Hypothesis Testing Exercise

1. A F&B manager wants to determine whether there is any significant difference in the diameter of the cutlet between two units. A randomly selected sample of cutlets was collected from both units and measured? Analyze the data and draw inferences at 5% significance level. Please state the assumptions and tests that you carried out to check validity of the assumptions.

Minitab File : **Cutlets.mtw**

**Ans) Given, significance level = 5%**

**Null Hypothesis [Ho] = µ1= µ2**

**Alternate Hypothesis [HA] =µ1 ≠ µ2**

**To determine whether there is a significant difference in the diameter of the cutlets between the two units, we can perform a hypothesis test. In this case, we'll use a two-sample t-test. Before conducting the t-test, we need to check the assumptions of the test:**

**Assumptions of the t-test:**

1. **Normality: The data should be approximately normally distributed within each group. This assumption can be checked using histograms and normality tests (e.g., Shapiro-Wilk test).**

**From Shapiro Test for both unit at 5% significance level :**

**P-value for “Unit A” and “Unit B” is greater than significance level, which signifies that both are normally distributed.**

1. **Homogeneity of Variance: The variances of the two groups should be roughly equal. This assumption can be assessed using tests like Levene's test or by comparing the standard deviations.**

**LeveneResult(statistic=0.67 pvalue=0.42) at 5% significance level.**

**We obtained a p-value of 0.47 from Levene's test, it means that the p-value is greater than the chosen significance level (typically 0.05). This indicates that we fail to reject the null hypothesis, suggesting that there is no significant difference in the variances of cutlet diameters between the two units.**

**Conducting 2-Sample, 2-Tail test using python :**

**>> *Scipy.stats.ttest\_ind(cutlest[“Unit A”], cutlets[“Unit B”])***

**We get the following result:-**

***Ttest\_indResult(statistic=0.7228688704678063, pvalue=0.4722394724599501)***

**Conclusions :-**

**Since the p-value (0.472) is greater than the significance level (0.05), we fail to reject the null hypothesis. This means that there is no significant difference in the mean diameter of cutlets between the two units at the 5% significance level.**

1. A hospital wants to determine whether there is any difference in the average Turn Around Time (TAT) of reports of the laboratories on their preferred list. They collected a random sample and recorded TAT for reports of 4 laboratories. TAT is defined as sample collected to report dispatch.

Analyze the data and determine whether there is any difference in average TAT among the different laboratories at 5% significance level.

Minitab File: **LabTAT.mtw**

**Ans :-**

**To determine whether there is a difference in the average Turn Around Time (TAT) among the different laboratories, we can use a one-way ANOVA (Analysis of Variance) test. The one-way ANOVA is suitable when we have more than two groups to compare, which is the case here as we have data from 4 laboratories.**

**Null Hypothesis [Ho] = µ1 = µ2 = µ3 = µ4**

**Alternate Hypothesis [HA] = there is some difference between the average of the four test report.**

**Given Significance level (0.05),**

**Python code for one-way ANOVA test:-**

***import pandas as pd***

***from scipy.stats import f\_oneway***

***labTAT = pd.read\_csv(“labTAT.csv”)***

***stats.f\_oneway(labTAT.iloc[:,0], labTAT.iloc[:,1], labTAT.iloc[:,2], labTAT.iloc[:,3])***

**OUTPUT:-**

***F\_onewayResult(statistic=118.70421654401437, pvalue=2.1156708949992414e-57)***

**Conclusions:-**

**A p-value of 2.1e-57 (which is a very small number close to zero) in a one-way ANOVA indicates extremely strong evidence against the null hypothesis. It suggests that there is a significant difference in the average Turn Around Time (TAT) among the different laboratories.**

3. Sales of products in four different regions is tabulated for males and females. Find if male-female buyer rations are similar across regions.

**Ans:-**

**To determine if the male-female buyer ratios are similar across different regions, we can use a chi-squared test for independence. This test assesses whether there is a significant association between two categorical variables (in this case, the region and the gender of buyers). If the test indicates a lack of independence, it suggests that there is a significant difference in the buyer ratios across regions.**

**Null Hypothesis [Ho] = All proportions are equal.**

**Alternate Hypothesis [HA] = Not all Proportions are equal**

**Python Code :-**

***import pandas as pd***

***from scipy.stats import chi2\_contingency***

***buyerRatio = pd.read\_csv(“BuyerRatio.csv”)***

***buyerRatio = buyerRatio.iloc[:, 1:6].values***

***chi2\_contingency(buyerRatio)***

**OUTPUT:-**

***Chi2ContingencyResult (***

***statistic = 1.595945538661058,***

***pvalue = 0.6603094907091882,***

***dof = 3,***

***expected\_freq = array([[ 42.76531299, 146.81287862, 131.11756787, 72.30424052],***

***[ 442.23468701, 1518.18712138, 1355.88243213, 747.69575948]])***

***)***

**Conclusion :-**

**Since the p-value (0.66) is greater than the significance level (alpha = 0.05), we would fail to reject the null hypothesis. This suggests that there is not enough evidence to conclude that the male-female buyer ratios are different across regions.**

4. TeleCall uses 4 centers around the globe to process customer order forms. They audit a certain % of the customer order forms. Any error in order form renders it defective and has to be reworked before processing. The manager wants to check whether the defective % varies by centre. Please analyze the data at *5%* significance level and help the manager draw appropriate inferences

Minitab File: **CustomerOrderForm.mtw**

**Ans:-**

**To analyze whether the defective percentage varies by center, we can use a chi-squared test for independence. This test will help determine if there is a significant association between the center and the defective status of order forms. If there's a significant association, it implies that the defective percentage does vary across different centers.**

**Null Hypothesis [Ho] = Defective percentage does not vary by center**

**Alternate Hypothesis [HA] = Defective percentage varies by center.**

**Significance level = 0.5%**

**Python code :-**

***import pandas as pd***

***from scipy.stats import chi2\_contingency***

***df = pd.read\_csv("Costomer+OrderForm.csv")***

***dict = {}***

***for column in df.columns:***

***print(column)***

***dict[column] = {df[column].value\_counts().index[i] : df[column].value\_counts().values[i]***

***for i in range(len(df[column].value\_counts()))}***

***df2 = pd.DataFrame(dict)***

***chi2\_contingency(df2.values)***

***OUTPUT:-***

***Chi2ContingencyResult(***

***statistic = 3.858960685820355,***

***pvalue = 0.2771020991233135,***

***dof = 3,***

***expected\_freq = array([[271.75, 271.75, 271.75, 271.75],***

***[ 28.25, 28.25, 28.25, 28.25]])***

***)***

**Conclusions:-**

**The p-value (0.277) is greater than the significance level (e.g., 0.05), which indicates that you fail to reject the null hypothesis. This suggests that there is no significant evidence to conclude that the defective percentage varies by center.**