

# Assignment 4

## Python Programming

Assignment Date	25/10/2022
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Student Roll Number	311119106047
Maximum Marks	2 Marks

### Question 1:

#### 1 . Importing Required Package

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

### Question 2:

#### 2 . Loading the Datas

```
db = pd.read_csv('/content/Mall_Customers.csv')
db
```

```
   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
..          ...     ...   ...             ...             ...
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
[200 rows x 5 columns]
```

### Question 3:

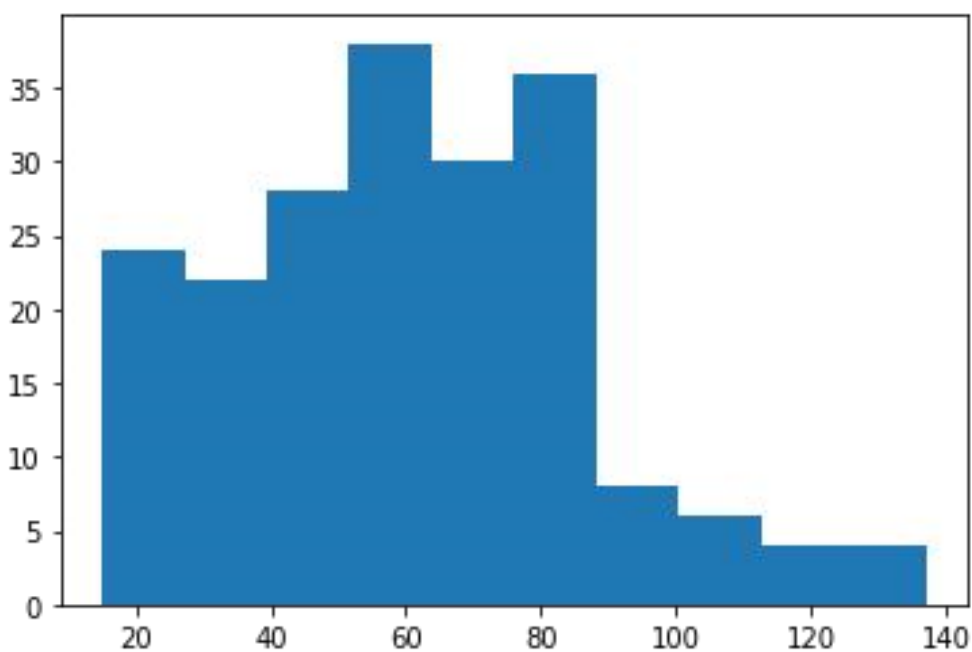
#### 3. Visualizations

##### 3.1 UniVariate Analysis 3.1.1

##### Solution

```
plt.hist(db['Annual
Income (k$)'])
```

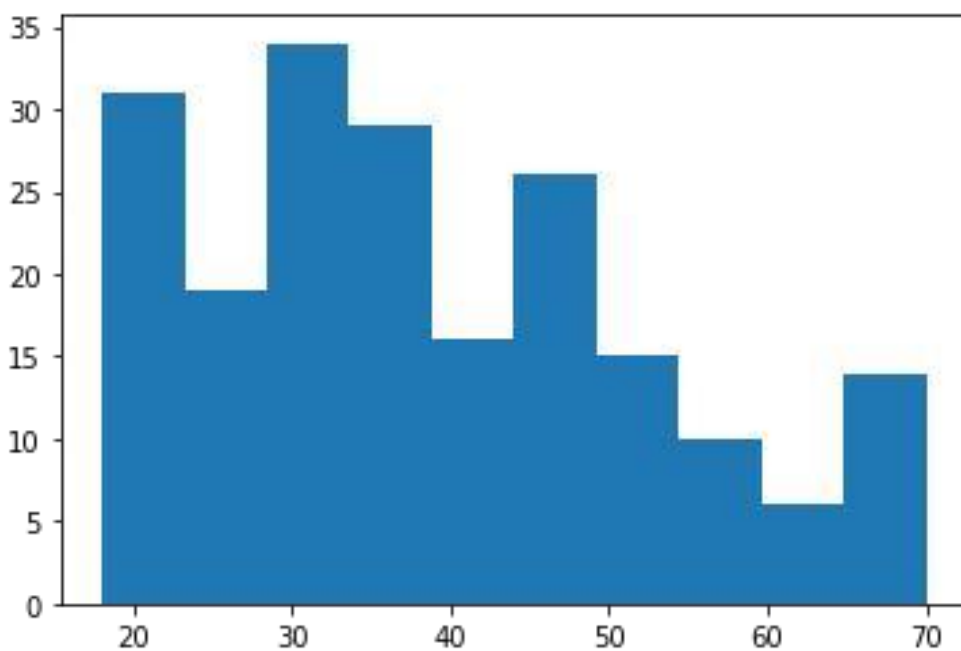
```
(array([24., 22., 28., 38., 30., 36., 8., 6., 4., 4.]), array([ 15. ,
27.2, 39.4, 51.6, 63.8, 76. , 88.2, 100.4, 112.6, 124.8, 137. ]),
<a list of 10 Patch objects>)
```



### 3.1.2 Solution

```
plt.hist(db['Age'])
```

```
(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. ]), <a list of
10 Patch objects>)
```



### 3.1.3 Solution

```
sbn.countplot(db['Age'])
```

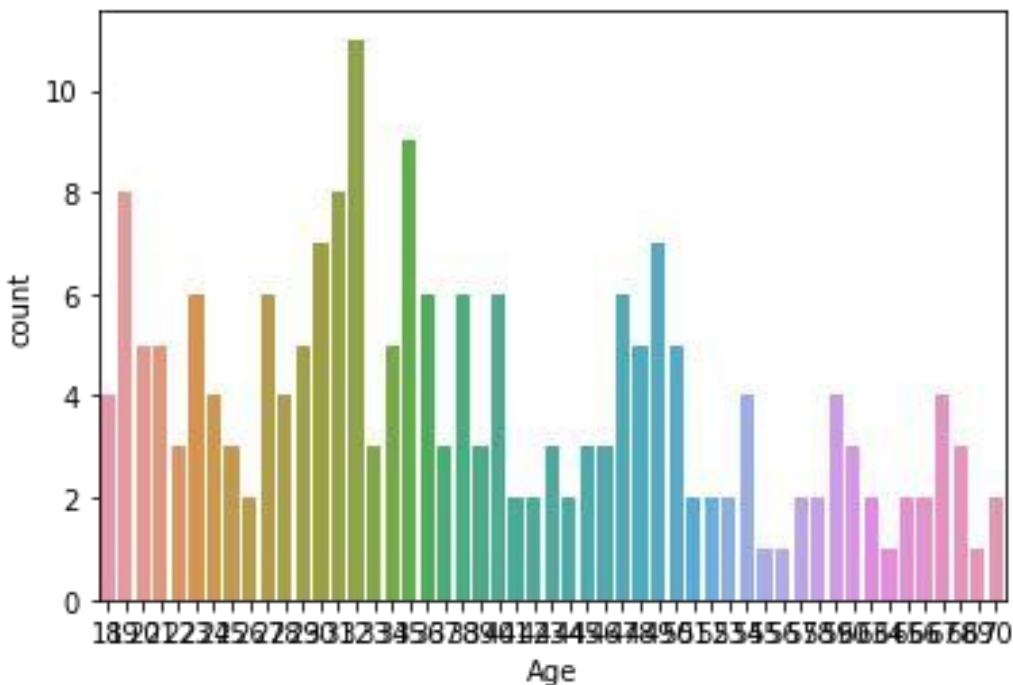
/usr/local/lib/python3.7/dist-packages/seaborn/\_decorators.py:43:

FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or

misinterpretation.

FutureWarning

<matplotlib.axes.\_subplots.AxesSubplot at 0x7f4b0afd0090>



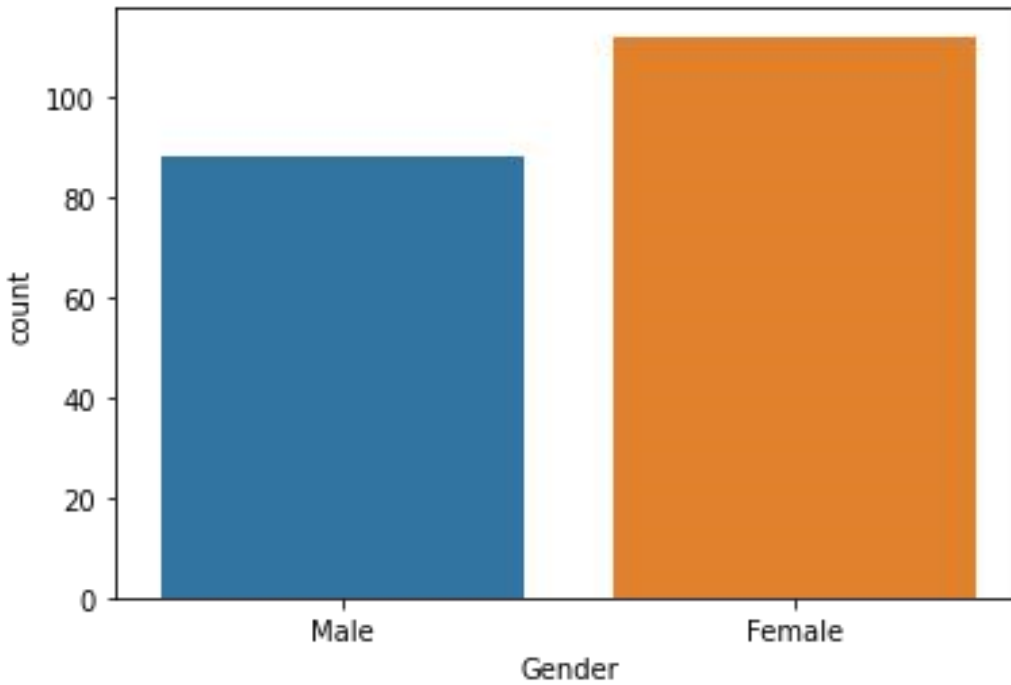
### 3.1.4 Solution

```
sbn.countplot(db['Gender'])
```

/usr/local/lib/python3.7/dist-packages/seaborn/\_decorators.py:43:

FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation. FutureWarning

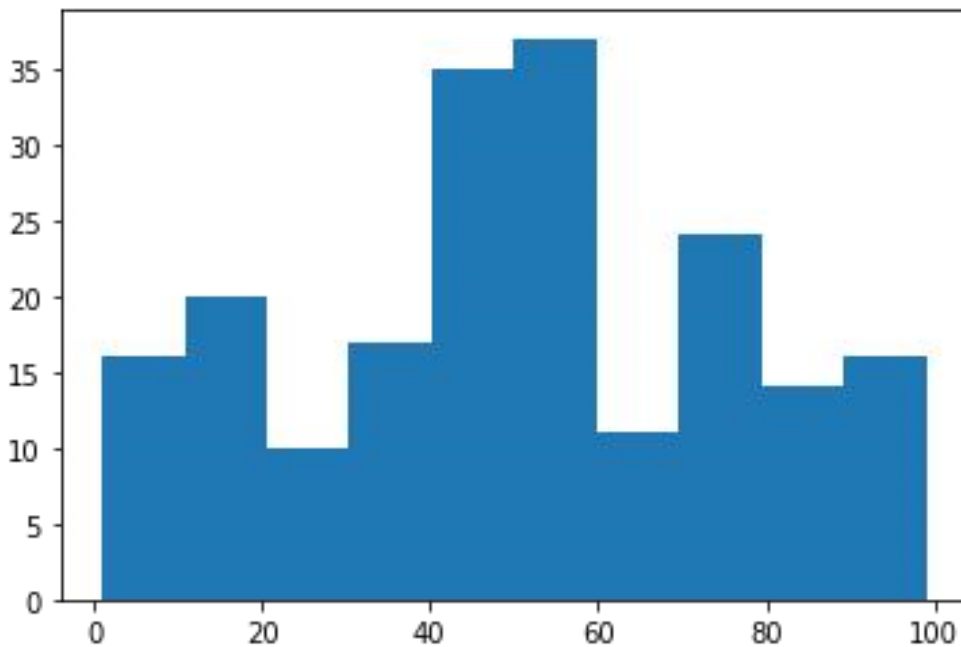
<matplotlib.axes.\_subplots.AxesSubplot at 0x7f4b0ae45790>



### 3.1.5 Solution

```
plt.hist(db['Spending  
Score (1-100)'])
```

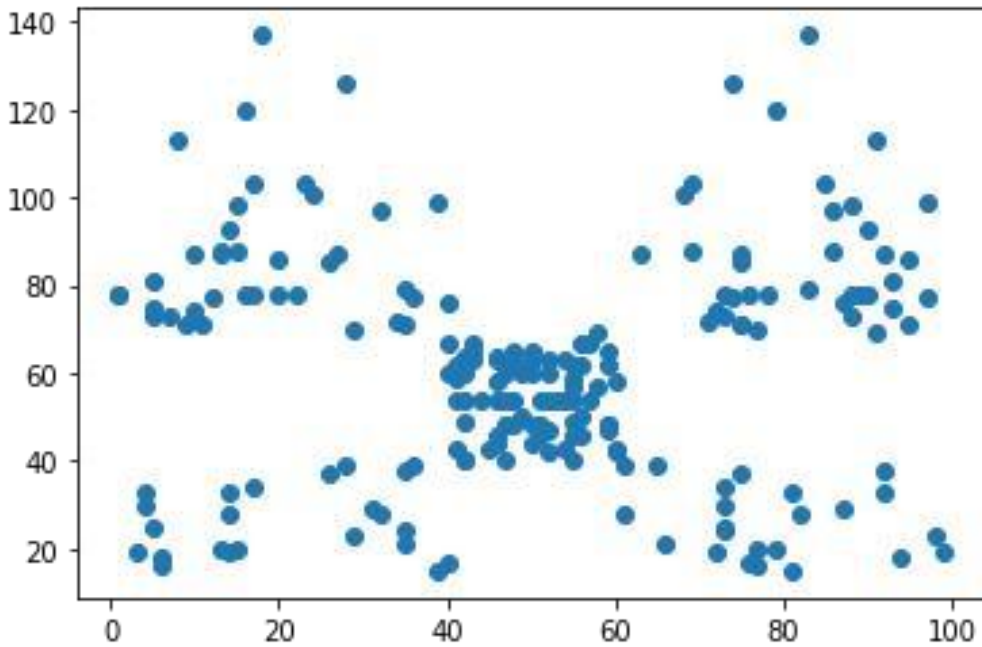
(array([16., 20., 10., 17., 35., 37., 11., 24., 14., 16.]), array([ 1. , 10.8, 20.6, 30.4, 40.2, 50. , 59.8, 69.6, 79.4, 89.2, 99. ]), <a list of 10 Patch objects>)



## 3.2 Bi-Variate Analysis

**3.2.1 Solution** `plt.scatter(db['Spending  
Score (1-100)'],db['Annual Income (k$)'])`

`<matplotlib.collections.PathCollection at 0x7f4b0acfadd0>`



### 3.2.2 Solution

`plt.scatter(db['Gender'],db['Annual Income  
(k$)'])`

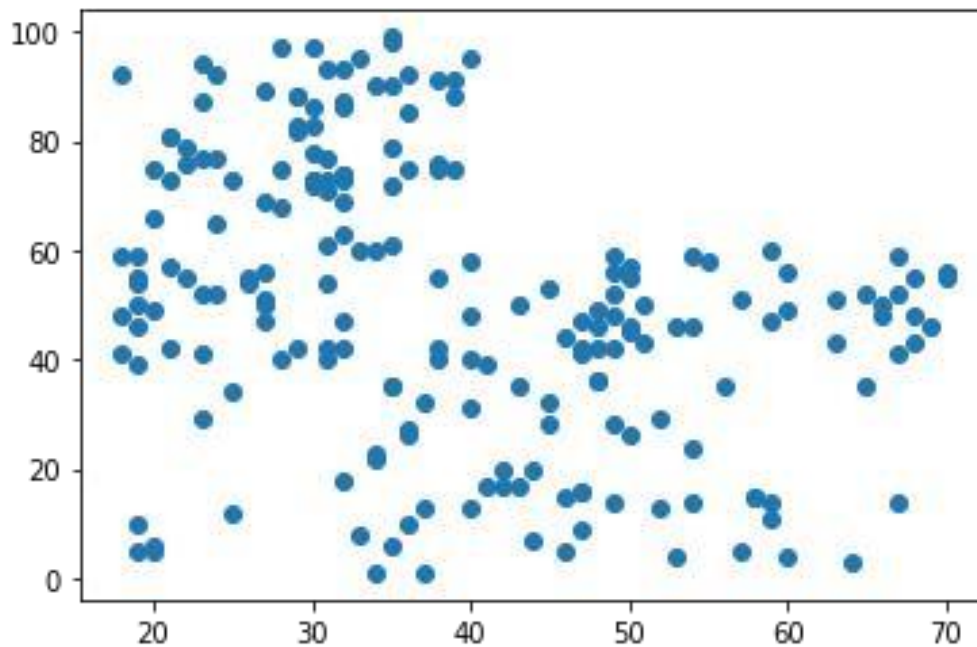
`<matplotlib.collections.PathCollection at 0x7f4b0acd3410>`



### 3.2.3 Solution

```
plt.scatter(db['Age'],db['Spending Score
(1-100)'])
```

<matplotlib.collections.PathCollection at 0x7f4b0aca6550>



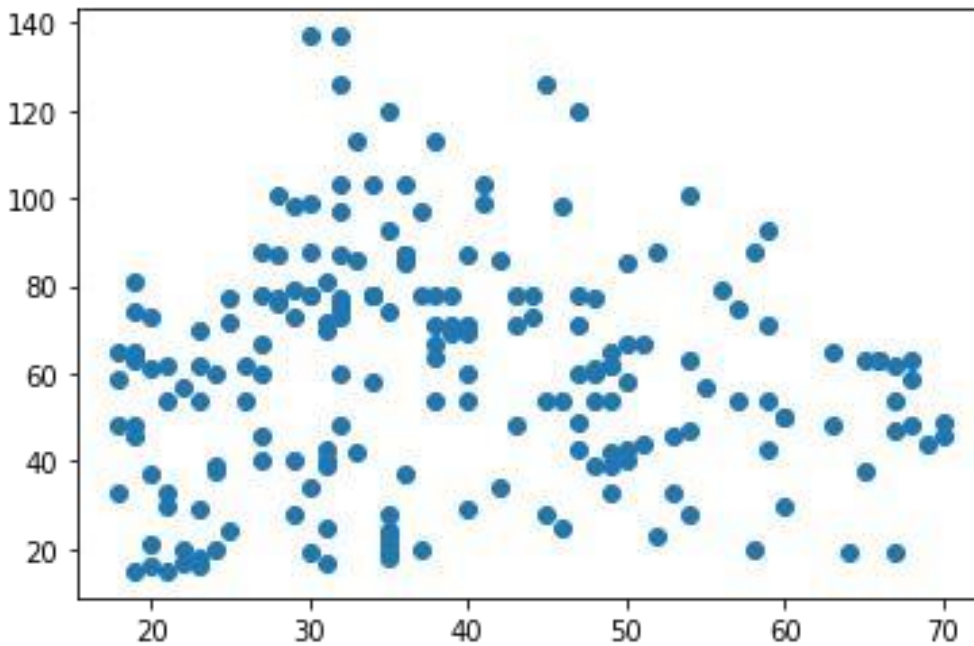
### 3.2.4 Solution

```
plt.scatter(db['Age'],db['Annual Income
```

```
(k$')'])
```

```
<matplotlib.collections.PathCollection at
```

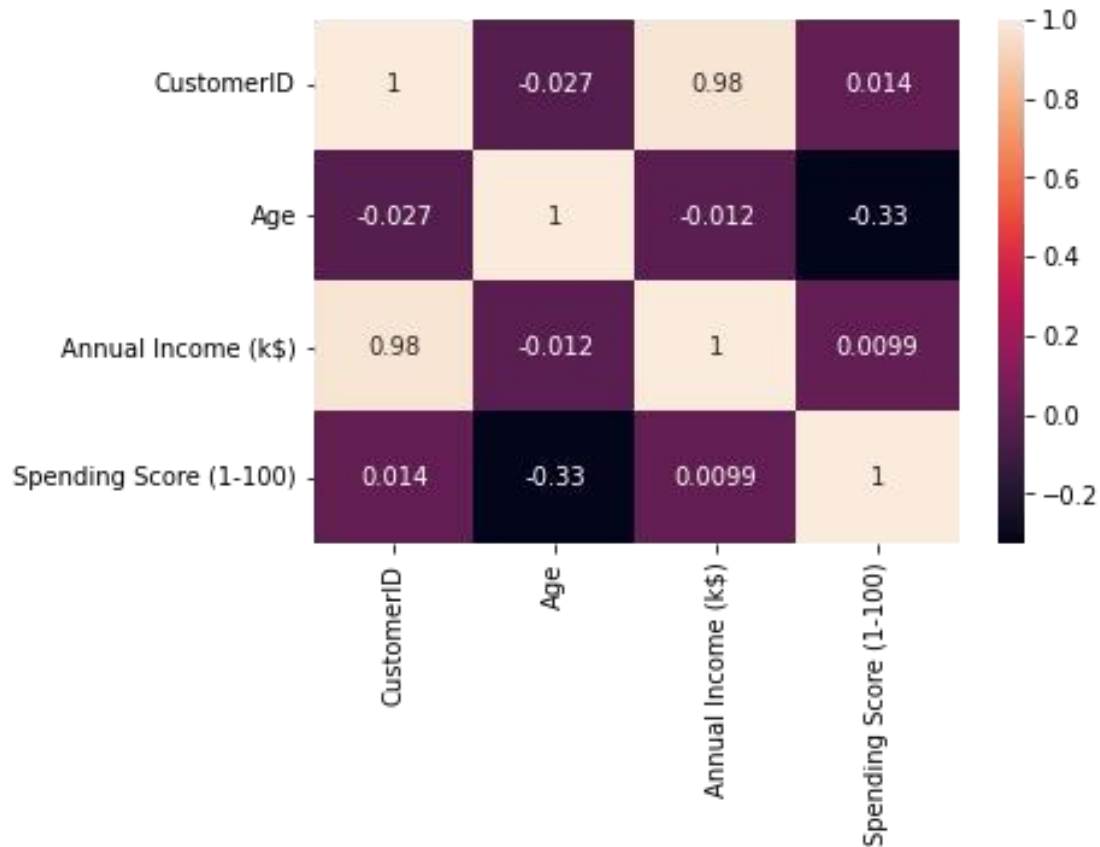
```
0x7f4b0c009790>
```



**3.2.5 Solution** `sbn.heatmap(db.corr(), annot`

`= True)`

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f4b0b527450>
```

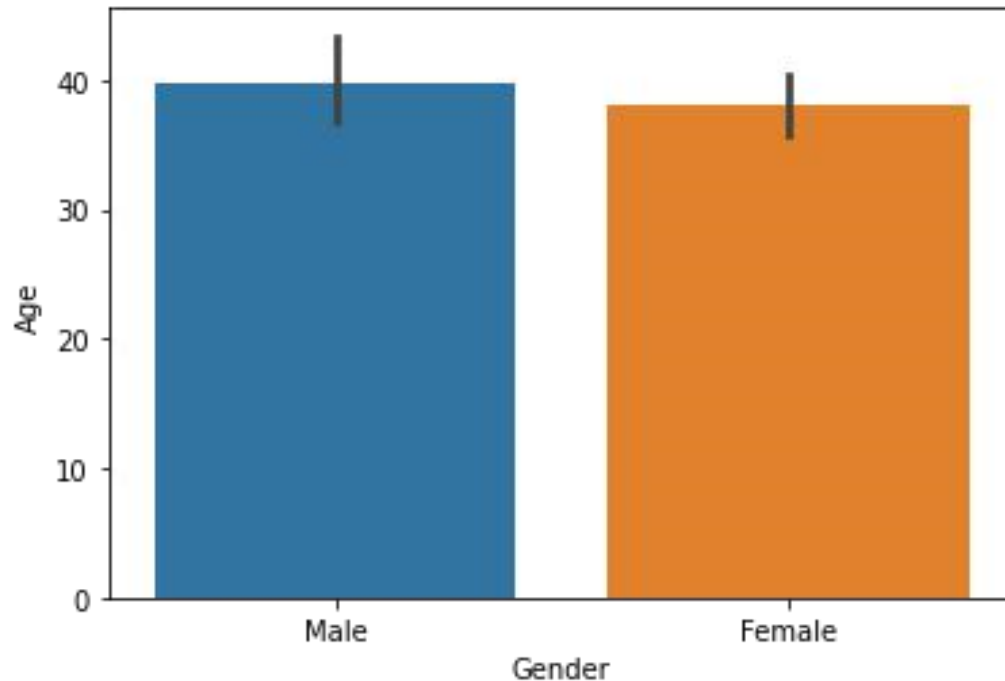


**3.2.6 Solution** `sbn.barplot(db['Gender'],  
db['Age'])`

/usr/local/lib/python3.7/dist-packages/seaborn/\_decorators.py:43:  
FutureWarning: Pass the following variables as keyword args: x, y. From  
version 0.12, the only valid positional argument will be `data`, and passing  
other arguments without an explicit keyword will result in an error or  
misinterpretation. FutureWarning

<matplotlib.axes.\_subplots.AxesSubplot at 0x7f4b0830c450>





### 3.3 Multi-Variate Analysis

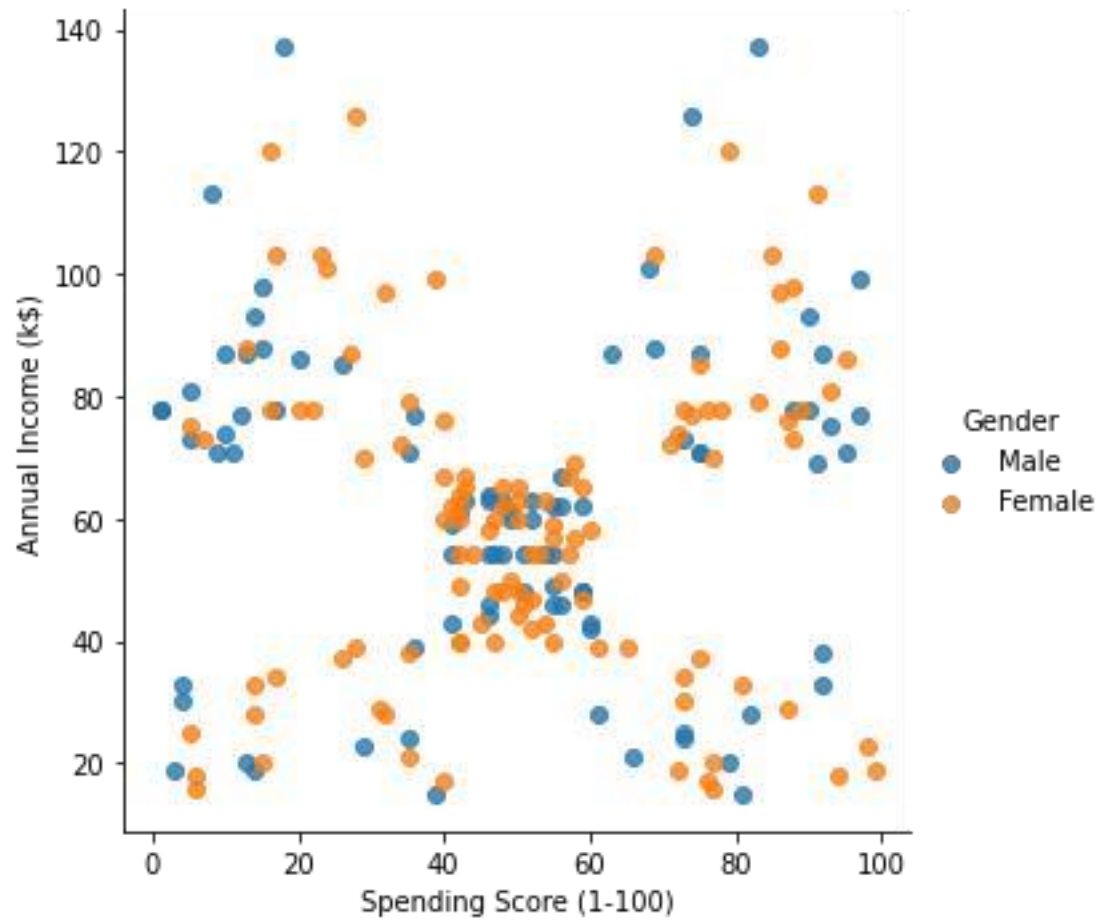
#### 3.3.1 Solution

```
sbn.lmplot("Spending Score (1-100)", "Annual Income (k$)", db, hue="Gender",  
fit_reg=False);
```

/usr/local/lib/python3.7/dist-packages/seaborn/\_decorators.py:43:

FutureWarning: Pass the following variables as keyword args: x, y, data. From  
version 0.12, the only valid positional argument will be `data`, and passing  
other arguments without an explicit keyword will result in an error or  
misinterpretation.

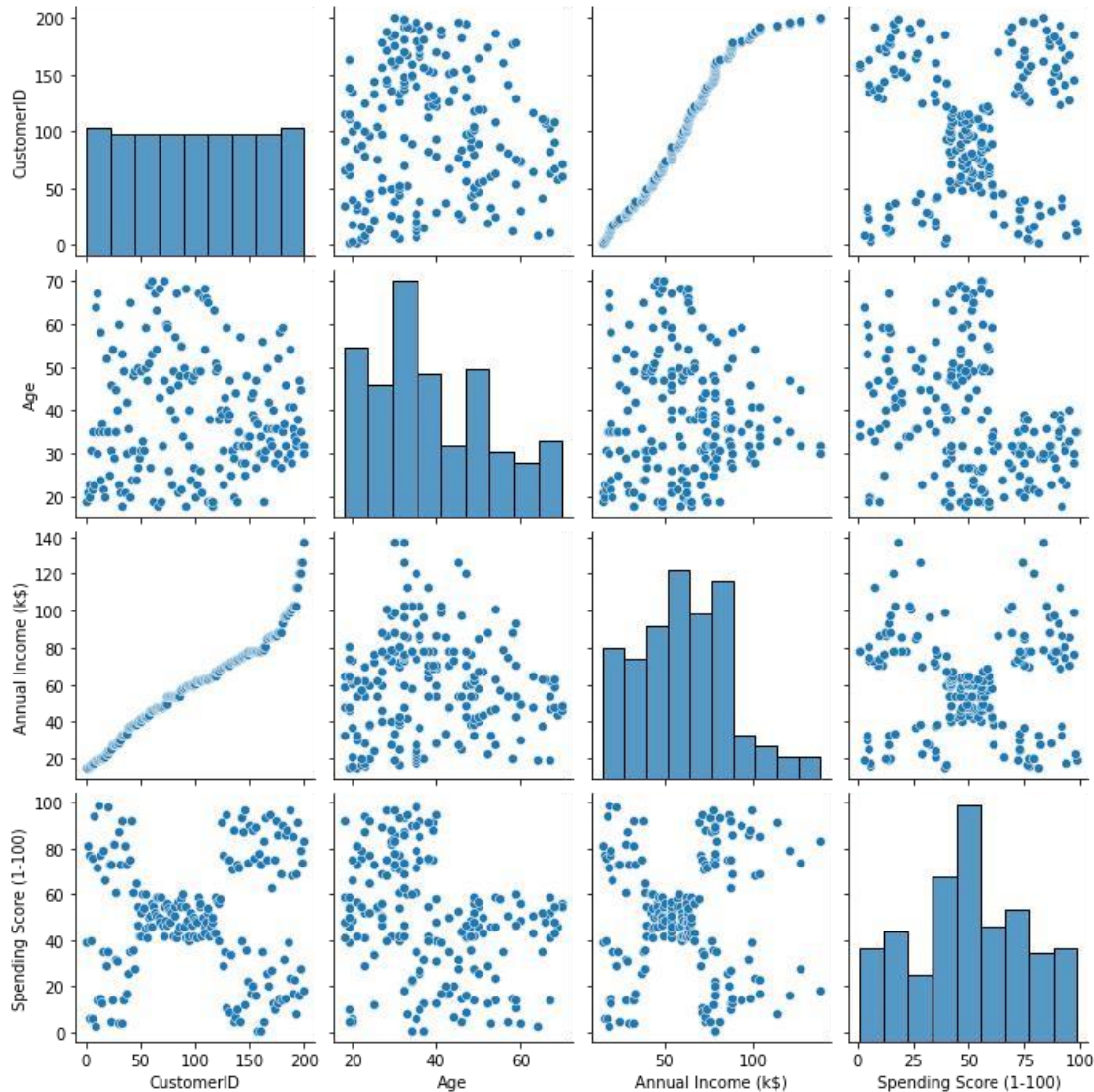
FutureWarning



### 3.3.2 Solution

```
sbn.pairplot(db)
```

```
<seaborn.axisgrid.PairGrid at 0x7f4b081f76d0>
```



#### Question 4:

##### 4. Perform descriptive statistics on the dataset 4.1

**Solution** `db.describe()`

	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

##### 4.2 Solution

`db.dtypes`

```

CustomerID          int64
Gender              object
Age                int64
Annual   Income    (k$)   int64
Spending  Score  (1-100)  int64
dtype: object
4.3 Solution
db.var()

```

```

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError. Select only valid columns before calling the reduction.
"""Entry point for launching an IPython kernel.

```

```

CustomerID          3350.000000
Age                195.133166
Annual   Income    (k$)   689.835578
Spending  Score  (1-100)  666.854271
dtype: float64
4.4 Solution
db.skew()

```

```

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError. Select only valid columns before calling the reduction.
"""Entry point for launching an IPython kernel.

```

```

CustomerID          0.000000
Age                0.485569
Annual   Income    (k$)   0.321843
Spending  Score  (1-100) -0.047220
dtype: float64
4.5 Solution
db.corr()

```

```

CustomerID  Age Annual Income (k$) \ CustomerID
1.000000 -0.026763 0.977548
Age -0.026763 1.000000 -0.012398
Annual Income (k$) 0.977548 -0.012398 1.000000
Spending Score (1-100) 0.013835 -0.327227 0.009903
Spending Score (1-100)
CustomerID 0.013835
Age -0.327227
Annual Income (k$) 0.009903
Spending Score (1-100) 1.000000

```

## 4.6 Solution

```
db.std()
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError. Select only valid columns before calling the reduction.
"""Entry point for launching an IPython kernel.
```

```
CustomerID          57.879185
Age                 13.969007
Annual Income (k$)  26.264721
Spending Score (1-100) 25.823522
dtype: float64
```

### Question 5:

#### 5. Check for Missing values and deal with them

**5.1 Solution** `db.isna().sum()`

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

#### 5.2 Solution

```
db.isna().sum().sum()
```

```
0
```

#### 5.3 Solution

```
db.duplicated().sum()
```

```
0
```

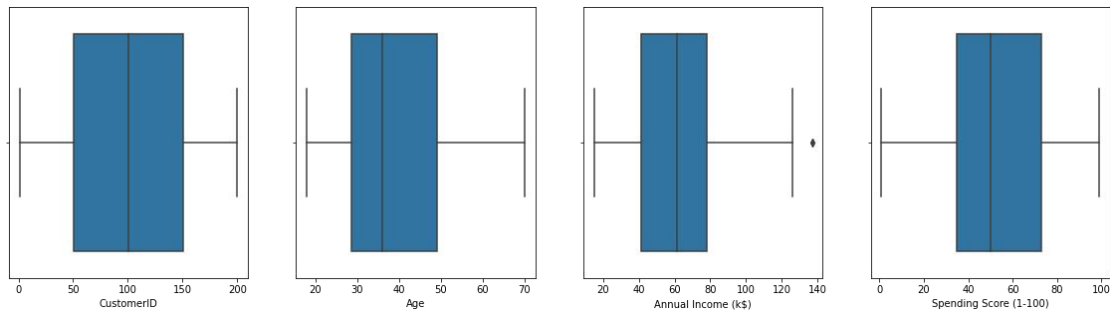
### Question 6:

#### 6. Find the outliers and replace them

##### 6.1 Solution

```
fig,ax=plt.subplots(figsize=(25,5))
plt.subplot(1, 5, 2)
sbn.boxplot(x=db['Age'])
plt.subplot(1, 5, 3)
sbn.boxplot(x=db['Annual Income (k$)'])
plt.subplot(1, 5, 4)
sbn.boxplot(x=db['Spending Score (1-100)'])
plt.subplot(1, 5, 1)
sbn.boxplot(x=db['CustomerID'])
```

<matplotlib.axes.\_subplots.AxesSubplot at 0x7f4b061aa610>



## 6.2 Solution

```
q=db.quantile(q = [0.25, 0.75])
q
```

	CustomerID	Age	Annual Income (k\$)	Spending Score (1-100)
0.25	50.75	28.75	41.5	34.75
0.75	150.25	49.00	78.0	73.00

## 6.3 Solution

```
q.loc[0.75]
```

CustomerID	150.25
Age	49.00
Annual Income (k\$)	78.00
Spending Score (1-100)	73.00

Name: 0.75, dtype: float64

## 6.4 Solution

```
q.loc[0.25]
```

CustomerID	50.75
Age	28.75
Annual Income (k\$)	41.50
Spending Score (1-100)	34.75

Name: 0.25, dtype: float64

## 6.5 Solution

```
IQR=q.iloc[1]-q.iloc[0]
IQR
```

CustomerID	99.50
Age	20.25
Annual Income (k\$)	36.50
Spending Score (1-100)	38.25

dtype: float64 **6.6 Solution**

```
upper=q.iloc[1] + (1.5 *IQR)
upper
```

```
CustomerID          299.500
Age                 79.375
Annual   Income   (k$)  132.750
Spending  Score  (1-100) 130.375
```

dtype: float64 **6.7 Solution**

```
lower=q.iloc[0] - (1.5* IQR)
lower
```

```
CustomerID          -98.500
Age                -1.625
Annual   Income   (k$)  -13.250
Spending  Score  (1-100) -22.625
```

dtype: float64 **6.8 Solution**

```
db.mean()
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: FutureWarning:
Dropping of nuisance columns in DataFrame reductions (with
'numeric_only=None') is deprecated; in a future version this will raise
TypeError. Select only valid columns before calling the reduction.
"""Entry point for launching an IPython kernel.
```

```
CustomerID          100.50
Age                 38.85
Annual   Income   (k$)   60.56
Spending  Score  (1-100)  50.20
```

dtype: float64 **6.9 Solution**

```
db['Annual Income (k$)'].max()
```

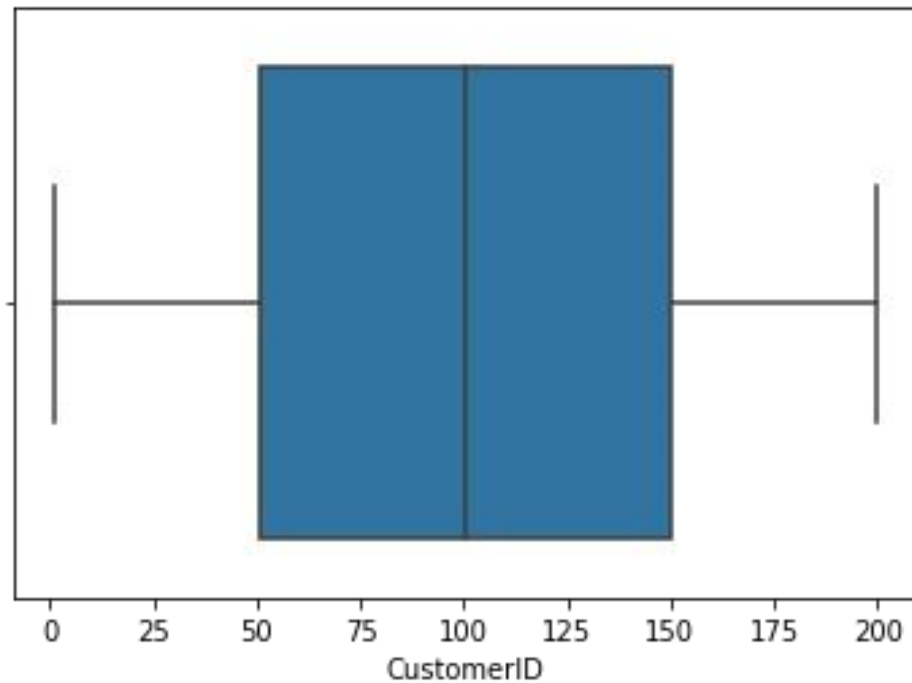
137

**6.10 Solution**

```
sbn.boxplot(db['CustomerID'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation. FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f94da48bfd0>
```



### 6.11 Solution

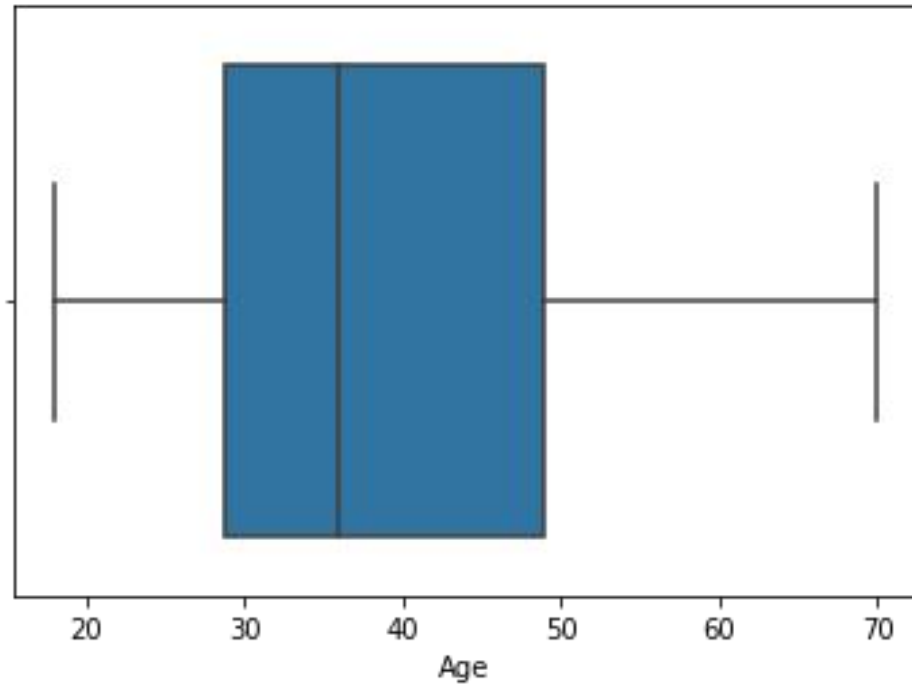
```
sbn.boxplot(db['Age'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
```

```
FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation. FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f4b06126f10>
```





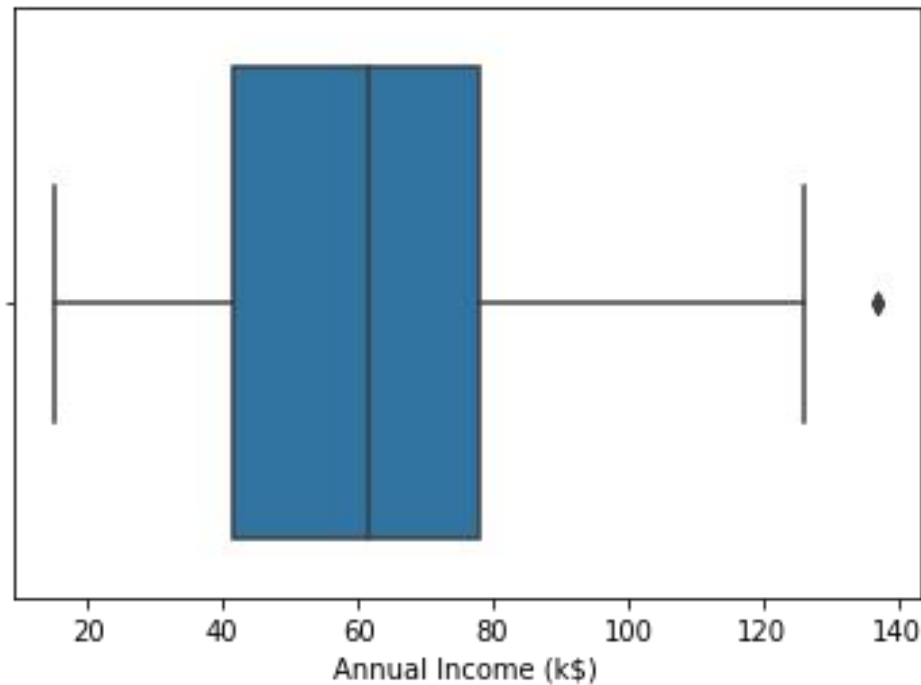
**6.12 Solution** `sbn.boxplot(db['Annual`

`Income (k$)'])`

`/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:`

FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation. FutureWarning

`<matplotlib.axes._subplots.AxesSubplot at 0x7f94da411d10>`



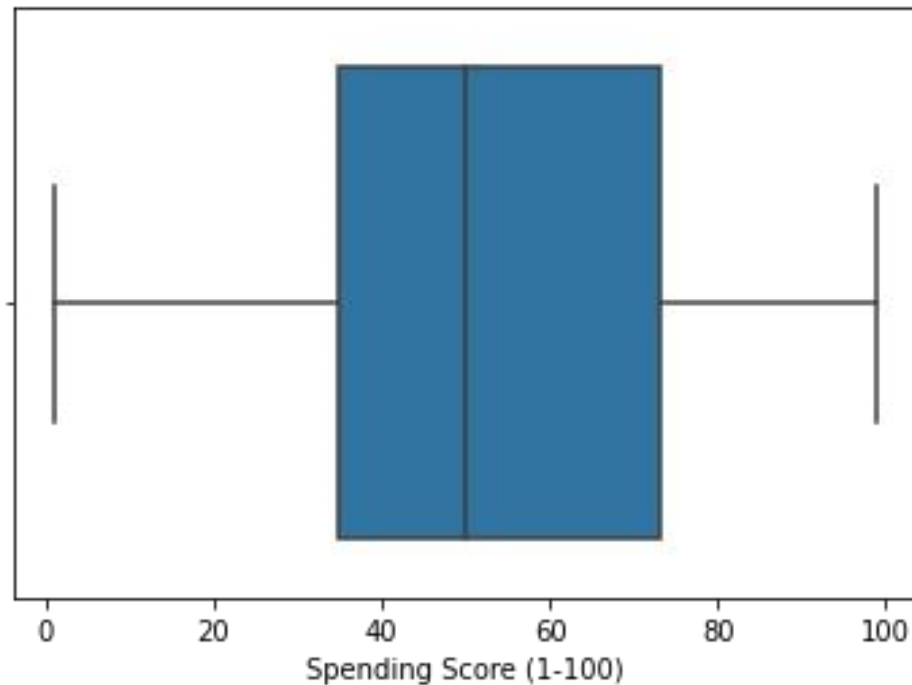
**6.13 Solution** `sbn.boxplot(db['Spending`

`Score (1-100)'])`

`/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:`

FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation. FutureWarning

`<matplotlib.axes._subplots.AxesSubplot at 0x7f4b060a9c10>`



## Question 7 7. Check for Categorical columns and perform encoding 7.1 Solution

```
db.select_dtypes(include='object').columns
```

```
Index(['Gender'], dtype='object')
```

**7.2 Solution** `db['Gender'].unique()`

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

## 7.3 Solution

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

```
db
```

```
CustomerID Gender Age Annual Income (k$) Spending Score (1-100)
```

```
0          1    1  19   15    39
```

```
1          2    1  21   15    81
```

```
2          3    0  20   16     6
```

```
3          4    0  23   16    77
```

```
4          5    0  31   17    40
```

```
..          ...    ...    ...    ...
```

```
195         196    0  35  120    79
```

```

196      197      0 45 126 28
197      198      1 32 126 74
198      199      1 32 137 18
199      200      1 30 137 83

```

```
[200 rows x 5 columns]
```

## 7.4 Solution

```
db.head()
```

```

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

```

## Question 8 8 . Scaling the data 8.1 Solution

```
from sklearn.preprocessing import StandardScaler
```

```
ss = StandardScaler().fit_transform(db) ss
```

```

array([[ -1.7234121 ,  1.12815215, -1.42456879, -1.73899919, -0.43480148],
       [ -1.70609137,  1.12815215, -1.28103541, -1.73899919,  1.19570407],
       [ -1.68877065, -0.88640526, -1.3528021 , -1.70082976, -1.71591298], [ -
       1.67144992, -0.88640526, -1.13750203, -1.70082976,  1.04041783],
       [ -1.6541292 , -0.88640526, -0.56336851, -1.66266033, -0.39597992],
       [ -1.63680847, -0.88640526, -1.20926872, -1.66266033,  1.00159627],
       [ -1.61948775, -0.88640526, -0.27630176, -1.62449091, -1.71591298],
       [ -1.60216702, -0.88640526, -1.13750203, -1.62449091,  1.70038436],
       [ -1.5848463 ,  1.12815215,  1.80493225, -1.58632148, -1.83237767],
       [ -1.56752558, -0.88640526, -0.6351352 , -1.58632148,  0.84631002],
       [ -1.55020485,  1.12815215,  2.02023231, -1.58632148, -1.4053405 ],
       [ -1.53288413, -0.88640526, -0.27630176, -1.58632148,  1.89449216], [ -
       1.5155634 , -0.88640526,  1.37433211, -1.54815205, -1.36651894], [ -
       1.49824268, -0.88640526, -1.06573534, -1.54815205,  1.04041783], [ -
       1.48092195,  1.12815215, -0.13276838, -1.54815205, -1.44416206],
       [ -1.46360123,  1.12815215, -1.20926872, -1.54815205,  1.11806095],
       [ -1.4462805 , -0.88640526, -0.27630176, -1.50998262, -0.59008772],
       [ -1.42895978,  1.12815215, -1.3528021 , -1.50998262,  0.61338066], [ -
       1.41163905,  1.12815215,  0.94373197, -1.43364376, -0.82301709],
       [ -1.39431833, -0.88640526, -0.27630176, -1.43364376,  1.8556706 ],
       [ -1.3769976 ,  1.12815215, -0.27630176, -1.39547433, -0.59008772],
       [ -1.35967688,  1.12815215, -0.99396865, -1.39547433,  0.88513158],
       [ -1.34235616, -0.88640526,  0.51313183, -1.3573049 , -1.75473454],
       [ -1.32503543,  1.12815215, -0.56336851, -1.3573049 ,  0.88513158],

```

[-1.30771471, -0.88640526, 1.08726535, -1.24279661, -1.4053405 ], [-  
1.29039398, 1.12815215, -0.70690189, -1.24279661, 1.23452563],  
[-1.27307326, -0.88640526, 0.44136514, -1.24279661, -0.7065524 ],  
[-1.25575253, 1.12815215, -0.27630176, -1.24279661, 0.41927286],  
[-1.23843181, -0.88640526, 0.08253169, -1.20462718, -0.74537397], [-  
1.22111108, -0.88640526, -1.13750203, -1.20462718, 1.42863343],  
[-1.20379036, 1.12815215, 1.51786549, -1.16645776, -1.7935561 ],  
[-1.18646963, -0.88640526, -1.28103541, -1.16645776, 0.88513158],  
[-1.16914891, 1.12815215, 1.01549866, -1.05194947, -1.7935561 ],  
[-1.15182818, 1.12815215, -1.49633548, -1.05194947, 1.62274124],  
[-1.13450746, -0.88640526, 0.7284319 , -1.05194947, -1.4053405 ],  
[-1.11718674, -0.88640526, -1.28103541, -1.05194947, 1.19570407],  
[-1.09986601, -0.88640526, 0.22606507, -1.01378004, -1.28887582],  
[-1.08254529, -0.88640526, -0.6351352 , -1.01378004, 0.88513158],  
[-1.06522456, -0.88640526, -0.20453507, -0.89927175, -0.93948177],  
[-1.04790384, -0.88640526, -1.3528021 , -0.89927175, 0.96277471], [-  
1.03058311, -0.88640526, 1.87669894, -0.86110232, -0.59008772],  
[-1.01326239, 1.12815215, -1.06573534, -0.86110232, 1.62274124], [-  
0.99594166, 1.12815215, 0.65666521, -0.82293289, -0.55126616],  
[-0.97862094, -0.88640526, -0.56336851, -0.82293289, 0.41927286],  
[-0.96130021, -0.88640526, 0.7284319 , -0.82293289, -0.86183865],  
[-0.94397949, -0.88640526, -1.06573534, -0.82293289, 0.5745591 ],  
[-0.92665877, -0.88640526, 0.80019859, -0.78476346, 0.18634349],  
[-0.90933804, -0.88640526, -0.85043527, -0.78476346, -0.12422899], [-  
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```

### Question 9:

## 9 . Perform any of the clustering algorithms

### 9.1 Solution from sklearn.cluster import

KMeans



```

TWSS = []
for k in range(2,9):
    kmeans=KMeans(n_clusters=k, init='k-means++')
    kmeans.fit(db)
    TWSS.append(kmeans.inertia_)
TWSS

[387065.71377137717,
 271384.508782868,
 195401.19855991466,
 157620.9714797914,
 122625.19813553878,
 103244.10476410593,
 86053.67444777445]

```

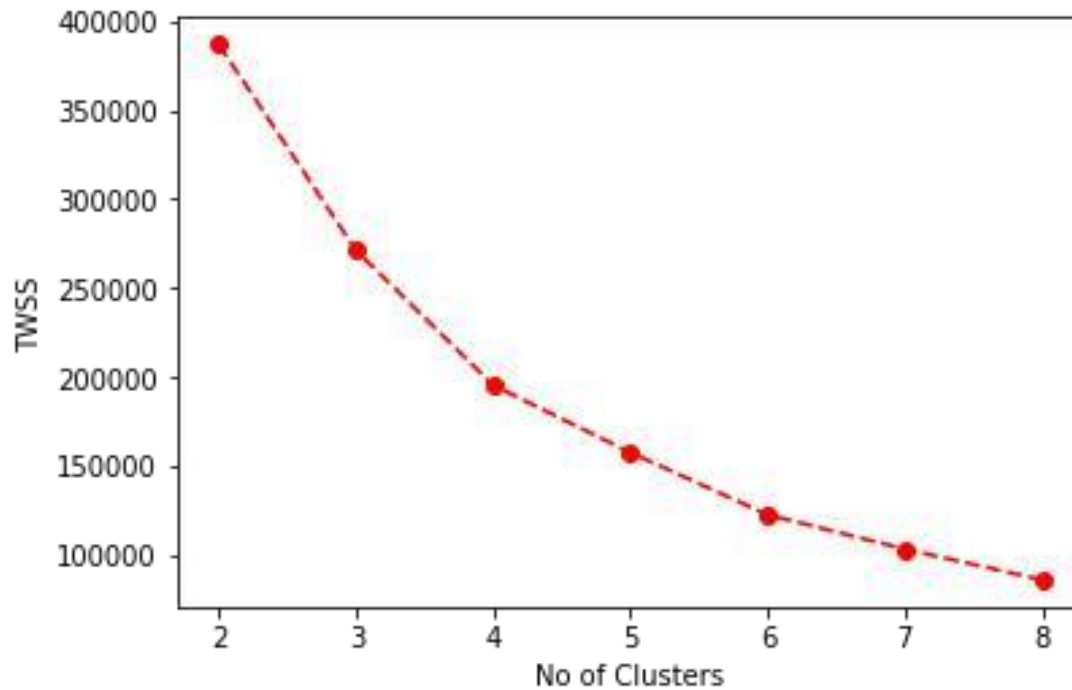
## 9.2 Solution

```

plt.plot(k,TWSS, 'ro--')
plt.xlabel('No of Clusters')
plt.ylabel('TWSS')

```

```
Text(0, 0.5, 'TWSS')
```



## 9.3 Solution

```

model = KMeans(n_clusters = 4)
model.fit(db)

```

```
KMeans(n_clusters=4)
```

#### 9.4 Solution

```
mb = pd.Series(model.labels_)
db['Cluster'] = mb
```

```
CustomerID Gender Age Annual Income (k$) Spending Score (1-100) \
0          1      1 19 15      39
1          2      1 21 15     81 2   3      0 20 16      6 3   4      0 23
          16      77
4          5      0 31          17          40
.. ..
195        196 0 35 120 79
196        197 0 45 126 28
197        198 1 32 126 74
198        199 1 32 137 18
199        200 1 30 137 83

Cluster
0          3
1          3
2          3
3          3
4          3
.. ..195
196 0
197
198 0
199

[200 rows x 6 columns]
```

#### 9.5 Solution

```
mb=pd.Series(model.labels_)
db.head(3)
```

```
CustomerID Gender Age Annual Income (k$) Spending Score (1-100) \
0          1      1 19 15      39
1          2      1 21 15     81
2          3      0 20 16      6

Cluster
0          3
1          3
2          3
```

## Question 10

### 10 . Add the cluster data with the primary dataset 10.1

#### Solution

```
db['Cluster']=kmeans.labels_  
db.head()
```

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

	Cluster
0	6
1	5
2	6
3	5
4	6

### 10.2 Solution

```
db.tail()
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100) \
195	196	0	35	120	79
196	197	0	45	126	28
197	198	1	32	126	74
198	199	1	32	137	18
199	200	1	30	137	83

	Cluster
195	3
196	1
197	3
198	1
199	3

## Question 11

### 11 . Split the data into dependent and independent variables

#### 11.1 Solution

```
X=db.drop('Cluster',axis=1)  
Y=db['Cluster']  
y=db['Cluster'] y
```

```

0      6
1      5
2      6
3      5
4      6
..
195    3
196    1
197    3
198    1
199    3
Name: Cluster, Length: 200, dtype: int32

```

## 11.2 Solution

```

from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,Y,test_size=0.2,random_state
=42)
print("Number transactions X_train dataset: ", X_train.shape)
print("Number transactions y_train dataset: ", y_train.shape)
print("Number transactions X_test dataset: ", X_test.shape)
print("Number transactions y_test dataset: ", y_test.shape)

```

```

Number transactions X_train dataset: (160, 5)
Number transactions y_train dataset: (160,)
Number transactions X_test dataset: (40, 5)
Number transactions y_test dataset: (40,)

```

## Question 12 12 . Split the data into training and testing

### 12.1 Solution

```

X_train
CustomerID Gender Age Annual Income (k$) Spending Score (1-100)
79          80      0 49          54          42
197         198      1 32         126          74
38          39      0 36          37          26
24          25      0 54          28          14
122         123      0 40          69          58
..          ...      ... ...      ...          ...
106         107      0 66          63          50
14          15      1 37          20          13
92          93      1 48          60          49

```

179	180	1 35	93	90
102	103	1 67	62	59

[160 rows x 5 columns]

## 12.2 Solution

X\_test

CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
95	96	1 24	60	52
15	16	1 22	20	79
30	31	1 60	30	4
158	159	1 34	78	1
128	129	1 59	71	11
115	116	0 19	65	50
69	70	0 32	48	47
170	171	1 40	87	13
174	175	0 52	88	13
45	46	0 24	39	65
66	67	0 43	48	50
182	183	1 46	98	15
165	166	0 36	85	75
78	79	0 23	54	52
186	187	0 54	101	24
177	178	1 27	88	69
56	57	0 51	44	50
152	153	0 44	78	20
82	83	1 67	54	41
68	69	1 19	48	59
124	125	0 23	70	29
16	17	0 35	21	35
148	149	0 34	78	22

93	94	0 40	60	40
65	66	1 18	48	59
60	61	1 70	46	56
84	85	0 21	54	57
67	68	0 68	48	48
125	126	0 31	70	77
132	133	0 25	72	34
9	10	0 30	19	72
18	19	1 52	23	29
55	56	1 47	43	41
75	76	1 26	54	54
150	151	1 43	78	17
104	105	1 49	62	56
135	136	0 29	73	88
137	138	1 32	73	73
164	165	1 50	85	26
76	77	0 45	54	53

### 12.3 Solution

y\_train

```

79      6
197     2
38      4
24      4
122     7
..
106     7
14      4
92      7
179     2

```

102 7

Name: Cluster, Length: 160, dtype: int32

## 12.4 Solution

y\_test

95	4
15	5
30	6
158	2
128	2
115	4
69	0
170	1
174	1
45	5
66	0
182	1
165	3
78	4
186	1
177	3
56	0
152	2
82	0
68	0
124	2
16	6
148	2
93	4
65	0
60	0
84	4
67	0
125	7
132	2
9	5
18	6
55	0
75	0
150	2
104	4
135	7
137	7
164	1

```
76      0
Name: Cluster, dtype: int32
```

### Question 13

#### 13 . Build the Model 13. Solution

```
from sklearn.linear_model import LogisticRegression
model=LogisticRegression()
model.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](https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression)

```
extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,
LogisticRegression()
```

### Question 14

#### 14. Train the Model 14.

##### Solution

```
model.score(X_train,y_train)

0.85
```

### Question 15

#### 15 . Test the Model 15.

##### Solution

```
model.score(X_test,y_test)

0.725
```

### Question 16 16. Measure the performance using

#### Evaluation Metrics 16. Solution

```
from sklearn.metrics import confusion_matrix,classification_report
y_pred=model.predict(X_test) confusion_matrix(y_test,y_pred)

array([[8, 0, 0, 0, 3, 0, 0, 0],
```



```
[0, 2, 3, 0, 0, 0, 0, 0],  
[0, 3, 4, 0, 0, 0, 0, 0],  
[0, 0, 0, 1, 0, 0, 0, 1],  
[0, 0, 0, 1, 5, 0, 0, 0],  
[0, 0, 0, 0, 0, 3, 0, 0],  
[0, 0, 0, 0, 0, 0, 3, 0],  
[0, 0, 0, 0, 0, 0, 0, 3]])
```