Problem Statement

Sales of products in four different regions is given in 'BuyerRatio.csv' 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

1. Understanding Business Problem

To find out if male-female buyer rations are similar across above 4 regions

2. Given Data

```
Level of Significance → α  = 0.05
(Since α is not given, considering it as 5% level of Significance. In other words 95% level of Confidence)
Null hypothesis       → H0 = All proportions are equeal
Alternate Hypothesis  → Ha = Not all proportions are equeal
```

3. Import Necessary Libraries

In [2]:
```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
from sklearn import preprocessing
from scipy.stats import chi2_contingency

import warnings
warnings.filterwarnings('ignore')
```

4. Import Data

In [3]:
```
sales_data = pd.read_csv('BuyerRatio.csv')
sales_data
```

Out[3]:

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

5. Perform Initial Analysis

In [4]:
```
# to know the data type of each feature
sales_data.dtypes
```

Out[4]:
```
Observed Values    object
East                int64
West                int64
North               int64
South               int64
dtype: object
```

In [5]:
```
# renaming column 'Observed Values' to 'Values'
sales_data.rename(columns={'Observed Values':'Values'},inplace=True)
sales_data
```

Out[5]:

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

In [6]:
```
type(sales_data)
```

Out[6]:
```
pandas.core.frame.DataFrame
```

In [7]:
```
# Since 'Observed Values' is a categorical feature lets apply 'Label ENcoder' to convert it into numbers.
```

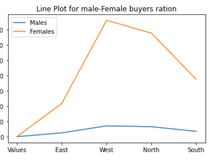
In [8]:
```
label_encoder = preprocessing.LabelEncoder()
```

In [9]:
```
# applying label encoder on 'Values' column
sales_data['Values'] = label_encoder.fit_transform(sales_data['Values'])
sales_data
```

Out[9]:

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

In [10]:
```
y1 = sales_data.iloc[0]
y2 = sales_data.iloc[1]
plt.plot(y1, label = 'Males')
plt.plot(y2, label = 'Females')
plt.legend(loc='upper left')
plt.title('Line Plot for male-Female buyers ration')
plt.show()
```



6. Hypothesis Formulation

```
H0 = All proportions are equal.
H1 = Not all proportions are equal.
α  = 0.05
```

7. Perform Hypothesis Testing

Since there are more than 2 variables, we will perform Chi-Square test

In [11]:
```
chi2,p_val_sales,dof_sales,expected_sales  = chi2_contingency(sales_data)
```

In [12]:
```
p_val_sales
```

Out[12]:
```
0.018035974243023764
```

In [13]:
```
print(round(p_val_sales,4))
```

```
0.018
```

In [29]:
```
print('Chi-Square test   :',chi2)
print('P-value           :',p_val_sales)
print('Degrees of Freedom:',dof_sales)
print('Expected Sales    :\n',expected_sales)
```

```
Chi-Square test   : 1.5959455538661058
P-value           : 0.6603094907091882
Degrees of Freedom: 3
Expected Sales    :
 [[  42.76531299  146.81287862  131.11756787   72.30424052]
 [ 442.23468701 1518.18712138 1355.88243213  747.69575948]]
```

In above data 'Values' column is also considered which is affecting our P-value

In [15]:
```
sales_data
```

Out[15]:

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

In [16]:
```
# Lets create a copy of 'sales_data' and remove 'Values' column from newly created data
```

In [17]:
```
sales_data_copy = sales_data.copy
```

In [18]:
```
sales_data_copy
```

Out[18]:
```
<bound method NDFrame.copy of    Values  East  West  North  South
0       1    50   142    131     70
1       0   435  1523   1356    750>
```

In [19]:
```
# To avoid the error above, always use () with the method
```

In [20]:
```
sales_data_copy = sales_data.copy()
```

In [21]:
```
sales_data_copy
```

Out[21]:

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

In [22]:
```
sales_data_copy = sales_data_copy.drop(columns=['Values'])
sales_data_copy
```

Out[22]:

	East	West	North	South
0	50	142	131	70
1	435	1523	1356	750

In [23]:
```
chi2,p_val_sales,dof_sales,expected_sales  = chi2_contingency(sales_data_copy)
```

In [24]:
```
p_val_sales
```

Out[24]:
```
0.6603094907091882
```

In [25]:
```
print(round(p_val_sales,4))
```

```
0.6603
```

In [26]:
```
print('Chi-Square test   :',chi2)
print('P-value           :',p_val_sales)
print('Degrees of Freedom:',dof_sales)
print('Expected Sales    :\n',expected_sales)
```

```
Chi-Square test   : 1.595945538661058
P-value           : 0.6603094907091882
Degrees of Freedom: 3
Expected Sales    :
 [[  42.76531299  146.81287862  131.11756787   72.30424052]
 [ 442.23468701 1518.18712138 1355.88243213  747.69575948]]
```

8. Conclusion

In [27]:
```
# checking if 'α > P-value' or 'α < P-value'
```

In [28]:
```
if p_val_sales > 0.05:
    print('At 5% level of significance, we cannot reject the Null Hypothesis and we can say that all proportion
else:
    print('At 5% level of significance, we can reject the Null Hypothesis and we can say that not all proportio
```

```
At 5% level of significance, we cannot reject the Null Hypothesis and we can say that all proportions are equea
l.
```