm ask a random sample of $n$ voters whether or not they support him. He will use a large sample test for proportions to test the null hypothesis that the proportion of all voters who support him is 30 percent or less against the alternative that the percentage is higher than 30 percent. Suppose that 35 percent of all voters in the state actually support him. In which of the following situations would the power for this test be highest?
   a) The mayor uses a significance level of 0.01 and $n = 250$ voters.  
   b) The mayor uses a significance level of 0.01 and $n = 500$ voters.  
   c) The mayor uses a significance level of 0.01 and $n = 1000$ voters.  
   d) The mayor uses a significance level of 0.05 and $n = 500$ voters.  
   e) The mayor uses a significance level of 0.05 and $n = 1000$ voters.

12. Which of the following are true statements?
   I. The p-value of a test is the probability of obtaining a result or more extreme as the one obtained assuming the null hypothesis is true.
   II. If the p-value for a test is .015, the probability that the null hypothesis is true is .015.
   III. When the null hypothesis is rejected, it is because it is not true.
   a) I only  
   b) II only  
   c) III only  
   d) I and III  
   d) None of these

13. A researcher investigating whether runners are less likely to get colds than non-runners found a P-value of .03. This means that:
   A) 3% of runners get colds.
   B) 3% fewer runners get colds.
   C) There’s a 3% chance that runners get fewer colds.
   D) There’s a 3% chance our assumption of no difference in number of colds whether a runner or not is incorrect.
   E) There’s a 3% chance that the sample statistic or more extreme will occur assuming there is no difference between number of colds whether a runner or not.
Free-Response Questions

14. Part 1: Last week’s Denton Record Chronicle newspaper reported that a poll President Obama’s approval rating stood at 62%. They claimed a margin of error of ± 3% with a 98% confidence level. What sample size was used? (Not 800 from part 2)

Part 2: Last week’s Denton Record Chronicle newspaper reported that a poll based on a sample of 800 registered voters in the area showed President Obama’s approval rating stood at 62%. They claimed a margin of error of ± 3%. What level of confidence were the pollsters using? [Note: not 98% from part 1.]

15. A manufacturer of computer monitors receives shipments of LCD panels from a supplier overseas. It is not cost effective to inspect each LCD panel for defects, so a sample is taken from each shipment. A significance test is conducted to determine whether the proportion of defective LCD panels is greater than the acceptable limit of 1%. If it is, the shipment will be returned to the supplier. Essentially, this is a test of

\[ H_0 : p = 0.01 \text{ vs } H_a : p > 0.01 \]

where \( p \) is the true proportion of defective panels in the shipment.

a.) Describe the Type I and Type II errors in the context of the situation.

b.) If you were the supplier of the LCD panels, which error would be more serious and why?

c.) If you were the computer monitor manufacturer, which error would be more serious and why?

16. The Pew Research Center recently polled \( n = 1048 \) U.S. drivers and showed 38% of the respondents “shouted, cursed or made gestures to other drivers” in the last year. Construct a 98% confidence interval for the true proportion of U.S. drivers who did these actions in the last year.
17. A national survey of high school students conducted by the Josephson Institute of Ethics was sent to 37,328 students, and 24,142 were returned. One question asked students if they had cheated during a test in the last school year. Of those who returned the survey, 9054 responded that they had cheated at least two times in the last year. Construct a 95% confidence interval for the true proportion of student who have cheated on at least two test in the last year.

18. Is there evidence that more than half of seniors at RHS will attend post-secondary school (i.e. college, university...)? From the Class of 2003, we found 59 of the 100 randomly sampled graduates to be attending a post-secondary school. Let alpha = 0.05.

19. A 2005 survey of Internet users reported that 22% downloaded music onto their computers. The filing of lawsuits by the recording industry may be a reason why this percent has decreased from the estimate of 29% from a survey taken two years before. Assume that the sample sizes are both 1421. Using a significance test, evaluate whether or not there has been a decreased in percent of internet users downloading music since 2003. Also report a 95% confidence interval for the difference in proportions.
1. During a flu vaccine shortage in the United States, it was believed that 45 percent of vaccine-eligible people received flu vaccine. The results of a survey given to a random sample of 2,350 vaccine-eligible people indicated that 978 of the 2,350 people had received flu vaccine.

(a) Construct a 99 percent confidence interval for the proportion of vaccine-eligible people who had received flu vaccine. Use your confidence interval to comment on the belief that 45 percent of the vaccine-eligible people had received flu vaccine.

(b) Suppose a similar survey will be given to vaccine-eligible people in Canada by Canadian health officials. A 99 percent confidence interval for the proportion of people who will have received flu vaccine is to be constructed. What is the smallest sample size that can be used to guarantee that the margin of error will be less than or equal to 0.02?

2. A husband and wife, Mike and Lori, share a digital music player that has a feature that randomly selects which song to play. A total of 2,384 songs were loaded onto the player, some by Mike and the rest by Lori. Suppose that when the player was in the random-selection mode, 13 of the first 50 songs selected were songs loaded by Lori.

(a) Construct and interpret a 90 percent confidence interval for the proportion of songs on the player that were loaded by Lori.

(b) Mike and Lori are unsure about whether the player samples the songs with replacement or without replacement when the player is in random-selection mode. Explain why this distinction is not important for the construction of the interval in part (a).
3. A French study was conducted in the 1990s to compare the effectiveness of using an instrument called a cardiopump with the effectiveness of using traditional cardiopulmonary resuscitation (CPR) in saving lives of heart attack victims. Heart attack patients in participating cities were treated with either a cardiopump or CPR, depending on whether the individual’s heart attack occurred on an even-numbered or an odd-numbered day of the month. Before the start of the study, a coin was tossed to determine which treatment, a cardiopump or CPR, was given on the even-numbered days. The other treatment was given on the odd-numbered days. In total, 754 patients were treated with a cardiopump, and 37 survived at least one year; while 746 patients were treated with CPR, and 15 survived at least one year.

(a) The conditions for inference are satisfied in the study. State the conditions and indicate how they are satisfied.

(b) Perform a statistical test to determine whether the survival rate for patients treated with a cardiopump is significantly higher than the survival rate for patients treated with CPR.

4. Some boxes of a certain brand of breakfast cereal include a voucher for a free video rental inside the box. The company that makes the cereal claims that a voucher can be found in 20 percent of the boxes. However, based on their experiences eating this cereal at home, a group of students believe that the proportion of boxes with vouchers is less than .2. This group of students purchased 65 boxes of the cereal to investigate the company’s claim. The students found a total of 11 vouchers for free video rental in the 65 boxes.

Suppose it is reasonable to assume that the 65 boxes purchased by the student are a random sample of all boxes of this cereal. Based on this sample, is there support for the students’ belief that the proportion of boxes with vouchers is less than .2? Provide statistical evidence to support your answer.
5. When a law firm represents a group of people in a class action lawsuit and wins that lawsuit, the firm receives a percentage of the group’s monetary settlement. That settlement amount is based on the total number of people in the group – the larger the group and the larger the settlement, the more money the firm will receive.

A law firm is trying to decide whether to represent car owners in a class action lawsuit against the manufacturer of a certain make and model for a particular defect. If 5 percent or less of the cars of this make and model have the defect, the firm will not recover its expenses. Therefore, the firm will handle the lawsuit only if it is convinced that more than 5 percent of the cars of this make and model have the defect. The firm plans to take a random sample of 1,000 people who bought this car and ask them if they experienced this defect in their cars.

a.) Define the parameter of interest and state the null and alternative hypotheses that the law firm should test.

b. In the context of this situation, describe Type I and Type II errors AND describe the consequences of each of these for the law firm.

6. A large company has two shifts – a day shift and a night shift. Parts produced by the two shifts must meet the same specifications. The manager of the company believes that there is a difference in the proportions of parts produced within specifications by the two shifts. To investigate this belief, random samples of parts that were produced on each of these shifts were selected. For the day shift, 188 of its 200 selected parts met specifications. For the night shift, 180 of its 200 selected parts met specifications.

a.) Use a 96 percent confidence interval to estimate the difference in the proportions of parts produced within specifications by the two shifts.

b.) Based on this confidence interval, do you think that the difference in the proportions of parts produced within specifications by the two shifts is significantly different from 0? Justify your answer.