ASSIGNMENT – 4

Assignment Date	28 october
Student Name	Ms. M.Loganayaki
Student Roll Number	913219104008
Maximum Marks	2 marks

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

2) LOAD DATASET

In [2]:

```
f1=pd.read_csv("Mall_Customers.csv")
```

In [3]:

```
f1.head()
```

Out[3]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

In [4]:

```
f1.columns
```

Out[4]:

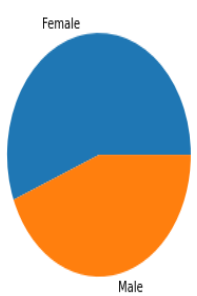
```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

3) PERFORM VISUALIZATIONS

3.1 UNIVARIATE ANALYSIS

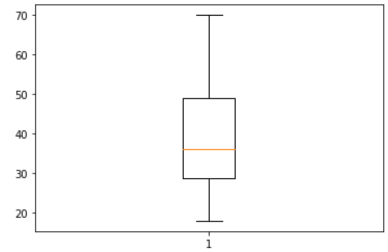
In [5]:

```
#pie chart
data1=f1.groupby("Gender",axis=0)
plt.pie(data1.count()["Age"], labels=data1.indices)
plt.show()
```



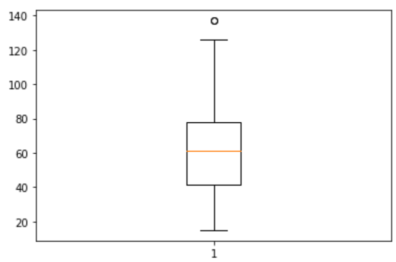
InÂ [6]:

```
#boxplot
plt.boxplot(f1["Age"])
plt.show()
```



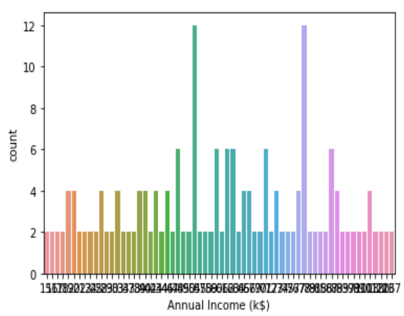
InÂ [7]:

```
#boxplot
plt.boxplot(f1["Annual Income (k$)"])
plt.show()
```



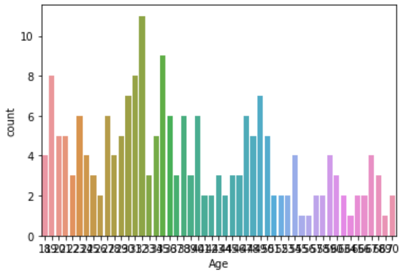
InÂ [11…

```
#countplot
sns.countplot(x=f1["Annual Income (k$)"])
plt.show()
```



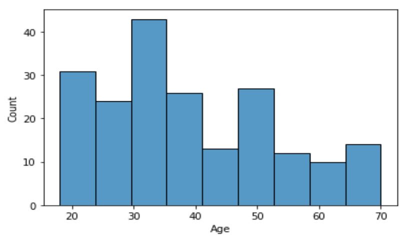
InÂ [12…

```
#countplot
sns.countplot(x=f1["Age"])
plt.show()
```



InÂ [13…

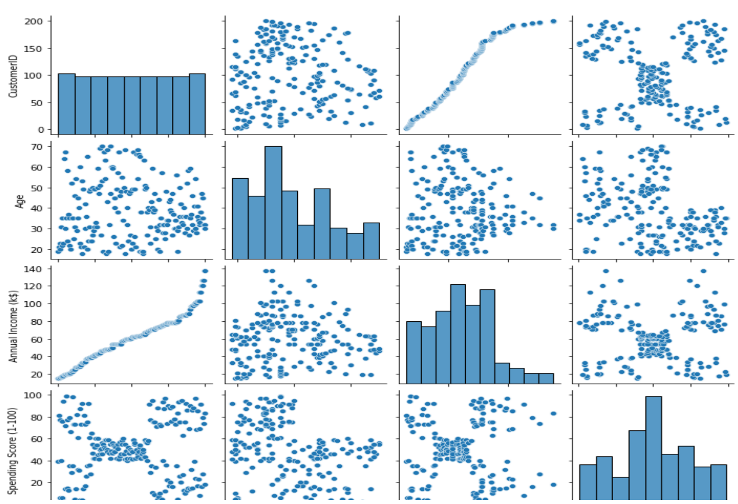
```
#histplot
sns.histplot(f1["Age"])
plt.show()
```

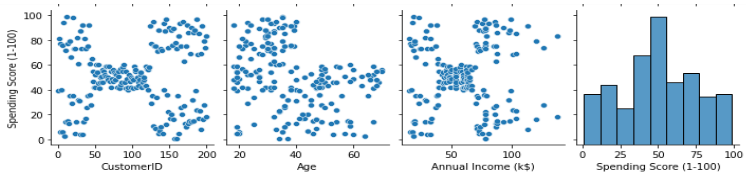


3.2 BI-VARIATE ANALYSIS

[15…

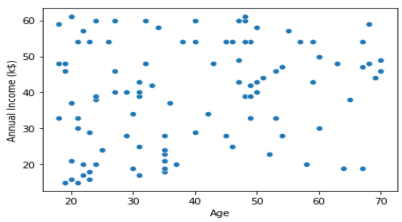
```
#pairplot
sns.pairplot(f1)
plt.show()
```





:nÂ [17…

```
#scatterplot for Age and Annual Income (k$)
sns.scatterplot(x=f1.iloc[:100,:]["Age"],y=f1.iloc[:100,:]["Annual Income (k$)"])
plt.show()
```

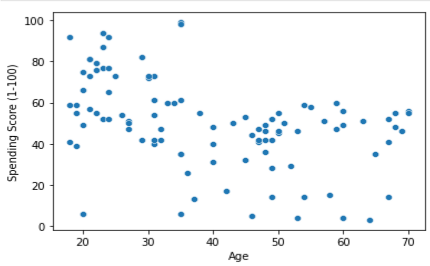


:nÂ [18…

```
#scatterplot for Age and Spending Score (1-100)
sns.scatterplot(x=f1.iloc[:100,:]["Age"],y=f1.iloc[:100,:]["Spending Score (1-100)"])
plt.show()
```

3…


```
#scatterplot for Age and Spending Score (1-100)
sns.scatterplot(x=f1.iloc[:100,:]["Age"],y=f1.iloc[:100,:]["Spending Score (1-100)"])
plt.show()
```

3.3 MULTI-VARIATE ANALYSIS

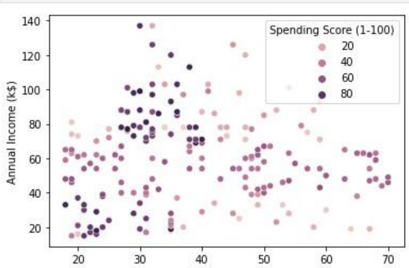
3…

```
#scatterplot for Age, Annual Income (k$) and Spending Score (1-100)
sns.scatterplot(x=f1.iloc[:200,:]["Age"],y=f1.iloc[:200,:]["Annual Income (k$)"],hue=f1.iloc[:200,:]["Spending Score (1-100)"])
plt.show()
```

3.3 MULTI-VARIATE ANALYSIS

InÂ [19…


```
#scatterplot for Age, Annual Income (k$) and Spending Score (1-100)
sns.scatterplot(x=f1.iloc[:200,:]["Age"],y=f1.iloc[:200,:]["Annual Income (k$)"],hue=f1.iloc[:200,:]["Spending Score (1-100)"])
plt.show()
```

4) PERFORM DESCRIPTIVE STATISTICS ON THE DATASET

InÂ [20…

```
f1.describe()
```

Out[20]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

InÂ [21…

```
f1.mode(numeric_only=True)
```

Out[21]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
0	1	32.0	54.0	42.0
1	2	NaN	78.0	NaN
2	3	NaN	NaN	NaN
3	4	NaN	NaN	NaN
4	5	NaN	NaN	NaN
...	...	...	...	...
195	196	NaN	NaN	NaN
196	197	NaN	NaN	NaN
197	198	NaN	NaN	NaN
198	199	NaN	NaN	NaN
199	200	NaN	NaN	NaN

200 rows ÃƒÂ— 4 columns

InÂ [22…

```
f1.median(numeric_only=True)
```

Out[22]:

```
CustomerID                100.5
Age                        36.0
Annual Income (k$)         61.5
Spending Score (1-100)     50.0
dtype: float64
```

InÂ [23…

```
f1.skew(numeric_only=True)
```

Out[23]:

```
CustomerID                0.000000
Age                       0.485569
Annual Income (k$)        0.321843
Spending Score (1-100)   -0.047220
dtype: float64
```

InÂ [24…

```
f1.kurt(numeric_only=True)
```

Out[24]:

```
CustomerID               -1.200000
Age                      -0.671573
Annual Income (k$)       -0.098487
Spending Score (1-100)   -0.826629
dtype: float64
```

5) HANDLE MISSING VALUES

InÂ [25…

```
#find the null columns
f1.isnull().sum()
```

Out[25]:

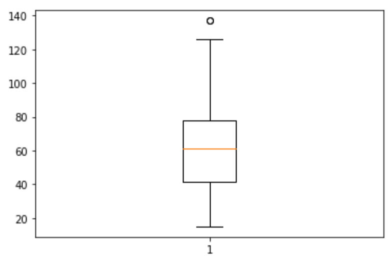
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

InÂ [23…
```
f1.skew(numeric_only=True)
```
Out[23]:
```
CustomerID              0.000000
Age                     0.485569
Annual Income (k$)      0.321843
Spending Score (1-100)  -0.047220
dtype: float64
```
InÂ [24…
```
f1.kurt(numeric_only=True)
```
Out[24]:
```
CustomerID              -1.200000
Age                     -0.671573
Annual Income (k$)      -0.098487
Spending Score (1-100)  -0.826629
dtype: float64
```

5) HANDLE MISSING VALUES

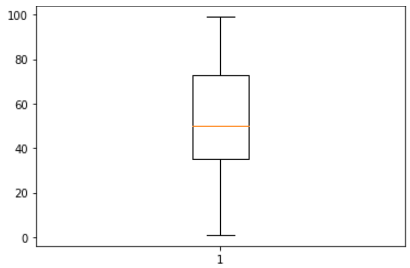
InÂ [25…
```
#find the null columns
f1.isnull().sum()
```
Out[25]:
```
CustomerID              0
Gender                  0
Age                     0
Annual Income (k$)      0
Spending Score (1-100)  0
dtype: int64
```

6) FIND THE OUTLIERS AND REPLACE THE OUTLIERS

InÂ [36…
```
#find outliers-Annual Income (k$)
plt.boxplot(f1["Annual Income (k$)"])
plt.show()
```


InÂ [37…
```
#handling outliers: InterQuartile Range(IQR)
Q3=np.percentile(f1["Annual Income (k$)"],75,interpolation='midpoint')
Q1=np.percentile(f1["Annual Income (k$)"],25,interpolation='midpoint')
IQR=Q3-Q1
print("Q1: ", Q1)
print("Q3:", Q3)
print("IQR: ", IQR)
```
```
Q1:  41.0
Q3: 78.0
IQR:  37.0
```
InÂ [38…
```
upperOutlayers=Q3+1.5*IQR
lowerOutlayers=Q1-1.5*IQR
print(upperOutlayers)
print(lowerOutlayers)
```
```
133.5
-14.5
```
InÂ [39…
```
f1.drop(np.where(f1["Annual Income (k$)"]>=upperOutlayers)[0],inplace=True)
f1.drop(np.where(f1["Annual Income (k$)"]<=lowerOutlayers)[0],inplace=True)
```
InÂ [40…
```
#find outliers-Spending Score (1-100)
plt.boxplot(f1["Spending Score (1-100)"])
plt.show()
```


InÂ [37…
```
#handling outliers: InterQuartile Range(IQR)
Q3=np.percentile(f1["Annual Income (k$)"],75,interpolation='midpoint')
Q1=np.percentile(f1["Annual Income (k$)"],25,interpolation='midpoint')
IQR=Q3-Q1
print("Q1: ", Q1)
print("Q3:", Q3)
print("IQR: ", IQR)
```
```
Q1:  41.0
Q3: 78.0
IQR:  37.0
```
InÂ [38…
```
upperOutlayers=Q3+1.5*IQR
lowerOutlayers=Q1-1.5*IQR
print(upperOutlayers)
print(lowerOutlayers)
```
```
133.5
-14.5
```
InÂ [39…
```
f1.drop(np.where(f1["Annual Income (k$)"]>=upperOutlayers)[0],inplace=True)
f1.drop(np.where(f1["Annual Income (k$)"]<=lowerOutlayers)[0],inplace=True)
```
InÂ [40…
```
#find outliers-Spending Score (1-100)
plt.boxplot(f1["Spending Score (1-100)"])
plt.show()
```

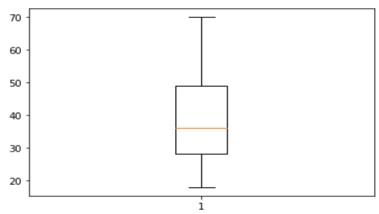


1…

```
#find outliers-Age
plt.boxplot(f1["Age"])
plt.show()
```

InÂ [41…

```
#find outliers-Age
plt.boxplot(f1["Age"])
plt.show()
```



7) CHECK FOR CATEGORICAL COLUMNS AND PERFORM ENCODING

InÂ [42…

```
f1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 198 entries, 0 to 197
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              198 non-null    int64
 1   Gender                  198 non-null    object
 2   Age                     198 non-null    int64
 3   Annual Income (k$)      198 non-null    int64
 4   Spending Score (1-100)  198 non-null    int64
dtypes: int64(4), object(1)
memory usage: 17.4+ KB
```

InÂ [43…

```
from sklearn.preprocessing import LabelEncoder
```

InÂ [45…

```
encod=LabelEncoder()
f1['Spending Score (1-100)']=encod.fit_transform(f1['Spending Score (1-100)'])
```

InÂ [48…

```
print(f1["Spending Score (1-100)"].unique())
```

```
[29 66  4 63 30 62 78  1 58 12 82 13 11 65 27 54 23 81 59  3 67 25 51 24
 71  2 76 15 20 61 28 22 53 45 37 32 42 50 44 35 31 40 36 41 46 49 38 39
 43 34 47 48 33 75 79  9  7 26 57 72  5  8 77 10 80 60 17 74 16 14 73  0
 64 68 21 52 70 56 19 55 69 18  6]
```

[46…

```
f1.head()
```

:[46]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	29
1	2	Male	21	15	66
2	3	Female	20	16	4
3	4	Female	23	16	63
4	5	Female	31	17	30

[47…

```
f1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 198 entries, 0 to 197
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              198 non-null    int64
 1   Gender                  198 non-null    object
 2   Age                     198 non-null    int64
 3   Annual Income (k$)      198 non-null    int64
 4   Spending Score (1-100)  198 non-null    int64
dtypes: int64(4), object(1)
memory usage: 17.4+ KB
```

8) SCALING THE DATA

InÂ [49…
```
from sklearn.preprocessing import scale
```

InÂ [50…
```
x=f1.drop(columns=['Gender'],axis=1)
x.head()
```

Out[50]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
0	1	19	15	29
1	2	21	15	66
2	3	20	16	4
3	4	23	16	63
4	5	31	17	30

InÂ [52…
```
x.mean()
```

Out[52]:
```
1.570012358055777e-17
```

InÂ [54…
```
x.std()
```

Out[54]:
```
1.0
```

9) PERFORM CLUSTERING ALGORITHM

InÂ [56…
```
from sklearn.cluster import KMeans
wcss=[]
for i in range (1,11):
  kmeans=KMeans(n_clusters=i, init='k-means++',random_state=0)
  kmeans.fit(x)
  wcss.append(kmeans.inertia_)
```

InÂ [57…
```
wcss
```

Out[57]:
```
[791.9999999999998,
 508.44874485439107,
 368.58328054500737,
 257.0929393027723,
 206.35125359279914,
 156.94571620133905,
 140.89593744774663,
 125.07516278994356,
 114.55898071571418,
 101.0295653122749]
```


InÂ [52…
```
x.mean()
```

Out[52]:
```
1.570012358055777e-17
```

InÂ [54…
```
x.std()
```

Out[54]:
```
1.0
```

9) PERFORM CLUSTERING ALGORITHM

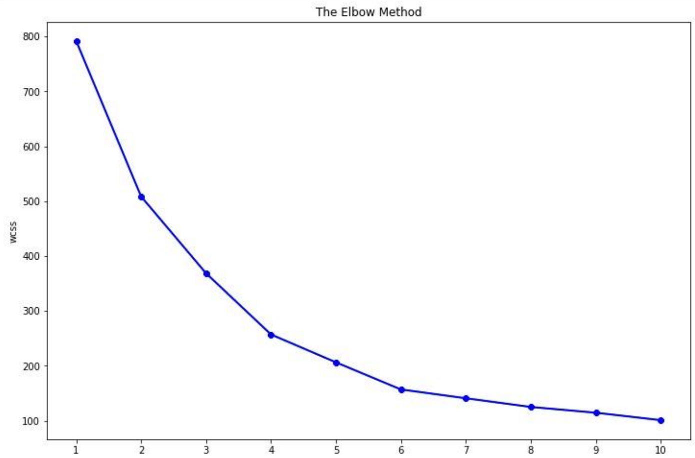
InÂ [56…
```
from sklearn.cluster import KMeans
wcss=[]
for i in range (1,11):
  kmeans=KMeans(n_clusters=i, init='k-means++',random_state=0)
  kmeans.fit(x)
  wcss.append(kmeans.inertia_)
```

InÂ [57…
```
wcss
```

Out[57]:
```
[791.9999999999998,
 508.44874485439107,
 368.58328054500737,
 257.0929393027723,
 206.35125359279914,
 156.94571620133905,
 140.89593744774663,
 125.07516278994356,
 114.55898071571418,
 101.0295653122749]
```

InÂ [60…

```
plt.figure(figsize=(12,8))
plt.plot(range(1,11),wcss)
plt.title('The Elbow Method')
plt.plot(range(1,11),wcss, linewidth=2, color="red", marker ="8")
plt.xlabel("No. of clusters/ k-value")
plt.xticks(np.arange(1,11,1))
plt.ylabel("wcss")
plt.show()
```



InÂ [62…

```
#BUILD MODEL
kmodel=KMeans(n_clusters=5,init='k-means++',random_state=0)
y_kmeans=kmodel.fit_predict(x)
```

InÂ [64…

```
kmodel.labels_
```

Out[64]:

```
array([0, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0,
       4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 1, 0, 4, 0,
       4, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0,
       1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0,
       0, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1,
       1, 0, 2, 0, 0, 0, 1, 1, 1, 1, 3, 2, 3, 3, 2, 3, 2, 3, 2, 3, 2, 3,
       2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3,
       2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3,
       2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3],
      dtype=int32)
```

InÂ [75…

```
plt.scatter(x[y_kmeans==0,0],x[y_kmeans==0,1],s=100,c='red',label='Cluster 1')
plt.scatter(x[y_kmeans==1,0],x[y_kmeans==1,1],s=100,c='blue',label='Cluster 2')
plt.scatter(x[y_kmeans==2,0],x[y_kmeans==2,1],s=100,c='pink',label='Cluster 3')
plt.scatter(x[y_kmeans==3,0],x[y_kmeans==3,1],s=100,c='green',label='Cluster 4')
plt.scatter(x[y_kmeans==4,0],x[y_kmeans==4,1],s=100,c='orange',label='Cluster 5')
plt.scatter(kmeans.cluster_centers_[:, 0],kmeans.cluster_centers_[:, 1],s=300,c='black',label='Centroids')
plt.title('Clusters of cutomers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score(1-100)')
plt.show()
```