Assignment-03-Q1 (Hypothesis Testing)

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. Consider Cutlets.csv as the dataset.

Ans.

We are going to conduct a 2 tailed t-Test on 2 Independent samples with Numerical Data. We need to check whether the mean of both samples are different and Is there any significant difference between the two sample.

Step 1

Make two Hypothesis one contradicting to other Null Hypothesis is what we want to prove
Null Hypothesis: Ho: μ1 = μ2 (There is no difference in diameters of cutlets between two units).
Alternative Hypthosis: Ha: μ1 ≠ μ2 (There is significant difference in diameters of cutlets between two units).

Step 2

Decide a cut-off value

- Significance 5%
- alpha = 0.05

As it is a two-tailed test

- alpha/2 = 0.025

Step 3

Collect Evidence

In [1]:
```
import pandas as pd
import numpy as np
from scipy import stats
from scipy.stats import norm
```

In [2]:
```
df=pd.read_csv('03_04_Cutlets.csv')
df.head(3)
```

Out[2]:

	Unit A	Unit B
0	6.8090	6.7703
1	6.4376	7.5093
2	6.9157	6.7300

In [3]:
```
unitA = df['Unit A']
unitB = df['Unit B']
```

2-sample 2-tail ttest

In [4]:
```
tstatistic, p_value = stats.ttest_ind(unitA,unitB)
p_value # 2 tail probability
```

Out[4]:
```
0.47223947245995
```

Interpret the results:
If the p-value is less than the significance level alpha (5% in this case), we reject the null hypothesis and conclude that there is a significant difference in the diameter of the cutlet between the two units.
If the p-value is greater than the significance level, we fail to reject the null hypothesis and conclude that there is not enough evidence to suggest a significant difference.

In [5]:
```
alpha = 0.025
print('Significance=%.3f, p=%.3f\n' % (alpha, p_value))
if p_value <= alpha:
    print('We reject Null Hypothesis that there is a significant difference between two
else:
    print('We fail to reject Null hypothesis')
```

```
Significance=0.025, p=0.472

We fail to reject Null hypothesis
```

Since p_value > alpha , We fail to reject Null Hypothesis that there is no significant difference between the two samples.

Assignment-03-Q2 (Hypothesis Testing)

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. Dataset is LabTAT.csv

Ans.

This problem is regarding Analysis of variance between more than 2 samples or columns. We are going to conduct a ANOVA Test on 4 Independent samples with Numerical Data. We need to check whether the mean of any of these samples are different or the same.

Step 1

Make two Hypothesis one contradicting to other
Null Hypothesis is what we want to prove
Null Hypothesis Ho as: $\mu 1 = \mu 2 = \mu 3 = \mu 4$, All samples TAT population means are same.
Alternative Hypthosis Ha as: Atleast one sample TAT population mean is different

Step 2

Decide a cut-off value

- Significance 5%
- alpha = 0.05

Step 3

Collect Evidence

In [6]:
```
import pandas as pd
import numpy as np
from scipy import stats
from scipy.stats import norm
```

In [7]:
```
df = pd.read_csv('03_05_LabTAT.csv')
df.head(3)
```

Out[7]:

	Laboratory 1	Laboratory 2	Laboratory 3	Laboratory 4
0	185.35	165.53	176.70	166.13
1	170.49	185.91	198.45	160.79
2	192.77	194.92	201.23	185.18

Anova ftest statistics: stats.f_oneway(column-1,column-2,column-3,column-4)

In [8]:
```
test_statistic , p_value=stats.f_oneway(df.iloc[:,0],df.iloc[:,1],df['Laboratory 3'],df[
p_value
```

Out[8]:
```
2.1156708949992414e-57
```

Compare p_value with Significane Level alpha.

If p_value is != alpha we failed to reject Null Hypothesis because of lack of evidence
If p_value is = alpha we reject Null Hypothesis

In [9]:
```
alpha = 0.05
print('Significance=%.3f, p=%.3f\n' % (alpha, p_value))
if p_value <= alpha:
    print('We reject Null Hypothesis there is a significant difference between TAT of re
else:
    print('Independent. We fail to reject Null hypothesis')
```

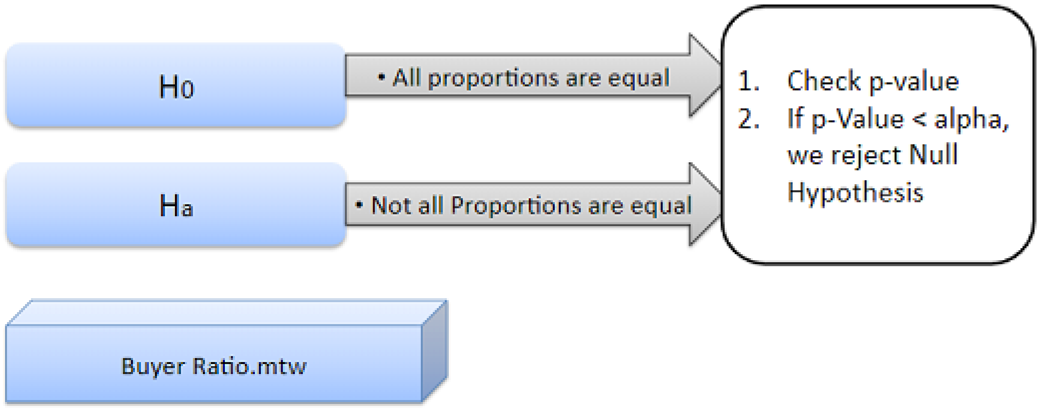
```
Significance=0.050, p=0.000

We reject Null Hypothesis there is a significant difference between TAT of reports of th
e laboratories
```

Since Hence, We fail to reject Null Hypothesis because of lack evidence, there is no significant difference between the samples

Assignment-03-Q3 (Hypothesis Testing)

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

	East	West	North	South
Males	50	142	131	70
Females	550	351	480	350



Ans.

We are going to conduct a Test of Independence using Chi-Square test with Contingency table. We need to check whether the proportion of any of these samples are different or same.

Step 1

Make two Hypothesis one contradicting to other
Null Hypothesis is what we want to prove

- Null Hypothesis: There is no association or dependency between the gender based buyer rations across regions
- Alternative Hypthosis: There is a significant association or dependency between the gender based buyer rations across regions

Step 2

Decide a cut-off value

- Significance 5%
- alpha = 0.05

As it is a one-tailed test

- alpha = 1 - 0.95 = 0.05

Step 3

Collect Evidence

In [10]:
```python
import pandas as pd
import numpy as np
from scipy import stats
from scipy.stats import norm
from scipy.stats import chi2_contingency
```

In [11]:
```python
df=pd.read_csv('03_02_BuyerRatio.csv')
df.head(3)
```

Out[11]:

	Observed Values	East	West	North	South
0	Males	50	142	131	70
1	Females	435	1523	1356	750

In [12]:
```python
no_of_rows=len(df.iloc[0:2,0])
no_of_columns=len(df.iloc[0,0:4])
degree_of_f=(no_of_rows-1)*(no_of_columns-1)
print('Degree of Freedom =',degree_of_f)
```

```
Degree of Freedom = 3
```

In [13]:
```python
observed = df[['East','West','North','South']].values
```

Step 4

Comparing Evidence with Hypothesis

Applying Chi-Square contingency table to convert observed value into expected value

In [14]:
```python
chi2_statistic, p_value, df, expected = stats.chi2_contingency(observed)
```

In [15]:
```python
critical_value = stats.chi2.ppf(0.95,3)
critical_value
```

Out[15]:
```
7.814727903251179
```

In [16]:
```python
if chi2_statistic >= critical_value:
        print('Dependent (reject H0)')
else:
        print('Independent (fail to reject H0)')
```

```
Independent (fail to reject H0)
```

In [17]:
```python
p_value, 1-stats.chi2.cdf(chi2_statistic,3)
```

Out[17]:
```
(0.6603094907091882, 0.6603094907091882)
```

In [18]:
```python
alpha = 0.05
print('Significance=%.3f, p=%.3f\n' % (alpha, p_value))
if p_value <= alpha:
    print('We reject Null Hypothesis there is a significant difference between TAT of re
else:
    print('Independent. We fail to reject Null hypothesis')
```

```
Significance=0.050, p=0.660

Independent. We fail to reject Null hypothesis
```

Since p_value > alpha, we fail to reject Null Hypothesis because of lack

evidence. Therefore, there is no association or dependency between male-female buyers rations and are similar across regions.

Assignment-03-Q4 (Hypothesis Testing)

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.

Ans.

We are going to conduct a Test of Independence using Chi-Square test with Contingency table. We need to check whether the mean of any of these samples are same or different.

Step 1

Make two Hypothesis one contradicting to other
Null Hypothesis is what we want to prove

- Null Hypothesis: μ1 = μ2 = μ3 = μ4
- Alternative Hypthosis: Atleast One of them is Different

Step 2

Decide a cut-off value

- Significance 5%
- alpha = 0.05

Step 3

Collect Evidence

In [19]:
```
import pandas as pd
import numpy as np
from scipy import stats
from scipy.stats import norm
from scipy.stats import chi2_contingency
```

In [20]:
```
df=pd.read_csv('03_03_Costomer+OrderForm.csv')
df.head(3)
```

Out[20]:

	Phillippines	Indonesia	Malta	India
0	Error Free	Error Free	Defective	Error Free
1	Error Free	Error Free	Error Free	Defective
2	Error Free	Defective	Defective	Error Free

In [21]:
```
df.shape
```
Out[21]:
```
(300, 4)
```

Applying descriptive statistics

In [22]:
```
df.describe()
```
Out[22]:

	Phillippines	Indonesia	Malta	India
count	300	300	300	300
unique	2	2	2	2
top	Error Free	Error Free	Error Free	Error Free
freq	271	267	269	280

Checking for Null Values

In [23]:
```
df.isnull().sum()
```
Out[23]:
```
Phillippines    0
Indonesia       0
Malta           0
India           0
dtype: int64
```

In [24]:
```
df[df.isnull().any(axis=1)]
```
Out[24]:

Phillippines	Indonesia	Malta	India

Checking the data type

In [25]:
```
df.info()
```
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300 entries, 0 to 299
Data columns (total 4 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   Phillippines  300 non-null    object
 1   Indonesia     300 non-null    object
 2   Malta         300 non-null    object
 3   India         300 non-null    object
dtypes: object(4)
memory usage: 9.5+ KB
```

Checking value counts in data

In [26]:
```
df['India'].value_counts()
```
Out[26]:
```
India
Error Free    280
Defective      20
Name: count, dtype: int64
```

In [27]:
```
vals = dict()

for x in df.columns.values:
    vals[x] = df[x].value_counts().values
```

```
df_new = pd.DataFrame(data=vals, index=['Error Free', 'Defective'])
df_new
```

Out[27]:

	Phillippines	Indonesia	Malta	India
Error Free	271	267	269	280
Defective	29	33	31	20

Creating Contingency table

In [28]:
```
obs=np.array([[271,267,269,280],[29,33,31,20]])
```

Calculating Expected Values for Observed data

In [29]:
```
chi2_statistic, p_value, df, expected = stats.chi2_contingency(obs)
chi2_statistic
```

Out[29]:
```
3.858960685820355
```

In [30]:
```
critical_value = stats.chi2.ppf(0.95,3)
critical_value
```

Out[30]:
```
7.814727903251179
```

In [31]:
```
if chi2_statistic >= critical_value:
        print('Dependent (reject H0),variables are related')
else:
        print('Independent (fail to reject H0), variables are not related')
```

```
Independent (fail to reject H0), variables are not related
```

In [32]:
```
p_value, 1-stats.chi2.cdf(chi2_statistic,3)
```

Out[32]:
```
(0.2771020991233135, 0.2771020991233135)
```

In [33]:
```
alpha = 0.05
print('Significance=%.3f, p=%.3f\n' % (alpha, p_value))
if p_value <= alpha:
        print('Dependent (reject H0)')
else:
        print('Independent (fail to reject H0)')
```

```
Significance=0.050, p=0.277

Independent (fail to reject H0)
```

Since p_value > alpha, We fail to reject Null Hypothesis because of lack of evidence. Thus, customer order forms defective % does not varies by centre.