

Assignment 4

Python Programming

Assignment Date	25/10/2022
Student Name	Kathirvel.P
Student Roll Number	730419205020
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:

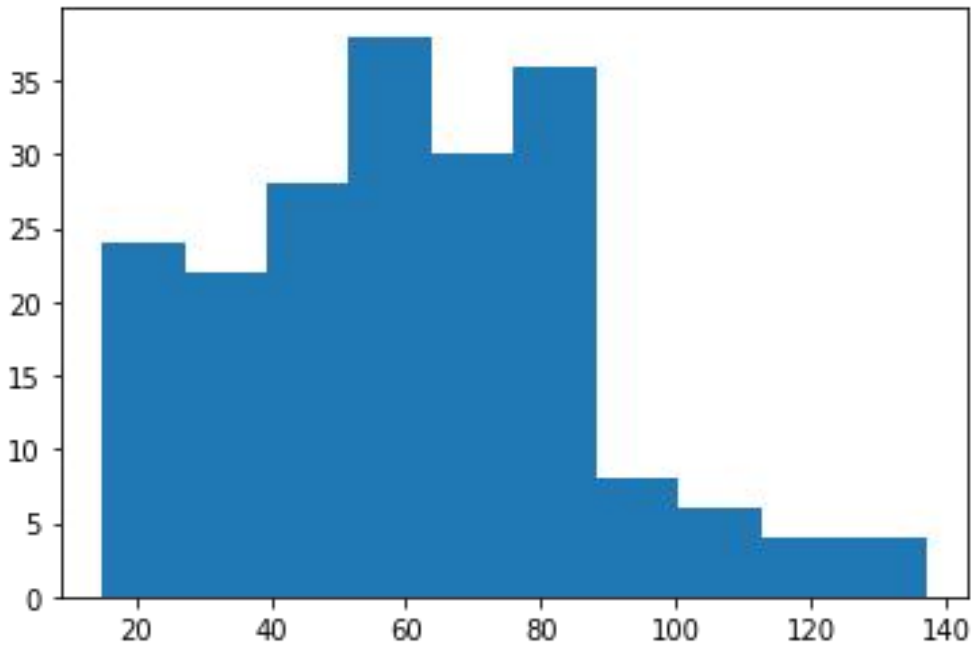
3. Visualizations

3.1 UniVariate Analysis

3.1.1 Solution

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

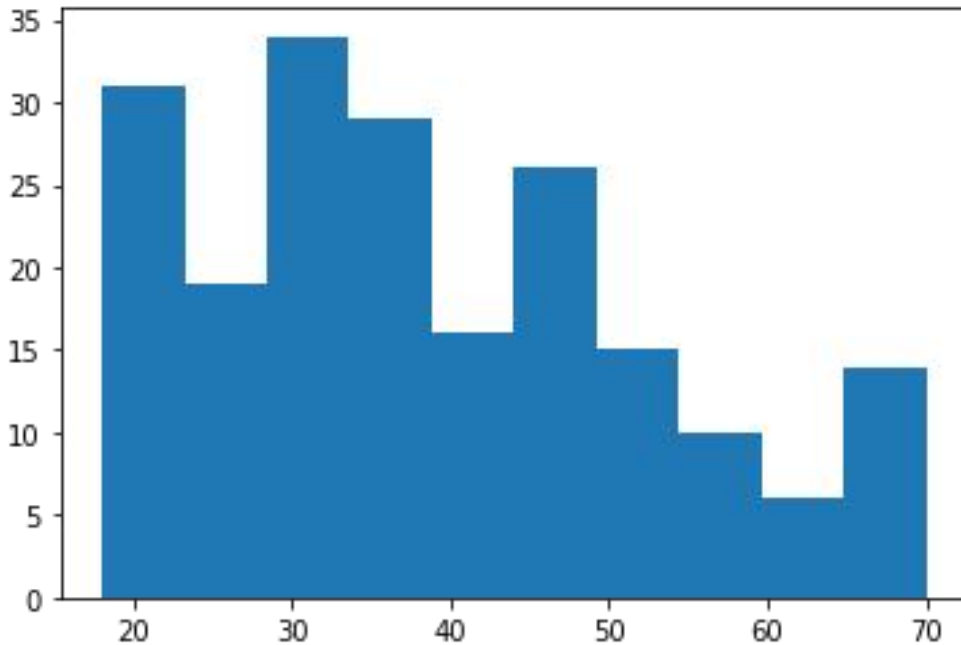
```
(array([24., 22., 28., 38., 30., 36., 8., 6., 4., 4.]),
 array([ 15. , 27.2, 39.4, 51.6, 63.8, 76. , 88.2, 100.4, 112.6,
        124.8, 137. ]),
 <a list of 10 Patch objects>)
```



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

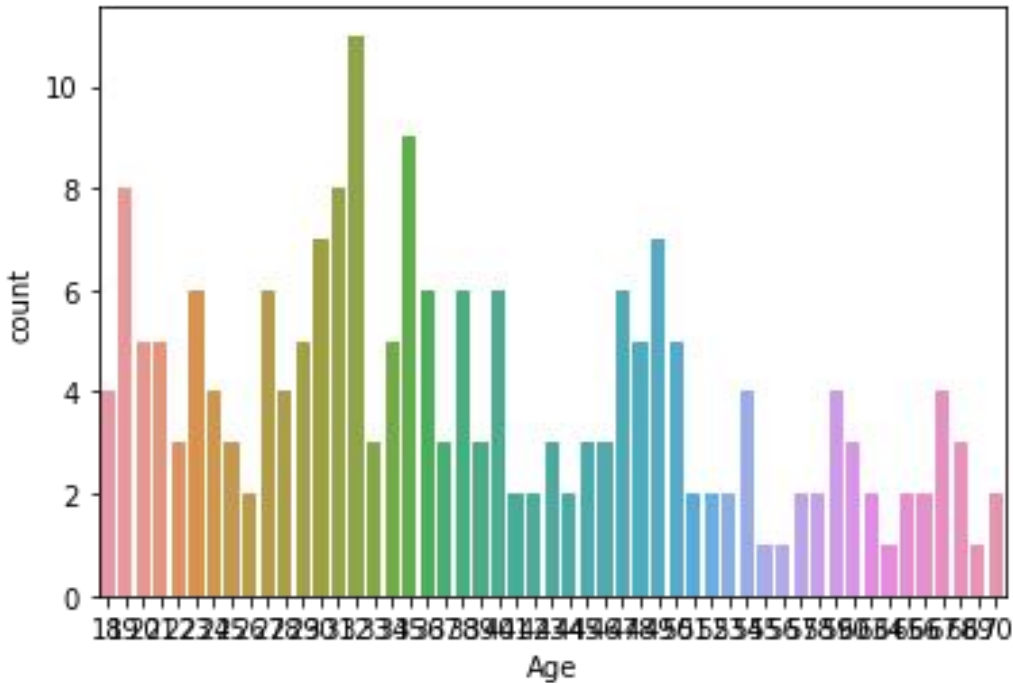
```
sbn.countplot(db['Age'])
```

/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>



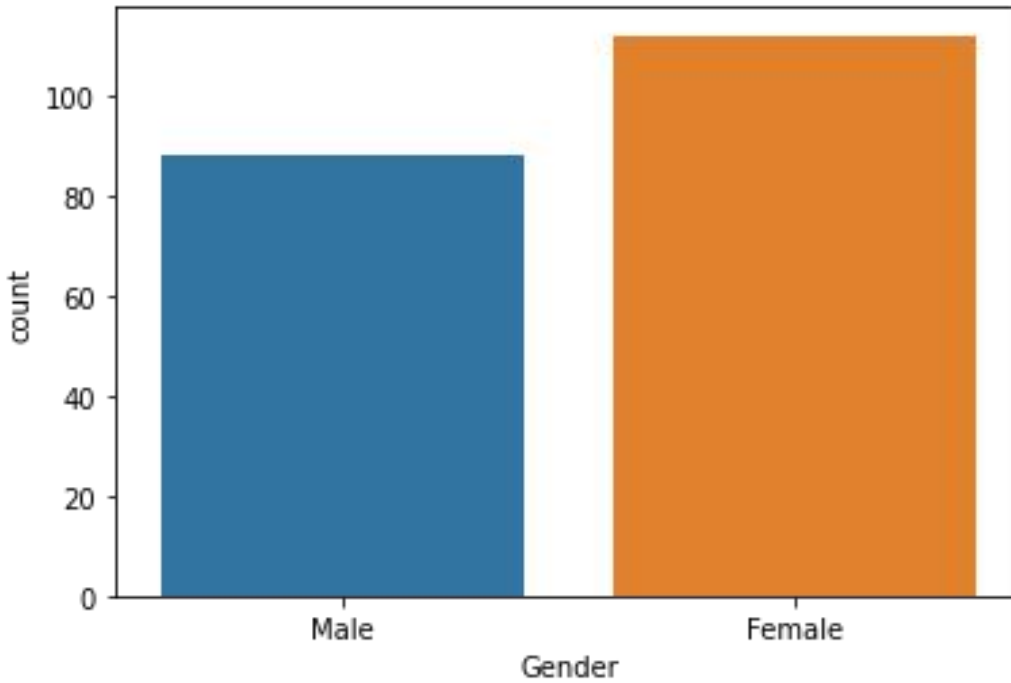
3.1.4 Solution

```
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.
```

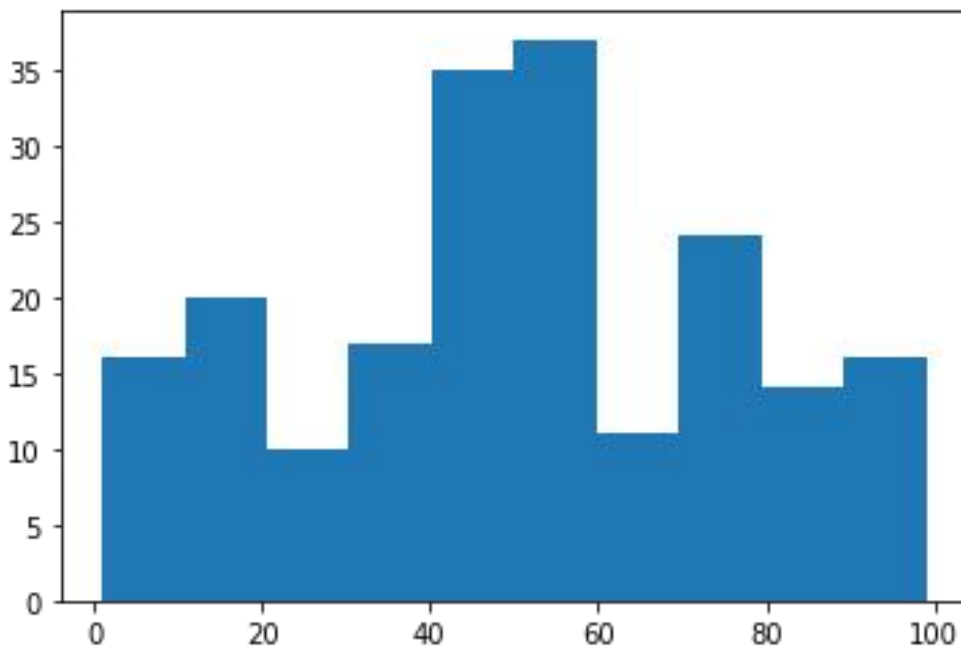
```
FutureWarning
```

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



3.1.5 Solution

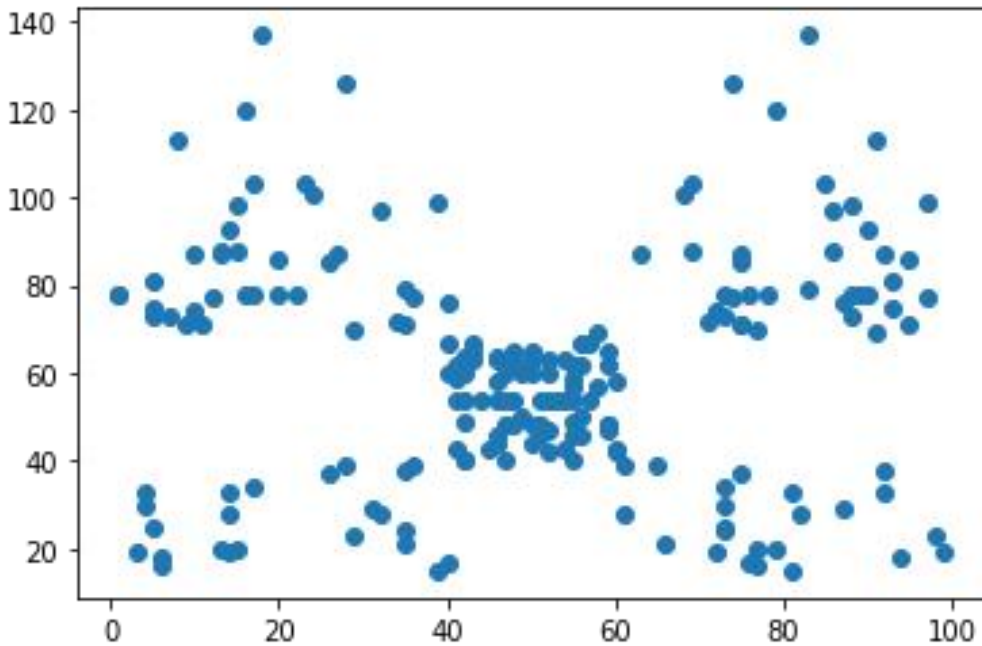
```
plt.hist(db['Spending Score (1-100)'])  
  
(array([16., 20., 10., 17., 35., 37., 11., 24., 14., 16.]),  
 array([ 1. , 10.8, 20.6, 30.4, 40.2, 50. , 59.8, 69.6, 79.4, 89.2, 99. ]),  
 <a list of 10 Patch objects>)
```



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>
```



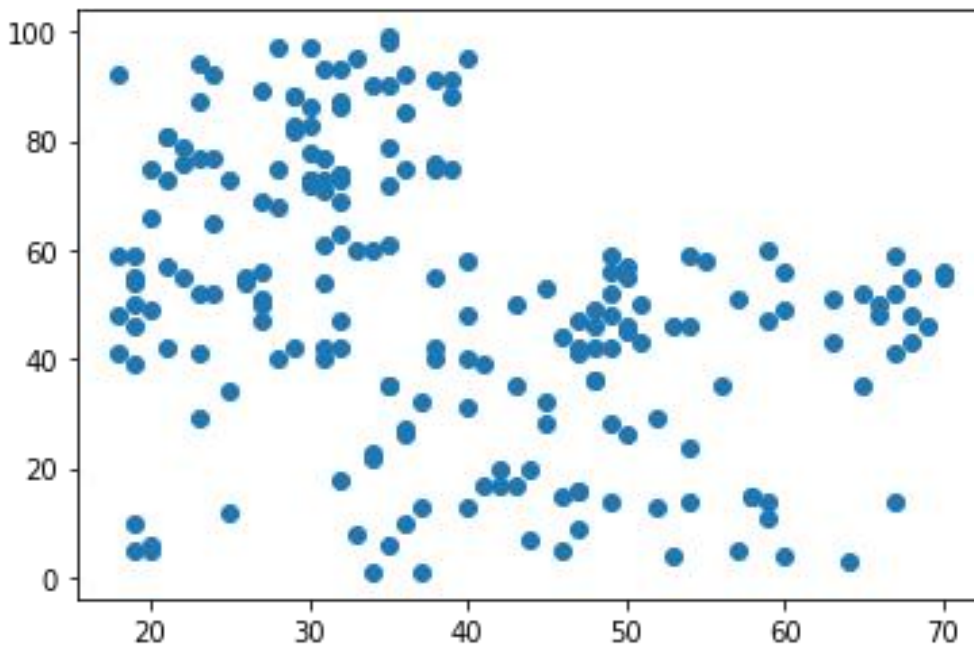
3.2.2 Solution

```
plt.scatter(db['Gender'],db['Annual Income (k$)'])  
<matplotlib.collections.PathCollection at 0x7f4b0acd3410>
```



3.2.3 Solution

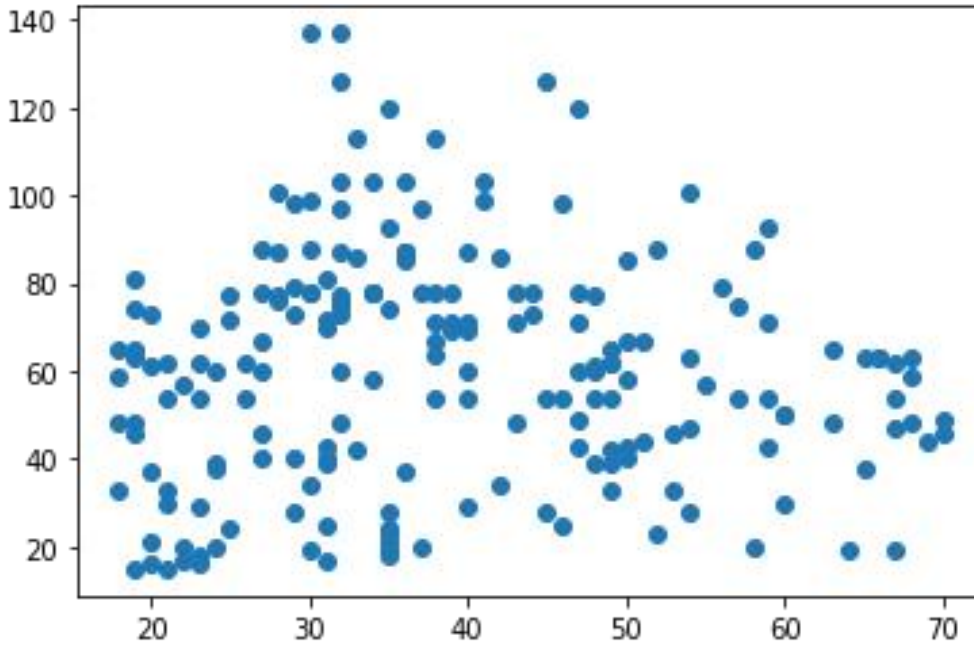
```
plt.scatter(db['Age'],db['Spending Score (1-100)'])  
<matplotlib.collections.PathCollection at 0x7f4b0aca6550>
```



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

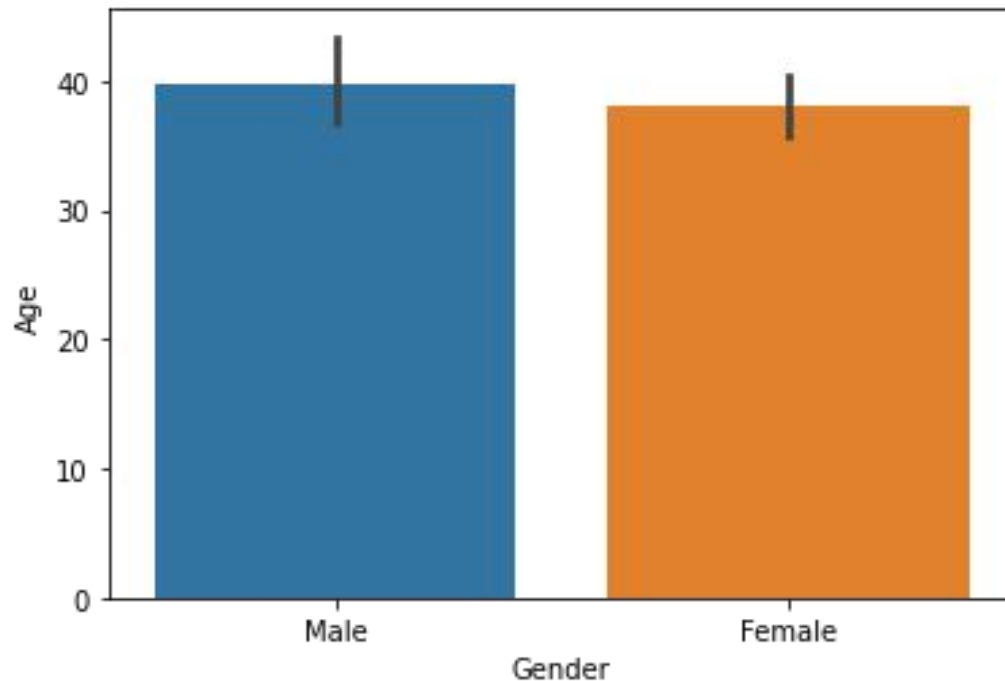
```
sbn.barplot(db['Gender'], db['Age'])
```

/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

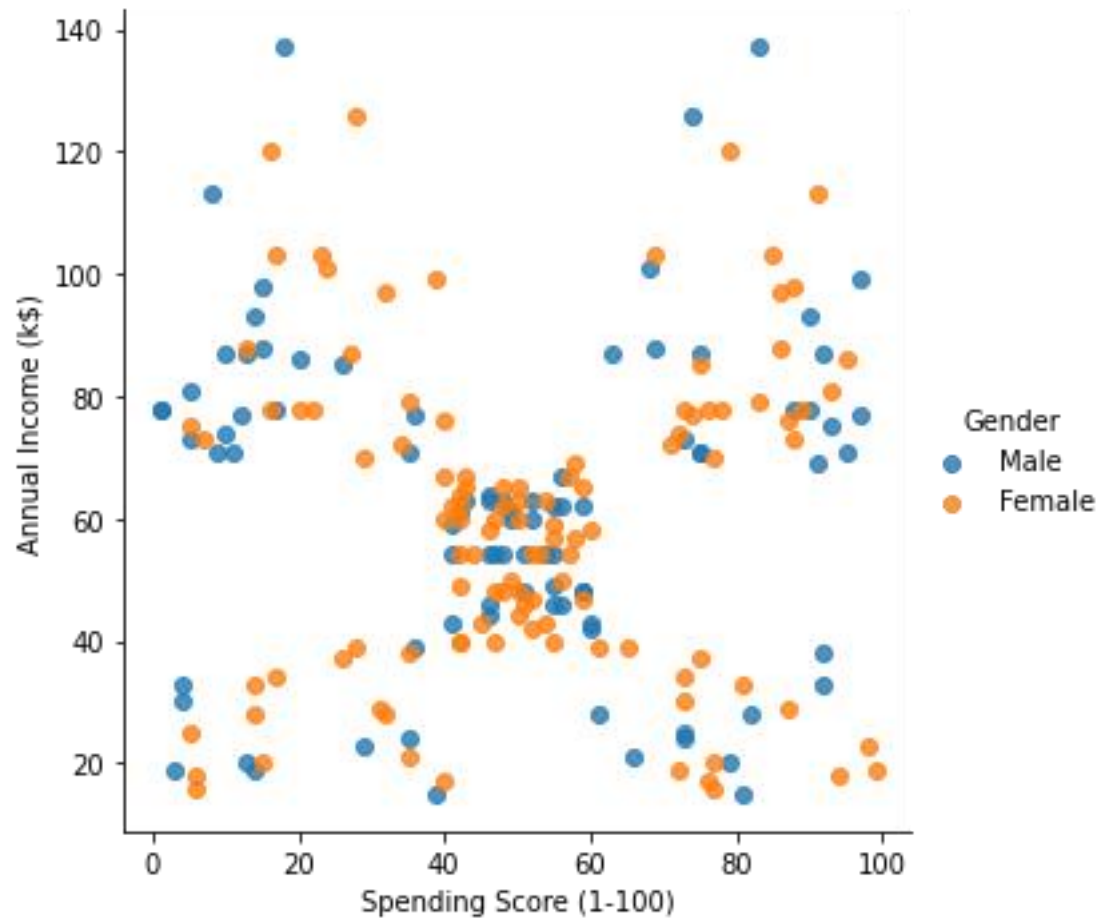
3.3.1 Solution

```
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.

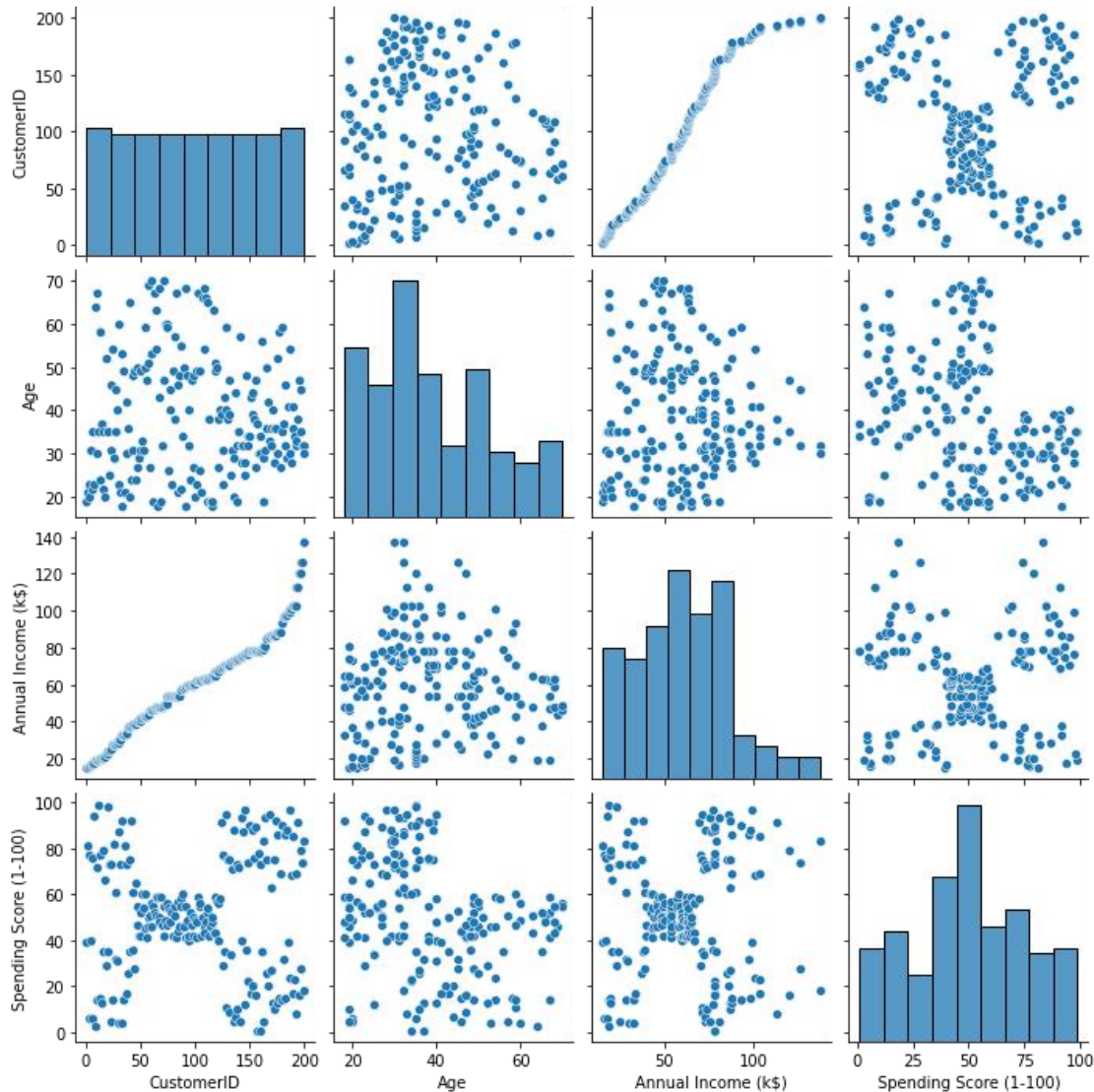
FutureWarning



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      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 outliers

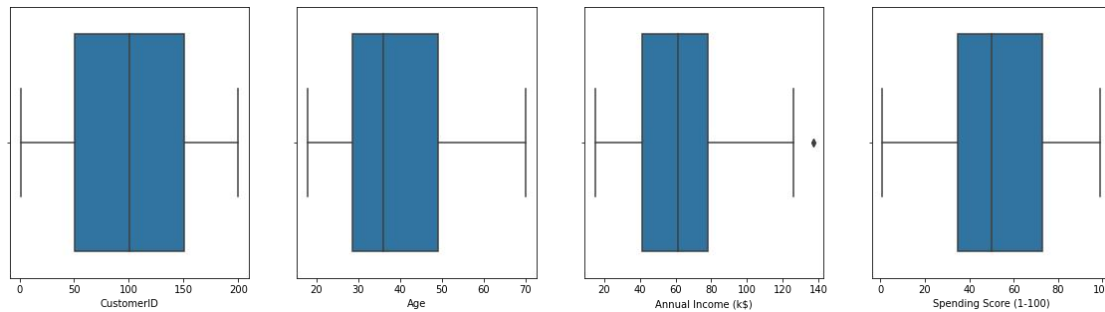
6.1 Solutiion

```

ig,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()
```


6.10 Solution

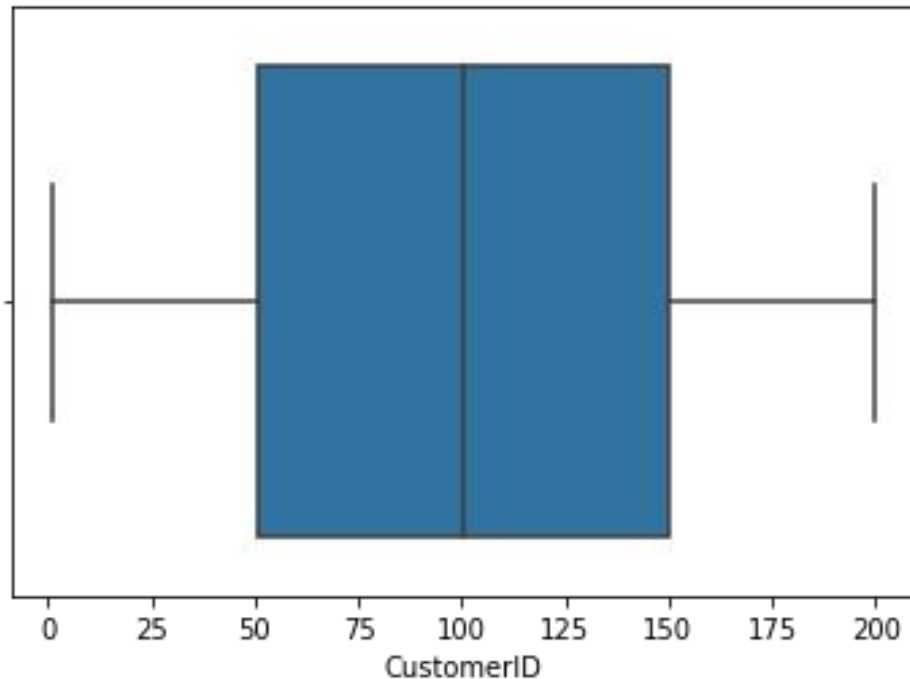
```
sbn.boxplot(db['CustomerID'])
```

```
/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

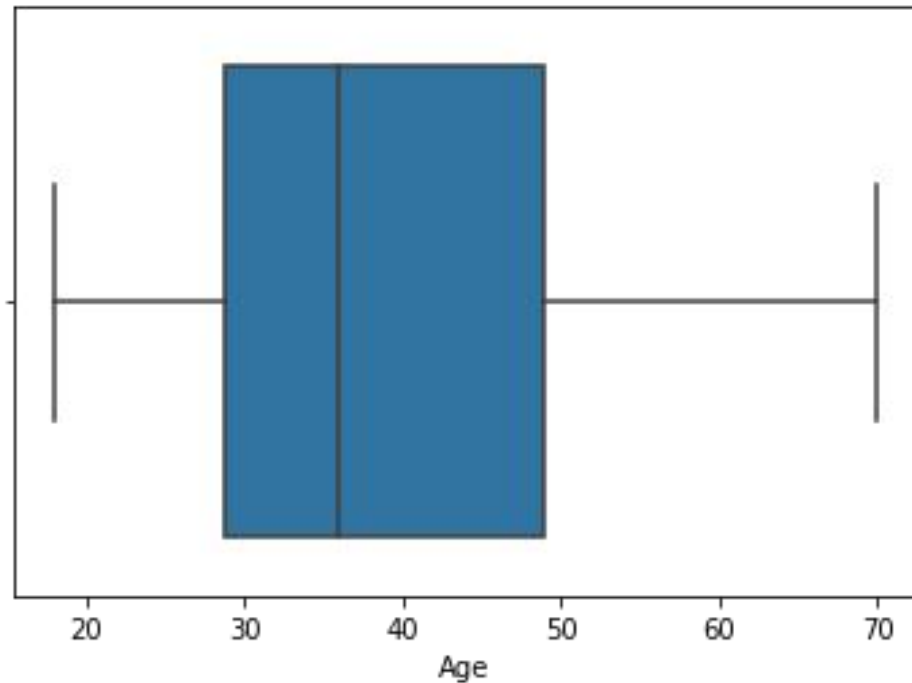
```
sbn.boxplot(db['Age'])
```

```
/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>
```



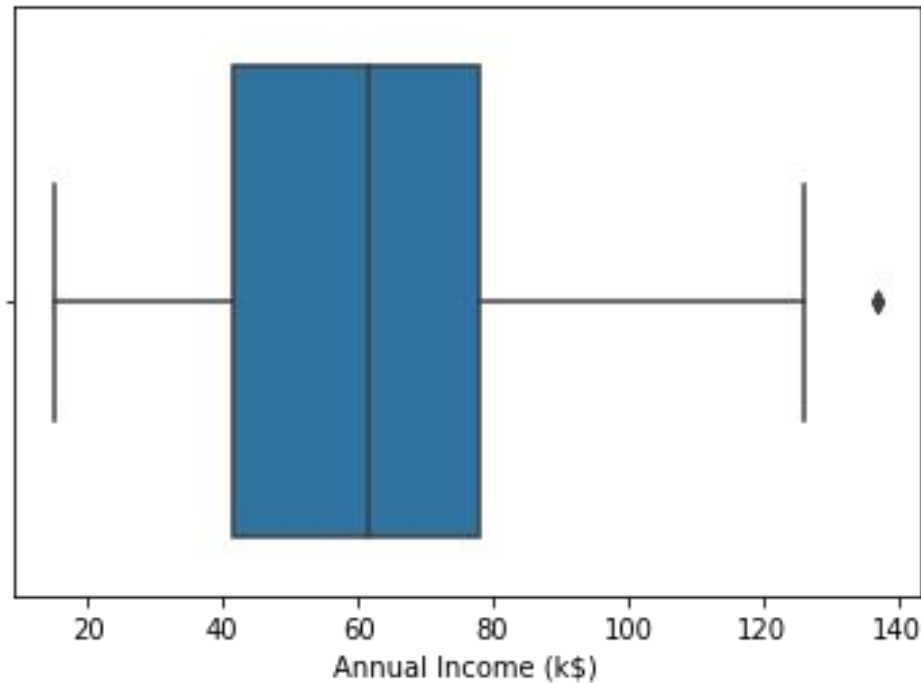
6.12 Solution

```
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>
```



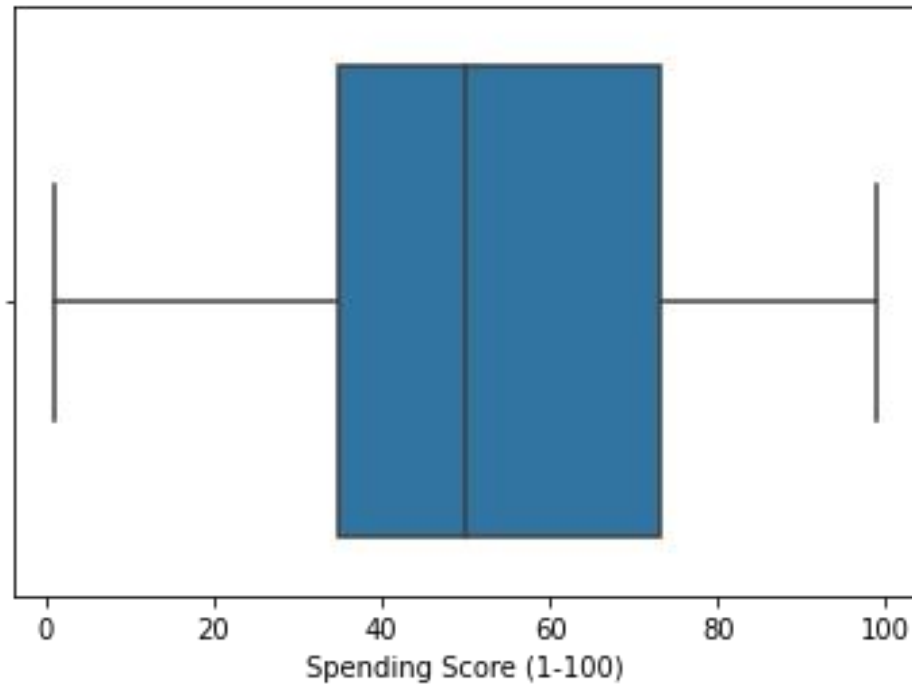
6.13 Solution

```
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],
[-0.89201732, -0.88640526, -0.70690189, -0.78476346, -0.3183368],
[-0.87469659, -0.88640526, -0.56336851, -0.78476346, -0.3183368],
[-0.85737587, -0.88640526, 0.7284319 , -0.70842461, 0.06987881],
[-0.84005514, 1.12815215, -0.41983513, -0.70842461, 0.38045129],
[-0.82273442, -0.88640526, -0.56336851, -0.67025518, 0.14752193],
[-0.80541369, 1.12815215, 1.4460988 , -0.67025518, 0.38045129],
[-0.78809297, -0.88640526, 0.80019859, -0.67025518, -0.20187212],
[-0.77077224, 1.12815215, 0.58489852, -0.67025518, -0.35715836],
[-0.75345152, -0.88640526, 0.87196528, -0.63208575, -0.00776431],
[-0.73613079, 1.12815215, 2.16376569, -0.63208575, -0.16305055],
[-0.71881007, -0.88640526, -0.85043527, -0.55574689, 0.03105725],
[-0.70148935, 1.12815215, 1.01549866, -0.55574689, -0.16305055],
[-0.68416862, 1.12815215, 2.23553238, -0.55574689, 0.22516505],
[-0.6668479 , 1.12815215, -1.42456879, -0.55574689, 0.18634349],
[-0.64952717, -0.88640526, 2.02023231, -0.51757746, 0.06987881],
[-0.63220645, -0.88640526, 1.08726535, -0.51757746, 0.34162973],
[-0.61488572, 1.12815215, 1.73316556, -0.47940803, 0.03105725],
[-0.597565 , 1.12815215, -1.49633548, -0.47940803, 0.34162973],
[-0.58024427, -0.88640526, 0.29783176, -0.47940803, -0.00776431],
[-0.56292355, -0.88640526, 2.091999 , -0.47940803, -0.08540743],
[-0.54560282, 1.12815215, -1.42456879, -0.47940803, 0.34162973],
[-0.5282821 , -0.88640526, -0.49160182, -0.47940803, -0.12422899],
[-0.51096138, 1.12815215, 2.23553238, -0.4412386 , 0.18634349],
[-0.49364065, -0.88640526, 0.58489852, -0.4412386 , -0.3183368],
[-0.47631993, -0.88640526, 1.51786549, -0.40306917, -0.04658587],
[-0.4589992 , -0.88640526, 1.51786549, -0.40306917, 0.22516505],
[-0.44167848, 1.12815215, 1.4460988 , -0.25039146, -0.12422899],

[-0.42435775, 1.12815215, -0.92220196, -0.25039146, 0.14752193],
[-0.40703703, -0.88640526, 0.44136514, -0.25039146, 0.10870037],
[-0.3897163 , 1.12815215, 0.08253169, -0.25039146, -0.08540743],
[-0.37239558, -0.88640526, -1.13750203, -0.25039146, 0.06987881],
[-0.35507485, -0.88640526, 0.7284319 , -0.25039146, -0.3183368],
[-0.33775413, 1.12815215, 1.30256542, -0.25039146, 0.03105725],
[-0.3204334 , 1.12815215, -0.06100169, -0.25039146, 0.18634349],
[-0.30311268, 1.12815215, 2.02023231, -0.25039146, -0.35715836],
[-0.28579196, -0.88640526, 0.51313183, -0.25039146, -0.24069368],
[-0.26847123, -0.88640526, -1.28103541, -0.25039146, 0.26398661],
[-0.25115051, 1.12815215, 0.65666521, -0.25039146, -0.16305055],
[-0.23382978, -0.88640526, 1.15903204, -0.13588317, 0.30280817],
[-0.21650906, -0.88640526, -1.20926872, -0.13588317, 0.18634349],
[-0.19918833, -0.88640526, -0.34806844, -0.09771374, 0.38045129],
[-0.18186761, -0.88640526, 0.80019859, -0.09771374, -0.16305055],
[-0.16454688, -0.88640526, 2.091999 , -0.05954431, 0.18634349],
[-0.14722616, 1.12815215, -1.49633548, -0.05954431, -0.35715836],
[-0.12990543, 1.12815215, 0.65666521, -0.02137488, -0.04658587],
[-0.11258471, -0.88640526, 0.08253169, -0.02137488, -0.39597992],
[-0.09526399, -0.88640526, -0.49160182, -0.02137488, -0.3183368],
[-0.07794326, 1.12815215, -1.06573534, -0.02137488, 0.06987881],
[-0.06062254, -0.88640526, 0.58489852, -0.02137488, -0.12422899],
[-0.04330181, -0.88640526, -0.85043527, -0.02137488, -0.00776431],
[-0.02598109, 1.12815215, 0.65666521, 0.01679455, -0.3183368],
[-0.00866036, 1.12815215, -1.3528021 , 0.01679455, -0.04658587],
[0.00866036, -0.88640526, -1.13750203, 0.05496398, -0.35715836],
[0.02598109, -0.88640526, 0.7284319 , 0.05496398, -0.08540743],
[0.04330181, 1.12815215, 2.02023231, 0.05496398, 0.34162973],
[0.06062254, 1.12815215, -0.92220196, 0.05496398, 0.18634349],
[0.07794326, 1.12815215, 0.7284319 , 0.05496398, 0.22516505],
[0.09526399, -0.88640526, -1.28103541, 0.05496398, -0.3183368],
[0.11258471, -0.88640526, 1.94846562, 0.09313341, -0.00776431],
[0.12990543, 1.12815215, 1.08726535, 0.09313341, -0.16305055],
[0.14722616, 1.12815215, 2.091999 , 0.09313341, -0.27951524],
[0.16454688, 1.12815215, 1.94846562, 0.09313341, -0.08540743],
[0.18186761, 1.12815215, 1.87669894, 0.09313341, 0.06987881],
[0.19918833, -0.88640526, -1.42456879, 0.09313341, 0.14752193],
[0.21650906, -0.88640526, -0.06100169, 0.13130284, -0.3183368],
[0.23382978, 1.12815215, -1.42456879, 0.13130284, -0.16305055],
[0.25115051, -0.88640526, -1.49633548, 0.16947227, -0.08540743],
[0.26847123, -0.88640526, -1.42456879, 0.16947227, -0.00776431],
[0.28579196, -0.88640526, 1.73316556, 0.16947227, -0.27951524],
[0.30311268, -0.88640526, 0.7284319 , 0.16947227, 0.34162973],
[0.3204334 , -0.88640526, 0.87196528, 0.24581112, -0.27951524],
[0.33775413, -0.88640526, 0.80019859, 0.24581112, 0.26398661],
[0.35507485, 1.12815215, -0.85043527, 0.24581112, 0.22516505],
[0.37239558, -0.88640526, -0.06100169, 0.24581112, -0.39597992],
[0.3897163 , -0.88640526, 0.08253169, 0.32214998, 0.30280817],
[0.40703703, 1.12815215, 0.010765 , 0.32214998, 1.58391968],
[0.42435775, -0.88640526, -1.13750203, 0.36031941, -0.82301709],

[0.44167848, -0.88640526, -0.56336851, 0.36031941, 1.04041783],
[0.4589992 , 1.12815215, 0.29783176, 0.39848884, -0.59008772],
[0.47631993, 1.12815215, 0.08253169, 0.39848884, 1.73920592],
[0.49364065, 1.12815215, 1.4460988 , 0.39848884, -1.52180518],
[0.51096138, 1.12815215, -0.06100169, 0.39848884, 0.96277471],
[0.5282821 , 1.12815215, 0.58489852, 0.39848884, -1.5994483],
[0.54560282, 1.12815215, 0.010765 , 0.39848884, 0.96277471],
[0.56292355, -0.88640526, -0.99396865, 0.43665827, -0.62890928],
[0.58024427, -0.88640526, -0.56336851, 0.43665827, 0.80748846],
[0.597565 , 1.12815215, -1.3528021 , 0.4748277 , -1.75473454],
[0.61488572, -0.88640526, -0.70690189, 0.4748277 , 1.46745499],
[0.63220645, -0.88640526, 0.36959845, 0.4748277 , -1.67709142],
[0.64952717, 1.12815215, -0.49160182, 0.4748277 , 0.88513158],
[0.6668479 , 1.12815215, -1.42456879, 0.51299713, -1.56062674],
[0.68416862, -0.88640526, -0.27630176, 0.51299713, 0.84631002],
[0.70148935, -0.88640526, 1.30256542, 0.55116656, -1.75473454],
[0.71881007, 1.12815215, -0.49160182, 0.55116656, 1.6615628],
[0.73613079, -0.88640526, -0.77866858, 0.58933599, -0.39597992],
[0.75345152, -0.88640526, -0.49160182, 0.58933599, 1.42863343],
[0.77077224, 1.12815215, -0.99396865, 0.62750542, -1.48298362],
[0.78809297, 1.12815215, -0.77866858, 0.62750542, 1.81684904],
[0.80541369, 1.12815215, 0.65666521, 0.62750542, -0.55126616],
[0.82273442, -0.88640526, -0.49160182, 0.62750542, 0.92395314],
[0.84005514, -0.88640526, -0.34806844, 0.66567484, -1.09476801],
[0.85737587, 1.12815215, -0.34806844, 0.66567484, 1.54509812],
[0.87469659, 1.12815215, 0.29783176, 0.66567484, -1.28887582],
[0.89201732, 1.12815215, 0.010765 , 0.66567484, 1.46745499],
[0.90933804, -0.88640526, 0.36959845, 0.66567484, -1.17241113],
[0.92665877, -0.88640526, -0.06100169, 0.66567484, 1.00159627],
[0.94397949, -0.88640526, 0.58489852, 0.66567484, -1.32769738],
[0.96130021, -0.88640526, -0.85043527, 0.66567484, 1.50627656],
[0.97862094, 1.12815215, -0.13276838, 0.66567484, -1.91002079],
[0.99594166, -0.88640526, -0.6351352 , 0.66567484, 1.07923939],
[1.01326239, 1.12815215, -0.34806844, 0.66567484, -1.91002079],
[1.03058311, -0.88640526, -0.6351352 , 0.66567484, 0.88513158],
[1.04790384, -0.88640526, 1.23079873, 0.70384427, -0.59008772],
[1.06522456, -0.88640526, -0.70690189, 0.70384427, 1.27334719],
[1.08254529, 1.12815215, -1.42456879, 0.78018313, -1.75473454],
[1.09986601, -0.88640526, -0.56336851, 0.78018313, 1.6615628],
[1.11718674, 1.12815215, 0.80019859, 0.93286085, -0.93948177],
[1.13450746, -0.88640526, -0.20453507, 0.93286085, 0.96277471],
[1.15182818, 1.12815215, 0.22606507, 0.97103028, -1.17241113],
[1.16914891, -0.88640526, -0.41983513, 0.97103028, 1.73920592],
[1.18646963, -0.88640526, -0.20453507, 1.00919971, -0.90066021],
[1.20379036, 1.12815215, -0.49160182, 1.00919971, 0.49691598],
[1.22111108, 1.12815215, 0.08253169, 1.00919971, -1.44416206],
[1.23843181, 1.12815215, -0.77866858, 1.00919971, 0.96277471],
[1.25575253, 1.12815215, -0.20453507, 1.00919971, -1.56062674],
[1.27307326, 1.12815215, -0.20453507, 1.00919971, 1.62274124],
[1.29039398, -0.88640526, 0.94373197, 1.04736914, -1.44416206],


```
[ 1.30771471, -0.88640526, -0.6351352 , 1.04736914, 1.38981187],
[ 1.32503543, 1.12815215, 1.37433211, 1.04736914, -1.36651894],
[ 1.34235616, 1.12815215, -0.85043527, 1.04736914, 0.72984534],
[ 1.35967688, 1.12815215, 1.4460988 , 1.23821628, -1.4053405 ],
[ 1.3769976 , 1.12815215, -0.27630176, 1.23821628, 1.54509812],
[ 1.39431833, -0.88640526, -0.13276838, 1.390894 , -0.7065524 ],
[ 1.41163905, -0.88640526, -0.49160182, 1.390894 , 1.38981187],
[ 1.42895978, 1.12815215, 0.51313183, 1.42906343, -1.36651894],
[ 1.4462805 , -0.88640526, -0.70690189, 1.42906343, 1.46745499],
[ 1.46360123, -0.88640526, 0.15429838, 1.46723286, -0.43480148],
[ 1.48092195, 1.12815215, -0.6351352 , 1.46723286, 1.81684904],
[ 1.49824268, -0.88640526, 1.08726535, 1.54357172, -1.01712489],
[ 1.5155634 , 1.12815215, -0.77866858, 1.54357172, 0.69102378],
[ 1.53288413, -0.88640526, 0.15429838, 1.61991057, -1.28887582],
[ 1.55020485, -0.88640526, -0.20453507, 1.61991057, 1.35099031],
[ 1.56752558, -0.88640526, -0.34806844, 1.61991057, -1.05594645],
[ 1.5848463 , -0.88640526, -0.49160182, 1.61991057, 0.72984534],
[ 1.60216702, 1.12815215, -0.41983513, 2.00160487, -1.63826986],
[ 1.61948775, -0.88640526, -0.06100169, 2.00160487, 1.58391968],
[ 1.63680847, -0.88640526, 0.58489852, 2.26879087, -1.32769738],
[ 1.6541292 , -0.88640526, -0.27630176, 2.26879087, 1.11806095],
[ 1.67144992, -0.88640526, 0.44136514, 2.49780745, -0.86183865],
[ 1.68877065, 1.12815215, -0.49160182, 2.49780745, 0.92395314],
[ 1.70609137, 1.12815215, -0.49160182, 2.91767117, -1.25005425],
[ 1.7234121 , 1.12815215, -0.6351352 , 2.91767117, 1.27334719]])
```

Question 9:

9 . Perform any of the clustering algorithms

9.1 Solution

```
from sklearn.cluster import KMeans

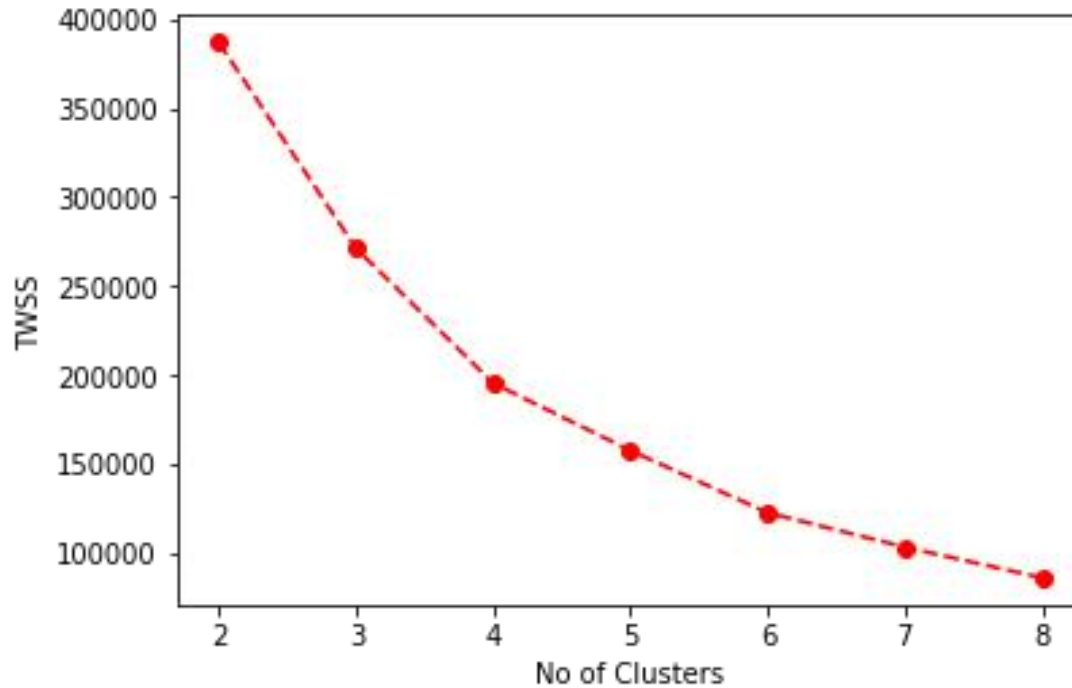
TWSS = []
k = list(range(2,9))
for i in k:
    kmeans=KMeans(n_clusters=i, init='k-means++')
    kmeans.fit(db)
    TWSS.append(kmeans.inertia_)
TWSS

[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
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

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

[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	
2	3	0	20	16	6	
3	4	0	23	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

```
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]])
```