```
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

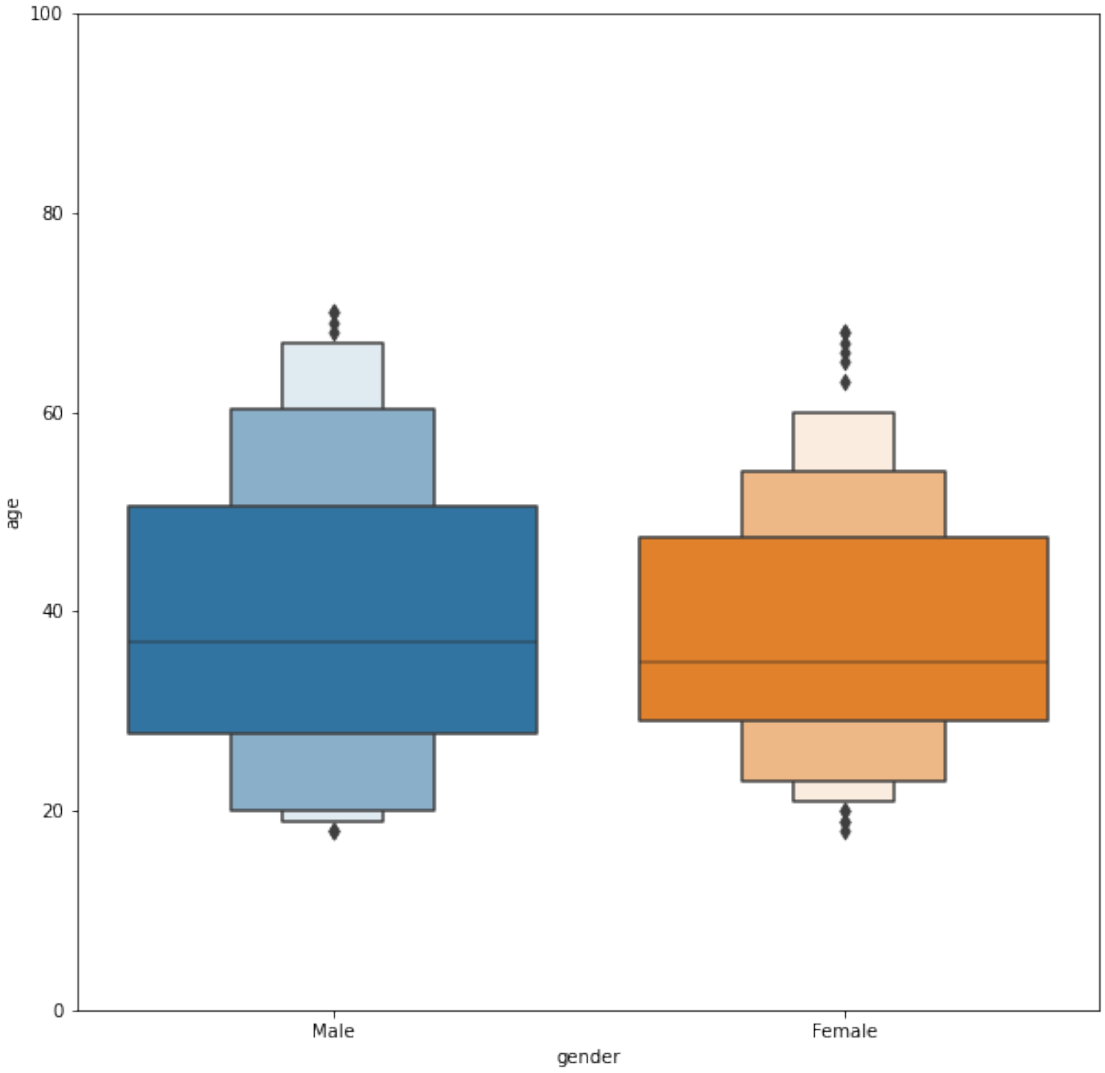
```
data.head()
```

```
   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);
```



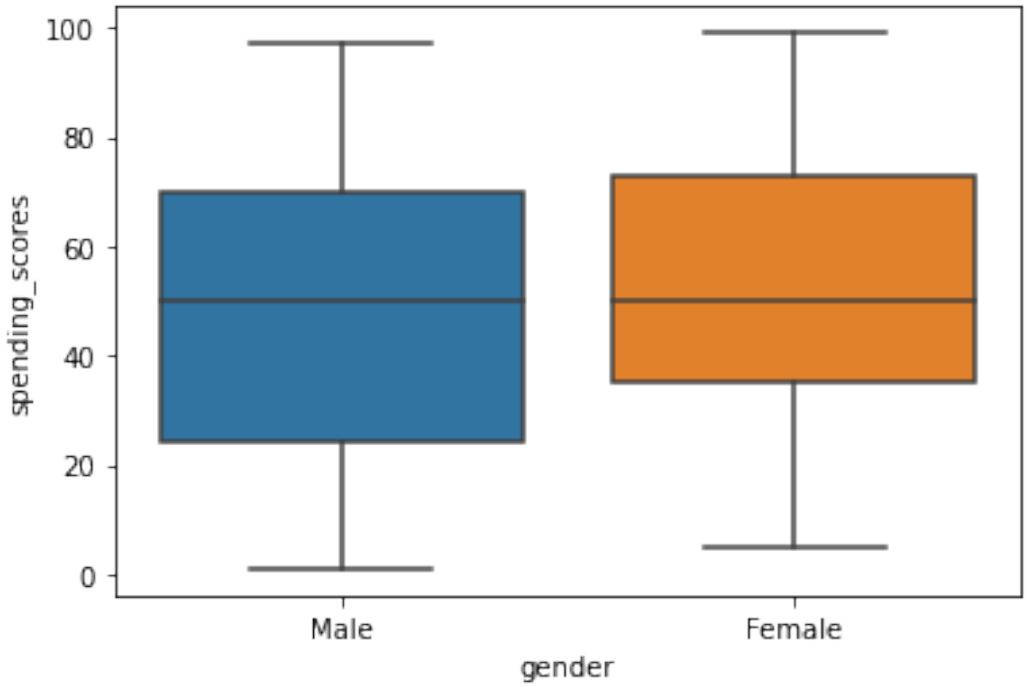
ANALYSIS

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

Count plot

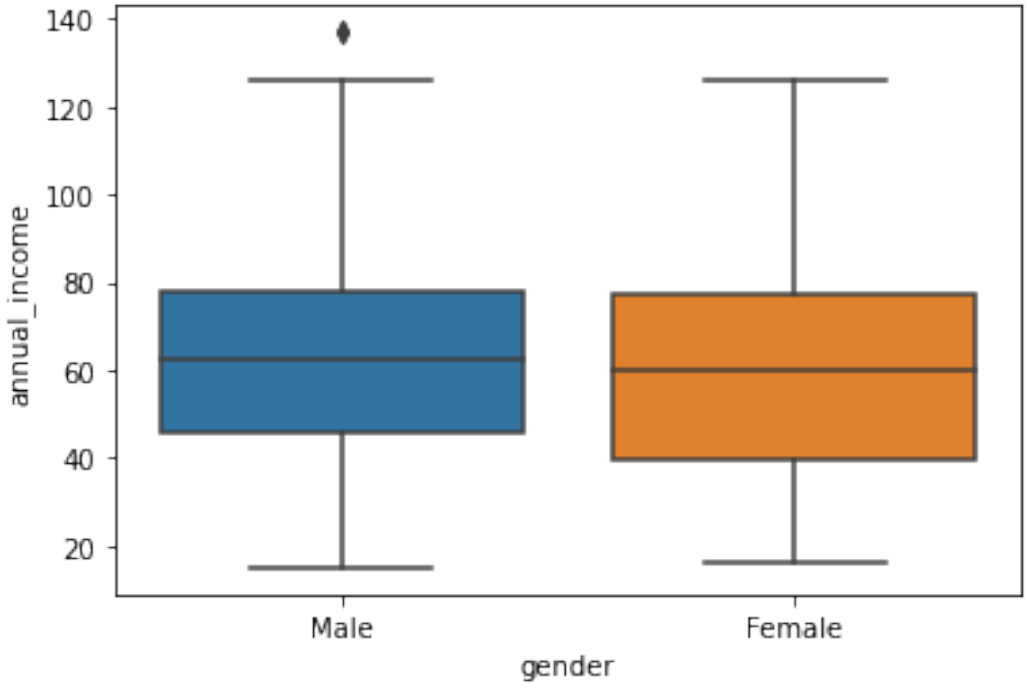
```
sns.boxplot(x=data['gender'],y=data['spending_scores'])
```

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



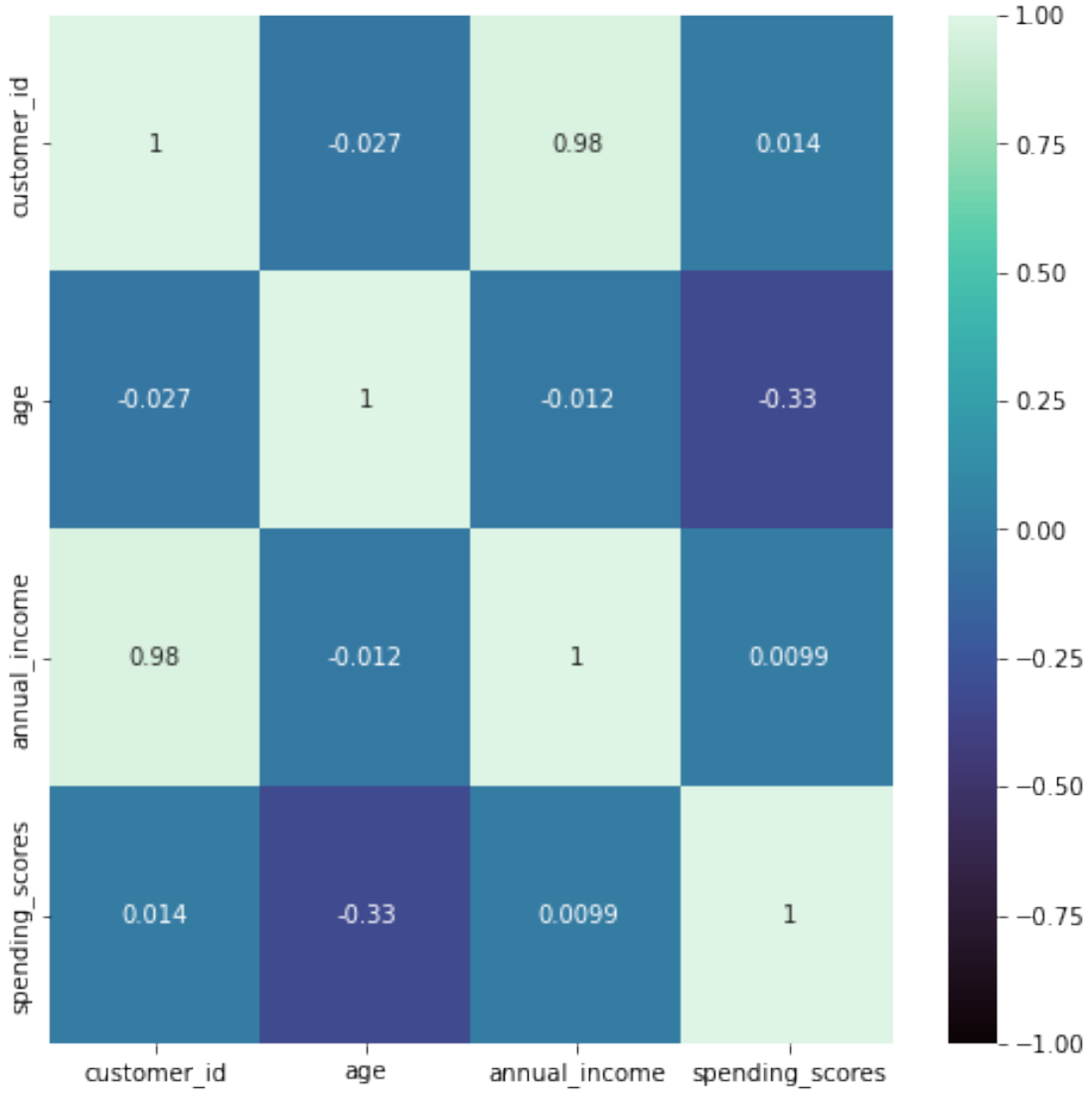

```
sns.boxplot(x=data['gender'],y=data['annual_income'])
```

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



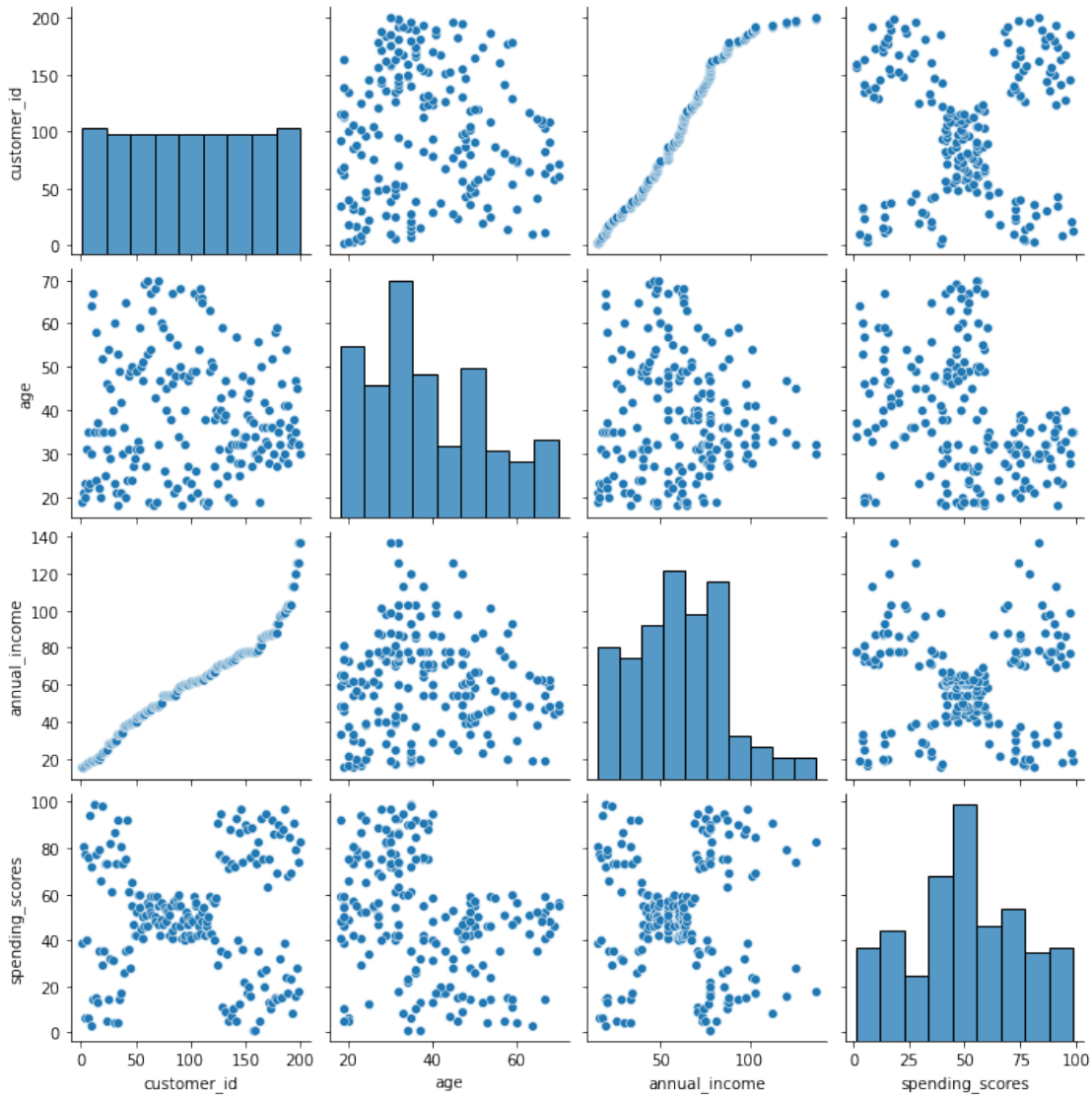
Coorelation Plot

```
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

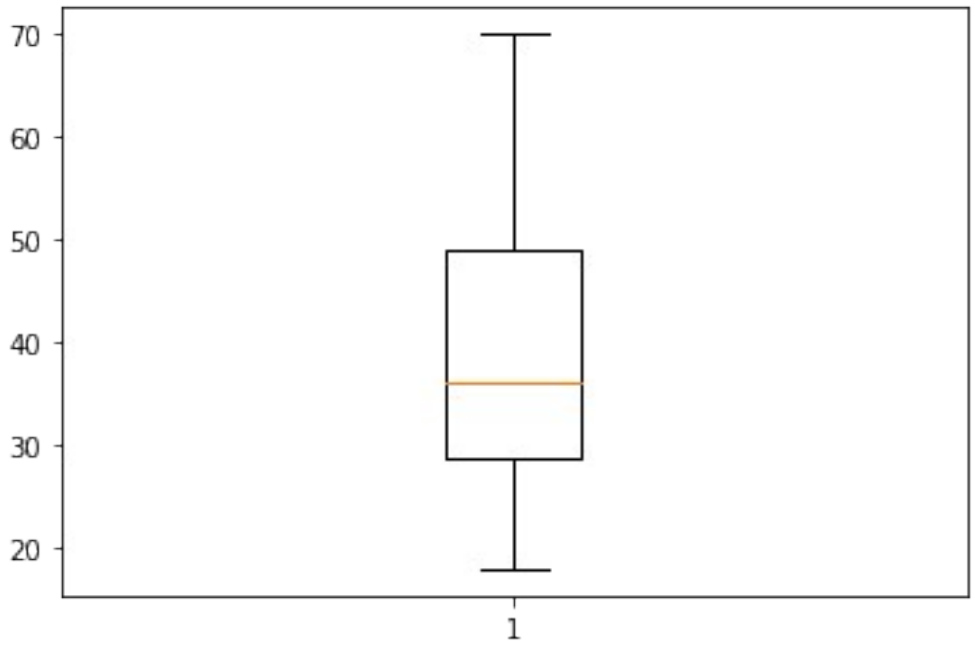
```
for i in data:
    if data[i].dtype=='int64':
        q1=data[i].quantile(0.25)
```

```
        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>],
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 'means': []}
```

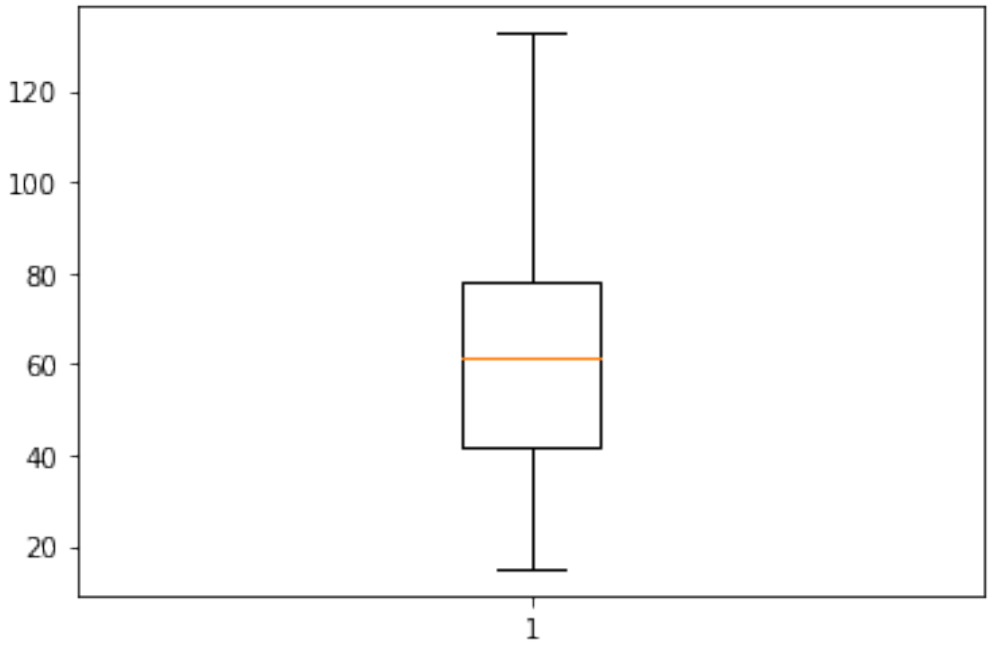


```
plt.boxplot(data['spending_scores'])
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7fe741823f50>,
  <matplotlib.lines.Line2D at 0x7fe7417a74d0>],
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 'fliers': [<matplotlib.lines.Line2D at 0x7fe7417afa50>],
 'means': []}
```

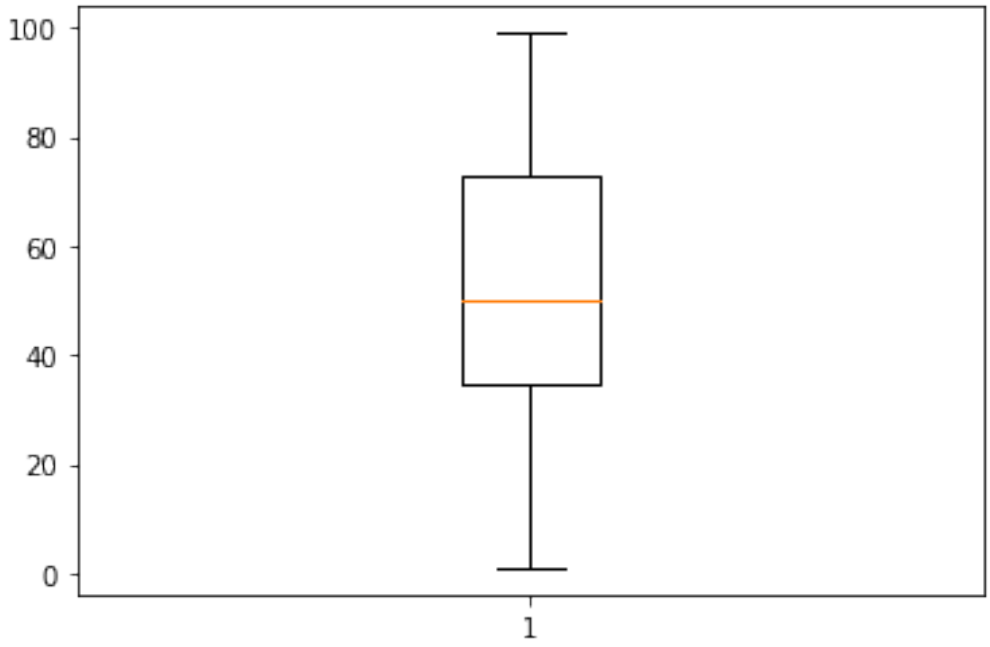

7. Check for Categorical columns and perform encoding.

```
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, -
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       [-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],
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1.00159627],
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1.71591298],
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       [-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, -
```

```
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0.59008772],
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0.59008772],
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```

```
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```

```
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```

```
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```

```
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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

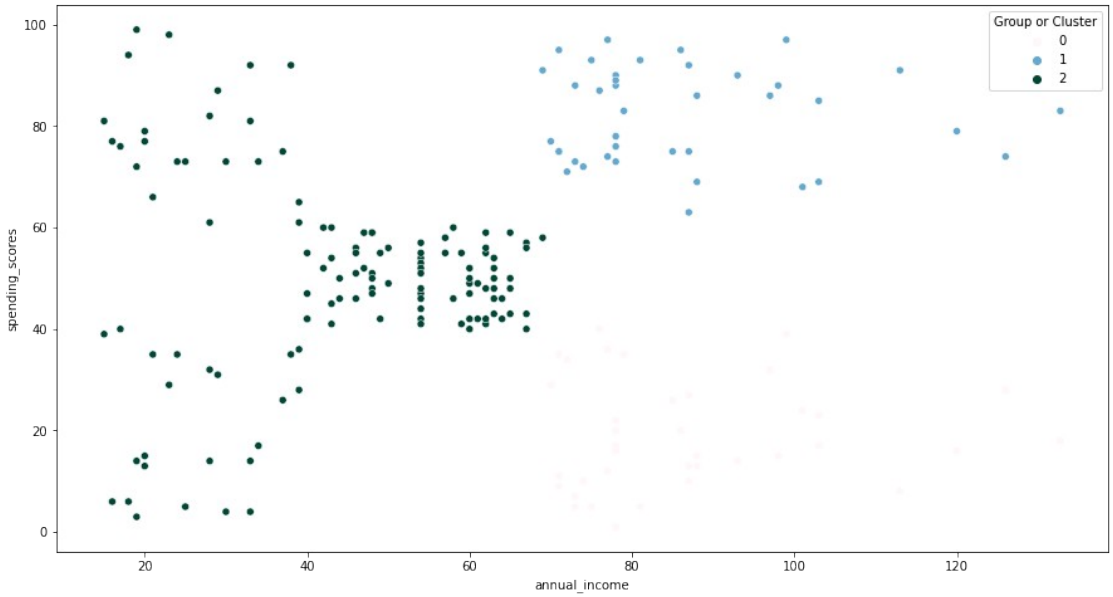
```
data['Group or Cluster'].value_counts()

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()
```



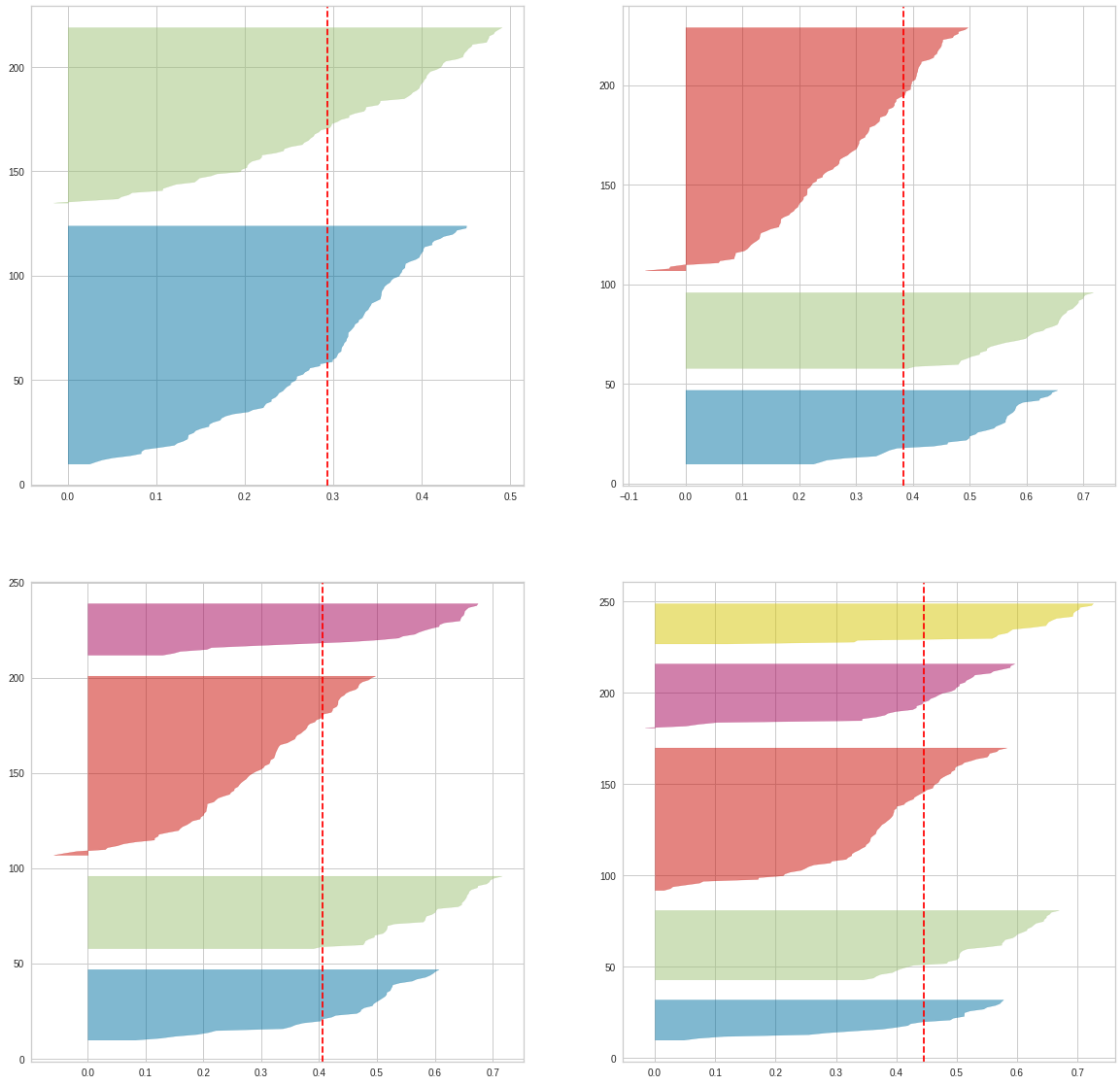

```
from sklearn.metrics import silhouette_score, silhouette_samples
score = silhouette_score(data,
                         km.labels_,
                         metric='euclidean')
score
```

```
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
```