1. 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 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.
Answer: C

2. A random sample of 600 adults is taken from a population of over one million, in order to compute a confidence interval for a proportion. If the researchers wanted to decrease the width of the confidence interval, they could
A. decrease the size of the population.
B. decrease the size of the sample.
C. increase the size of the population.
D. increase the size of the sample.
Answer: D

3. Which of the following quantities does not affect the width of a confidence interval?
A. The confidence level.
B. The sample proportion.
C. The sample size.
D. The population size.
Answer: D

4. In a past General Social Survey, 22% of \( n = 1006 \) respondents answered yes to the question “Are you a member of any sports groups?” A 95% confidence interval for the population proportion of Americans who belonged to a sports group at that time is 19.4% to 24.6%. Based on these results, you can reasonably conclude that
A. less than 50% of all Americans belong to sports clubs.
B. more than 50% of all Americans belong to sports clubs.
C. 22% of all Americans belong to sports clubs.
D. None of the above
Answer: A

5. A group of 50 students each measured the length of their right arm and the length of their left arm. The average right arm lengths were compared to the average left arm lengths.
A. Independent samples
B. Paired samples
Answer: A

6. What is the primary purpose of a 95% confidence interval for a mean?
A. to estimate a sample mean
B. to test a hypothesis about a sample mean
C. to estimate a population mean
D. to provide an interval that covers 95% of the individual values in the population
Answer: C

7. The confidence level for a confidence interval for a mean is
A. the probability the procedure provides an interval that covers the sample mean.
B. the probability of making a Type I error if the interval is used to test a null hypothesis about the population mean.
C. the probability that individuals in the population have values that fall into the interval.
D. the probability the procedure provides an interval that covers the population mean.
Answer: D

Questions 8 to 9: For each statement, determine if the statement is a typical null hypothesis ($H_0$) or alternative hypothesis ($H_a$).

8. There is no difference between the proportion of overweight men and overweight women in America.
   A. Null hypothesis
   B. Alternative hypothesis
   Answer: A

9. The proportion of overweight men is greater than the proportion of overweight women in America.
   A. Null hypothesis
   B. Alternative hypothesis
   Answer: B

10. Null and alternative hypotheses are statements about
    A. population parameters.
    B. sample parameters.
    C. sample statistics.
    D. it depends
    Answer: A

11. Which statement is correct about a $p$-value?
    A. The smaller the $p$-value the stronger the evidence in favor of the alternative hypothesis.
    B. The smaller the $p$-value the stronger the evidence in favor the null hypothesis.
    C. Whether a small $p$-value provides evidence in favor of the null hypothesis depends on whether the test is one-sided or two-sided.
    D. Whether a small $p$-value provides evidence in favor of the alternative hypothesis depends on whether the test is one-sided or two-sided.
    Answer: A

12. When the $p$-value is less than or equal to the designated level of 0.05, the result is called a
    A. statistically significant result.
    B. test statistic.
C. significance level.
D. none of the above.
Answer: A

13. In hypothesis testing, a Type 1 error occurs when
A. the null hypothesis is not rejected when the null hypothesis is true.
B. the null hypothesis is rejected when the null hypothesis is true.
C. the null hypothesis is not rejected when the alternative hypothesis is true.
D. the null hypothesis is rejected when the alternative hypothesis is true.
Answer: B

14. The primary purpose of a significance test is to
A. estimate the $p$-value of a sample.
B. estimate the $p$-value of a population.
C. decide whether there is enough evidence to support a research hypothesis about a sample.
D. decide whether there is enough evidence to support a research hypothesis about a population.
Answer: D

15. The level of significance associated with a significance test is the probability
A. of rejecting a true null hypothesis.
B. of not rejecting a true null hypothesis.
C. that the null hypothesis is true.
D. that the alternative hypothesis is true.
Answer: A

16. A result is called statistically significant whenever
A. the null hypothesis is true.
B. the alternative hypothesis is true.
C. the $p$-value is less or equal to the significance level.
D. the $p$-value is larger than the significance level.
Answer: C

17. The household income in a certain community is known to have a right skewed distribution with a mean of $42,000 and a standard deviation of $5,000. Without knowing the exact distribution we cannot find the probability that a randomly selected household has a yearly income less than $41,000. Suppose we randomly sample 80 incomes from this population, what is the (approximate) probability that the average income in the sample is less than $41,000?
Answer:

\[
P(\bar{x} \leq 41,000) = 0.0368 = 3.68\%
\]

18. An Anti-Smoking organization wishes to determine what percentage of students in the state of Pennsylvania smoke cigarettes at least once a day. The organization will randomly sample 2400 students. In the sample they obtain, 450 students say they smoke
cigarettes at least once a day. Calculate a 95% confidence interval for the proportion of all students in the state of Pennsylvania that smoke cigarettes at least once a day.

**Answer**

(0.172, 0.203)

19. In a recent poll of 500 13-year-olds, many indicated to enjoy their relationships with their parents. Suppose that 200 of the 13-year olds were boys and 300 of them were girls. We wish to estimate the difference in proportions of 13-year old boys and girls who say that their parents are very involved in their lives. In the sample, 93 boys and 172 girls said that their parents are very involved in their lives. What is a 96% confidence interval for the difference in proportions (proportion of boys minus proportion of girls)?

**Answer**

(−0.2015, −0.0151)

20. Many people now-a-days use e-mail to communicate with family and friends and as a primary source of communication at their job. Is there a difference between the use of e-mail for men with a college education and those without? A survey in a large city reveals that out of 230 males with a college degree, 212 use email more than twice a day. Out of the 150 without a college education, 122 use e-mail more than twice a day. What is the estimate for the difference between the proportions of men with and without a college degree who use e-mail often? Calculate a 98% confidence interval for the difference in proportions.

**Answer**

(0.0237, 0.1931)

21. A randomly selected sample of \( n = 51 \) men in Brazil had an average lifespan of 59 years. The standard deviation was 10 years. Calculate a 98% confidence interval for the average lifespan for all men in Brazil.

**Answer**

(55.6, 62.4)

22. A random sample of 800 high school boys showed that 420 had done strenuous exercise during the past year. The researcher wants to test the hypotheses below for \( p = \) the proportion of all high school boys who do strenuous exercise.

\[
H_0: p \leq 0.50 \\
H_a: p > 0.50
\]

Complete a hypothesis test for a significance level of \( \alpha = 0.05 \).

**Answer**

(1) State the null hypothesis \( (H_0) \) and the alternative hypothesis \( (H_a) \) in words.

\( H_0: \) At most 50% of high school boys do strenuous exercise.

\( H_a: \) More than 50% of high school boys do strenuous exercise.

(2) Verify necessary data conditions for a \( z \)-statistic and calculate the \( z \)-statistic.

Since \( np_0 = n(1 - p_0) = 400 \times 0.5 > 10 \), so the sample size is large enough. The sample is also a random sample.

(3) Find test statistics and the \( p \)-value.

\( z = 1.41 \)
STA 2023H
Solutions for Practice Test 4

$p$-value = 0.079.
(4) We fail to reject $H_0$ at a significance level of $\alpha = 0.05$.
(5) Report the conclusion in the context of the situation.
There is insufficient evidence to discount the possibility that the proportion of boys who to strenuous exercise is 50% or less.

23. Gun control is a sensitive issue in the US. In a survey, 650 people favored a ban on handguns out of a total of 1250 individuals polled. Do the data provide sufficient evidence to conclude that a majority of individuals in the population favor banning handguns? Complete a hypothesis test for a significance level of $\alpha = 0.01$.

Answer
(1) State the appropriate hypotheses about $p$, the population proportion of people who favor banning handguns.
$H_0: p = 0.5$, $H_a: p > 0.5$
(2) We have a random sample and $np_0 = n(1 - p_0) > 10.88$. Note that $\hat{p} = 0.52$
(3) Find the test statistic and the $p$-value.
$z = 1.414$
$p$-value = 0.079
(4) The $p$-value is not smaller than 0.05, so we cannot reject the null hypothesis.
(5) We do not have sufficient evidence to conclude that a majority of individuals favor banning handguns at a level of significance of 0.05.

24. A sample of $n = 9$ men are asked. "What's the fastest you've ever driven a car?" The sample mean is 120 mph and the standard deviation is 30. Test the null hypothesis that the population mean response is 100 mph? Complete a hypothesis test for a significance level of $\alpha = 0.01$.

Answer
$H_0: \mu = 100$
$H_a: \mu \neq 100$
(2) Unclear, needs to be a random sample from a normal population.
$t = 2$
$p$-value $= 2\text{cdf}(-10, 2, 8) = 0.0805$
Or use table in the textbook.
(4) We fail to reject $H_0$ at a level of significance of 0.01.
(5) There is not sufficient evidence to the support the conclusion that the population mean is not 100 mph.

25. A counselor wants to show that for men who are married by the time they are 30, $\mu$ = average age when the men are married is not 21 years old. A random sample of 10 men who were married by age 30 showed an average age at marriage of 22.2, with a sample standard deviation of 1.9 years. Assume that the age at which this population of men gets married for the first time is normally distributed. Complete a hypothesis test for a significance level of $\alpha = 0.05$.

Answer
(1) What are the appropriate null and alternative hypotheses?
$H_0$: $\mu = 21$ and $H_a$: $\mu \neq 21$.
(2) The population is normally distributed, the sample is random, and we are test a population mean, we use a t distribution.
(3) What is the value of the test statistic?
   \[ t = 2.00 \]
   What is the \( p \)-value?
   \[ p\text{-value} = 0.076 \]
(4) We fail to reject $H_0$ at a significance level of $\alpha = 0.05$. So the result is not statistically significant.
(5) The results are not statistically significant so there is not enough evidence to conclude average age is different from 21.