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

1. Download the dataset:
1. Load the dataset into the tool.

```
data=pd.read_csv("/content/Mall_Customers.csv")
```

1. Perform Below Visualizations. · Univariate Analysis · Bi-Variate Analysis · Multi-Variate Analysis

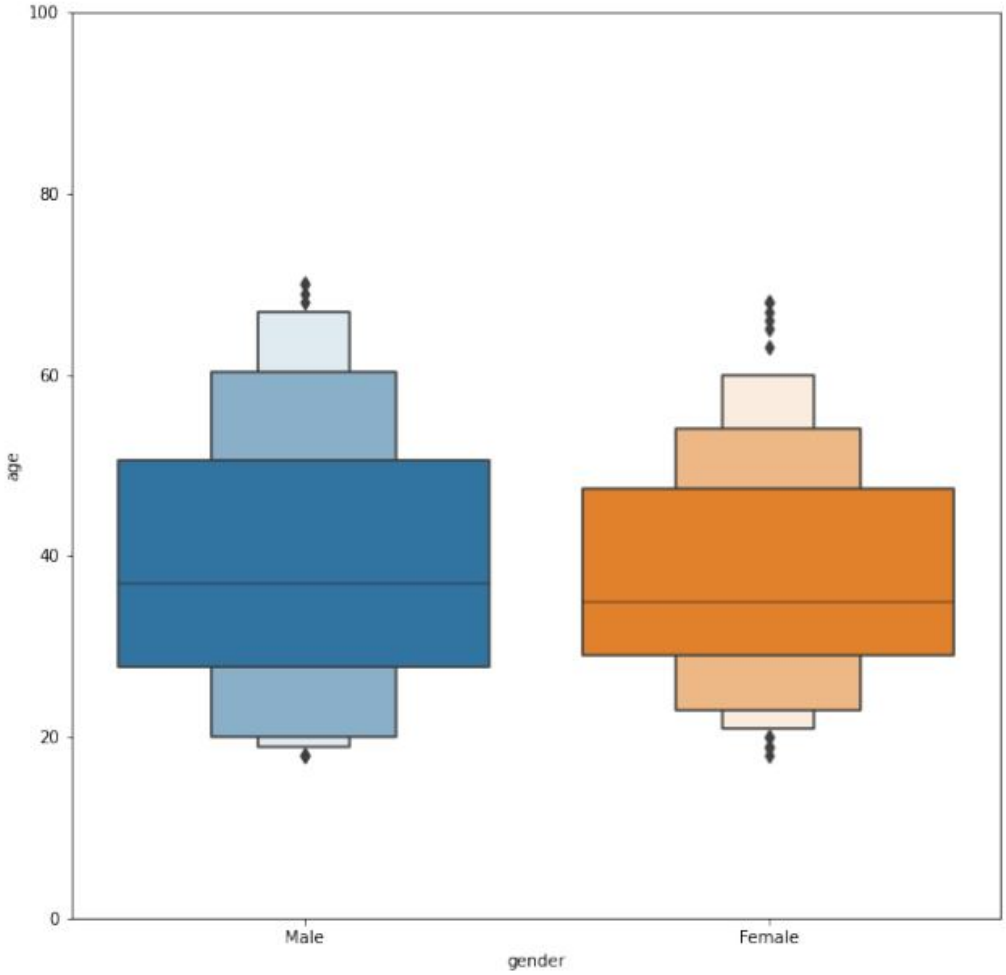
```
data.head()
```

	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

```
data.rename(columns={"CustomerID":"customer_id","Gender":"gender","Age
":"age","Annual Income (k$)":"annual_income",
                     "Spending Score (1-
100)":"spending_scores"},inplace=True)
```

```
temp = pd.concat([data['age'], data['gender']], axis=1)

f, ax = plt.subplots(figsize=(10,10))
fig = sns.boxenplot(x='gender', y="age", data=data)
fig.axis(ymin=0, ymax=100);
```



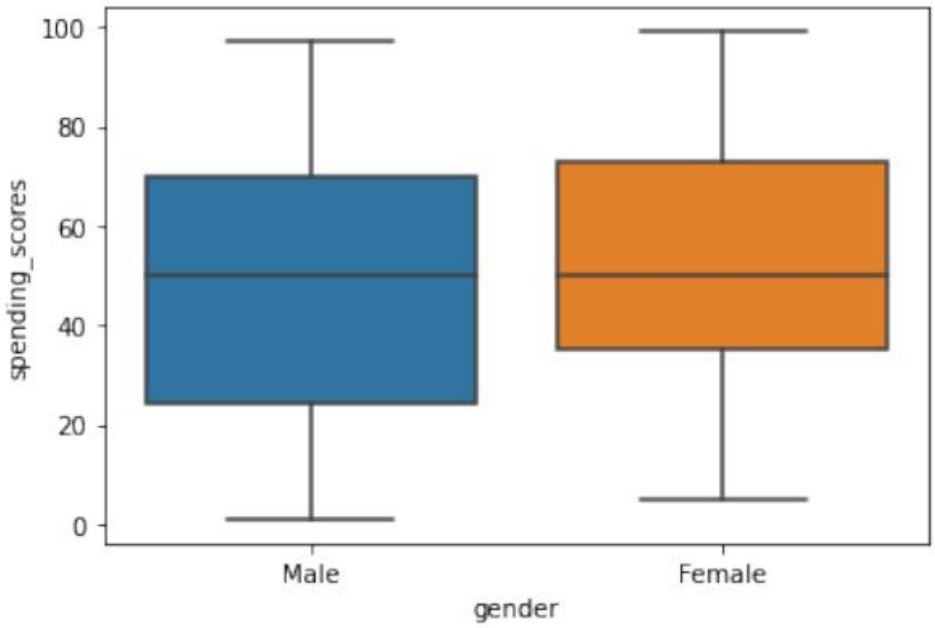
ANALYSIS

There is no difference in age of rings for male and female (18-70).

Count plot

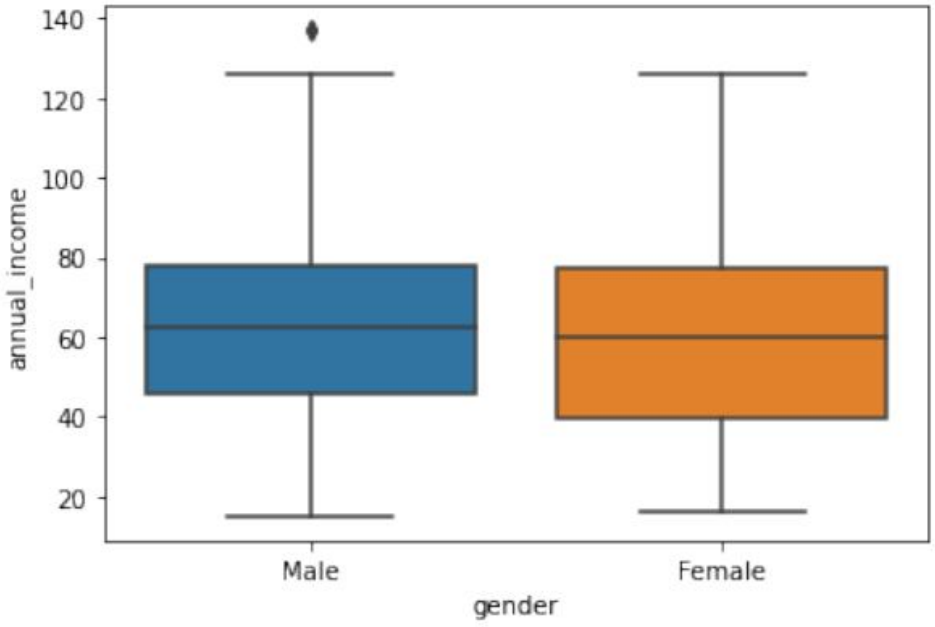
```
sns.boxplot(x=data['gender'],y=data['spending_scores'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe743f1b710>
```



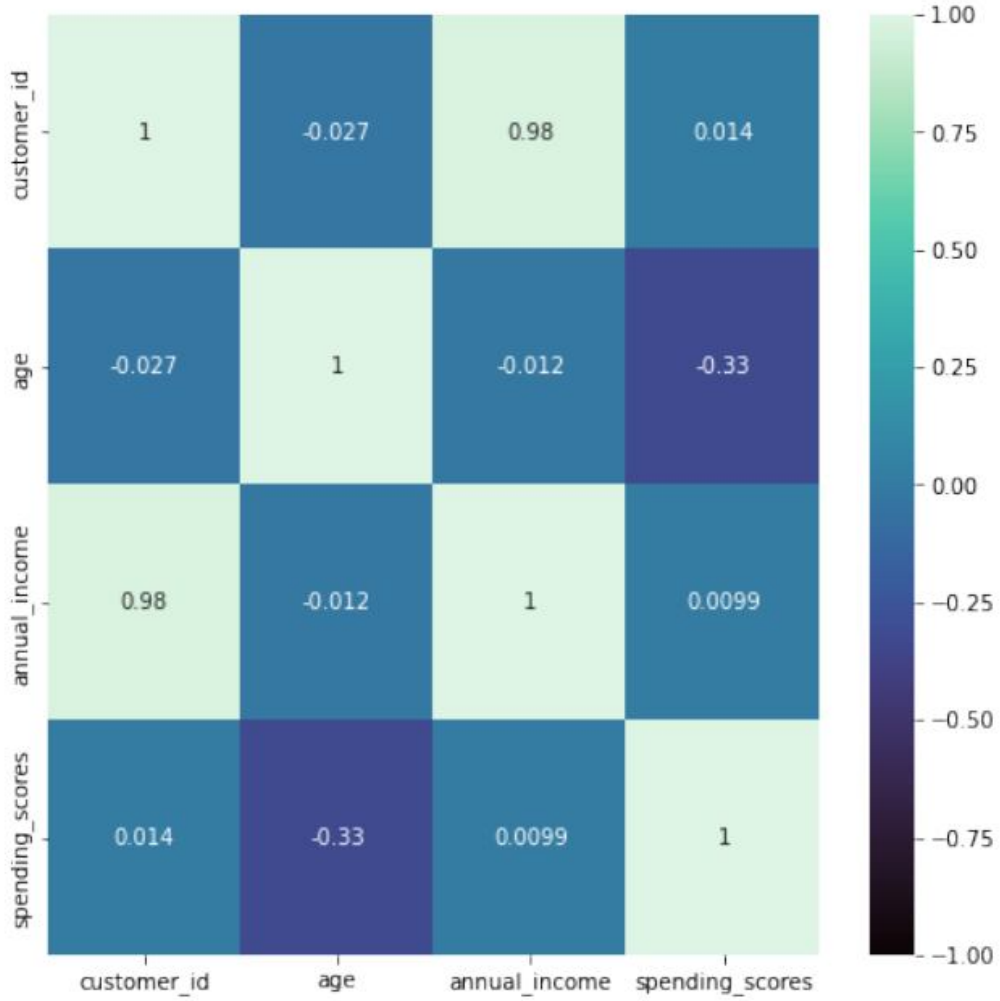

```
sns.boxplot(x=data['gender'],y=data['annual_income'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe743f23250>
```



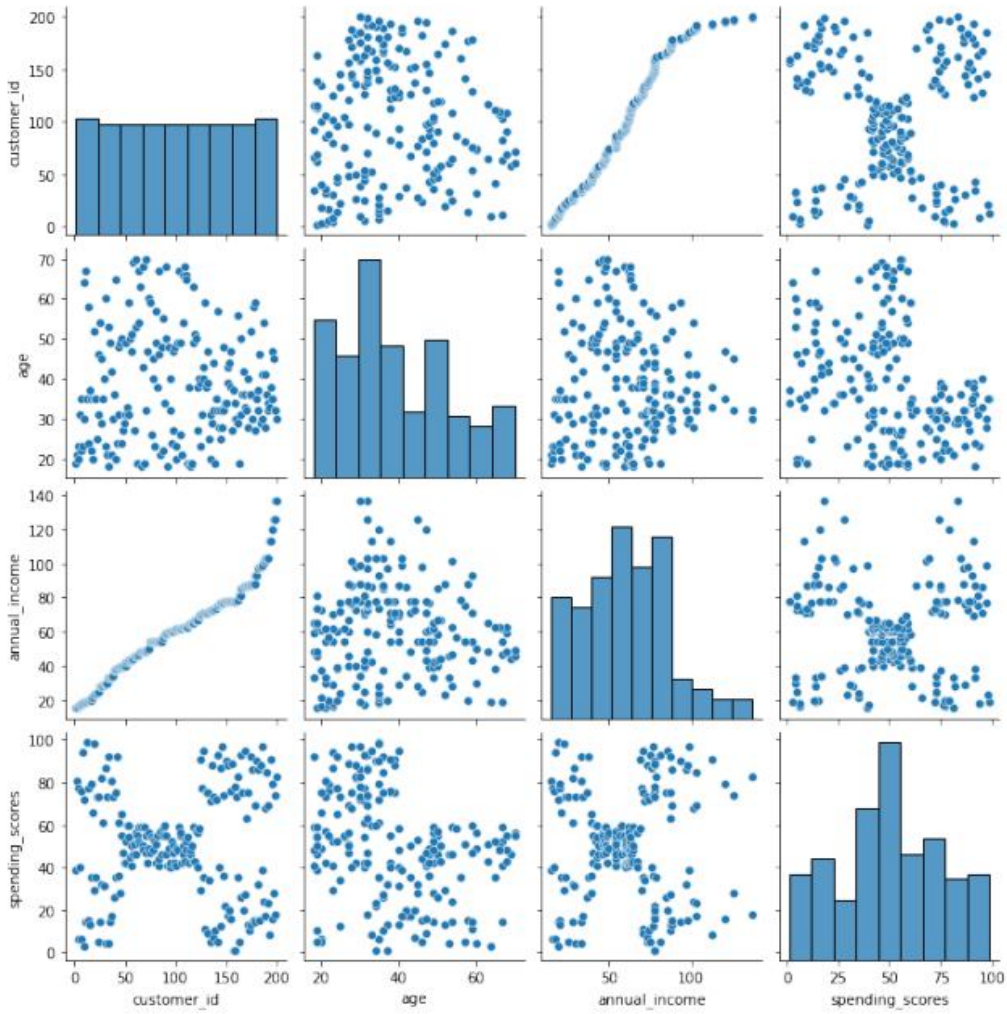
Coorelation Plot

```
corr=data.corr()
plt.figure(figsize=(8,8))
sn=sns.heatmap(corr,vmin=-1,center=0, annot = True, cmap = 'mako')
```




```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x7fe7438d8310>
```



4. Perform descriptive statistics on the dataset.

```
data.head(10)
```

	customer_id	gender	age	annual_income	spending_scores
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
5	6	Female	22	17	76
6	7	Female	35	18	6
7	8	Female	23	18	94
8	9	Male	64	19	3
9	10	Female	30	19	72

```
data.shape
```

```
(200, 5)
```

```
data.describe()
```

```
       customer_id         age  annual_income  spending_scores
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
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   customer_id      200 non-null    int64 
 1   gender           200 non-null    object
 2   age              200 non-null    int64 
 3   annual_income    200 non-null    int64 
 4   spending_scores  200 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

5. Check for Missing values and deal with them.

```
data[data.duplicated()]
```

```
Empty DataFrame
Columns: [customer_id, gender, age, annual_income, spending_scores]
Index: []
```

```
data.isna().sum()
```

```
customer_id        0
gender             0
age                0
annual_income      0
spending_scores    0
dtype: int64
```

there is no missing values and duplicates in dataframe

6. Find the outliers and replace them outliers

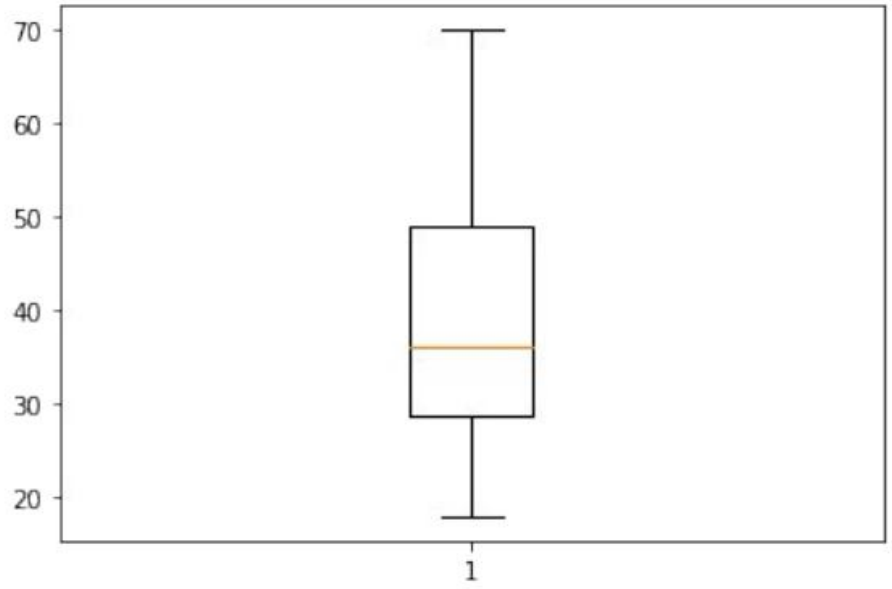
```
for i in data:
    if data[i].dtype=='int64':
        q1=data[i].quantile(0.25)
```

```
        q3=data[i].quantile(0.75)
        iqr=q3-q1
        upper=q3+1.5*iqr
        lower=q1-1.5*iqr
        data[i]=np.where(data[i] >upper, upper, data[i])
        data[i]=np.where(data[i] <lower, lower, data[i])
```

After removing outliers, boxplot will be like

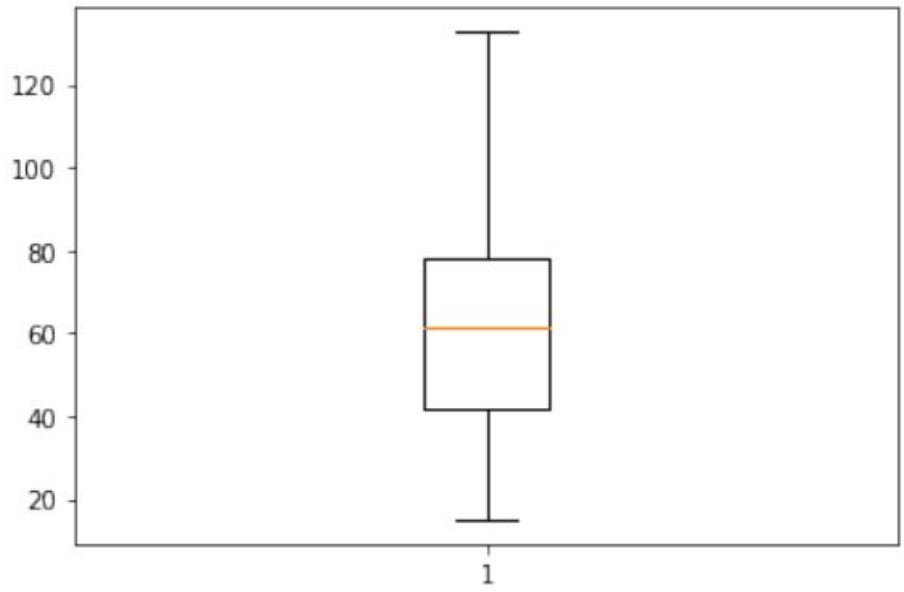
```
plt.boxplot(data['age'])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7fe7418d49d0>,
  <matplotlib.lines.Line2D at 0x7fe7418d4f10>],
 'caps': [<matplotlib.lines.Line2D at 0x7fe7418d9490>,
  <matplotlib.lines.Line2D at 0x7fe7418d99d0>],
 'boxes': [<matplotlib.lines.Line2D at 0x7fe7418d4410>],
 'medians': [<matplotlib.lines.Line2D at 0x7fe7418d9f50>],
 'fliers': [<matplotlib.lines.Line2D at 0x7fe7418de4d0>],
 'means': []}
```



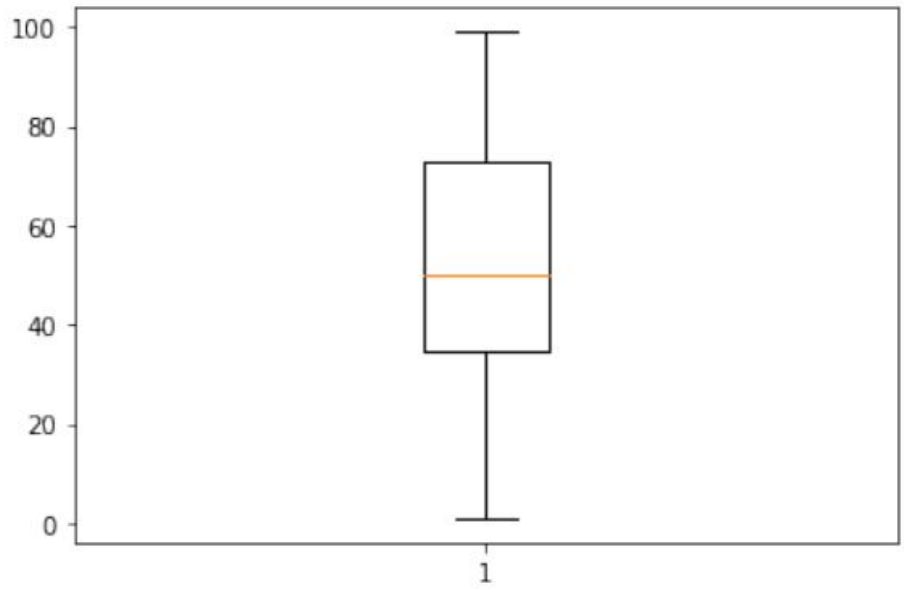

```
plt.boxplot(data['annual_income'])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7fe741838510>,
  <matplotlib.lines.Line2D at 0x7fe741838a50>],
 'caps': [<matplotlib.lines.Line2D at 0x7fe741838f90>,
  <matplotlib.lines.Line2D at 0x7fe74183e510>],
 'boxes': [<matplotlib.lines.Line2D at 0x7fe741831f50>],
 'medians': [<matplotlib.lines.Line2D at 0x7fe74183ea90>],
 'fliers': [<matplotlib.lines.Line2D at 0x7fe74183efd0>],
 'means': []}
```




```
plt.boxplot(data['spending_scores'])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7fe741823f50>,
  <matplotlib.lines.Line2D at 0x7fe7417a74d0>],
 'caps': [<matplotlib.lines.Line2D at 0x7fe7417a7a10>,
  <matplotlib.lines.Line2D at 0x7fe7417a7f50>],
 'boxes': [<matplotlib.lines.Line2D at 0x7fe7418239d0>],
 'medians': [<matplotlib.lines.Line2D at 0x7fe7417af510>],
 'fliers': [<matplotlib.lines.Line2D at 0x7fe7417afa50>],
 'means': []}
```



7. Check for Categorical columns and perform encoding.

```
from sklearn.preprocessing import LabelEncoder
encoder=LabelEncoder()
data['gender']=encoder.fit_transform(data['gender'])

data.head()
```

```
   customer_id  gender   age  annual_income  spending_scores
0          1.0       1  19.0           15.0             39.0
1          2.0       1  21.0           15.0             81.0
2          3.0       0  20.0           16.0              6.0
3          4.0       0  23.0           16.0             77.0
4          5.0       0  31.0           17.0             40.0
```

8. Scalaing the data

```
from sklearn.preprocessing import StandardScaler
df=StandardScaler()
data1=df.fit_transform(data)

data1
```

```
array([[-1.7234121 ,  1.12815215, -1.42456879, -1.74542941, -
0.43480148],
       [-1.70609137,  1.12815215, -1.28103541, -1.74542941,
1.19570407],
       [-1.68877065, -0.88640526, -1.3528021 , -1.70708307, -
1.71591298],
       [-1.67144992, -0.88640526, -1.13750203, -1.70708307,
1.04041783],
       [-1.6541292 , -0.88640526, -0.56336851, -1.66873673, -
0.39597992],
       [-1.63680847, -0.88640526, -1.20926872, -1.66873673,
1.00159627],
       [-1.61948775, -0.88640526, -0.27630176, -1.6303904 , -
1.71591298],
       [-1.60216702, -0.88640526, -1.13750203, -1.6303904 ,
1.70038436],
       [-1.5848463 ,  1.12815215,  1.80493225, -1.59204406, -
1.83237767],
       [-1.56752558, -0.88640526, -0.6351352 , -1.59204406,
0.84631002],
       [-1.55020485,  1.12815215,  2.02023231, -1.59204406, -1.4053405
],
       [-1.53288413, -0.88640526, -0.27630176, -1.59204406,
1.89449216],
       [-1.5155634 , -0.88640526,  1.37433211, -1.55369772, -
1.36651894],
       [-1.49824268, -0.88640526, -1.06573534, -1.55369772,
1.04041783],
       [-1.48092195,  1.12815215, -0.13276838, -1.55369772, -
```

```
1.44416206],
       [-1.46360123,  1.12815215, -1.20926872, -1.55369772,
1.11806095],
       [-1.4462805 , -0.88640526, -0.27630176, -1.51535138, -
0.59008772],
       [-1.42895978,  1.12815215, -1.3528021 , -1.51535138,
0.61338066],
       [-1.41163905,  1.12815215,  0.94373197, -1.43865871, -
0.82301709],
       [-1.39431833, -0.88640526, -0.27630176, -1.43865871,  1.8556706
],
       [-1.3769976 ,  1.12815215, -0.27630176, -1.40031237, -
0.59008772],
       [-1.35967688,  1.12815215, -0.99396865, -1.40031237,
0.88513158],
       [-1.34235616, -0.88640526,  0.51313183, -1.36196603, -
1.75473454],
       [-1.32503543,  1.12815215, -0.56336851, -1.36196603,
0.88513158],
       [-1.30771471, -0.88640526,  1.08726535, -1.24692702, -1.4053405
],
       [-1.29039398,  1.12815215, -0.70690189, -1.24692702,
1.23452563],
       [-1.27307326, -0.88640526,  0.44136514, -1.24692702, -0.7065524
],
       [-1.25575253,  1.12815215, -0.27630176, -1.24692702,
0.41927286],
       [-1.23843181, -0.88640526,  0.08253169, -1.20858069, -
0.74537397],
       [-1.22111108, -0.88640526, -1.13750203, -1.20858069,
1.42863343],
       [-1.20379036,  1.12815215,  1.51786549, -1.17023435, -1.7935561
],
       [-1.18646963, -0.88640526, -1.28103541, -1.17023435,
0.88513158],
       [-1.16914891,  1.12815215,  1.01549866, -1.05519534, -1.7935561
],
       [-1.15182818,  1.12815215, -1.49633548, -1.05519534,
1.62274124],
       [-1.13450746, -0.88640526,  0.7284319 , -1.05519534, -1.4053405
],
       [-1.11718674, -0.88640526, -1.28103541, -1.05519534,
1.19570407],
       [-1.09986601, -0.88640526,  0.22606507, -1.016849  , -
1.28887582],
       [-1.08254529, -0.88640526, -0.6351352 , -1.016849  ,
0.88513158],
       [-1.06522456, -0.88640526, -0.20453507, -0.90180999, -
0.93948177],
       [-1.04790384, -0.88640526, -1.3528021 , -0.90180999,
```

```
0.96277471],
       [-1.03058311, -0.88640526,  1.87669894, -0.86346365, -
0.59008772],
       [-1.01326239,  1.12815215, -1.06573534, -0.86346365,
1.62274124],
       [-0.99594166,  1.12815215,  0.65666521, -0.82511731, -
0.55126616],
       [-0.97862094, -0.88640526, -0.56336851, -0.82511731,
0.41927286],
       [-0.96130021, -0.88640526,  0.7284319 , -0.82511731, -
0.86183865],
       [-0.94397949, -0.88640526, -1.06573534, -0.82511731,  0.5745591
],
       [-0.92665877, -0.88640526,  0.80019859, -0.78677098,
0.18634349],
       [-0.90933804, -0.88640526, -0.85043527, -0.78677098, -
0.12422899],
       [-0.89201732, -0.88640526, -0.70690189, -0.78677098, -0.3183368
],
       [-0.87469659, -0.88640526, -0.56336851, -0.78677098, -0.3183368
],
       [-0.85737587, -0.88640526,  0.7284319 , -0.7100783 ,
0.06987881],
       [-0.84005514,  1.12815215, -0.41983513, -0.7100783 ,
0.38045129],
       [-0.82273442, -0.88640526, -0.56336851, -0.67173196,
0.14752193],
       [-0.80541369,  1.12815215,  1.4460988 , -0.67173196,
0.38045129],
       [-0.78809297, -0.88640526,  0.80019859, -0.67173196, -
0.20187212],
       [-0.77077224,  1.12815215,  0.58489852, -0.67173196, -
0.35715836],
       [-0.75345152, -0.88640526,  0.87196528, -0.63338563, -
0.00776431],
       [-0.73613079,  1.12815215,  2.16376569, -0.63338563, -
0.16305055],
       [-0.71881007, -0.88640526, -0.85043527, -0.55669295,
0.03105725],
       [-0.70148935,  1.12815215,  1.01549866, -0.55669295, -
0.16305055],
       [-0.68416862,  1.12815215,  2.23553238, -0.55669295,
0.22516505],
       [-0.6668479 ,  1.12815215, -1.42456879, -0.55669295,
0.18634349],
       [-0.64952717, -0.88640526,  2.02023231, -0.51834661,
0.06987881],
       [-0.63220645, -0.88640526,  1.08726535, -0.51834661,
0.34162973],
       [-0.61488572,  1.12815215,  1.73316556, -0.48000028,
```

```
0.03105725],
       [-0.597565  ,  1.12815215, -1.49633548, -0.48000028,
0.34162973],
       [-0.58024427, -0.88640526,  0.29783176, -0.48000028, -
0.00776431],
       [-0.56292355, -0.88640526,  2.091999  , -0.48000028, -
0.08540743],
       [-0.54560282,  1.12815215, -1.42456879, -0.48000028,
0.34162973],
       [-0.5282821 , -0.88640526, -0.49160182, -0.48000028, -
0.12422899],
       [-0.51096138,  1.12815215,  2.23553238, -0.44165394,
0.18634349],
       [-0.49364065, -0.88640526,  0.58489852, -0.44165394, -0.3183368
],
       [-0.47631993, -0.88640526,  1.51786549, -0.4033076 , -
0.04658587],
       [-0.4589992 , -0.88640526,  1.51786549, -0.4033076 ,
0.22516505],
       [-0.44167848,  1.12815215,  1.4460988 , -0.24992225, -
0.12422899],
       [-0.42435775,  1.12815215, -0.92220196, -0.24992225,
0.14752193],
       [-0.40703703, -0.88640526,  0.44136514, -0.24992225,
0.10870037],
       [-0.3897163 ,  1.12815215,  0.08253169, -0.24992225, -
0.08540743],
       [-0.37239558, -0.88640526, -1.13750203, -0.24992225,
0.06987881],
       [-0.35507485, -0.88640526,  0.7284319 , -0.24992225, -0.3183368
],
       [-0.33775413,  1.12815215,  1.30256542, -0.24992225,
0.03105725],
       [-0.3204334 ,  1.12815215, -0.06100169, -0.24992225,
0.18634349],
       [-0.30311268,  1.12815215,  2.02023231, -0.24992225, -
0.35715836],
       [-0.28579196, -0.88640526,  0.51313183, -0.24992225, -
0.24069368],
       [-0.26847123, -0.88640526, -1.28103541, -0.24992225,
0.26398661],
       [-0.25115051,  1.12815215,  0.65666521, -0.24992225, -
0.16305055],
       [-0.23382978, -0.88640526,  1.15903204, -0.13488324,
0.30280817],
       [-0.21650906, -0.88640526, -1.20926872, -0.13488324,
0.18634349],
       [-0.19918833, -0.88640526, -0.34806844, -0.0965369 ,
0.38045129],
       [-0.18186761, -0.88640526,  0.80019859, -0.0965369 , -
```

```
0.16305055],
       [-0.16454688, -0.88640526,  2.091999  , -0.05819057,
0.18634349],
       [-0.14722616,  1.12815215, -1.49633548, -0.05819057, -
0.35715836],
       [-0.12990543,  1.12815215,  0.65666521, -0.01984423, -
0.04658587],
       [-0.11258471, -0.88640526,  0.08253169, -0.01984423, -
0.39597992],
       [-0.09526399, -0.88640526, -0.49160182, -0.01984423, -0.3183368
],
       [-0.07794326,  1.12815215, -1.06573534, -0.01984423,
0.06987881],
       [-0.06062254, -0.88640526,  0.58489852, -0.01984423, -
0.12422899],
       [-0.04330181, -0.88640526, -0.85043527, -0.01984423, -
0.00776431],
       [-0.02598109,  1.12815215,  0.65666521,  0.01850211, -0.3183368
],
       [-0.00866036,  1.12815215, -1.3528021 ,  0.01850211, -
0.04658587],
       [ 0.00866036, -0.88640526, -1.13750203,  0.05684845, -
0.35715836],
       [ 0.02598109, -0.88640526,  0.7284319 ,  0.05684845, -
0.08540743],
       [ 0.04330181,  1.12815215,  2.02023231,  0.05684845,
0.34162973],
       [ 0.06062254,  1.12815215, -0.92220196,  0.05684845,
0.18634349],
       [ 0.07794326,  1.12815215,  0.7284319 ,  0.05684845,
0.22516505],
       [ 0.09526399, -0.88640526, -1.28103541,  0.05684845, -0.3183368
],
       [ 0.11258471, -0.88640526,  1.94846562,  0.09519478, -
0.00776431],
       [ 0.12990543,  1.12815215,  1.08726535,  0.09519478, -
0.16305055],
       [ 0.14722616,  1.12815215,  2.091999  ,  0.09519478, -
0.27951524],
       [ 0.16454688,  1.12815215,  1.94846562,  0.09519478, -
0.08540743],
       [ 0.18186761,  1.12815215,  1.87669894,  0.09519478,
0.06987881],
       [ 0.19918833, -0.88640526, -1.42456879,  0.09519478,
0.14752193],
       [ 0.21650906, -0.88640526, -0.06100169,  0.13354112, -0.3183368
],
       [ 0.23382978,  1.12815215, -1.42456879,  0.13354112, -
0.16305055],
       [ 0.25115051, -0.88640526, -1.49633548,  0.17188746, -
```

```
0.08540743],
       [ 0.26847123, -0.88640526, -1.42456879,  0.17188746, -
0.00776431],
       [ 0.28579196, -0.88640526,  1.73316556,  0.17188746, -
0.27951524],
       [ 0.30311268, -0.88640526,  0.7284319 ,  0.17188746,
0.34162973],
       [ 0.3204334 , -0.88640526,  0.87196528,  0.24858013, -
0.27951524],
       [ 0.33775413, -0.88640526,  0.80019859,  0.24858013,
0.26398661],
       [ 0.35507485,  1.12815215, -0.85043527,  0.24858013,
0.22516505],
       [ 0.37239558, -0.88640526, -0.06100169,  0.24858013, -
0.39597992],
       [ 0.3897163 , -0.88640526,  0.08253169,  0.32527281,
0.30280817],
       [ 0.40703703,  1.12815215,  0.010765  ,  0.32527281,
1.58391968],
       [ 0.42435775, -0.88640526, -1.13750203,  0.36361914, -
0.82301709],
       [ 0.44167848, -0.88640526, -0.56336851,  0.36361914,
1.04041783],
       [ 0.4589992 ,  1.12815215,  0.29783176,  0.40196548, -
0.59008772],
       [ 0.47631993,  1.12815215,  0.08253169,  0.40196548,
1.73920592],
       [ 0.49364065,  1.12815215,  1.4460988 ,  0.40196548, -
1.52180518],
       [ 0.51096138,  1.12815215, -0.06100169,  0.40196548,
0.96277471],
       [ 0.5282821 ,  1.12815215,  0.58489852,  0.40196548, -1.5994483
],
       [ 0.54560282,  1.12815215,  0.010765  ,  0.40196548,
0.96277471],
       [ 0.56292355, -0.88640526, -0.99396865,  0.44031182, -
0.62890928],
       [ 0.58024427, -0.88640526, -0.56336851,  0.44031182,
0.80748846],
       [ 0.597565  ,  1.12815215, -1.3528021 ,  0.47865816, -
1.75473454],
       [ 0.61488572, -0.88640526, -0.70690189,  0.47865816,
1.46745499],
       [ 0.63220645, -0.88640526,  0.36959845,  0.47865816, -
1.67709142],
       [ 0.64952717,  1.12815215, -0.49160182,  0.47865816,
0.88513158],
       [ 0.6668479 ,  1.12815215, -1.42456879,  0.51700449, -
1.56062674],
       [ 0.68416862, -0.88640526, -0.27630176,  0.51700449,
```

```
0.84631002],
       [ 0.70148935, -0.88640526,  1.30256542,  0.55535083, -
1.75473454],
       [ 0.71881007,  1.12815215, -0.49160182,  0.55535083,  1.6615628
],
       [ 0.73613079, -0.88640526, -0.77866858,  0.59369717, -
0.39597992],
       [ 0.75345152, -0.88640526, -0.49160182,  0.59369717,
1.42863343],
       [ 0.77077224,  1.12815215, -0.99396865,  0.6320435 , -
1.48298362],
       [ 0.78809297,  1.12815215, -0.77866858,  0.6320435 ,
1.81684904],
       [ 0.80541369,  1.12815215,  0.65666521,  0.6320435 , -
0.55126616],
       [ 0.82273442, -0.88640526, -0.49160182,  0.6320435 ,
0.92395314],
       [ 0.84005514, -0.88640526, -0.34806844,  0.67038984, -
1.09476801],
       [ 0.85737587,  1.12815215, -0.34806844,  0.67038984,
1.54509812],
       [ 0.87469659,  1.12815215,  0.29783176,  0.67038984, -
1.28887582],
       [ 0.89201732,  1.12815215,  0.010765  ,  0.67038984,
1.46745499],
       [ 0.90933804, -0.88640526,  0.36959845,  0.67038984, -
1.17241113],
       [ 0.92665877, -0.88640526, -0.06100169,  0.67038984,
1.00159627],
       [ 0.94397949, -0.88640526,  0.58489852,  0.67038984, -
1.32769738],
       [ 0.96130021, -0.88640526, -0.85043527,  0.67038984,
1.50627656],
       [ 0.97862094,  1.12815215, -0.13276838,  0.67038984, -
1.91002079],
       [ 0.99594166, -0.88640526, -0.6351352 ,  0.67038984,
1.07923939],
       [ 1.01326239,  1.12815215, -0.34806844,  0.67038984, -
1.91002079],
       [ 1.03058311, -0.88640526, -0.6351352 ,  0.67038984,
0.88513158],
       [ 1.04790384, -0.88640526,  1.23079873,  0.70873618, -
0.59008772],
       [ 1.06522456, -0.88640526, -0.70690189,  0.70873618,
1.27334719],
       [ 1.08254529,  1.12815215, -1.42456879,  0.78542885, -
1.75473454],
       [ 1.09986601, -0.88640526, -0.56336851,  0.78542885,  1.6615628
],
       [ 1.11718674,  1.12815215,  0.80019859,  0.9388142 , -
```

```
0.93948177],
       [ 1.13450746, -0.88640526, -0.20453507,  0.9388142 ,
0.96277471],
       [ 1.15182818,  1.12815215,  0.22606507,  0.97716054, -
1.17241113],
       [ 1.16914891, -0.88640526, -0.41983513,  0.97716054,
1.73920592],
       [ 1.18646963, -0.88640526, -0.20453507,  1.01550688, -
0.90066021],
       [ 1.20379036,  1.12815215, -0.49160182,  1.01550688,
0.49691598],
       [ 1.22111108,  1.12815215,  0.08253169,  1.01550688, -
1.44416206],
       [ 1.23843181,  1.12815215, -0.77866858,  1.01550688,
0.96277471],
       [ 1.25575253,  1.12815215, -0.20453507,  1.01550688, -
1.56062674],
       [ 1.27307326,  1.12815215, -0.20453507,  1.01550688,
1.62274124],
       [ 1.29039398, -0.88640526,  0.94373197,  1.05385321, -
1.44416206],
       [ 1.30771471, -0.88640526, -0.6351352 ,  1.05385321,
1.38981187],
       [ 1.32503543,  1.12815215,  1.37433211,  1.05385321, -
1.36651894],
       [ 1.34235616,  1.12815215, -0.85043527,  1.05385321,
0.72984534],
       [ 1.35967688,  1.12815215,  1.4460988 ,  1.2455849 , -1.4053405
],
       [ 1.3769976 ,  1.12815215, -0.27630176,  1.2455849 ,
1.54509812],
       [ 1.39431833, -0.88640526, -0.13276838,  1.39897025, -0.7065524
],
       [ 1.41163905, -0.88640526, -0.49160182,  1.39897025,
1.38981187],
       [ 1.42895978,  1.12815215,  0.51313183,  1.43731659, -
1.36651894],
       [ 1.4462805 , -0.88640526, -0.70690189,  1.43731659,
1.46745499],
       [ 1.46360123, -0.88640526,  0.15429838,  1.47566292, -
0.43480148],
       [ 1.48092195,  1.12815215, -0.6351352 ,  1.47566292,
1.81684904],
       [ 1.49824268, -0.88640526,  1.08726535,  1.5523556 , -
1.01712489],
       [ 1.5155634 ,  1.12815215, -0.77866858,  1.5523556 ,
0.69102378],
       [ 1.53288413, -0.88640526,  0.15429838,  1.62904827, -
1.28887582],
       [ 1.55020485, -0.88640526, -0.20453507,  1.62904827,
```

```
1.35099031],
       [ 1.56752558, -0.88640526, -0.34806844,  1.62904827, -
1.05594645],
       [ 1.5848463 , -0.88640526, -0.49160182,  1.62904827,
0.72984534],
       [ 1.60216702,  1.12815215, -0.41983513,  2.01251165, -
1.63826986],
       [ 1.61948775, -0.88640526, -0.06100169,  2.01251165,
1.58391968],
       [ 1.63680847, -0.88640526,  0.58489852,  2.28093601, -
1.32769738],
       [ 1.6541292 , -0.88640526, -0.27630176,  2.28093601,
1.11806095],
       [ 1.67144992, -0.88640526,  0.44136514,  2.51101403, -
0.86183865],
       [ 1.68877065,  1.12815215, -0.49160182,  2.51101403,
0.92395314],
       [ 1.70609137,  1.12815215, -0.49160182,  2.76985181, -
1.25005425],
       [ 1.7234121 ,  1.12815215, -0.6351352 ,  2.76985181,
1.27334719]])
```

9. Perform any of the clustering algorithms

```
from sklearn.cluster import KMeans

data.drop('customer_id',axis=1,inplace=True)

km = KMeans(n_clusters=3, random_state=0)

data['Group or Cluster'] = km.fit_predict(data)

data.head()
```

	gender	age	annual_income	spending_scores	Group or Cluster
0	1	19.0	15.0	39.0	2
1	1	21.0	15.0	81.0	2
2	0	20.0	16.0	6.0	2
3	0	23.0	16.0	77.0	2
4	0	31.0	17.0	40.0	2

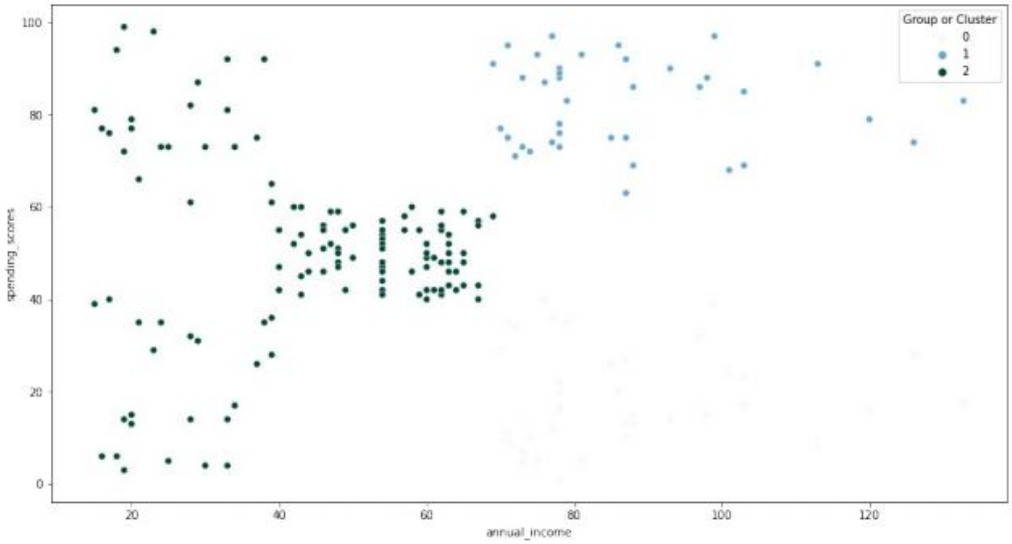
```
data['Group or Cluster'].value_counts()
```

```
2    123
1     39
0     38
Name: Group or Cluster, dtype: int64

import matplotlib.pyplot as plt

fig,ax = plt.subplots(figsize=(15,8))
sns.scatterplot(x=data['annual_income'],
```

```
                y=data['spending_scores'],
                hue=data['Group or Cluster'],
                palette='PuBuGn')
plt.show()
```




```
from sklearn.metrics import silhouette_score, silhouette_samples
score = silhouette_score(data,
                         km.labels_,
                         metric='euclidean')
score
```

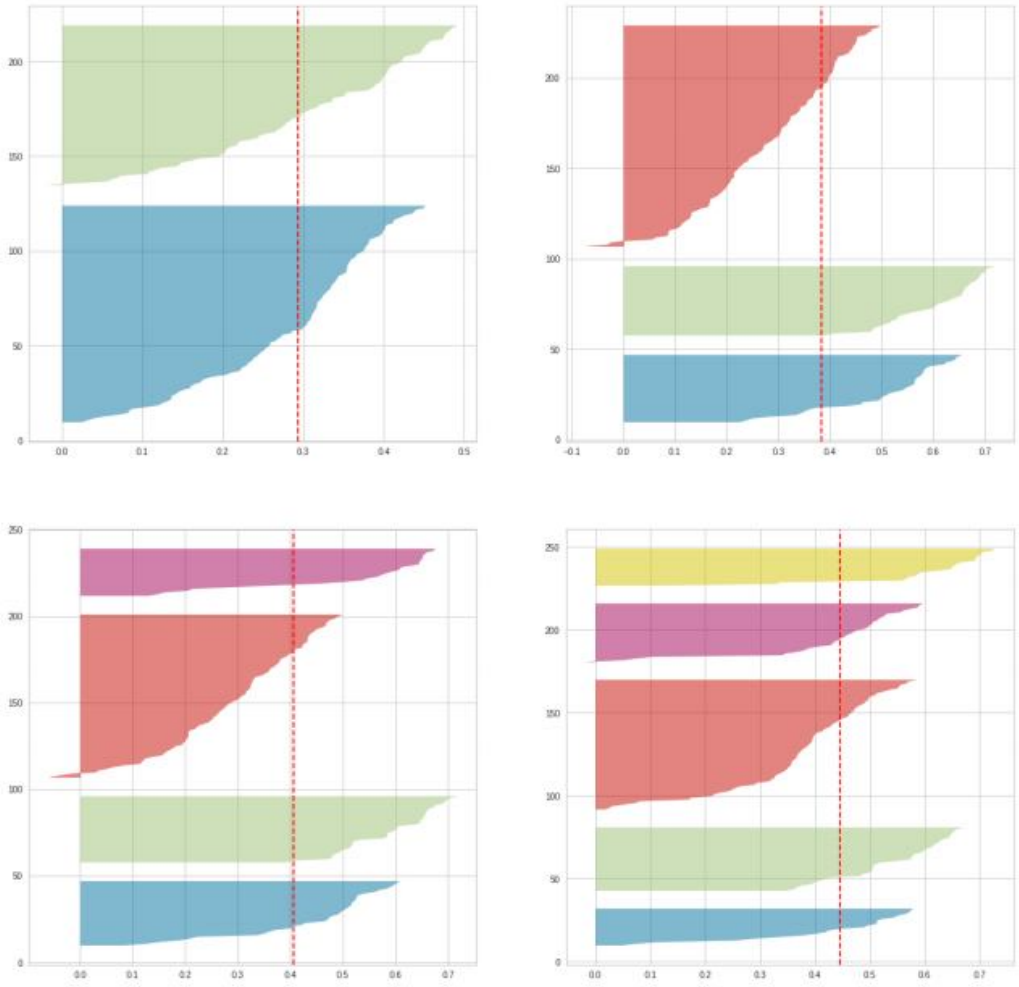
```
0.3842057644019546
```

```
import matplotlib.pyplot as plt
from yellowbrick.cluster import SilhouetteVisualizer

fig, ax = plt.subplots(2, 2, figsize=(20,20))
for i in [2, 3, 4, 5]:
    '''
    Create KMeans instance for different number of clusters
    '''
    km = KMeans(n_clusters=i,
                init='k-means++',
                n_init=10,
                max_iter=100,
                random_state=0)
    q, mod = divmod(i, 2)
    '''
    Create SilhouetteVisualizer instance with KMeans instance
    Fit the visualizer
    '''
    visualizer = SilhouetteVisualizer(km,
```

```
colors='yellowbrick',
ax=ax[q-1][mod])
```

```
visualizer.fit(data)
```



11. Split the data into dependent and independent variables

```
x=data.iloc[:,:-1]
x.head()
```

	gender	age	annual_income	spending_scores
0	1	19.0	15.0	39.0
1	1	21.0	15.0	81.0
2	0	20.0	16.0	6.0
3	0	23.0	16.0	77.0
4	0	31.0	17.0	40.0

```
y=data.iloc[:,-1]
y.head()
```

```
0    2
1    2
2    2
3    2
4    2
Name: Group or Cluster, dtype: int32
```

12. Split the data into training and testing

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.33)
```

```
x_train.shape
```

```
(134, 4)
```

```
x_test.shape
```

```
(66, 4)
```

```
y_train.shape
```

```
(134,)
```

```
y_test.shape
```

```
(66,)
```

13. Build the Model

```
from sklearn.linear_model import LogisticRegression
lgr = LogisticRegression()
lgr.fit(x_train,y_train)
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/
_logistic.py:818: ConvergenceWarning: lbfgs failed to converge
(status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as
shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,

LogisticRegression()
```

15. Test the Model

```
y_pred = lgr.predict(x_test)
print(y_pred)
```

```
[0 2 2 2 2 2 1 2 2 0 2 2 2 2 0 2 1 0 1 2 0 2 2 0 2 1 1 2 1 2 2 2 1 2 2
2 2
 0 2 0 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2 0 2 0 1 0 1 0 1 0]
```

16. Measure the performance using Evaluation Metrics

```
from sklearn.metrics import accuracy_score
score = accuracy_score(y_test,y_pred)
print(score)
```

```
1.0
```