

I. Multiple Choice, True/False, Short Answer. (Multiple choice questions are 4 points each, others as indicated - 47 points total)

1. In order to determine if smoking causes cancer, researchers surveyed a large sample of adults. For each adult they recorded whether the person had smoked regularly at any period in their life and whether the person had cancer. They then compared the proportion of cancer cases in those who had smoked regularly at some time in their lives with the proportion of cases in those who had never smoked regularly at any point in their lives. The researchers found that there was a higher proportion of cancer cases among those who had smoked regularly than among those who had never smoked regularly. What type of study is this? (circle one)

- (a) An observational study. (b) A double-blind experiment.
(c) A block design. (d) An experiment, but not a double-blind experiment.

2. Bob has a severe cold. His roommate takes a garlic tablet every morning and has not had a cold in two years. Bob's aunt also has a friend who takes garlic tablets daily and has not had a cold in more than a year. Based on these data, Bob decides to start taking garlic tablets as soon as his cold clears up. What type of study is Bob's decision based on? (circle one)

- (a) An experiment. (b) An observational study based on available data.
(c) Anecdotal evidence. (d) An observational study based on a sample survey.

3. If we want to compute an 86% confidence interval for a population mean, then the value of z^* (rounded to three decimal places) will be: (circle one)

- (a) 1.080 (b) 1.476 (c) 1.645 (d) None of the above

4. Hoping to attract more shoppers, a city is planning to build a new public parking garage downtown. The city plans to pay for the structure through parking fees. The consultant, who is advising the city on this project, has selected a simple random sample of 44 weekdays and calculated the average amount in fees collected from neighboring parking structures. The sample mean was \$967. Which of the following scenarios would lead to the smallest margin of error? (circle one)

- (a) Sample fewer days, so that the sample mean may be lower than \$967 and the margin of error will be smaller as well.
(b) Sample more days. With more days we have more data and our estimate is expected to be more accurate, leading to a smaller margin of error.
(c) Stay with a sample size of 44 days. This sample size was used for a reason, which was most likely to reduce the margin of error.
(d) None of the above.

I. Multiple Choice, True/False, Short Answer, continued.

5. The test statistic for a two-sided significance test for a population mean is $z = -1.37$. What is the corresponding p -value?

- (a) 0.1707 (b) 0.8293 (c) 0.4147 (d) 0.0853

6. Write “true” or “false” next to each statement according to which is correct. (3 points each – 6 points total)

_____ The margin of error for a 95% confidence interval for the mean μ increases as the sample size decreases.

_____ The margin of error for a confidence interval for the mean μ , based on a specified sample size n , increases as the confidence level decreases.

7. For each of the following scenarios, write “yes” in the blank next to the scenario if the binomial distribution is the appropriate distribution for the random variable X , otherwise write “no”: (2 points each – 6 points total)

_____ A fair coin is flipped ten times. Let X = the number of times the coin comes up tails.

_____ A fair coin is flipped multiple times. Let X = the number of times the coin needs to be flipped until we see ten tails.

_____ There are ten people in the room: five men and five women. Three people are to be selected at random to form a committee. Let X = the number of men on the three-person committee.

8. Suppose a multiple choice test has 30 questions, each with 5 possible answers and a rather unprepared student decides to randomly guess the answers to all 30 questions. Let X be the number of questions the student answers correctly on the test. Then X has a binomial distribution with the parameters $n =$ _____ and $p =$ _____. (3 points each – 6 total)

9. Weight is a measure that tends to be normally distributed. Suppose the mean weight of all women at a large university is 135 pounds, with a standard deviation of 12 pounds. If you were to randomly sample 9 women at the university, there would be a 68% chance that the **sample mean weight** would be between: (circle one)

- (a) 119 and 151 pounds. (b) 125 and 145 pounds. (c) 123 and 147 pounds.
(d) 131 and 139 pounds. (e) 133 and 137 pounds.

10. What are the appropriate null and alternative hypotheses to answer the following question: Is the mean height for all adult American males between the ages of 18 and 21 still less than 6 feet? Let μ represent the population mean height of all adult American males between the ages of 18 and 21. (5 points)

Problem II. A one-question survey is to be distributed to a random sample of 1000 adults in Ohio. The question asks if they support a decrease in the state sales tax from 5% to 4%, with the lost revenue coming from the education budget. Let \hat{p} denote the proportion of adults in the sample who say they support the decrease and let X denote the number in the sample who support the increase. Suppose that 47% of *all* adults in Ohio actually support the increase. Please answer the following: (21 points total)

(a) If 450 voters in the sample support the increase, then complete the table to the right. (2 points each, 12 points total)

Symbol	Value	Parameter or Statistic?
p		
X		
\hat{p}		

(b) On average, how many voters in the sample do you expect to support the tax increase? (4 points)

(c) How likely is it that at least 50% of the voters in the random sample will favor the tax increase? Clearly indicate how you compute this value and show all calculator input. Clearly indicate your answer. (5 points)

Problem III. A nationally distributed college newspaper conducts a survey among students nationwide every year. This year, responses from a simple random sample of 204 college students to the question “About how many CDs do you own?” resulted in a sample mean $\bar{x} = 72.8$. Based on data from previous years, the editors of the newspaper will assume that $\sigma = 7.2$. (16 points total)

(a) Use the information given to obtain a 95% confidence interval for the mean number of CDs owned by all college students. Please show all calculator input. (4 points)

(b) Write an English sentence clearly explaining the meaning of the confidence interval you found in part (a). (4 points)

(c) Answer each of the following questions with yes, no, or can't tell. (2 points each – 4 total)

- Does the sample mean lie in the 95% confidence interval? _____
- Does the population mean lie in the 95% confidence interval? _____

Problem III, continued.

(d) Suppose we wish to calculate a 90% confidence interval for the mean number of CDs owned by all college students and we want the confidence interval to have a margin of error of 2 CDs. How many students would we need to sample to achieve this margin of error? Please show all work. (4 points)

Problem IV. An agricultural researcher wants to test the yield on a new variety of yellow corn. She plants 25 plots with the new variety. The average yield for these 25 plots is 150 bushels per acre. Assume that the yield per acre for the new variety of yellow corn follows a normal distribution with unknown mean μ . The current variety of yellow corn being grown by farmers has a mean yield per acre of 147 bushels per acre with a standard deviation of 10 bushels per acre. The researcher conducts the following hypothesis test: $H_0 : \mu = 147$, $H_a : \mu > 147$. Please answer the following questions. (16 points total)

(a) Find the value of the researcher's test statistic. Clearly indicate any assumptions you make. You must clearly indicate all calculator input. (5 points)

(b) What is the p -value of the researcher's test? Draw a graph that shows the test statistic computed in part (a) and the p -value of the test. (4 points)

(c) What is your conclusion in terms of the hypotheses given above? Use an alpha level of 0.10 to justify your answer. (3 points)

(d) Write an English sentence explaining the results of this test in the context of the problem. You should correctly (in a statistical sense) use the word "significant" in your explanation. (4 points)