

Global Academy of Technology, Bengaluru
Department of Mathematics
Assignment on Testing of Hypothesis

1. It is hoped that a newly developed pain reliever will more quickly produce perceptible reduction in pain to patients after minor surgeries than a standard pain reliever. The standard pain reliever is known to bring relief in an average of 3.5 minutes with **standard deviation** 2.1 minutes. To test whether the new pain reliever works more quickly than the standard one, 50 patients with minor surgeries were given the new pain reliever and their times to relief were recorded. The experiment yielded sample mean 3.1 minutes and **standard deviation** 1.5 minutes. Is there sufficient evidence in the sample to indicate, at the 5% level of significance, that the newly developed pain reliever does deliver perceptible relief more quickly?

2. A cosmetics company fills its best-selling 8 ounce jars of facial cream by an automatic dispensing machine. The machine is set to dispense a mean of 8.1 ounces per jar. Uncontrollable factors in the process can shift the mean away from 8.1 and cause either underfill or overfill, both of which are undesirable. In such a case the dispensing machine is stopped and recalibrated. Regardless of the mean amount dispensed, the **standard deviation of the amount dispensed always has value 0.22 ounce**. A quality control engineer routinely selects 40 jars from the assembly line to check the amounts filled. On one occasion, the **sample mean is 8.2 ounces** and the sample **standard deviation is 0.25 ounce**. Determine if there is sufficient evidence in the sample to indicate, at the 1% level of significance, that the machine should be recalibrated.

3. The government of an impoverished country reports the mean age at death among those who have survived to adulthood as 66.2 years. A relief agency examines 50 randomly selected deaths and obtains a mean of 62.3 years with standard deviation 8.1 years. Test whether the agency's data support the alternative hypothesis, at the 1% level of significance, that the population mean is less than 66.2.

4. Authors of a computer algebra system wish to compare the speed of a new computational algorithm to the currently implemented algorithm. They apply the new algorithm to 50 standard problems; it averages 8.16 seconds with standard deviation 0.17 second. The current algorithm averages 8.21 seconds on such problems. Test, at the 1% level of significance, the alternative hypothesis that the new algorithm has a lower average time than the current algorithm.
5. The price of a popular tennis racket at a national chain store is Rs.179. Ramesh bought five of the same racket at an online auction site for the following prices:

155, 179, 175, 175, 161

Assuming that the auction prices of rackets are normally distributed, determine whether there is sufficient evidence in the sample, at the 5% level of significance, to conclude that the average price of the racket is less than Rs.179 if purchased at an online auction.

6. A small component in an electronic device has two small holes where another tiny part is fitted. In the manufacturing process the average distance between the two holes must be tightly controlled at 0.02 mm, else many units would be defective and wasted. Many times throughout the day quality control engineers take a small sample of the components from the production line, measure the distance between the two holes, and make adjustments if needed. Suppose at one time four units are taken and the distances are measured as

0.021, 0.019, 0.023, 0.020

Determine, at the 1% level of significance, if there is sufficient evidence in the sample to conclude that an adjustment is needed. Assume the distances of interest are normally distributed.

7. Six coins of the same type are discovered at an archaeological site. If their weights on average are significantly different from 5.25 grams then it can be assumed that their provenance is not the site itself. The coins are

weighed and have mean 4.73 g with sample standard deviation 0.18 g. Perform the relevant test at the 0.1% level of significance, assuming a normal distribution of weights of all such coins.

8. An online shoe retailer sells men's shoes in sizes 8 to 13. In the past orders for the different shoe sizes have followed the distribution given in the table provided. The management believes that recent marketing efforts may have expanded their customer base and, as a result, there may be a shift in the size distribution for future orders. To have a better understanding of its future sales, the shoe seller examined 1,040 sales records of recent orders and noted the sizes of the shoes ordered. The results are given in the table provided. Test, at the 1% level of significance, whether there is sufficient evidence in the data to conclude that the shoe size distribution of future sales will differ from the historic one.

Shoe Size	Past Size Distribution	Recent Size Frequency
8	0.03	25
8.5	0.06	43
9	0.09	88
9.5	0.19	221
10	0.23	272
10.5	0.14	150
11	0.1	107
11.5	0.06	51
12	0.05	37
12.5	0.03	35
13	0.02	11