



I. TRUE OR FALSE. Write 'True' if the statement is always true; otherwise, write 'False'.

1. In hypothesis testing, if the p-value is 0.01 then  $H_0$  will be rejected at 0.05 level of significance.
2. If  $H_0$  is not rejected at 0.05 level of significance then  $H_0$  will not be rejected at 0.10 level of significance using the same test on the same data set.
3. If  $H_0$  is rejected at 0.05 level of significance then  $H_0$  will also be rejected at 0.10 level of significance using the same test on the same data set.
4. The size of the critical region of a test increases as we increase the level of significance.
5. It is impossible to commit a Type II error when we decide to reject  $H_0$ .
6. We decide to reject  $H_0$  if the value of the test statistic belongs in the critical region.
7. If the 90% confidence interval estimate for  $\mu$  does not contain 0, then the 2-tailed test  $H_0: \mu = 0$  vs  $H_a: \mu \neq 0$  will lead to the rejection of  $H_0$  at 0.1 level of significance.
8. If the value of the test statistic belongs in the acceptance region at .05 level of significance then we conclude that the data provide us with sufficient evidence supporting  $H_0$  at .05 level of significance.
9. If the value of the test statistic belongs in the critical region at .05 level of significance then we conclude that the data provide us with sufficient evidence supporting  $H_a$  at .05 level of significance.
10. When testing  $H_0: \mu = 0$  vs  $H_a: \mu \neq 0$  at  $\alpha$  level of significance based on a random sample of size 10 from a normal distribution with known variance  $\sigma^2$ , the probability of committing a Type II increases when the true value of  $\mu$  is farther away from 0.
11. When testing  $H_0: \mu = 0$  vs  $H_a: \mu \neq 0$  at  $\alpha$  level of significance based on a random sample of size 10 from a normal distribution with known variance  $\sigma^2$ , the probability of committing a Type II error decreases as the sample size increases.
12. When testing  $H_0: \mu = 0$  vs  $H_a: \mu > 0$  at  $\alpha$  level of significance based on a random sample of size 10 from a normal distribution with known variance  $\sigma^2$ , the null distribution of the test statistic is standard normal.
13. When testing  $H_0: \mu = 0$  vs  $H_a: \mu > 0$  at  $\alpha$  level of significance based on a random sample of size 10 from a normal distribution with known variance  $\sigma^2$ , the p-value if the computed value of the test statistic is 2.5 is smaller than the p-value if the computed value of the test statistic is 1.5.
14. The t-test used to test  $H_0: \mu = 0$  vs  $H_a: \mu > 0$  at  $\alpha$  level of significance based on a random sample of size 10 from a normal distribution with unknown variance  $\sigma^2$  has the smallest probability of committing a Type II error among all other statistical tests.
15. The t-test about the population mean is very sensitive to the assumption of normality.

## II. COMPUTATIONS

1. A social psychologist wishes to determine if the attitude toward the social behavior becomes more favorable after viewing an informational film about the behavior. For each subject in a random sample of size 10, an attitude measurement was made before viewing the film and a second measurement was taken after viewing the film. The larger the attitude score, the more favorable is the subject toward the social behavior. The attitude scores for the sample are as follows:

Before	41.0	60.3	23.9	36.2	52.7	22.5	67.5	50.3	50.9	24.6
After	46.9	64.5	33.3	36.0	43.5	56.8	60.7	57.3	65.4	41.9

- a) State  $H_0$  and  $H_a$ . Define the parameters.
  - b) Write the formula of the test statistic to be used assuming normality.
  - c) State the decision rule at 0.10 level of significance
  - d) Compute for the value of the test statistic.
  - e) Is there sufficient evidence at 0.10 level of significance supporting the psychologist's theory that, on the average, the attitude toward the social behavior becomes more favorable after viewing the film?
2. An educational psychologist wishes to know if two different mathematics achievement tests lead to different achievement scores. From a group of students having about the same IQs, a random sample was selected and were administered Test 1. Then another random sample was selected independently from the first sample and were administered Test 2. The test scores follow, where X and Y denote the scores on test 1 and test 2, respectively:

X	93	70	79	106	123	124	94	85	95	101
Y	103	102	101	102	100	104	99	103	100	102

- a) State  $H_0$  and  $H_a$ . Define the parameters.
  - b) Write the formula of the test statistic to be used assuming normality.
  - c) State the decision rule at 0.05 level of significance
  - d) Compute for the value of the test statistic.
  - e) Is there sufficient evidence at 0.05 level of significance supporting the psychologist's theory that the mean scores of students on the two mathematics achievement tests are different?
3. A manufacturer obtained data on breakdowns in two models of portable turntables designed to rotate food in microwave ovens. In a sample of 197 turntables of the first model, 33 broke down within two years of the date of purchase. In a sample of 290 units of the second model, there were 42 that broke down within two years. The manufacturer wishes to know if the proportions of break-down of the two models are different.
    - a) State  $H_0$  and  $H_a$ . Define the parameters.
    - b) Write the formula of the test statistic.
    - c) Compute for the value of the test statistic.
    - d) Compute for the p-value.
    - e) Is there sufficient evidence at 0.05 level of significance to conclude that the proportions of break-down of the two models are different.
  4. A production process produces and packages soap in boxes weighing 140 grams. Owing to inspection carried out by several large municipalities, the penalty for placing, on the average, less than 140 grams in a box can be severe. Likewise, it would also be wasteful for the company if they place, on the

average, more than 140 grams in a box. Hence, the machine was adjusted to put 140 grams of soap in a box. After a year, the company wants to check if there is a need to readjust the machine. The company wishes to perform a test of hypothesis at 0.01 level of significance using the following data collected from a random sample.

140.01	139.98	140.00	140.01	139.95	139.98	140.05	140.06	140.05	140.00
140.02	140.00	140.04	139.99	140.12	139.97	140.00	140.09	140.07	140.05
140.00	140.01	140.08	139.98	140.10	139.94	139.92	140.10	140.06	140.03
140.05	140.05	139.95	140.03	140.06	140.05	140.12	139.95	140.00	140.02
139.99	140.03	139.97	140.05	140.00	140.09	140.06	139.93	139.90	140.01

- State  $H_0$  and  $H_a$ .
  - Write the formula of the test statistic to be used.
  - State the decision rule at 0.01 level of significance
  - Compute for the value of the test statistic.
  - Is there sufficient evidence at 0.01 level of significance for the company to conclude that mean weight of soap packaged in a box is not equal to 140 grams (so that there is a need to readjust the machine)?
5. Company A believes that the proportion of households buying the leading brand of milk is more than 0.75. They wish to test this hypothesis at 0.1 level of significance. In a random sample of 300 households, there were 240 who bought the leading brand of milk in their last purchase.
- State  $H_0$  and  $H_a$ .
  - Write the formula of the test statistic to be used.
  - Compute for the value of the test statistic.
  - Compute for the p-value.
  - Is there sufficient evidence at 0.1 level of significance for Company A to conclude that proportion of households buying the leading brand of milk is more than 0.75?

*Formulas:*

$$S_P^2 = \frac{(n_1 - 1)S_X^2 + (n_2 - 1)S_Y^2}{n_1 + n_2 - 2}$$

$$v = \frac{\left( \frac{S_X^2}{n_1} + \frac{S_Y^2}{n_2} \right)^2}{\frac{\left( \frac{S_X^2}{n_1} \right)^2}{n_1 - 1} + \frac{\left( \frac{S_Y^2}{n_2} \right)^2}{n_2 - 1}}$$