**EE1004 Assignment 2 – 2023/24 Semester A**

**Solutions**

1. A battery manufacturer claims that a certain brand of its flashlight battery

lasts, on average, at least 290 hours of flashlight use. You suspect that the population of batteries average fewer than 290 hours. You select a random sample of 50 batteries

and obtain a sample mean of 280 and a sample standard deviation S=65. You may assume that run times are normally distributed.

(a) Test the null hypothesis that the mean run time is at least 290 hours against the alternative hypothesis that the mean run time is less than 290 hours. Use a 0.1 level of significance.

(15 marks)

(b) If your test conclusion is in error, what type of error is it? Type I or II? Please explain clearly.

(10 marks)

(c) How would your calculations change if you were to test the null hypothesis that the mean run time is equal to 290 hours against the alternative hypothesis that the mean run time is not equal to 290 hours. Use a 0.1 level of significance.

(15 marks)

(a) Null hypothesis is *H*0: *μ*≥290

Alternative hypothesis is *Ha*: *μ*<290—single-tailed test. (2.5 marks)

Since sample standard deviation is given, we should use t distribution

Calculating the t-score, we get: *t* = (280 – 290)/65/sqrt(50) = -1.088 (5 marks)

df = 49

Then, the corresponding *p*-value = 0.141 (5marks)

Decision: Accept the null hypothesis. (2.5 marks)

Reason for decision: The *p*-value is greater than the level of significance 0.1.

(b)

If the above test conclusion is wrong, it means we accepted null hypothesis when it was false.

(5marks)

This is Type II error. (5marks)

(c) Null hypothesis is *H*0: *μ* = 290

Alternative hypothesis is *Ha*: *μ* 290—two-tailed test. (2.5 marks)

Since sample standard deviation is given, we should use t distribution

Calculating the t-score, we get: *t* = (280 – 290)/65/sqrt(50) = -1.088 (5 marks)

df = 49

Then, the corresponding *p*-value = 0.141 + 0.141 = 0.282 (5marks)

Decision: Accept the null hypothesis. (2.5 marks)

Reason for decision: The *p*-value is greater than the level of significance 0.1.

2. A particular brand of tires claims that its deluxe tire averages at least 50,000 miles before it needs to be replaced. From past studies of this tire, the standard deviation is known to be 8,000. A survey of owners of that tire design is conducted. From the 28 tires surveyed, the mean lifespan was 46,500 miles with a standard deviation of 9,800 miles. Using level of significance of 0.05, test the claim of the tire company as the null hypothesis and explain if it should be accepted or not. Clearly state the alternative hypothesis as well.

(30 marks)

Null hypothesis is *H*0: *μ*≥50,000 (5 marks)

Alternative hypothesis is *Ha*: *μ*<50,000 -- single-tailed test (5marks)

Let denote the average lifespan of a brand of tires.

Since population standard deviation is given, we can use normal distribution

Calculating the z-score, we get: *z* = −2.315 (5 marks)

Then, the corresponding *p*-value = 0.0103 (10 marks)

Decision: Reject the null hypothesis. (5 marks)

Reason for decision: The *p*-value is less than the level of significance 0.05.

Conclusion: There is sufficient evidence to conclude that the mean lifespan of the tires is less than 50,000 miles.

3. The volume of vegetable oil in in one-litre bottles may be assumed to be a normally distributed random variable with mean μ and standard deviation of 3 mL.

The volume of vegetable oil in a random sample of 16 bottles was measured to give a mean value of 1008.5 mL. Construct a 95% confidence interval for the mean.

(30 marks)

Since population standard deviation is given, we can use normal distribution. (5 marks)

For 95% confidence interval, z = 1.96 (10 marks)

Confidence interval for μ = sample mean + Critical value x Population standard deviation of the statistic / sqrt( n )

= 1008.5 + 1.96x3/sqrt(16) = 1008.5 + 1.47 (10 marks)

Therefore, the CI is (1007.03,1009.97) (5 marks)