

Assignment -4

Assignment Date	22 October 2022
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Student Roll Number	732219CS108
Maximum Marks	2 Marks

Problem Statement: Customer Segmentation Analysis

Problem Statement

You own the mall and want to understand the customers who can quickly converge [Target Customers] so that the insight can be given to the marketing team and plan the strategy accordingly.

1. Download the dataset:

```
In [1]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

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

2. Load the dataset.

```
In [2]: data= pd.read_csv("F:Mall_Customers.csv")
```

```
In [3]: data.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]: data.tail()
```

Out[4]:

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74

```
In [4]: data.tail()
```

```
Out[4]:
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74
198	199	Male	32	137	18
199	200	Male	30	137	83

```
In [5]: data=data.iloc[:,1:]
```

```
In [6]: data.head()
```

```
Out[6]:
```

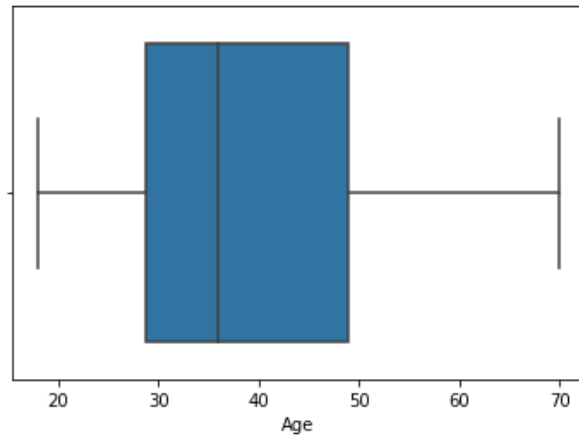
	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	Male	19	15	39
1	Male	21	15	81
2	Female	20	16	6
3	Female	23	16	77
4	Female	31	17	40

3. Perform Below Visualizations

Univariate Analysis

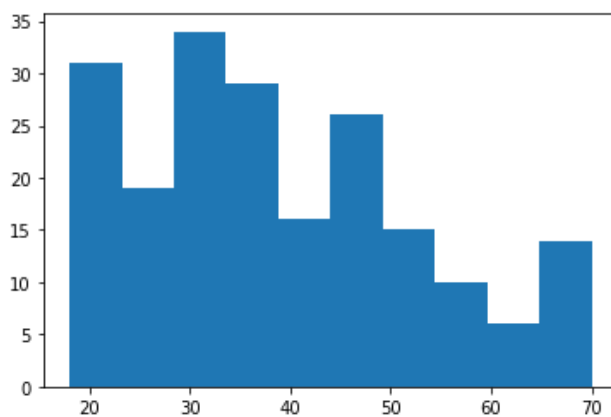
```
In [7]: sns.boxplot(data['Age'])
```

```
Out[7]: <AxesSubplot:xlabel='Age'>
```



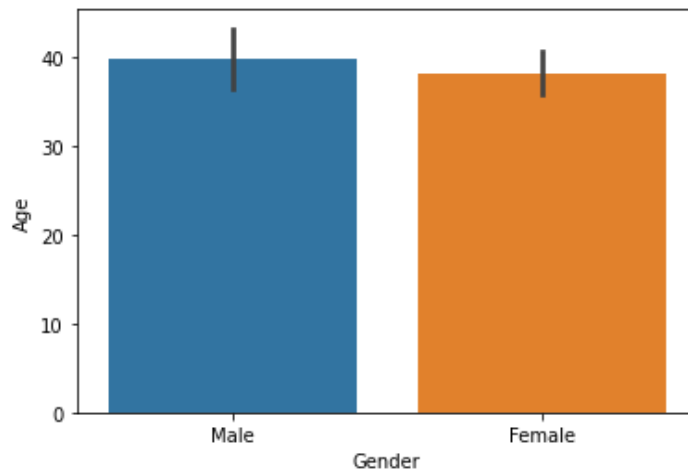
```
In [8]: plt.hist(data['Age'])
```

```
Out[8]: (array([31., 19., 34., 29., 16., 26., 15., 10., 6., 14.]),  
array([18., 23.2, 28.4, 33.6, 38.8, 44., 49.2, 54.4, 59.6, 64.8, 70. ]),  
<BarContainer object of 10 artists>)
```



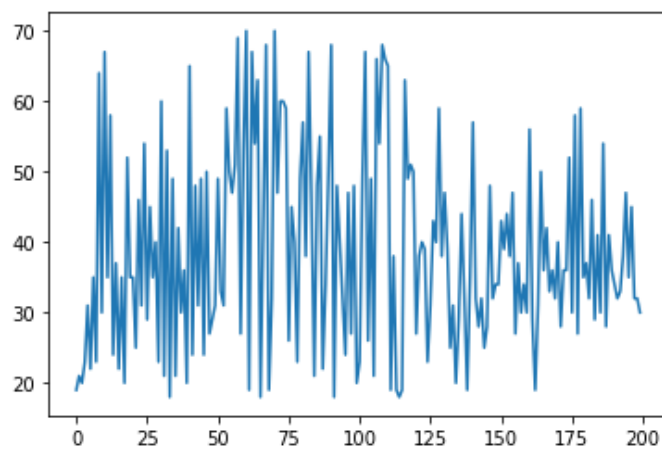
```
In [9]: sns.barplot(data['Gender'], data['Age'])
```

```
Out[9]: <AxesSubplot:xlabel='Gender', ylabel='Age'>
```



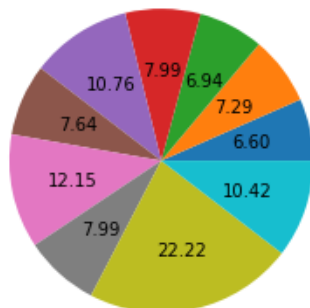
```
In [10]: plt.plot(data['Age'])
```

```
Out[10]: [<matplotlib.lines.Line2D at 0x1f4220bceb0>]
```



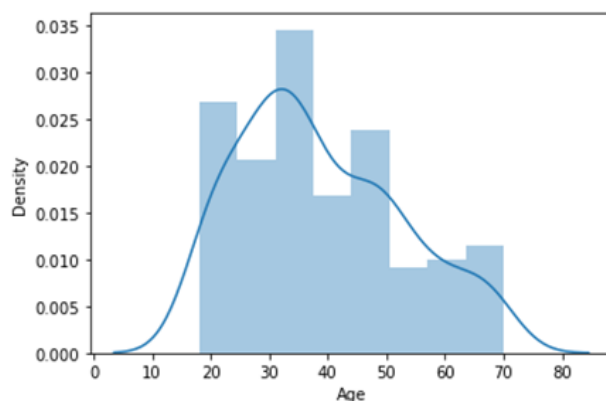
```
In [11]: plt.pie(data['Age'].head(10), autopct="%.2f")
```

```
Out[11]: ([<matplotlib.patches.Wedge at 0x1f42212d970>,
<matplotlib.patches.Wedge at 0x1f42213e130>,
<matplotlib.patches.Wedge at 0x1f42213e850>,
<matplotlib.patches.Wedge at 0x1f42213ef70>,
<matplotlib.patches.Wedge at 0x1f42214b6d0>,
<matplotlib.patches.Wedge at 0x1f42214bdf0>,
<matplotlib.patches.Wedge at 0x1f422157550>,
<matplotlib.patches.Wedge at 0x1f422157c70>,
<matplotlib.patches.Wedge at 0x1f422165370>,
<matplotlib.patches.Wedge at 0x1f422165a90>],
[Text(1.07645875087365, 0.22635493736064408, ''),
Text(0.8799412198934483, 0.6600783662054303, ''),
Text(0.5079234694833851, 0.975711919138001, ''),
Text(0.011998880619069147, 1.099934555718607, ''),
Text(-0.6011141928104972, 0.9212283795030332, ''),
Text(-1.006842632792316, 0.4430213457519151, ''),
Text(-1.07645875087365, -0.22635493736064374, ''),
Text(-0.7342584950726593, -0.8190631614311766, ''),
Text(0.23808358650393244, -1.0739256053551496, ''),
Text(1.0416231452033553, -0.35358340370649477, '6.60'),
Text(0.5871593186583546, 0.12346632946944221, '7.29'),
Text(0.47996793812369903, 0.3600427452029619, '6.94'),
Text(0.27704916517275546, 0.5322065013480005, '7.99'),
Text(0.006544843974037716, 0.5999643031192401, '10.42'),
Text(-0.3278804688057257, 0.5024882070016544, '12.15'),
Text(-0.5491868906139904, 0.24164800677377185, '7.99'),
Text(-0.5871593186583546, -0.12346632946944203, '10.76'),
Text(-0.4005046336759959, -0.4467617244170054, '7.64'),
Text(0.12986377445669042, -0.5857776029209907, '22.22'),
Text(0.5681580792018301, -0.19286367474899713, '10.42')])
```



```
In [12]: sns.distplot(data['Age'].head(200))
```

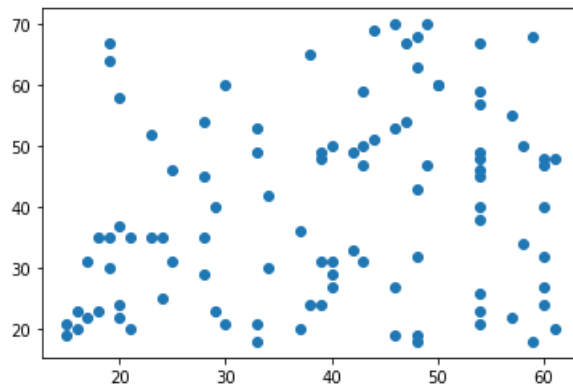
```
Out[12]: <AxesSubplot:xlabel='Age', ylabel='Density'>
```



BI - Variate Analysis

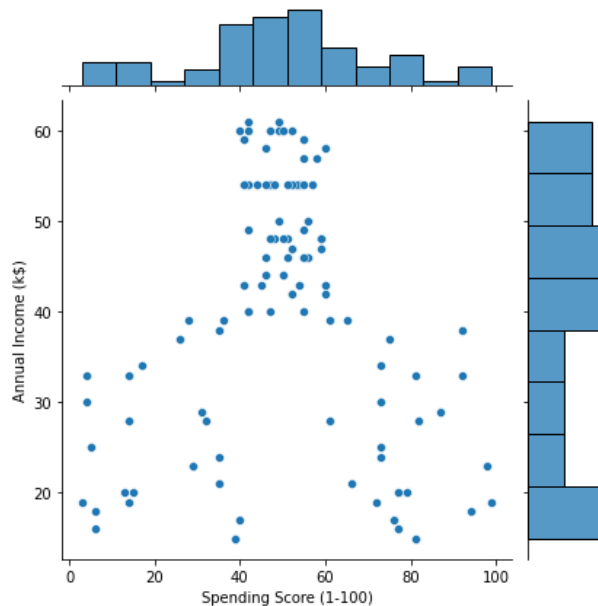
```
In [13]: plt.scatter(data['Annual Income (k$)'].head(100),data['Age'].head(100))
```

```
Out[13]: <matplotlib.collections.PathCollection at 0x1f42225e4c0>
```



```
In [14]: sns.jointplot(data['Spending Score (1-100)'].head(100),data['Annual Income (k$)'].head(100), )
```

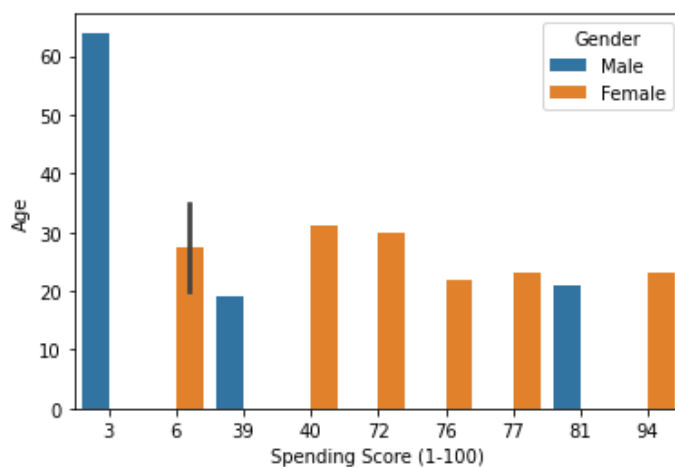
```
Out[14]: <seaborn.axisgrid.JointGrid at 0x1f422283f70>
```



Multi - Variate Analysis

```
In [15]: sns.barplot('Spending Score (1-100)', 'Age', hue='Gender', data=data.head(10))
```

```
Out[15]: <AxesSubplot:xlabel='Spending Score (1-100)', ylabel='Age'>
```



```
In [16]: sns.heatmap(data.head().corr(), annot = True)
```

```
Out[16]: <AxesSubplot:>
```



4. Perform descriptive statistics on the dataset.

```
In [17]: data.mean()
```

```
Out[17]: Age                38.85  
Annual Income (k$)         60.56  
Spending Score (1-100)     50.20  
dtype: float64
```

```
In [18]: data.median()
```

```
Out[18]: Age                36.0  
Annual Income (k$)         61.5  
Spending Score (1-100)     50.0  
dtype: float64
```

```
In [19]: data.mode()
```

```
Out[19]:
```

	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	Female	32.0	54	42.0
1	NaN	NaN	78	NaN

```
In [20]: data.std()
```

```
Out[20]: Age                13.969007  
Annual Income (k$)         26.264721  
Spending Score (1-100)     25.823522  
dtype: float64
```

```
In [21]: data.var()
```

```
Out[21]: Age                195.133166  
Annual Income (k$)         689.835578  
Spending Score (1-100)     666.854271  
dtype: float64
```



```
In [22]: data.describe()
```

```
Out[22]:
```

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

```
In [23]: data.skew()
```

```
Out[23]: Age                0.485569  
Annual Income (k$)        0.321843  
Spending Score (1-100)   -0.047220  
dtype: float64
```

```
In [24]: data.kurt()
```

```
Out[24]: Age                -0.671573  
Annual Income (k$)        -0.098487  
Spending Score (1-100)   -0.826629  
dtype: float64
```

```
In [25]: quantile= data['Age'].quantile(q=[0.75, 0.25])  
quantile
```

```
Out[25]: 0.75    49.00  
         0.25    28.75  
         Name: Age, dtype: float64
```

5. Handle the Missing values.

```
In [26]: data.isna().any()
```

```
Out[26]: Gender                False  
Age                False  
Annual Income (k$)        False  
Spending Score (1-100)   False  
dtype: bool
```

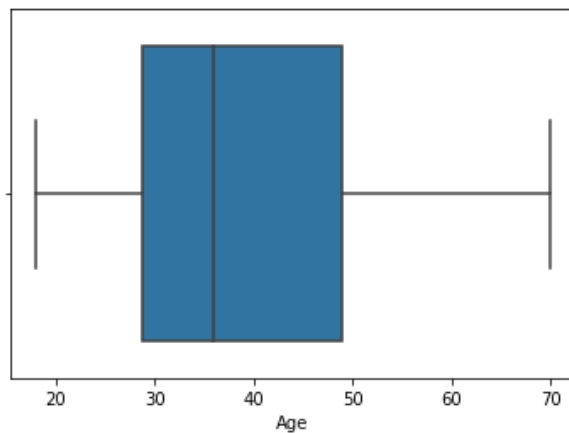
```
In [27]: data.duplicated().any()
```

```
Out[27]: False
```

6. Find the outliers and replace the outliers

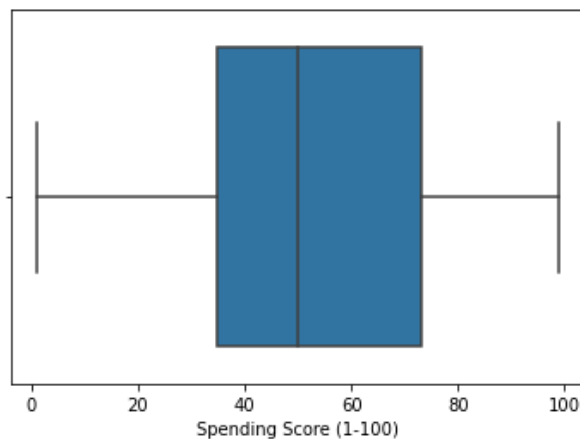
```
In [28]: sns.boxplot(data['Age'])
```

```
Out[28]: <AxesSubplot:xlabel='Age'>
```



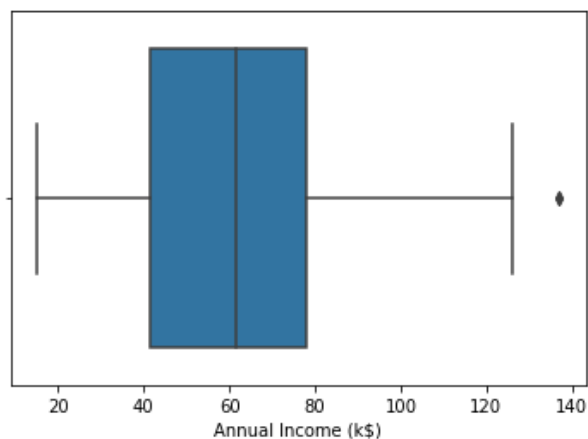
```
In [29]: sns.boxplot(data['Spending Score (1-100)'])
```

```
Out[29]: <AxesSubplot:xlabel='Spending Score (1-100)'>
```



```
In [30]: sns.boxplot(data['Annual Income (k$)'])
```

```
Out[30]: <AxesSubplot:xlabel='Annual Income (k$)'>
```



```
In [31]: data['Annual Income (k$)'].mean()
```

```
Out[31]: 60.56
```

```
In [32]: qut= data.quantile(q=[0.25,0.75])
qut
```

```
Out[32]:
```

	Age	Annual Income (k\$)	Spending Score (1-100)
0.25	28.75	41.5	34.75
0.75	49.00	78.0	73.00

```
In [33]: irq=qut.loc[0.75]- qut.loc[0.25] # q3-q1
irq
```

```
Out[33]: Age                20.25
Annual Income (k$)         36.50
Spending Score (1-100)     38.25
dtype: float64
```

```
In [34]: lower= qut.loc[0.25]+(1.5*irq)
lower
```

```
Out[34]: Age                59.125
Annual Income (k$)         96.250
Spending Score (1-100)     92.125
dtype: float64
```

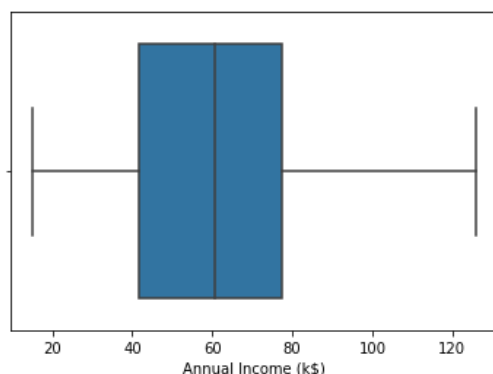
```
In [35]: upper= qut.loc[0.75]+(1.5*irq)
upper
```

```
Out[35]: Age                79.375
Annual Income (k$)        132.750
Spending Score (1-100)    130.375
dtype: float64
```

```
In [36]: data['Annual Income (k$)']=np.where(data['Annual Income (k$)']>131,60.56, data['Annual Income (k$)'])
```

```
In [37]: sns.boxplot(data['Annual Income (k$)'])
```

```
Out[37]: <AxesSubplot:xlabel='Annual Income (k$)'>
```



7. Check for Categorical columns and perform encoding.

```
In [38]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
#   Column              Non-Null Count  Dtype
---  -
0   Gender              200 non-null   object
1   Age                 200 non-null   int64
2   Annual Income (k$)  200 non-null   float64
3   Spending Score (1-100) 200 non-null   int64
dtypes: float64(1), int64(2), object(1)
memory usage: 6.4+ KB
```

```
In [39]: data.Gender.unique()
```

```
Out[39]: array(['Male', 'Female'], dtype=object)
```

```
In [40]: data['Gender'].replace({'Female':0, 'Male': 1 }, inplace=True)
```

```
In [41]: data.head()
```

```
Out[41]:
```

	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1	19	15.0	39
1	1	21	15.0	81
2	0	20	16.0	6
3	0	23	16.0	77
4	0	31	17.0	40

8. Scale the data

```
In [42]: from sklearn.preprocessing import MinMaxScaler
```

```
In [43]: sc=MinMaxScaler()
```

```
In [44]: data1=sc.fit_transform(data)
data1
```

```
[1.         , 0.48076923, 0.5045045 , 0.34693878],
[1.         , 0.42307692, 0.5045045 , 0.95918367],
[1.         , 0.78846154, 0.5045045 , 0.10204082],
[1.         , 0.38461538, 0.5045045 , 0.75510204],
[1.         , 0.55769231, 0.5045045 , 0.08163265],
[1.         , 0.40384615, 0.5045045 , 0.75510204],
[0.         , 0.13461538, 0.51351351, 0.33673469],
[0.         , 0.25         , 0.51351351, 0.71428571],
[1.         , 0.03846154, 0.52252252, 0.04081633],
[0.         , 0.21153846, 0.52252252, 0.8877551 ],
[0.         , 0.5         , 0.52252252, 0.06122449],
[1.         , 0.26923077, 0.52252252, 0.73469388],
[1.         , 0.01923077, 0.53153153, 0.09183673],
[0.         , 0.32692308, 0.53153153, 0.7244898 ],
[0.         , 0.75         , 0.54054054, 0.04081633],
[1.         , 0.26923077, 0.54054054, 0.93877551],
[0.         , 0.19230769, 0.54954955, 0.39795918],
[0.         , 0.26923077, 0.54954955, 0.87755102],
[1.         , 0.13461538, 0.55855856, 0.1122449 ],
[1.         , 0.19230769, 0.55855856, 0.97959184],
```

9. Perform any of the clustering algorithms

```
In [45]: from sklearn.cluster import KMeans
```

```
In [46]: TWSS=[]
k=list(range(2,9))

for i in k:
    kmeans=KMeans(n_clusters=i,init='k-means++')
    kmeans.fit(data1)
    TWSS.append(kmeans.inertia_)
```

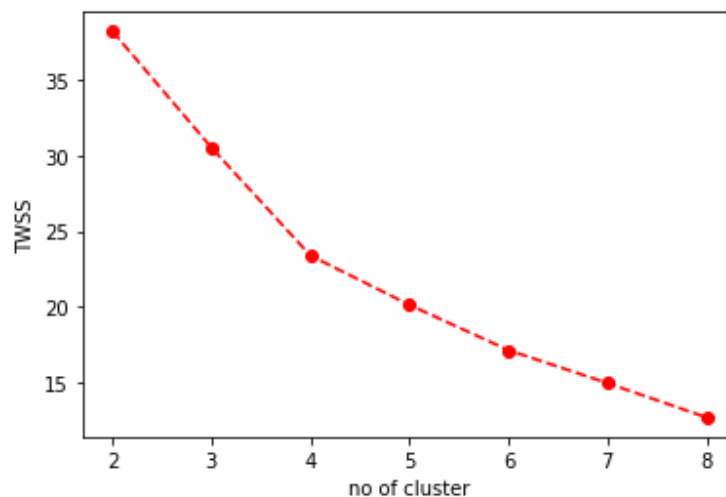
```
In [47]: TWSS
```

```
Out[47]: [38.256100195670456,
30.535982817704678,
23.373803580051828,
20.099663171218396,
17.095717979699913,
14.90873757676125,
12.635266048983096]
```

```
In [49]: #scree plot

plt.plot(k,TWSS,'ro--')
plt.xlabel('no of cluster')
plt.ylabel('TWSS')
```

```
Out[49]: Text(0, 0.5, 'TWSS')
```



```
In [50]: #selecting 4 clusters

model=KMeans(n_clusters=4)

model.fit(data1)
```

```
Out[50]: KMeans
KMeans(n_clusters=4)
```

```
In [51]: model.labels_
```

```
Out[51]: array([3, 3, 2, 0, 0, 0, 2, 0, 1, 0, 1, 0, 2, 0, 1, 3, 2, 3, 1, 0, 1, 3,
                2, 3, 2, 3, 2, 3, 2, 0, 1, 0, 1, 3, 2, 0, 2, 0, 2, 0, 2, 3, 1, 0,
                2, 0, 2, 0, 0, 0, 2, 3, 0, 1, 2, 1, 2, 1, 0, 1, 1, 3, 2, 2, 1, 3,
                2, 2, 3, 0, 1, 2, 2, 2, 1, 3, 2, 1, 0, 2, 1, 3, 1, 2, 0, 1, 2, 0,
                0, 2, 2, 3, 1, 2, 0, 3, 2, 0, 1, 3, 0, 2, 1, 3, 1, 0, 2, 1, 1, 1,
                1, 0, 2, 3, 0, 0, 2, 2, 2, 2, 3, 2, 0, 3, 0, 0, 1, 3, 1, 3, 1, 3,
                0, 0, 1, 0, 2, 3, 1, 0, 2, 3, 0, 0, 1, 3, 1, 0, 2, 3, 1, 3, 2, 0,
                2, 0, 1, 0, 1, 0, 2, 0, 1, 0, 1, 0, 1, 0, 2, 3, 1, 3, 1, 3, 2, 0,
                1, 3, 1, 3, 2, 0, 1, 0, 2, 3, 2, 3, 2, 0, 2, 0, 1, 0, 2, 0, 2, 3,
                1, 3])
```

```
In [52]: mb=pd.Series(model.labels_)
```

10. Add the cluster data with the primary dataset

```
In [53]: data.head()
```

```
Out[53]:
```

	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1	19	15.0	39
1	1	21	15.0	81
2	0	20	16.0	6
3	0	23	16.0	77
4	0	31	17.0	40

```
In [54]: #creating a new column with labels
data['clust']=mb
```

```
In [55]: data.head()
```

```
Out[55]:
```

	Gender	Age	Annual Income (k\$)	Spending Score (1-100)	clust
0	1	19	15.0	39	3
1	1	21	15.0	81	3
2	0	20	16.0	6	2
3	0	23	16.0	77	0
4	0	31	17.0	40	0

```
In [56]: data['clust'].unique()
```

```
Out[56]: array([3, 2, 0, 1])
```

```
In [57]: #storing the data set in csv format
```

```
data.to_csv('Kmeans_Mall.csv',encoding='utf-8')
```

```
In [58]: import os  
os.getcwd()
```

```
Out[58]: 'C:\\Users\\asadmin\\Downloads'
```

11. Split the data into dependent and independent variables.

```
In [149]: x=data.iloc[:,4]  
y=data['clust']  
x
```

```
Out[149]:
```

	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1	19	15.00	39
1	1	21	15.00	81
2	0	20	16.00	6
3	0	23	16.00	77
4	0	31	17.00	40
...
195	0	35	120.00	79
196	0	45	126.00	28
197	1	32	126.00	74
198	1	32	60.56	18
199	1	30	60.56	83

200 rows x 4 columns

y

```
0      3
1      3
2      2
3      0
4      0
..
195    0
196    2
197    3
198    1
199    3
Name: clust, Length: 200, dtype: int32
```

```
from sklearn.preprocessing import MinMaxScaler
sc=MinMaxScaler()
```

```
x=sc.fit_transform(data1)
```

```
array([[1., 0.01923077, 0., 0.3877551],  
       [1., 0.05769231, 0., 0.81632653],  
       [0., 0.03846154, 0.00900901, 0.05102041],  
       [0., 0.09615385, 0.00900901, 0.7755102 ],  
       [0., 0.25      , 0.01801802, 0.39795918],  
       [0., 0.07692308, 0.01801802, 0.76530612],  
       [0., 0.32692308, 0.02702703, 0.05102041],  
       [0., 0.09615385, 0.02702703, 0.94897959],  
       [1., 0.88461538, 0.03603604, 0.02040816],  
       [0., 0.23076923, 0.03603604, 0.7244898 ],  
       [1., 0.94230769, 0.03603604, 0.13265306],  
       [0., 0.32692308, 0.03603604, 1.        ],  
       [0., 0.76923077, 0.04504505, 0.14285714],  
       [0., 0.11538462, 0.04504505, 0.7755102 ],  
       [1., 0.36538462, 0.04504505, 0.12244898],  
       [1., 0.07692308, 0.04504505, 0.79591837],  
       [0., 0.32692308, 0.05405405, 0.34693878],  
       [1., 0.03846154, 0.05405405, 0.66326531],  
       [1., 0.65384615, 0.07207207, 0.28571429],  
       [1., 0.00000000, 0.00000000, 0.00000000]
```

12. Split the data into training and testing

```
In [154]: from sklearn.model_selection import train_test_split
```

```
In [155]: x_train, x_test, y_train, y_test = train_test_split(x,y, test_size = 0.2)
```

```
In [156]: print(x_train.shape, x_test.shape)
```

```
(160, 4) (40, 4)
```

13. Build the Model

```
In [157]: from sklearn.tree import DecisionTreeRegressor  
regr_1 = DecisionTreeRegressor(max_depth=5)
```

14. Train the Model

```
In [158]: regr_1.fit(x_train, y_train)
```

```
Out[158]: ▾ DecisionTreeRegressor  
DecisionTreeRegressor(max_depth=5)
```

15. Test the Model

```
In [159]: # predict on test data
```

```
y_predict = regr_1.predict(x_test)  
y_predict
```

```
Out[159]: array([1., 1., 2., 2., 2., 3., 1., 0., 3., 0., 2., 0., 2., 2., 0., 2., 3.,  
                2., 0., 0., 3., 0., 2., 1., 0., 3., 0., 0., 0., 1., 0., 3., 3., 1.,  
                2., 0., 0., 2., 0., 1.])
```

16. Measure the performance using Evaluation Metrics.

```
In [160]: from sklearn.metrics import r2_score  
acc=r2_score(y_test,y_predict)  
acc
```

Out[160]: 0.9206349206349207

RandomForest

```
In [161]: from sklearn.ensemble import RandomForestRegressor
```

```
In [162]: rf=RandomForestRegressor(max_depth=9)
```

```
In [163]: rf.fit(x_train, y_train)
```

```
Out[163]: ▼ RandomForestRegressor  
RandomForestRegressor(max_depth=9)
```

```
In [164]: ## prediction
```

```
pred= rf.predict(x_test)
```

```
In [165]: from sklearn.metrics import r2_score  
acc=r2_score(y_test,pred)  
acc
```

Out[165]: 0.9650171856440989