AP Statistics Name _____
Review Ch. 9

1. A university administrator in charge of computing facilities will close a computer lab if there is convincing evidence that the proportion of students at the university who have access to a computer at home is greater than .6. What hypotheses should the administrator test?

A. H_0: $\mu < .6$ H_a: $\mu = .6$
B. H_0: $\mu = .6$ H_a: $\mu > .6$
C. H_0: $p = .6$ H_a: $p > .6$
D. H_0: $p > .6$ H_a: $p = .6$
E. H_0: $p > .6$ H_a: $p < .6$

2. The manager of a large hotel must decide whether to hire additional front desk staff. He has decided to hire more staff if there is evidence that the average time customers must wait in line before being assisted with check-in is greater than 3 minutes. He decides to test H_0: $\mu = 3$ versus H_a: $\mu > 3$. Which of the following would be a consequence of making a Type II error?

A. Deciding not to hire additional staff when the wait time really is greater than 3 minutes.
B. Deciding not to hire additional staff when the wait time really is not greater than 3 minutes.
C. Deciding to hire additional staff when the wait time really is greater than 3 minutes.
D. Deciding to hire additional staff when the wait time really is not greater than 3 minutes.
E. Deciding that a wait time of greater than 3 minutes is acceptable.

3. The principal at a large high school will implement a proposed after-school tutoring program if there is evidence that the proportion of students at the school who would take advantage of such a program is greater than .10. She decides to collect data in order to test H_0: $p = .1$ versus H_a: $p > .1$. In this setting, which of the following would be a consequence of making a Type I error?

A. Implementing the program when the proportion of students who would take advantage of the program is greater than .10.
B. Not implementing the program when the proportion of students who would take advantage of the program is greater than .10.
C. Implementing the program when the proportion of students who would take advantage of the program is not greater than .10.
D. Not implementing the program when the proportion of students who would take advantage of the program is not greater than .10.
E. Deciding that it is acceptable to implement the program as long as 5% of the students would participate.

4. The marketing department of a national department store chain designs its advertising to target 18 – 24 year-olds. The marketing manager worries that the average age of the chain's customers is greater than 24, in which case the marketing plan should be reconsidered. He decides to survey a random sample of 100 customers and will use the resulting data to test H_0: $\mu = 24$ versus H_a: $\mu > 24$, where μ is the mean customer age. Suppose that the P-value from this test was .03. Which of the following is a correct interpretation of this P-value?

A. The probability that the null hypothesis is true is .03.
B. The probability that the null hypothesis is false is .03.
C. When the null hypothesis is true, the probability of seeing results as or more extreme than what was observed in the sample is .03.
D. When the null hypothesis is false, the probability of seeing results as extreme as what was observed in the sample is .03.
E. Approximately 3% of the chain's customers are older than 24.

5. In a random sample of 200 subscribers of a cooking magazine, 30 reported that they had logged on to the magazine website to download a recipe within the last month. These data were used to test the hypotheses

H_o: $p = .25$ versus H_a: $p < .25$

where p is the proportion of all subscribers who have downloaded recipes in the last month. The P-value for this test was .001. Which of the following is a correct conclusion if a significance level of .01 is used?

A. There is convincing evidence that the proportion of subscribers who have downloaded a recipe during the last month is .25.
B. There is convincing evidence that the proportion of subscribers who have downloaded a recipe during the last month is less than .25.
C. There is not convincing evidence that the proportion of subscribers who have downloaded a recipe during the last month is less than .25.
D. Because the P – value is so small, it is not possible to reach a conclusion.
E. Because the significance level of .01 is smaller than the hypothesized value of .25, the null hypothesis is not rejected.

6. Which of the following affects the power of a test?

I. The sample size
II. The significance level of the test
III. The size of the discrepancy between the actual value and the hypothesized value of the population characteristic

A. I only
B. II only
C. III only
D. I and II only
E. I, II and III

7. Assuming the same significance level is used, how does increasing the sample size from 50 to 100 affect the power of a test?

A. The power decreases.
B. The power increases.
C. The power does not change.
D. The power will change, but it might either decrease or increase.
E. It is not possible to predict whether the power will increase, decrease, or remain the unchanged.

8. Assuming the same sample size is used, how does changing the significance level from .05 to .01 affect the power of a test?

A. The power decreases.
B. The power increases.
C. The power does not change.
D. The power will change, but it might either decrease or increase.
E. It is not possible to predict whether the power will increase, decrease, or remain the unchanged.

9. In a test of H_0: $\mu = 100$ versus H_a: $\mu > 100$, the power of the test will be lowest when the true value of the population mean is

A. 101
B. 110
C. 120
D. 200
E. The power will be the same for any value greater than 100.

10. For which sample size and choice of significance level will the power of a test be greatest?

A. $n = 10$, $\alpha = .1$
B. $n = 10$, $\alpha = .01$
C. $n = 100$, $\alpha = .1$
D. $n = 100$, $\alpha = .05$
E. $n = 100$, $\alpha = .01$

11. A psychologist runs a study and reports her results were statistically significant at the 0.05 level. This result means which of the following?

A. The P-value calculated was smaller than the α level of 0.05.
B. The P-value calculated was larger than the α level of 0.05.
C. The α level calculated was larger than 0.05.
D. The α level calculated was smaller than 0.05.
E. There is insufficient information to make a decision.

12. A Type I error occurs in which of the following?

A. The H_a is rejected when it should not be rejected.
B. The H_0 is not rejected when it should be rejected.
C. The H_0 is rejected when it should not be rejected.
D. The P-value is too small to reject the H_0.
E. The α level is too small to reject H_0.

13. A Type II error occurs in which of the following?

A. The H_0 is rejected when it should not be rejected.
B. The H_0 is not rejected when it should be rejected.
C. The H_a is not rejected when it should be rejected.
D. The P-value is too small to reject the H_0.
E. The α level is too small to reject H_0.

14. A graduate student at a wealthy university wanted to study the amount of money typical college students carry in their pocket at his university. A recent study said that the average student carries $31 at any given time so he sets out to see if students at his campus actually have more money. What would be a consequence of a Type II error in his study?

A. This would lead to the wrong idea that students on his campus did routinely have more spending money at any time.
B. This would lead to the correct idea that students on his campus had more money on them at any time.
C. This would lead to the correct idea that students on his campus carry more than $31 on average.
D. This would lead to the wrong idea that students on his campus were like other campuses and only carry $31 on average when they really carry more.
E. This would lead to the wrong idea that students on all campuses carry less than $31 on average when they actually carry $31.

15. An animal rights group has been very supportive of a new silicon product that caps the nails on cats instead of surgically declawing the pets. The company who makes the caps claims they last for an average of 69 days before needing to be replaced. Before publically advertising their support of the product, the animal rights group plans to run a test to see if the caps last less than 69 days. What would be the appropriate hypotheses for this study?

A. H_0: $\mu = 69$ days, H_a: $\mu > 69$ days
B. H_0: $\mu = 69$ days, H_a: $\mu < 69$ days
C. H_0: $\mu = 69$ days, H_a: $\mu \neq 69$ days
D. H_0: $\bar{x} = 69$ days, H_a: $\bar{x} > 69$ days
E. H_0: $\bar{x} = 69$ days, H_a: $\bar{x} < 69$ days

16. The prom committee is debating about changing the location of the prom for this year to a better location. In order to do this, they must have at least 46% of the class in attendance. A preliminary survey of students showed 25 of 52 students would attend if the site changed. Assuming they have a large enough sample to run a test, what would their null and alternative hypothesis look like?

A. H_0: $\mu = 46\%$, H_a: $\mu > 46\%$
B. H_0: $\mu = 46\%$, H_a: $\mu \neq 48\%$
C. H_0: $p = 46\%$, H_a: $p > 46\%$
D. H_0: $p = 46\%$, H_a: $p \neq 46\%$
E. H_0: $p = 46\%$, H_a: $p > 48\%$

17. A consumer group claims that more than 60% of the teens driving after 10 p.m. are exceeding the speed limit. What would be an appropriate hypothesis for this group to use to study this?

A. The null hypothesis that less than 60% of the teens are exceeding the speed limit.
B. The null hypothesis that more than 60% of the teens are exceeding the speed limit.
C. The alternative hypothesis that less than 60% of the teens are exceeding the speed limit.
D. The alternative hypothesis that less or equal to 60% of the teens are exceeding the speed limit.
E. The alternative hypothesis that more than 60% of the teens are exceeding the speed limit.

18. True or False. If the null hypothesis is not rejected, there is strong statistical evidence that the null hypothesis is true.

19. The one sample t statistic from a sample of $n = 19$ observations for the two-sided test of H_0: $\mu = 6$, H_a: $\mu \neq 6$ 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) $0.025 < P\text{-value} < 0.05$.
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 $\alpha = 0.10$.

20. The heights (in inches) of males in the United States are believed to be normally distributed with mean μ. 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 21 through 24:

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 μ. Do the observed data represent evidence that μ has changed from its value of 7.5 years of 20 years ago? To determine this, we test the hypotheses H_0: $\mu = 7.5$, H_a: $\mu \neq 7.5$ using the one-sample t test.

21. The appropriate degrees of freedom for this test are
    A) 9. B) 10. C) 19. D) 99. E) 100.

22. 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.

23. A 95% confidence interval for the mean number of years μ 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.

24. 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.

Use the following to answer questions 25 and 26:

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 μ. 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.

25. 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.

26. 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.

27. We wish to see if the dial indicating the oven temperature for a certain model oven is properly calibrated. Four ovens of this model are selected at random. The dial on each oven is set to 300° F. After one hour, the actual temperature of each oven is measured. The temperatures observed are 305°, 310°, 300°, and 305°. Assuming that the actual temperatures for this model when the dial is set to 300° are normally distributed with mean μ, we test whether the dial is properly calibrated by testing the hypotheses H_0: $\mu = 300$, H_a: $\mu \neq 300$. Based on the data, the value of the one-sample *t* statistic is
    A) 5. B) 4.90. C) 2.82. D) 2.45. E) 1.23.

28. The water diet requires the dieter to drink two cups of water every half hour from when he gets up until he goes to bed, but otherwise allows him to eat whatever he likes. Four adult volunteers agree to test the diet. They are weighed prior to beginning the diet and after six weeks on the diet. The weights (in pounds) are

Person	1	2	3	4
Weight before the diet	180	125	240	150
Weight after six weeks	170	130	215	152

For the population of all adults, assume that weight loss (in pounds) after six weeks on the diet (weight before beginning the diet – weight after six weeks on the diet) is normally distributed with mean μ. To determine if the diet leads to significant weight loss, we test the hypotheses H_0: $\mu = 0$, H_a: $\mu > 0$. Based on these data,

A) we would not reject H_0 at significance level 0.10.
B) we would reject H_0 at significance level 0.10 but not at level 0.05.
C) we would reject H_0 at significance level 0.05 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.

Use the following to answer questions 29 and 30:

An inspector inspects large truckloads of potatoes to determine the proportion p in the shipment with major defects prior to using the potatoes to make potato chips. Unless there is clear evidence that this proportion is less than 0.10, the inspector will reject the shipment. To reach a decision, she will test the hypotheses H_0: $p = 0.10$, H_a: $p < 0.10$ using the large sample test for a population proportion. She selects an SRS of 100 potatoes from the shipment of over 2000 potatoes on a truck. Suppose that only four of the potatoes sampled are found to have major defects.

29. Referring to the information above, the P-value of the test is
A) 0.4544. B) 0.0456. C) 0.0228. D) 0.0011. E) less than 0.0002.

30. Referring to the information above, which of the following assumptions for inference about a proportion using a hypothesis test is violated?
A) The data are an SRS from the population of interest.
B) The population is at least 10 times as large as the sample.
C) The confidence level is not stated.
D) n is so large that both np_0 and $n(1 - p_0)$ are 10 or more, where p_0 is the proportion with major defects if the null hypothesis is true.
E) There appear to be no violations.

Use the following to answer questions 31 and 32:

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 that had a child within the first two years of marriage. Following up on these couples, she finds that 80 couples are divorced within five years.

31. Referring to the information above, a 90% confidence interval for the proportion p of all couples that had a child within the first two years of marriage and are divorced within five years is
    A) 0.40 ± 0.004. B) 0.40 ± 0.035. C) 0.40 ± 0.044. D) 0.40 ± 0.057.
    E) 0.40 ± 0.068.

32. Referring to the information above, in order to determine if having children within the first two years of marriage *increases* the divorce rate, we should
    A) test the hypotheses H_0: $p = 0.50$, H_a: $p \neq 0.50$.
    B) test the hypotheses H_0: $p = 0.40$, H_a: $p \neq 0.40$.
    C) test the hypotheses H_0: $p = 0.40$, H_a: $p > 0.40$.
    D) test the hypotheses H_0: $p = 0.50$, H_a: $p > 0.50$.
    E) do none of the above.

Free Response

1. In the bridal gown industry, the manufacturers claim that the average amount spent for a gown in the past five years is $1,012. A local bridal shop in an urban community has noticed their more expensive gowns are not selling lately. Instead, the brides seem to be selecting only lower priced gowns or clearance gowns. The shop suspects their market is looking for less expensive gowns. Over the past 3 months, they have randomly sampled 50 sales and found their average price to be $985 with a standard deviation of $235.

Based on this study, is there evidence that the amount spent in their area is less than the national market? Perform the significance test, make sure you use the 4-step process.

2. A local school district has had increased skipping on the last day of school for several years by their senior class. This has presented problems for students with graduation, makeup work, and more. Over the past 5 years, 39% of the seniors have skipped. This year, they tried a new reward program sponsored by local businesses where seniors at one of the schools had opportunities to win very nice prizes by the end of the day as a combination last day and senior fest. This year, only 129 of the 398 seniors were absent on the final day. School officials are trying to determine if this would be a program to implement district-wide to improve senior class attendance on the final school day.

a. State the hypotheses of interest for this study.

b. Identify the appropriate test and verify the conditions that must be met. Perform the hypothesis test with $\alpha = .05$.

c. Identify a Type I error and one consequence of this error for the district.

d. Identify a Type II error and one consequence of this error for the district.

Answers

1. C	2. A	3. C	4. C	5. B	6. E	7. B
8. A	9. A	10. C	11. A	12. C	13. B	
14. D	15. B	16. C	17. E	18. False	19. A	20. D
21. D	22. C	23. C	24. A	25. B	26. C	27. D
28. A	29. C	30. E	31. D	32. E		

Free Response

1. Population: A bridal gowns. Parameter: Mean amount spent on bridal gowns.
Hypothesis: Ho: $\mu = \$1012$ Ha: $\mu < \$1012$

Conditions: The problems states this was a random sample of purchases
Since 50 >30 the sample is large enough for the CLT to be used.
Population of wedding dresses is more than 500.

T-test Statistic: $t = -0.81$
P-value: $p = 0.21$

Conclusion: Since the P-value of 0.21 is not smaller than .05, there is insufficient evidence to suggest the market for bridal wear in this community is any different than than the national market. In other words, there is insufficient evidence to doubt that the average amount spent in this community is equal to the national average of $1,012. We fail to reject the null hypothesis.

2. a. Ho: $p = .39$ Ha: $p < .39$

b. This is a 1-sample proportions test where $\hat{p} = .32$.

Conditions: No mention of SRS, we are making the assumption that the seniors in the chosen school represent all seniors in the district.
Normality: $398(.39) > 10$ and $398(1 - .39) > 10$
Independence: # of seniors is greater than 10(398). We are making this assumption, proceed with caution.

z-test statistic: $z = -2.69$ p-value: $p = .0035$

Conclusion: Since the p-value is less than .05,we have sufficient evidence to reject the null that the proportion of seniors skipping is 39% in favor of the alternative, that with the incentives the percent of seniors skipping is less than 39%..

c. A type I error would occur if the district rejects the null that 39% of the seniors will skip and favors that this program lowered the skip rate, when in fact it did not lower it. A consequence would be spending a great deal of time and effort raising this business support only to find it really doesn't effect a significant amount of change in the percent of seniors who skip.

d. A type II error would occur if the district fails to reject the null when it was false. The district feels the incentive program is not lowering the skip rate when it really is. A consequence would be that they had found an effective program and they wouldn't pursue it thinking it did not work.