

Questions 1-4 are multiple choice. Circle the letter of the best response. [4 pts each]

1. A significance test is used to prevent a machine from under filling or overfilling quart bottles of oil. On the basis of a sample, the null hypothesis is rejected and the machine is shut down for inspection. A thorough examination reveals there is nothing wrong with the filling machine. From a statistical point of view:
 - a) A Type II error was made.
 - b) A Type I error was made.
 - c) A correct decision was made.
 - d) Both Type I and Type II errors were made.

2. A researcher was interested in comparing the salaries of female and male employees of a particular company. Independent random samples of female employees (sample 1) and male employees (sample 2) were taken to calculate the mean salary, in dollars per week, for each group. A 90% confidence interval for the difference, $\mu_1 - \mu_2$ between the mean weekly salary of all female employees and the mean weekly salary of all male employees was determined to be $(-\$110, \$10)$.
 - a) We know that 90% of female employees at this company make between \$110 less and \$10 more than the male employees.
 - b) We know that 90% of all random samples done on the employees at this company will show that the average female salary is between \$110 less and \$10 more per week than the average male salary.
 - c) We are 90% confident that a randomly selected female employee at this company makes between \$110 less and \$10 more per week than a randomly selected male employee.
 - d) Based on these data, with 90% confidence, female employees at this company average between \$110 less and \$10 more per week than the male employees.

3. Suppose you are conducting a test of significance at the $\alpha = 0.05$ level. You get a P -value of 0.01 and make the appropriate conclusion. What is the probability of making a type I error in this case?
 - a) 0.01
 - b) 0.05
 - c) 0.95
 - d) 0.99

4. I conduct a significance test and find that I am able to conclude that the alternative hypothesis is true at a significance level of $\alpha = .05$. I may also conclude:
 - a) The test would also be significant at level $\alpha = .01$
 - b) The test would also be significant at level $\alpha = .10$
 - c) Both a) and b) are true.
 - d) Neither a) nor b) are true.

5. Offspring of a certain fruit fly can have yellow or ebony bodies and normal or short wings. Genetic theory predicts these traits will appear in a ratio of 9:3:3:1. (9/16 of them will be yellow-normal, 3/16 will be yellow-short, 3/16 will be ebony-normal, and 1/16 will be ebony-short.) A researcher checks 100 such flies and finds the distribution of traits to be 59, 20, 11, and 10 respectively. [14 pts.]

a) Assuming the frequencies of the traits were distributed according to genetic theory, what would those expected counts be?

yellow-normal = _____, yellow-short = _____, ebony-normal = _____, ebony-short = _____

b) Test at the $\alpha = 0.05$ level to determine if the body and wing traits of the flies are not distributed according to the genetic model.

i) State the null and alternative hypotheses.

ii) Find the test statistic and P -value.

iii) State the conclusion in words.

6. In a study done here on campus, students were asked if they break parietals. It was found that 15 out of 40 female students answered yes and 22 out of 40 males answered yes. Find a 95% confidence interval for the difference in the proportions of Hope male students that break parietals and female students that break parietals (or at least say they do)? Assume these proportions are accurate and come from simple random samples. [10 pts.]

7. It is often said that the mean heart rate for adults is 72 beats per minute. You want to see if the mean rate is different than 72 beats per minute. From a random sample of 30 people you find that they have a mean heart rate of $\bar{x} = 74.5$ and a standard deviation of $s = 8.71$. From this, can you conclude that the mean heart rate of all adults is not 72 beats per minute? Test this at the 5% significance level. [12 pts]
- State the null and alternative hypotheses.
 - Find the test statistic and P -value.
 - State the conclusion in words.
8. Do a majority of all female Hope freshmen have at least one credit card? To answer this question, some student researchers collected data from 42 female Hope freshmen. They found that 27 of them had at least one credit card. Assume the statistics came from a random sample and are accurate. Test at the 5% significance level to determine if a majority of all female Hope freshmen have at least on credit card. [12 pts.]
- State the null and alternative hypotheses.
 - Find the test statistic and P -value.
 - State the conclusion in words.

9. Is it faster to get your Starbucks coffee by going through the drive-thru or ordering it inside at the counter? A student researcher investigated this question by observing costumers at the Starbucks north of Holland. She measured the time it took from the time a customer began an order to the time the order was received. She found that the 24 in-store customers had a mean time of 62.7 seconds and the standard deviation was 15.8 seconds. The 24 drive-thru customers had a mean time of 107.8 seconds with a standard deviation of 28.7 seconds. From this can we conclude that ordering Starbucks coffee inside is faster than doing it at the drive-thru? Assume these statistics are accurate and come from a simple random sample. [12 pts.]

a) State the null and alternative hypotheses.

b) Find the test statistic and P -value.

c) State the conclusion in words.

10. The Core Plus Mathematics Project is an innovative approach to teaching mathematics in high school. These materials, developed a Western Michigan University, involve the students in doing more reading and giving more written explanations than a traditional course. A comparison between how well students using the Core Plus materials to those of a traditional curriculum was done. One component of the study involved solving word problems. For this component of the test the 320 students in the Core Plus program had a mean of $\bar{x} = 57.4$ and a standard deviation of $s = 32.1$. The 273 students in the traditional program had a mean of $\bar{x} = 53.9$ and a standard deviation of $s = 28.5$. Find a 95% confidence interval for the difference in the mean on such a test for students in the Core Plus program to those in a traditional program. [10 pts.]

11. Hope College male students were asked how tall they were and their responses are the following reported heights. They were then measured and the results are the actual heights.

Student	1	2	3	4	5	6	7	8	9	10
Reported	74.5	72	70.5	70	70.5	71	68	72	71	73
Actual	74.5	71.5	69.5	68.5	70	69	67.5	72	70.5	72.5

Assume these data came from a random sample of all Hope College male students. Test at the 5% significance level to determine if all Hope College male students, on average, say they are taller than they actually are. [12 pts.]

- a) State the null and alternative hypotheses.
- b) Find the test statistic and P -value.
- c) State the conclusion in words.
12. A study about the change in weight on a new diet reports a P -value of 0.02 for testing $H_0: \mu = 0$ against $H_a: \mu \neq 0$. If the authors had instead reported a 95% confidence interval for μ , then the interval would have contained 0. (Circle correct response.) [2 pts.]

True

False