**Task Session 4**

1. **An automobile manufacturer recommends oil change intervals of 3, 000 miles. To compare actual intervals to the recommendation, the company randomly samples records of 50 oil changes at service facilities and obtains sample mean 3, 752 miles with sample standard deviation 638 miles. Determine whether the data provide sufficient evidence, at the 5% level of significance, that the population mean interval between oil changes exceeds 3, 000 miles.**

**Null Hypothesis (H0): The population mean interval between oil changes is not greater than 3,000 miles (μ ≤ 3000).**

**Alternative Hypothesis (H1): The population mean interval between oil changes is greater than 3,000 miles (μ > 3000).**

**level of significance is 5% , which is typically denoted as α = 0.05.**

**you have already collected the data, and the sample statistics are as follows:**

**Sample Mean (x̄) = 3,752 miles**

**Sample Standard Deviation (s) = 638 miles**

**Sample Size (n) = 50**

**Where:**

* **ˉ*x*ˉ is the sample mean,**
* **μ is the hypothesized population mean (3,000 miles in this case),**
* **s is the sample standard deviation, and**
* **n is the sample size.**

**Plugging in the values:**

**Z=(3,752−3,000) / (638/**√50**)**

**Calculate Z:**

**Z≈1.49*Z*≈1.49**

* **If the test statistic (Z) is greater than the critical value, you will reject the null hypothesis.**

**1.49<1.6451.49<1.645**

1. **A medical laboratory claims that the mean turn-around time for performance of a battery of tests on blood samples is 1.88 business days. The manager of a large medical practice believes that the actual mean is larger. A random sample of 45 blood samples yielded mean 2.09 and sample standard deviation 0.13 day. Perform the relevant test at the 10% level of significance using these data.**

* **Null Hypothesis (H0): The mean turn-around time for the battery of tests is equal to or less than 1.88 business days (μ ≤ 1.88).**
* **Alternative Hypothesis (H1): The mean turn-around time for the battery of tests is greater than 1.88 business days (μ > 1.88).**
  + **Sample Mean (ˉ*x*ˉ) = 2.09 days**
  + **Sample Standard Deviation (s) = 0.13 days**
  + **Sample Size (n) = 45**
* **Claimed Population Mean (*μ*0​) = 1.88 days**

***t*=​(2.09−1.88)/(0.13/**√45**)**

***t*≈4.61**

* **If the test statistic (t) is greater than the critical value, you will reject the null hypothesis.**

**4.61>1.3114.61>1.311**

**Since the test statistic (4.61) is greater than the critical value (1.311), you can reject the null hypothesis.**

1. **A grocery store chain has as one standard of service that the mean time customers wait in line to begin checking out not exceed 2 minutes. To verify the performance of a store the company measures the waiting time in 30 instances, obtaining mean time 2.17 minutes with standard deviation 0.46 minute. Use these data to test the null hypothesis that the mean waiting time is 2 minutes versus the alternative that it exceeds 2 minutes, at the 10% level of significance**

**Null Hypothesis (H0): The mean waiting time is 2 minutes (μ = 2).**

**Alternative Hypothesis (H1): The mean waiting time exceeds 2 minutes (μ > 2).**

**Step 2: Choose the level of significance (α):**

* + **Sample Mean (ˉ*x*ˉ) = 2.17 minutes**
  + **Sample Standard Deviation (s) = 0.46 minutes**
  + **Sample Size (n) = 30**

**Claimed Population Mean (*μ*0​) = 2 minutes**

***t*=​(2.17−2) / (0.46/**√30**)**

**1.75>1.311**

**Since the test statistic (1.75) is greater than the critical value (1.311), you can reject the null hypothesis.**

**4) A magazine publisher tells potential advertisers that the mean household income of its regular readership is $61, 500 An advertising agency wishes to test this claim against the alternative that the mean is smaller. A sample of 40 randomly selected regular readers yields mean income $59, 800 with standard deviation $5, 850 Perform the relevant test at the 1% level of significance**

**Null Hypothesis (H0): The mean household income of regular readers is $61,500 (μ = $61,500).**

**Alternative Hypothesis (H1): The mean household income of regular readers is smaller than $61,500 (μ < $61,500).**

**You have already collected the data, and the sample statistics are as follows:**

* + **Sample Mean (ˉ*x*ˉ) = $59,800**
  + **Sample Standard Deviation (s) = $5,850**
  + **Sample Size (n) = 40**

**Claimed Population Mean (*μ*0​) = $61,500**

**ˉ*x*ˉ is the sample mean,**

***μ*0​ is the hypothesized population mean ($61,500 in this case),**

**s is the sample standard deviation,**

**n is the sample size.**

**Plugging in the values:**

**Z=(59,800−61,500)(5,850/**√40)

**Calculate t:**

**Z≈−1.691**

**−1.691>−2.626**

**Since the test statistic (-1.691) is greater than the critical value (-2.626), you fail to reject the null hypothesis.**

**5) 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.**

**Null Hypothesis (H0): The new algorithm has an average time equal to or greater than the current algorithm (*μ*≥8.21 seconds).**

**Alternative Hypothesis (H1): The new algorithm has a lower average time than the current algorithm (*μ*<8.21 seconds).**

**You have already collected the data for the new algorithm. The sample statistics for the new algorithm are as follows:**

* + **Sample Mean (ˉ*x*ˉ) = 8.16 seconds**
  + **Sample Standard Deviation (s) = 0.17 seconds**
  + **Sample Size (n) = 50**

**Performance of the current algorithm (*μ*0​) = 8.21 seconds**

**ˉ*x*ˉ is the sample mean,**

***μ*0​ is the hypothesized population mean (8.21 seconds in this case),**

**s is the sample standard deviation,**

**n is the sample size.**

**Plugging in the values:**

**t=(8.16−8.21)/(0.1750*/***√50)

**Calculate t:**

**t≈−1.962*t***

**6) The mean household income in a region served by a chain of clothing stores is $48, 750 In a sample of 40 customers taken at various stores the mean income of the customers was $51, 505 with standard deviation $6, 852  
  
a. Test at the 10% level of significance the null hypothesis that the mean household income of customers of the chain is $48, 750 against that alternative that it is different from $48, 750  
  
b. The sample mean is greater than $48, 750 suggesting that the actual mean of people who patronize this store is greater than $48, 750 Perform this test, also at the 10% level of significance. (The computation of the test statistic done in part (a) still applies here.)**

**7) What are the types of statistical test and how we use each of them ?**

**8) What is COHEN `S D rule ?**

**9) What is meant by statistical power and how we use it ?**

* **Null Hypothesis (H0): The mean household income of customers of the chain is $48,750 (μ = $48,750).**
* **Alternative Hypothesis (H1): The mean household income of customers of the chain is different from $48,750 (μ ≠ $48,750).**
  + **Sample Mean (�ˉ*x*ˉ) = $51,505**
  + **Sample Standard Deviation (s) = $6,852**
  + **Sample Size (n) = 40**
* **Claimed Population Mean (�0*μ*0​) = $48,750**
* **ˉ*x*ˉ is the sample mean,**
* ***μ*0​ is the hypothesized population mean ($48,750 in this case),**
* **s is the sample standard deviation,**
* **n is the sample size.**

**Plugging in the values:**

**t=(51,505−48,750)/(6,852/**√40)

**Calculate t:**

**t≈2.215**

**−2.215<−1.682 or 2.215>1.682**

**There are various types of statistical tests, including t-tests, chi-square tests, ANOVA, regression analysis, and more. The choice of test depends on the research question, the type of data, and the specific hypotheses being tested. Each test has its assumptions and requirements. It's crucial to choose the right test for your analysis to ensure the validity of your results.**

**Cohen's d is a measure of effect size that quantifies the difference between two means in standard deviation units. The "Cohen's d rule" typically refers to guidelines for interpreting the magnitude of the effect size. It helps assess the practical significance of a result. Generally, a larger Cohen's d indicates a more substantial effect. A common rule of thumb is that a d of 0.2 is considered a small effect, 0.5 is a medium effect, and 0.8 or larger is a large effect.**