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

$$H_o\text{: } p = .25 \text{ versus } H_a\text{: } p < .25$$

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. 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: $p > .48$

16. 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.

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

Use the following to answer questions 18 and 19:

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.

18. Referring to the information above, the P-value of the test is:

a. 0.4544 b. 0.0456 c. 0.0228 0.0011 e. less than 0.002

19. Referring to the information above, which of the following assumptions for inference about a propotion 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 answers questions 20 and 21.

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. (Note: the overall divorce rate is 50%)

20. A 90% confidence interval for the proportion p of all couples that had a child withing the first two years of marriage and are divorced withing 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

21. 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

22. A manufacturer of balloons claims that p, the proportion of its balloons that burst when inflated to a diameter of up to 12 inches, is no more than 0.05. Some customers have complained that the balloons are bursting more frequently. If the customers want to conduct an experiment to test the manufacturer's claim, which of the following hypotheses would be appropriate?

a. Ho: $p > 0.05$, Ha: $p = 0.05$
b. Ho: $p = 0.05$, Ha: $p > 0.05$
c. Ho: $p = 0.05$, Ha: $p \neq 0.05$
d. Ho: $p = 0.05$, Ha: $p < 0.05$
e. Ho: $p < 0.05$, Ha: $p = 0.05$

23. A consulting statistician reported the results from a learning experiment to a psychologist. The report stated that on one particular phase of the experiment a statistical test result yielded a p-value of 0.24. Based on this p-value, which of the following conclusions should the psychologist make?

a. The test was statistically significant because a p-value of 0.24 is greater than a significance level of 0.05.
b. The test was statistically significant because p = 1 - 0.24 = 0.76 and this is greater than a significance level of 0.05.
c. The test was not statistically significant because 2 times 0.24 = 0.48 and that is less than 0.5.
d. The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 24% of the time.
e. The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 76% of the time.

24. As lab partners, Sally and Betty collected data for a significance test. Both calculated the same z-test statistic, but Sally found the results were significant at the $\alpha = 0.05$ level while Betty found that the results were not. When checking their results, the women found that the only difference in their work was that Sally had used a two-sided test, while Betty used a one-sided test. Which of the following could have been their test statistic?

a. -1.980 b. -1.690 c. 1.340 d. 1.690 e. 1.780

25. An independent research firm conducted a study of 100 randomly selected children who were participating in a program advertised to improve mathematics skills. The results showed no statistically significant improvement in mathematics skills, using $\alpha = 0.05$. The program sponsors complained that the study had insufficient statistical power. Assuming that the program is effective, which of the following would be an appropriate method for increasing power in this context.

a. Use a two-sided test instead of a one-sided test.
b. Use a one-sided test instead of a two-sided test.
c. Use $\alpha = 0.01$ instead of $\alpha = 0.05$.
d. Decrease the sample size to 50 children.
e. Increase the sample size to 200 children.

26. An environmental scientist wants to test the null hypothesis that an antipollution device for cars is not effective. Under which of the following conditions would a Type I error be committed?

a. The scientist concludes that the antipollution device is effective when it actually is not.
b. The scientist concludes that the antipollution device is not effective when it actually is.
c. The scientist concludes that the antipollution device is effective when it actually is.
d. The scientist concludes that the antipollution device is not effective when it actually is not.
e. A Type I error cannot be committed in this situation.

27. An experimenter conducted a two-tailed hypothesis test on a set of data and obtained a p- value of 0.44. If the experimenter had conducted a one-tailed test on the same set of data, which of the following is true about the possible p-value(s) that the experimenter could have obtained?

a. The only possible p-value is 0.22.
b. The only possible p-value is 0.44.
c. The only possible p-value is 0.88.
d. The possible p-values are 0.22 and 0.78.
e. The possible p-values are 0.22 and 0.88.

28. A soup manufacturer is deciding which company to use for their mushroom shipments. A random sample of each company's mushrooms showed that out of 30 cases each, 30% of the mushrooms where damaged from one company and 35 % from the other company. What assumption appears to be a concern for running this test?

a. We don't know that they are random samples from both companies.
b. Unsure if the population of mushrooms needed would be larger than 10% of the sample size (that is, more than 30 cases)
c. $0.30(30) < 10$
d. $0.35(30) > 10$
e. $0.30(70) > 10$

Free Response

29. A school districts in North Carolina have noticed increased skipping on the last day of school for several years by senior classes. This has presented problems for students with graduation, makeup work, and more. Over the past 5 years, 39% of NC seniors have skipped. This year, state officials tried a new reward program sponsored by local businesses where seniors at some 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 randomly selected seniors were absent on the final day. School officials are trying to determine if this would be a program to implement state-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.

30. A recent study of young voters showed the percentage of women and men changing their political affiliation. A news agency believes that more young males have changed parties based on their recent study where 58 out 248 women claimed to change parties and 120 of 387 men claimed to have changed political affiliation.

a. Is there convincing evidence to support the news agency's claim that more young male voters are changing their political affiliation? Carry out an appropriate test to help answer this question.

b. What type of error could you have made, Type I or II? Discuss this in context to problem.

c. Construct and interpret a 99% confidence level for the difference in population proportions.

Answer Key

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. c	16. e
17. false	18. c	19. e	20. d	21. d	22. b	23. d	24. a
25. e	26. a	27. d	28. c				

29. a. **State:** Ho: $p = .39$ Ha: $p < .39$

b. **Plan:** This is a 1-sample proportions test where $\hat{p} = .32$.
Conditions: Random sample of 398 seniors was taken.
Normality: $398(.39) > 10$ and $398(1 - .39) > 10$
Independence: $398 < ..1$(all NC seniors)

Do: $\hat{p} = 0.32$ 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 state 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 state 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.

30. **State:** We want to do a 2 sample z-test for the hypotheses Ho: $p_W - p_M = 0$ and Ha: $p_W - p_M < 0$ where p_W is the proportion of women voters changing affiliation and p_M is the proportion of men voters changing affiliation, we will use $\alpha = .05$.

Plan: SRS – Assuming the samples were randomly selected, Independence (10%) – 248 is less than 10% of women voters and 387 is less than 10% of men voters. Normality (Large Count)-- $\hat{p}_c = .28$; 248(.28), 248(.72), 387(.28) and 387(.72) are all more than 10.

Do: z = -2.09 and P-value = .018

Conclude: There is strong evidence to reject the null since P-value < .05, we have sufficient evidence that the proportion of men voters who change party affiliation is greater than the proportion of women voters who change party affiliation.

b. We could have possibly made a Type I error. We rejected the null and shouldn't have. We think that the proportion of male voters who change affiliation is greater than the proportion of women voters who change and this is not the case.

c. **State:** We want to construct a 2 sample z interval with 99% confidence, same parameters as part a. (Remember we are looking at $p_w - p_m$)

Plan: same as part a. Except the Large Count is $\hat{p}_w = .23$ and $\hat{p}_m = .31$; 248(.23), 248(.77), 387(.31) and 387(.69) are all more than 10.

Do: (-.16, .016).

Conclude: We are 99% confident that the interval -.16 to 0.016 captures the true difference in the proportion of men voters who change affiliation and the proportion of women voters who change affiliation.