Assignment-4
Python
Programming

Assignment Date	22 October 2022
Student Name	B.Jawahar Ashwanth
Student Roll Number	921319205301
Maximum Marks	2 Marks

In [1]:
```
importpandasaspdimportnump
yasnpimportmatplotlib.pyplo
taspltimportseabornassns
```

Loading the dataset

In [ ]:
```
df=pd.read_csv('Mall_Customers.csv')d
f
```

Out[ ]:

	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 × 5 columns

Encoding Categorical Columns

In [ ]:
```
fromsklearn.preprocessingimportLabelEncoderle=La
belEncoder()df['Gender']=le.fit_transform(d
f['Gender'])
```

In [ ]:
```
df
```

Out[ ]:

	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

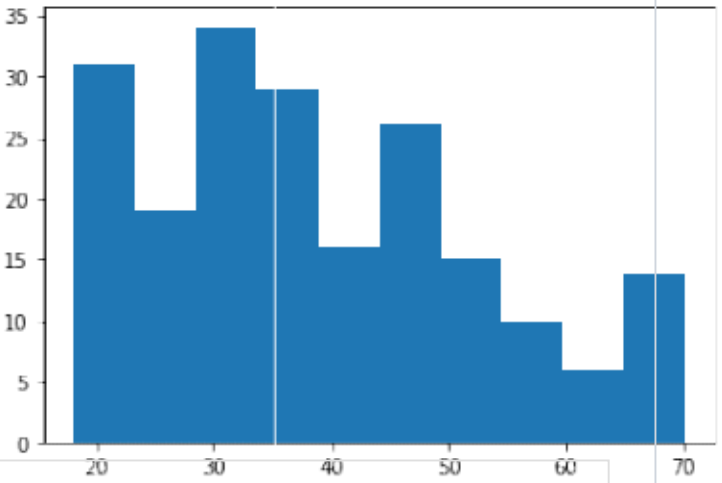
200 rows × 5 columns

Visualizations

Univariate Analysis

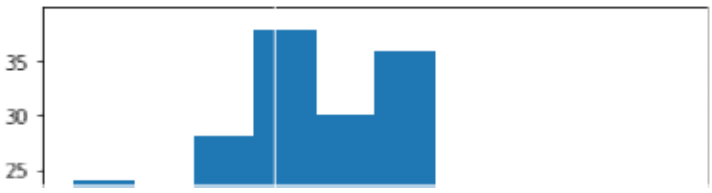
In [ ]:
```
plt.hist(df['Age'])
```

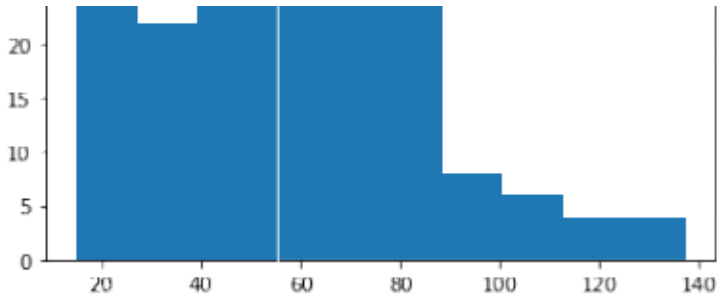
Out[ ]:
```
(array([31.,19.,34.,29.,16.,26.,15.,
        10., 6.,
        14.]),
 array([18. , 23.2, 28.4, 33.6, 38.8, 44. ,
 49.2, 54.4, 59.6, 64.8, 70. ]),
 <a list of 10 Patch objects>)
```



In [ ]:
```
plt.hist(df['AnnualIncome(k$)'])
```

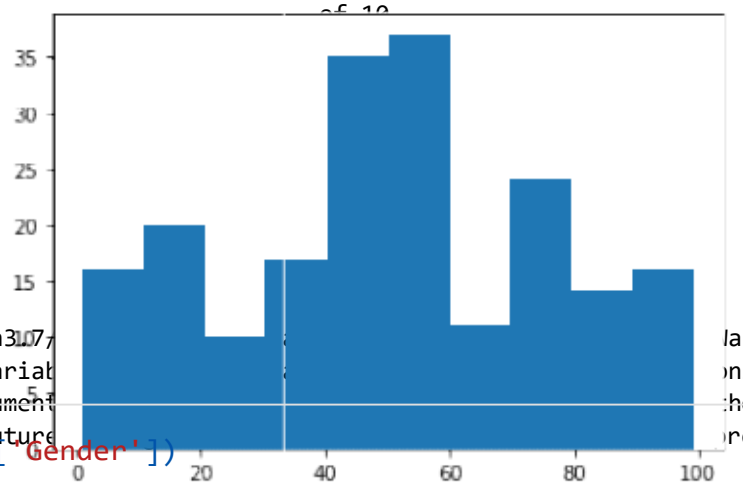
Out[ ]:
```
(array([24., 22., 28., 38., 30., 36., 8., 6., 4., 4.]),
    array([ 15. , 27.2, 39.4, 51.6, 63.8, 76. , 88.2, 100.4, 112.6,
       124.8, 137. ]),
 <a list of 10 Patch objects>)
```





In [ ]:
```
plt.hist(df['SpendingScore
(1-100)'])
```

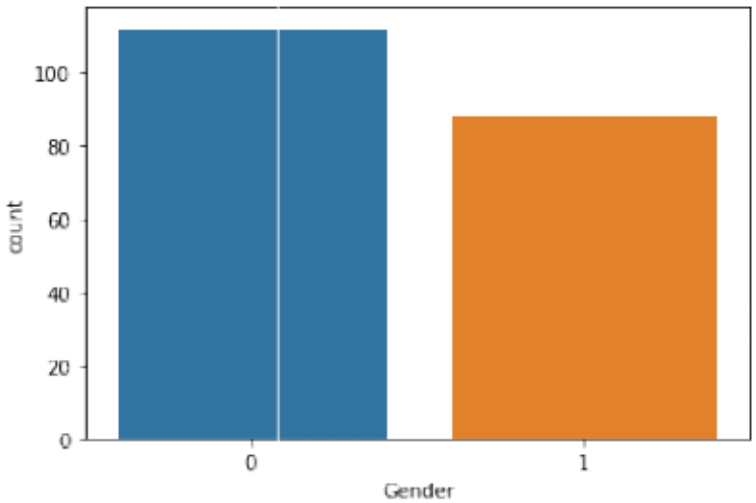
Out[ ]:
```
(array([16 89.2, 99. ]),
., 20.,
10., 17.,
35., 37.,
11., 24.,
14.,
16.]),
 array([
 1. ,
 10.8,
 20.6,
 30.4,
 40.2, 50.
 , 59.8,
 69.6,
 79.4,
 <a list
```



In [ ]:
```
sns.countplot(df['Gender'])
```

```
/usr/local/lib/python3.7/                                    /arnin g:
Pass the following variab                                    only
valid positional argument                                    thout a
n explicit keyword.Future                                    retation.
```

Out[ ]:
```
<matplotlib.axes._subplots.AxesSubplot at
0x7fdb93a2d490>
```



Bi-Variate Analysis

In [ ]:
```
sns.scatterplot(df['AnnualIncome(k$)'],df['SpendingScore(1-100)'])
```

Out[ ]:
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarnin g: Pass the following variables as keyword args: x, y. From version 0.12, the o nly valid positional argument will be `data`, and passing other arguments witho ut an explicit keyword will result in an error or misinterpretation.
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fdb93a1f1d0>
```

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

Out[ ]:
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarnin g: Pass the following variables as keyword args: x, y. From version 0.12, the o nly valid positional argument will be `data`, and passing other arguments witho ut an explicit keyword will result in an error or misinterpretation.
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7fdb93931b90>
```

In [ ]:
```
sns.heatmap(df.corr(),annot=True)
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fdb9390e4d0>
```

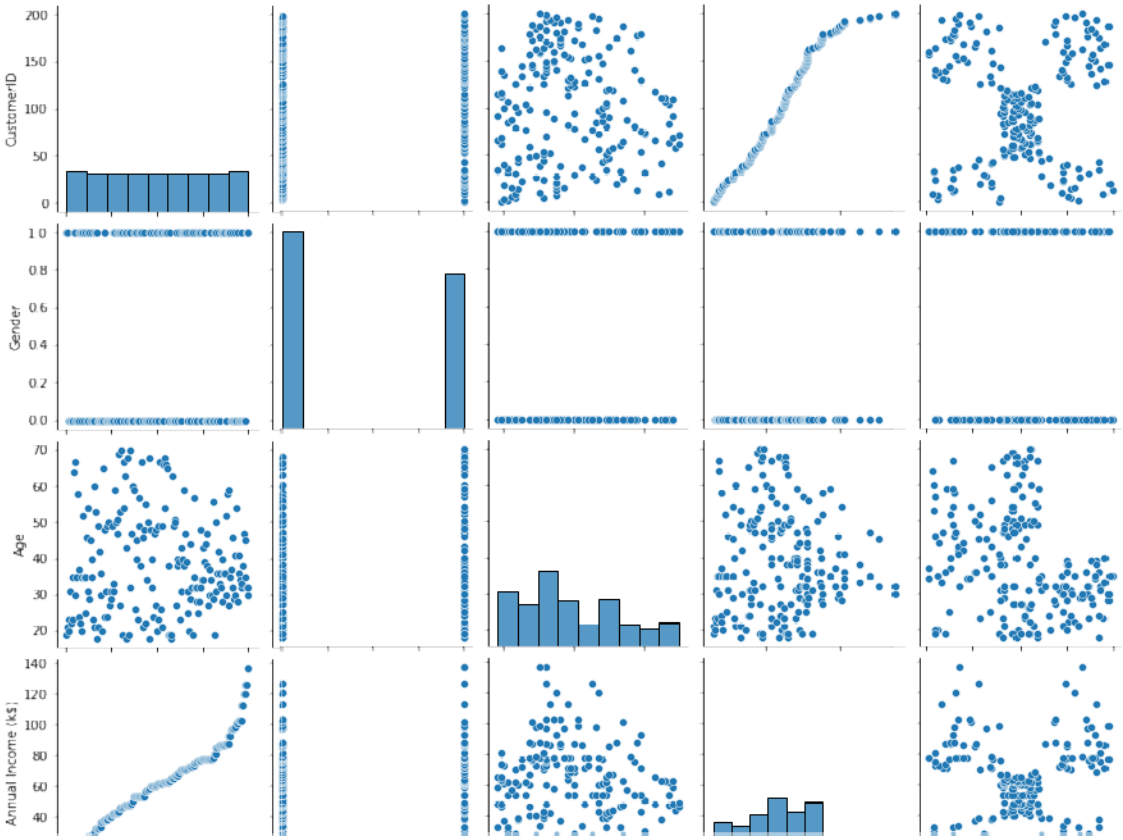
Multi-variate Analysis

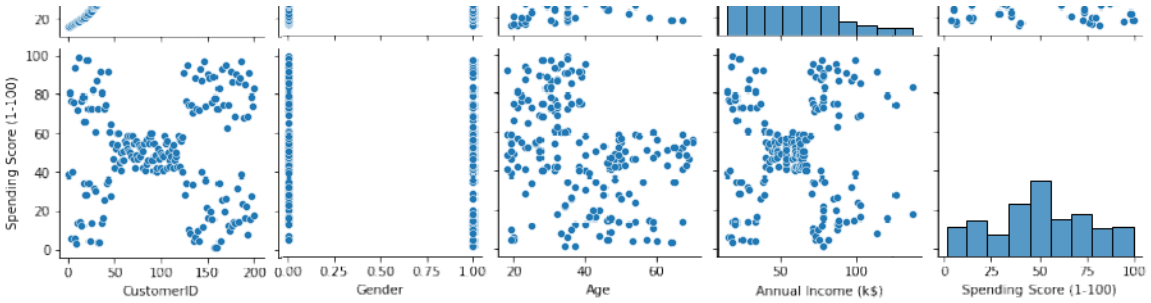
In [ ]:

```
sns.pairplot(df)
```

Out[ ]:

```
<seaborn.axisgrid.PairGrid at 0x7fdb91011e50>
```


CustomerID
Gender
Age
Annual Income (k$)



In [ ]:

Descriptive Statistics

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              200 non-null    int64
 1   Gender                  200 non-null    int64
 2   Age                     200 non-null    int64
 3   Annual Income (k$)      200 non-null    int64
 4   Spending Score (1-100)  200 non-null    int64
dtypes: int64(5)
memory usage: 7.9 KB
```

In [ ]:
```
df.describe()
```

Out[ ]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000	200.000000
mean	100.500000	0.440000	38.850000	60.560000	50.200000
std	57.879185	0.497633	13.969007	26.264721	25.823522
min	1.000000	0.000000	18.000000	15.000000	1.000000
25%	50.750000	0.000000	28.750000	41.500000	34.750000
50%	100.500000	0.000000	36.000000	61.500000	50.000000
75%	150.250000	1.000000	49.000000	78.000000	73.000000
max	200.000000	1.000000	70.000000	137.000000	99.000000

In [ ]:
```
df.skew()
```

Out[ ]:
```
CustomerID              0.000000
Gender                  0.243578
Age                     0.485569
AnnualIncome(k$)        0.321843
```

```
Spending Score (1-100)    -
0.047220 dtype: float64
```

In [ ]:
```
df.kurt()
```

Out[ ]:
```
                                                    Spending Score
                                                    (1-100)                    -
                                                    0.826629 dtype:
                                                    float64
```

In [ ]:
```
df.corr()
```

```
CustomerID              -1.200000
Gender                  -1.960375
Age                     -0.671573
Annual Income (k$)      -0.098487
```

Out[ ]:

	CustomerID	Gender	Age	AnnualIncome (k$)	Spending Score (1-100)
CustomerID	1.000000	0.057400	-0.026763	0.977548	0.013835
Gender	0.057400	1.000000	0.060867	0.056410	-0.058109
Age	-0.026763	0.060867	1.000000	-0.012398	-0.327227
AnnualIncome(k$)	0.977548	0.056410	-0.012398	1.000000	0.009903
Spending Score (1-100)	0.013835	-0.058109	0.327227	0.009903	1.000000

In [ ]:
```
df.var()
```

Out[ ]:
```
CustomerID                 3350.000000
Gender                        0.247638
Age                         195.133166
Annual Income (k$)          689.835578
Spending Score (1-100)      666.854271
dtype: float64
```

In [ ]:
```
df.std()
```

Out[ ]:
```
CustomerID                 57.879185
Gender                      0.497633
Age                        13.969007
Annual Income(k$)          26.264721
Spending Score (1-
100)dtype:float64          25.823522
```

Checking for missing values

In [ ]:
```
df.isna().sum()
```

Out[ ]:

CustomerID	0

```
Gender                  0
Age                     0
```

```
Spending Score (1-100)     0
```

```
dtype: int64
```

In [ ]:
```
df.isna().sum().sum()
```

Out[ ]:
```
0
```

In [ ]:
```
df.duplicated().sum()
```

Out[ ]:
```
0
```

Finding & HandlingOuliers

In [ ]:
```
quantile=df.quantile(q=[0.25,0.75])qu
antile
```

Out[ ]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0.25	50.75	0.0	28.75	41.5	34.75
0.75	150.25	1.0	49.00	78.0	73.00

In [ ]:
```
IQR=quantile.iloc[1]-
quantile.iloc[0]IQR
```

Out[ ]:
```
CustomerID              99.50
Gender
1.00
Age                     20.25
Annual Income (k$)      36.50
Spending Score (1-100)  38.25
dtype: float64
```

In [ ]:
```
upper=quantile.iloc[1]+(1.5*IQR
)upper
```

Out[ ]:
```
CustomerID           299.500
Gender                 2.500
Age                   79.375
Annual Income (k$)   132.750
Spending Score (1-
100)                 130.375
dtype: float64
```

In [ ]:
```
lower=quantile.iloc[0]-
(1.5*IQR)lower
```

Out[ ]:
```
CustomerID      -98.500
Gender           -1.500
Age              -1.625
Annual   Income (k$)   -13.250
SpendingScore   (1-100)-22.625
dtype:float64
```

In [ ]:
```
df.mean()
```

Out[ ]:
```
CustomerID              100.50
Gender                    0.44
Age                      38.85
Annual Income (k$)       60.56
Spending Score (1-100)   50.20
dtype: float64
```

In [ ]:
```
df['AnnualIncome(k$)'].max
()
```

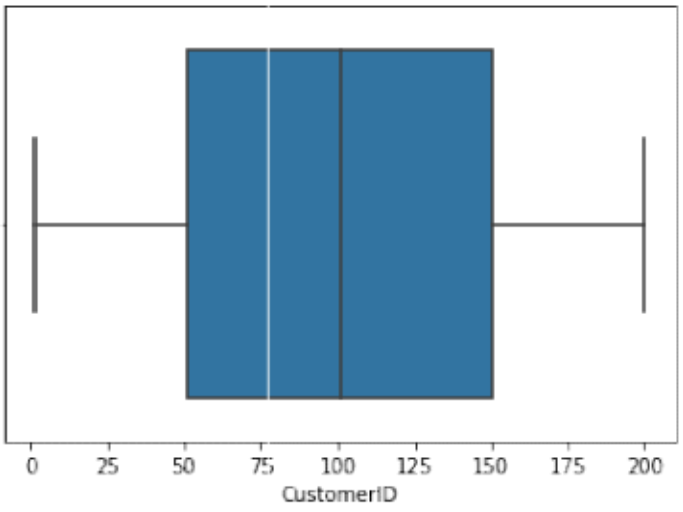
Out[ ]:
```
137
```

In [ ]:
```
sns.boxplot(df['CustomerID
'])
```

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

n explicit keyword FutureWarning     will result in an error or misinterpretation.
```

Out[ ]:
```
<matplotlib.axes._su
bplots.AxesSubplot
at 0x7fdb904c1290>
```



In [ ]:
```
sns.boxplot(df['Gender'])
```

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

```
n explicit keyword FutureWarning     will result
in an error or misinterpretation.
```

Out[ ]:

```
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ib.
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s._
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ts.
Axe
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at
0x7
fdb
8eb
ea2
50>
```
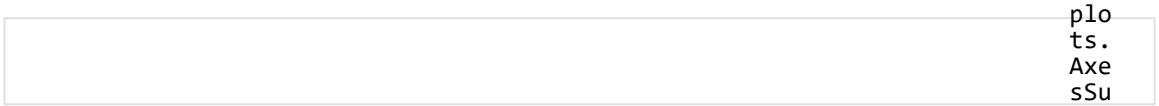
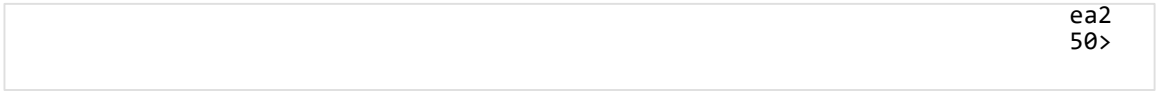
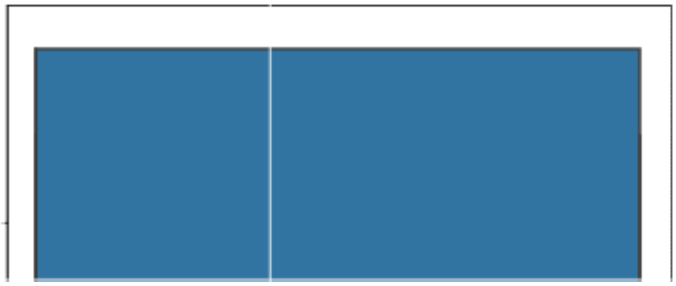
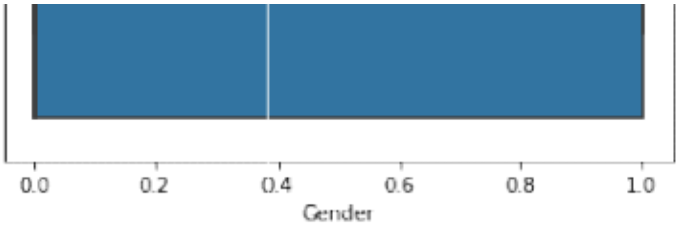









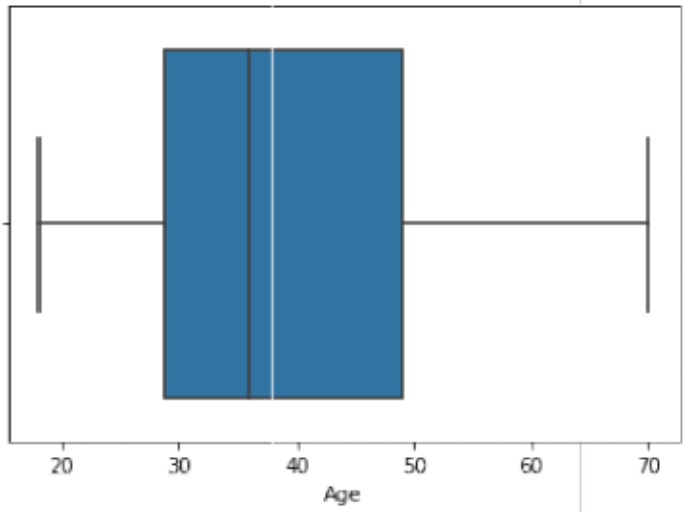
In [ ]:
```
sns.boxplot(df['Age'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarnin g: 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 a n explicit keyword FutureWarning     will result in an error or misinterpretation.
```

Out[ ]:
```
<ma
tpl
otl
ib.
axe
s._
sub
plo
ts.
Axe
sSu
bpl
ot
at
0x7
fdb
93b
3ee
50>
```

In [ ]:

Out[]:

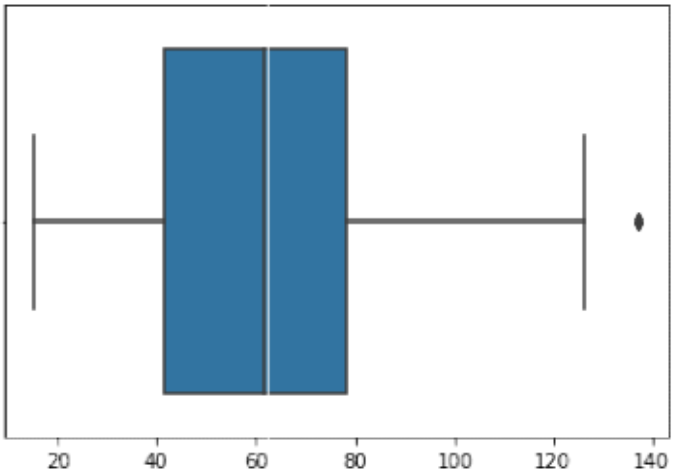



```
sns.boxplot(df['AnnualIncome(k$)'])
```

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

n explicit keyword FutureWarning will result in an error or misinterpretation.

<matplotlib.axes._subplots.AxesSubplot at 0x7fdb8eb28450>


20
40
60
80
100
120
140

Annual Income (k$)

In [ ]:
```
df['AnnualIncome(k$)']=np.where(df['AnnualIncome(k$)']>132.750,60.55,
```

In [ ]:
```
sns.boxplot(df['AnnualIncome(k$)'])
```

Out[ ]:
```
/usr/local/lib/python3.7/dist-
packages/seaborn/_decorators.py:43:
FutureWarnin g: 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
a
n explicit keyword FutureWarning     will result
in an error or misinterpretation.

<ma
tpl
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ib.
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Axe
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ot
at
0x7
fdb
8eb
18e
90>
```
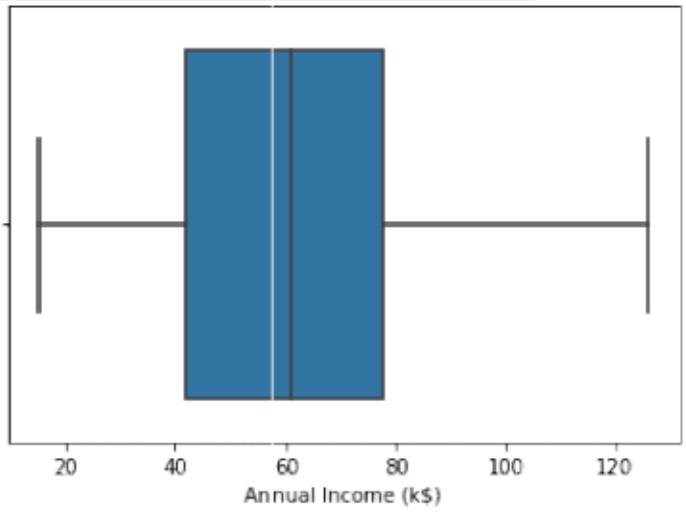



In [ ]:
```
df['AnnualIncome(k$)'].max()
```

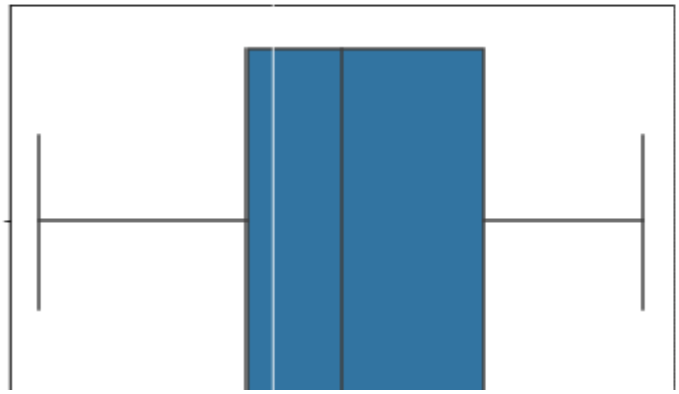
Out[ ]:
```
1
2
6
.
0
```

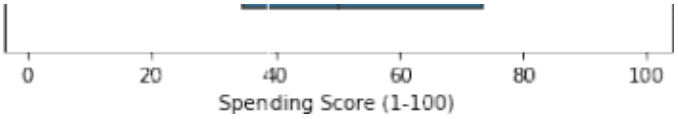
In [ ]:
```
sns.boxplot(df['SpendingScore(1-100)'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarnin g: 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 a n explicit keyword FutureWarning will result in an error or misinterpretation.
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fdb8ea8fc10>
```





Scaling the data

In [ ]:
```
fromsklearn.preprocessingimportStandardScal
erss=StandardScaler().fit_transform(df)s
s
```

Out[ ]:
```
array([[-1.7234121,  1.12815215,  -1.42456879, -1.78843062,-0.43480148],
[-1.70609137,       1.12815215,  -1.28103541, -1.78843062,1.19570407],
[-1.68877065,       -0.88640526, -1.3528021,  -1.74850629,-1.71591298],
[-1.67144992,       -0.88640526, -1.13750203, -1.74850629,1.04041783],
[-1.6541292,        -0.88640526, -0.56336851, -1.70858195,-0.39597992],
[-1.63680847,       -0.88640526, -1.20926872, -1.70858195,1.00159627],
[-1.61948775,       -0.88640526, -0.27630176, -1.66865761,-1.71591298],
[-1.60216702,       -0.88640526, -1.13750203, -1.66865761,1.70038436],
[-1.5848463,        1.12815215,  1.80493225,  -1.62873328,-1.83237767],
[-1.56752558,       -0.88640526, -0.6351352,  -1.62873328,0.84631002],
[-1.55020485,       1.12815215,  2.02023231,  -1.62873328,-1.4053405],
[-1.53288413,       -0.88640526, -0.27630176, -1.62873328,1.89449216],
[-1.5155634,        -0.88640526, 1.37433211,  -1.58880894,-1.36651894],
[-1.49824268,       -0.88640526, -1.06573534, -1.58880894,1.04041783],
[-1.48092195,       1.12815215,  -0.13276838, -1.58880894,-1.44416206],
[-1.46360123,       1.12815215,  -1.20926872, -1.58880894,1.11806095],
[-1.4462805,        -0.88640526, -0.27630176, -1.5488846,-0.59008772],
[-1.42895978,       1.12815215,  -1.3528021,  -1.5488846,0.61338066],
[-1.41163905,       1.12815215,  0.94373197,  -1.46903593,-0.82301709],
[-1.39431833,       -0.88640526, -0.27630176, -1.46903593,1.8556706],
[-1.3769976,        1.12815215,  -0.27630176, -1.42911159,-0.59008772],
[-1.35967688,       1.12815215,  -0.99396865, -1.42911159,0.88513158],
[-1.34235616,       -0.88640526, 0.51313183,  -1.38918726,-1.75473454],
[-1.32503543,       1.12815215,  -0.56336851, -1.38918726,0.88513158],
[-1.30771471,       -0.88640526, 1.08726535,  -1.26941425,-1.4053405],
[-1.29039398,       1.12815215,  -0.70690189, -1.26941425,1.23452563],
[-1.27307326,       -0.88640526, 0.44136514,  -1.26941425,-0.7065524],
[-1.25575253,       1.12815215,  -0.27630176, -1.26941425,0.41927286],
[-1.23843181,       -0.88640526, 0.08253169,  -1.22948991,-0.74537397],
[-1.22111108,       -0.88640526, -1.13750203, -1.22948991,1.42863343],
[-1.20379036,       1.12815215,  1.51786549,  -1.18956557,-1.7935561],
[-1.18646963,       -0.88640526, -1.28103541, -1.18956557,0.88513158],
[-1.16914891,       1.12815215,  1.01549866,  -1.06979256,-1.7935561],
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```

Clustering Algorithm

In [ ]:
```
fromsklearn.clusterimportKMeansTWSS=[
]
k=list(range(2,9))

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

In [ ]:
```
TWSS
```

Out[ ]:
```
[
3
8
1
5
0
7
.
6
4
7
3
```

In [ ]:

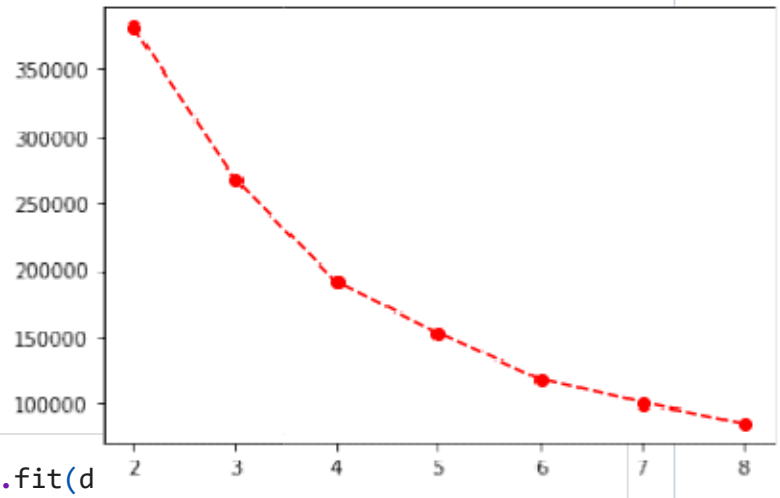
```
8
5
2
3
8
5
5
,
2
6
8
0
6
2
.
5
5
4
3
3
7
4
7
4
1
7
,
1
9
1
5
5
0
.
0
8
6
2
7
6
7
0
9
4
2
,
1
5
3
5
3
0
.
6
8
9
5
6
2
4
9
5
0
7
,
1
1
```

```
9
1
6
6
.
1
5
7
2
7
6
4
3
9
2
8
,
1
0
1
3
2
1
.
0
1
6
6
4
2
7
4
2
9
,
8
5
7
4
4
.
9
0
1
3
9
2
2
1
8
9
2
]
```

```
plt.plot(k,TWSS,'ro--')
```

Out[ ]:

```
[<matplotlib.lines.Line2D at 0x7fdb8d642b90>]
```



In [ ]:

```
model=KMeans(n_clusters=4)model.fit(df)
```

Out[ ]:

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

In [ ]:

```
mb=pd.Series(model.labels_)
```

In [ ]:

```
df['Cluster']=mb
```

In [ ]:

```
df
```

Out[ ]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)	Cluster
0	1	1	19	15.00	39	0
1	2	1	21	15.00	81	0
2	3	0	20	16.00	6	0
3	4	0	23	16.00	77	0
4	5	0	31	17.00	40	0
...	...	...	...	...	...	...
195	196	0	35	120.00	79	1
196	197	0	45	126.00	28	3
197	198	1	32	126.00	74	1
198	199	1	32	60.55	18	3
199	200	1	30	60.55	83	1

200 rows × 6 columns