Test 12B AP Statistics Name:

Directions: Work on these sheets. Answer completely, but be concise. *Tables are attached.*

Part 1: Multiple Choice. *Circle the letter corresponding to the best answer.*

1. 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 80 couples are divorced within five years.

To determine if having children within the first two years of marriage increases the divorce rate 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: $p = 0.40$, H_a: $p > 0.40$.
(e) none of the above.

2. In order to study the amounts owed to a particular city, a city clerk takes a random sample of 16 files from a cabinet containing a large number of delinquent accounts and finds the average amount $\bar{x}$ owed to the city to be \$230 with a sample standard deviation of \$36. It has been claimed that the true mean amount owed on accounts of this type is greater than \$250. If it is appropriate to assume that the amount owed is a Normally distributed random variable, the value of the test statistic appropriate for testing the claim is
(a) -3.33 (b) -1.96 (c) -2.22 (d) -0.55 (e) -2.1314

3. 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, she 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. To do so, she selects an SRS of 50 potatoes from the more than 2000 potatoes on the truck. Suppose that only two of the potatoes sampled are found to have major defects.

Which of the following conditions for inference about a proportion using a hypothesis test are 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) 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.
(d) There appear to be no violations.
(e) More than one condition is violated.

4. What is the value of t^*, the critical value of the t distribution with 8 degrees of freedom, which satisfies the condition that the probability is 0.10 of being larger than t^*?
(a) 1.415 (b) 1.397 (c) 1.645 (d) 2.896 (e) 0.90

5. The water diet requires one to drink two cups of water every half hour from when one gets up until one goes to bed, but otherwise allows one to eat whatever one 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 the weight loss 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 weight loss, we test the hypotheses

$$H_0: \mu = 0, H_a: \mu > 0$$

Based on these data we conclude that
(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 0.05.
(c) we would reject H_0 at significance level 0.05 but not at 0.01.
(d) we would reject H_0 at significance level 0.01.
(e) the sample size is too small to allow use of the *t* procedures.

6. Because *t* procedures are robust, the most important condition for their use is
(a) the population standard deviation is known
(b) the population distribution is exactly Normal
(c) the data can be regarded as an SRS from the population
(d) np and $n(1 - p)$ are both at least 10
(e) there are no outliers in the sample data

7. Which of the following 95% confidence intervals would lead us to reject $H_0 : p = 0.30$ in favor of $H_a : p \neq 0.30$ at the 5% significance level?
(a) (0.30, 0.38) (b) (0.19, 0.27) (c) (0.27, 0.31) (d) (0.24, 0.30)
(e) None of these

8. A medical researcher wishes to investigate the effectiveness of exercise versus diet in losing weight. Two groups of 25 overweight adult subjects are used, with a subject in each group matched to a similar subject in the other group on the basis of a number of physiological variables. One of the groups is placed on a regular program of vigorous exercise but with no restriction on diet, and the other is placed on a strict diet but with no requirement to exercise. The weight losses after 20 weeks are determined for each subject, and the difference between matched pairs of subjects (weight loss of subject in exercise group – weight loss of matched subject in diet group) is computed. The mean of these differences in weight loss is found to be -2 lb with standard deviation $s = 4$ lb. Is this evidence of a difference in mean weight loss for the two methods? To answer this question, you should use
(a) one-proportion *z* test
(b) one-sample *t* test
(c) one-sample *z* test
(d) one-proportion *z* interval
(e) one-sample *t* interval

Part 2: Free Response

Communicate your thinking clearly and completely.

9. Publishing scientific papers online is fast, and the papers can be long. Publishing in a paper journal means that the paper will live forever in libraries. The *British Medical Journal* combines the two: it prints short and readable versions, with longer versions available online. Is this OK with authors? The journal asked a random sample of 104 of its recent authors several questions. One question was "Should the journal continue using this system?" In the sample, 72 said "Yes."

(a) Do the data give good evidence that more than two-thirds (67%) of authors support continuing this system? Carry out an appropriate test to help answer this question.

10. "I can't get through my day without coffee" is a common statement from many students. Assumed benefits include keeping students awake during boring lectures and making them more alert for exams and tests. But this is purely anecdotal evidence, and firmer data are needed. Students in an introductory statistics class designed an experiment to measure memory retention with and without drinking a cup of coffee 1 hour prior to a test.

This experiment took place on two different days over the course of a week (Monday and Wednesday). Ten students were used. Each student received no coffee or 1 cup of coffee, one hour before the test on a particular day. The test consisted of a series of words flashed on a screen, after which the student had to write down as many of the words as possible. On the other day, each student received a different amount of coffee (none or 1 cup).

(a) One of the researchers suggested that all of the subjects in the experiment drink no coffee before Monday's test and one cup of coffee before Wednesday's test. Explain to the researcher why this is a bad idea and suggest a better method of deciding when each subject receives the two treatments.

(b) The data from the experiment are provided in the table below. Set up and carry out an appropriate test to determine the effect of drinking coffee on memory.

Student	No cup	1 cup
1	24	25
2	30	31
3	22	23
4	24	24
5	26	27
6	23	25
7	26	28
8	20	20
9	27	27
10	28	30

Answers to Chapter 12 Practice Test B

Test 12B

1. (e) 2. (c) 3. (c) 4. (b) 5. (a) 6. (c) 7. (b) 8. (b) 9. (a) ***Step 1:*** The population of interest is BMJ authors. We want to test $H_0: p = 0.67$ vs. $H_a: p > 0.67$, where p is the proportion of authors who would agree that the journal should continue its system. ***Step 2:*** SRS—The 104 authors were a random sample of recent authors but not necessarily an SRS of all BMJ authors. Normality—$np_0 = 69.68, n(1-p_0) = 34.32$; both of which are at least 10. Independence—There must be at least 10(104) = 1040 BMJ authors in the population. ***Step 3:*** The sample proportion $\hat{p} = 72/104 = 0.692$ and the test statistic is $z = (0.692 - 0.67)/\sqrt{(0.67)(0.33)/104} = 0.477$ and the P-value is 0.3156. The TI calculator gives $z = 0.484$ and a P-value of 0.314. ***Step 4:*** Because of this large P-value, there is insufficient evidence to reject H_0. We cannot conclude that more than 67% of all BMJ authors support continuing this system.

10. (a) The researchers' method would favor the scores obtained on Wednesday's test after having a cup of coffee. It would have been the second time the students took the test, so the students may be less nervous, know what to expect, and do better irrespective of the treatment they receive that day. A better method would be to randomly assign the order (for instance, by flipping a coin) of the treatments; either drinking coffee or not drinking coffee for each subject. (b) ***Step 1:*** Let $H_0: \mu = 0$ vs. $H_a: \mu \neq 0$ where μ = the mean difference of all student memory scores (coffee – no coffee). The sample differences are: 1, 1, 1, 0, 1, 2, 2, 0, 0, 2. ***Step 2:*** SRS—We must assume that these students are representative of all students. We know that the treatments were randomly assigned. Normality—A plot shows no outliers so we feel safe assuming Normality of the population. Independence—We need the 10 differences in test scores to be independent. ***Step 3:*** $\bar{x}_{diff} = 1$, $s_{diff} = 0.816$, and the test statistic is $t = (1 - 0)/(0.816/\sqrt{10}) = 3.88$ (df = 9); $0.002 < P\text{-value} < 0.005$ (TI-calculator gives P-value = 0.004). ***Step 4:*** With such a small P-value, H_0 should be rejected. There is enough evidence to show that there is a significant difference in memory scores between drinking coffee and not drinking coffee.