```
import pandas as pd
import numpy as np
```

```
df=pd.read_csv('Mall_Customers.csv')
df.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
```

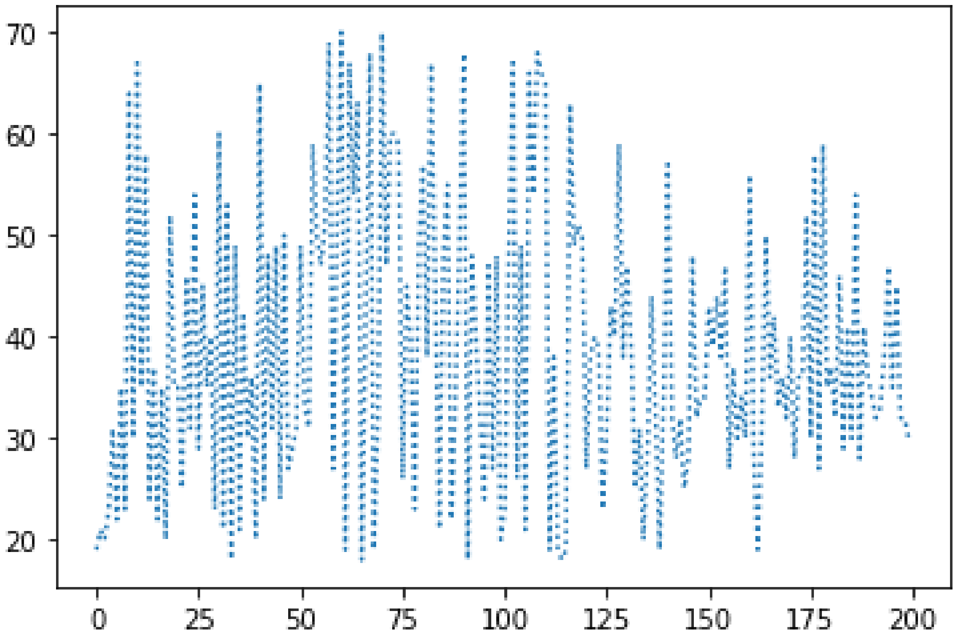
```
#univariate analysis
```

```
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
plt.plot(df['Annual Income (k$)'])
plt.show()
```

```
data=np.array(df['Age'])
plt.plot(data,linestyle = 'dotted')
```

```
[<matplotlib.lines.Line2D at 0x208915ef430>]
```

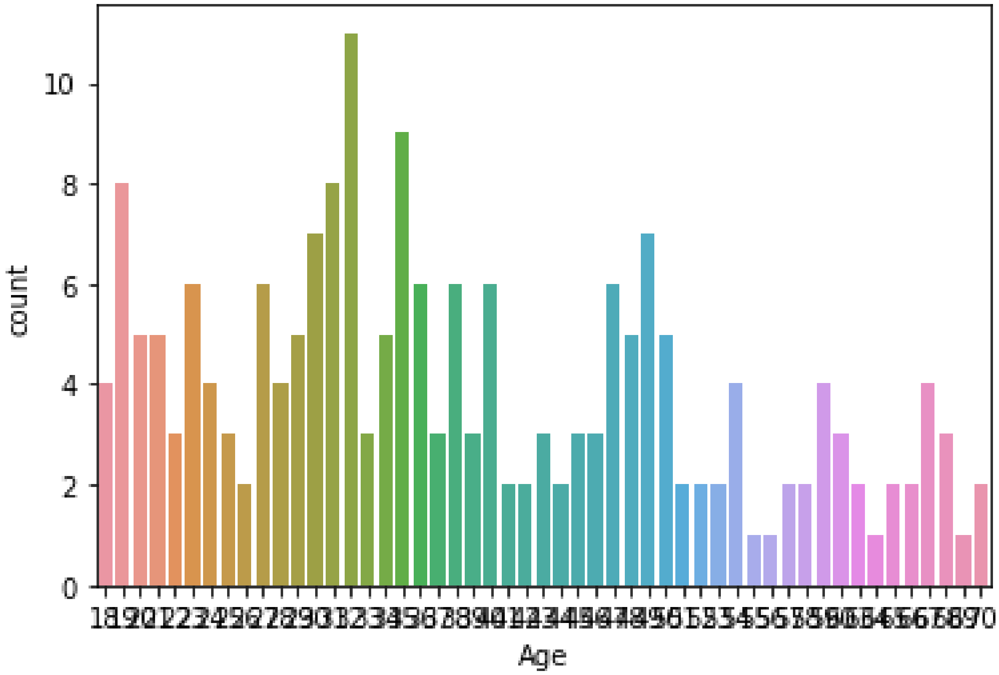


```
sns.countplot(df['Age'])
```

```
C:\Users\91948\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
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
```

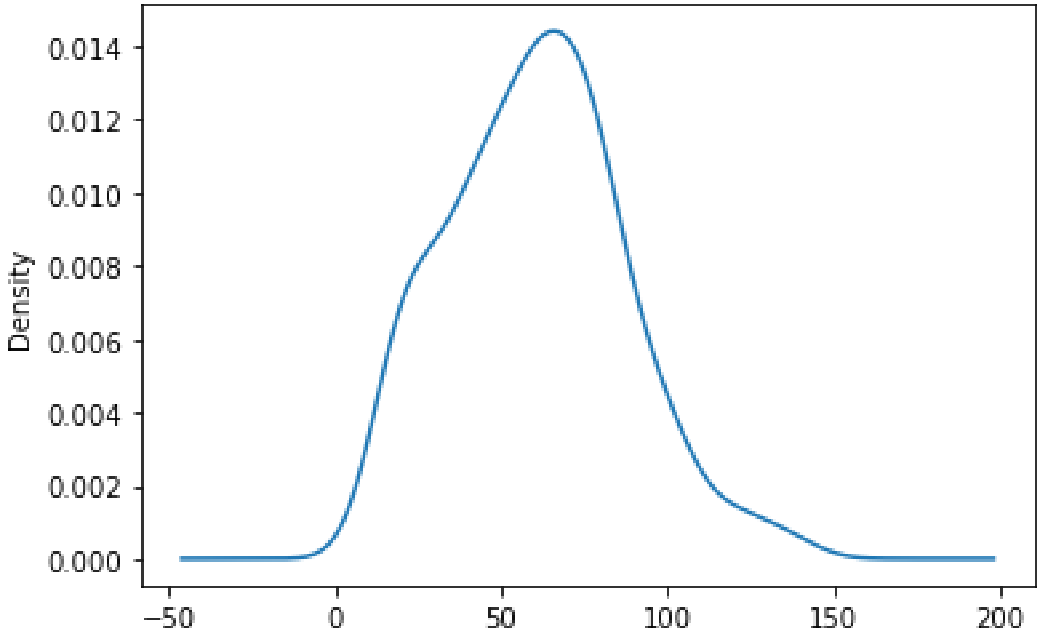
```
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

```
<AxesSubplot:xlabel='Age', ylabel='count'>
```



```
df['Annual Income (k$)'].plot(kind='density')
```

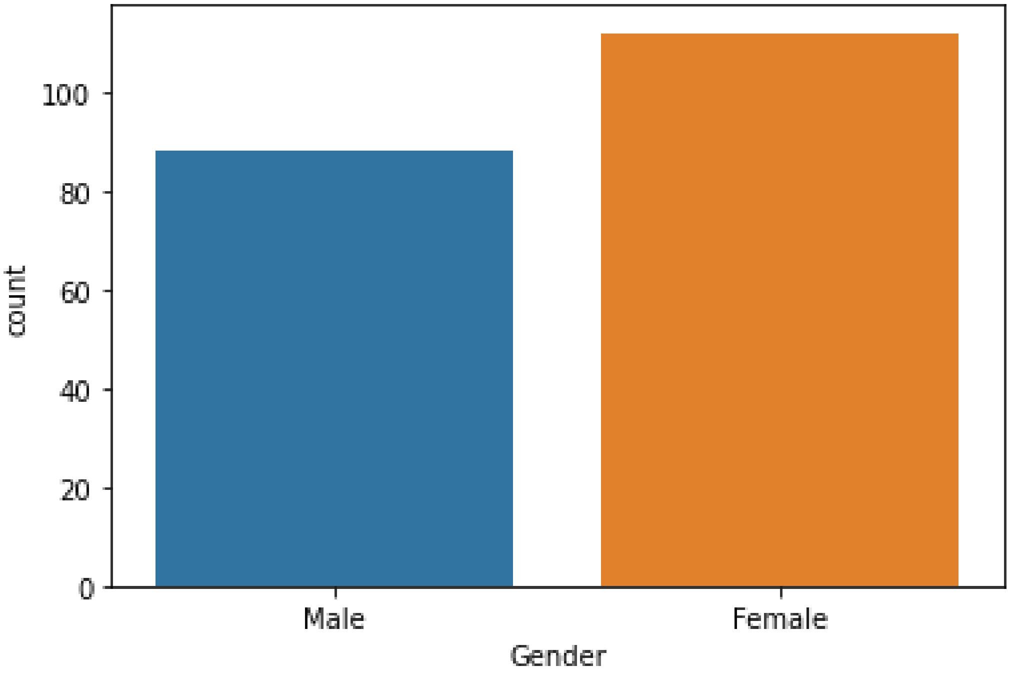
```
<AxesSubplot:ylabel='Density'>
```



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

```
C:\Users\91948\anaconda3\lib\site-packages\seaborn\_decorators.py:36: 
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.
  warnings.warn(
```

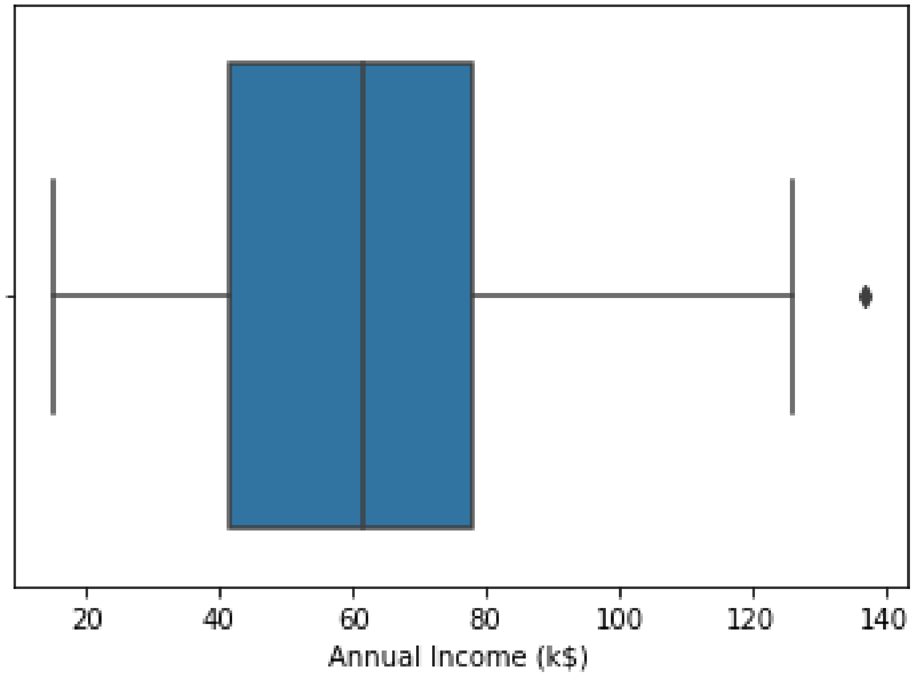
```
<AxesSubplot:xlabel='Gender', ylabel='count'>
```



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

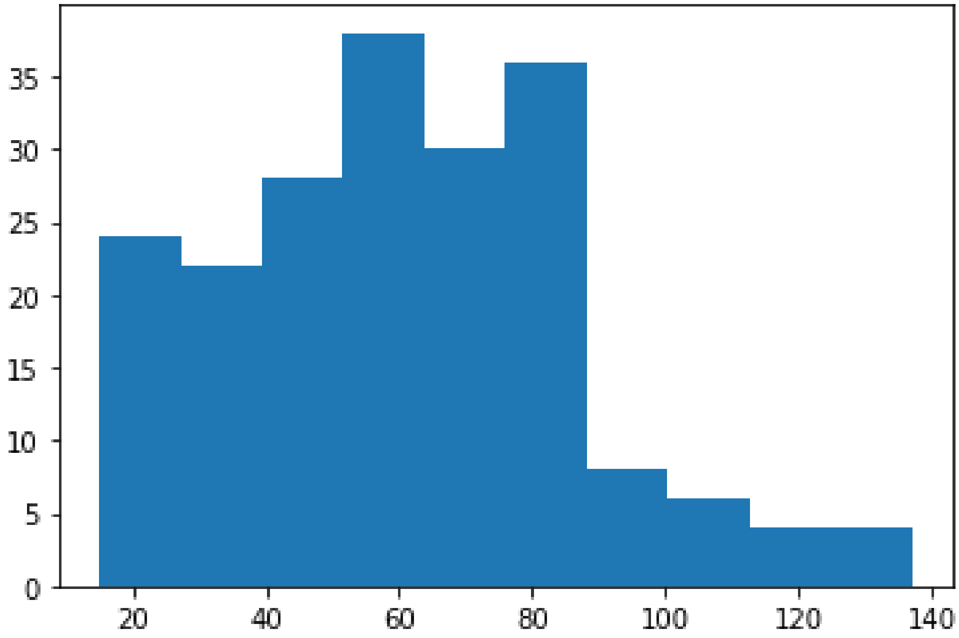
```
C:\Users\91948\anaconda3\lib\site-packages\seaborn\_decorators.py:36: 
FutureWarning: Pass the following variable as a keyword arg: x. From version 
0.12, the only valid positional argument will be `data`, and passing other 
arguments without an explicit keyword will result in an error or 
misinterpretation.
  warnings.warn(
```

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```



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

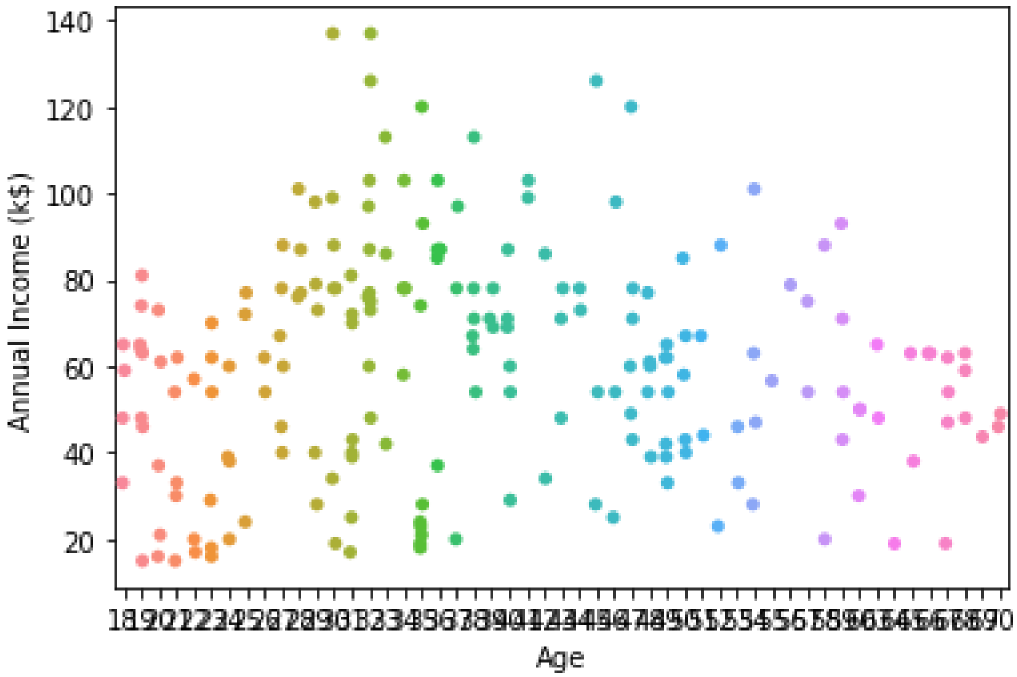
```
(array([24., 22., 28., 38., 30., 36.,  8.,  6.,  4.,  4.]),
 array([ 15. ,  27.2,  39.4,  51.6,  63.8,  76. ,  88.2, 100.4, 112.6,
        124.8, 137. ]),
 <BarContainer object of 10 artists>)
```



```
#Bivariate Analysis
```

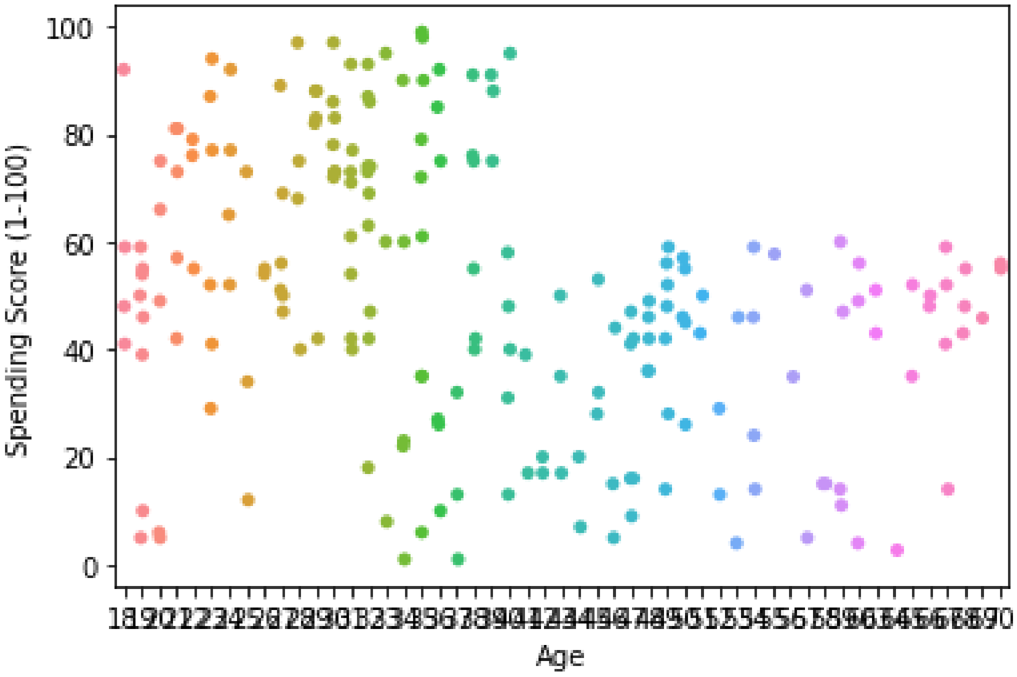
```
sns.stripplot(x=df['Age'],y=df['Annual Income (k$)'])
```

```
<AxesSubplot:xlabel='Age', ylabel='Annual Income (k$)'>
```



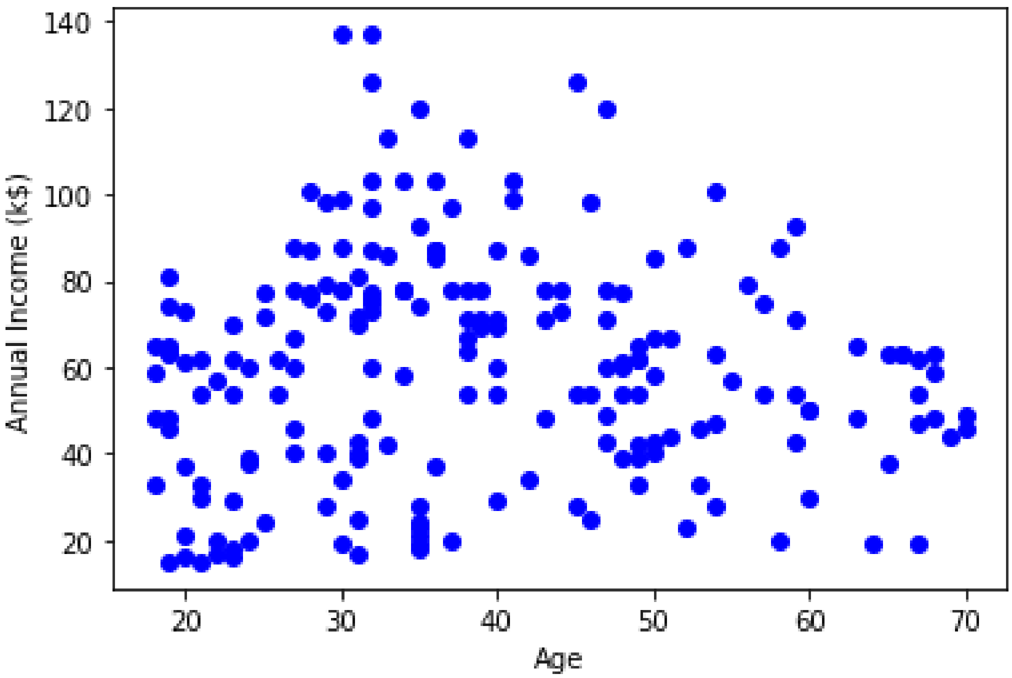
```
sns.stripplot(x=df['Age'],y=df['Spending Score (1-100)'])
```

```
<AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>
```



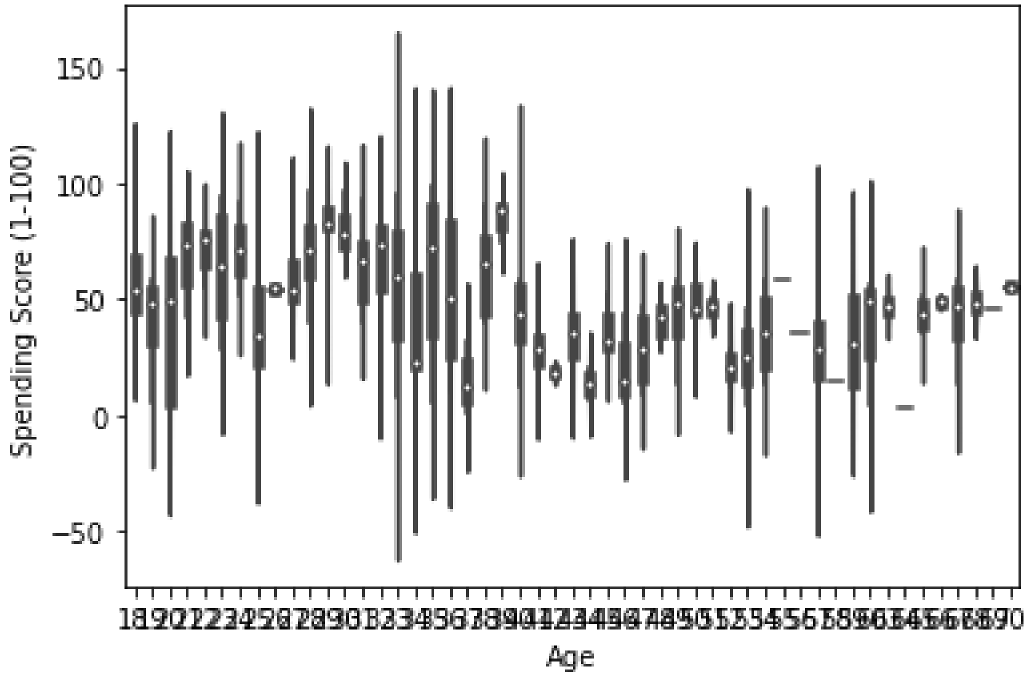
```
plt.scatter(df['Age'],df['Annual Income (k$)'],color='blue')
plt.xlabel("Age")
plt.ylabel("Annual Income (k$)")
```

```
Text(0, 0.5, 'Annual Income (k$)')
```



```
sns.violinplot(x ='Age', y ='Spending Score (1-100)', data = df)
```

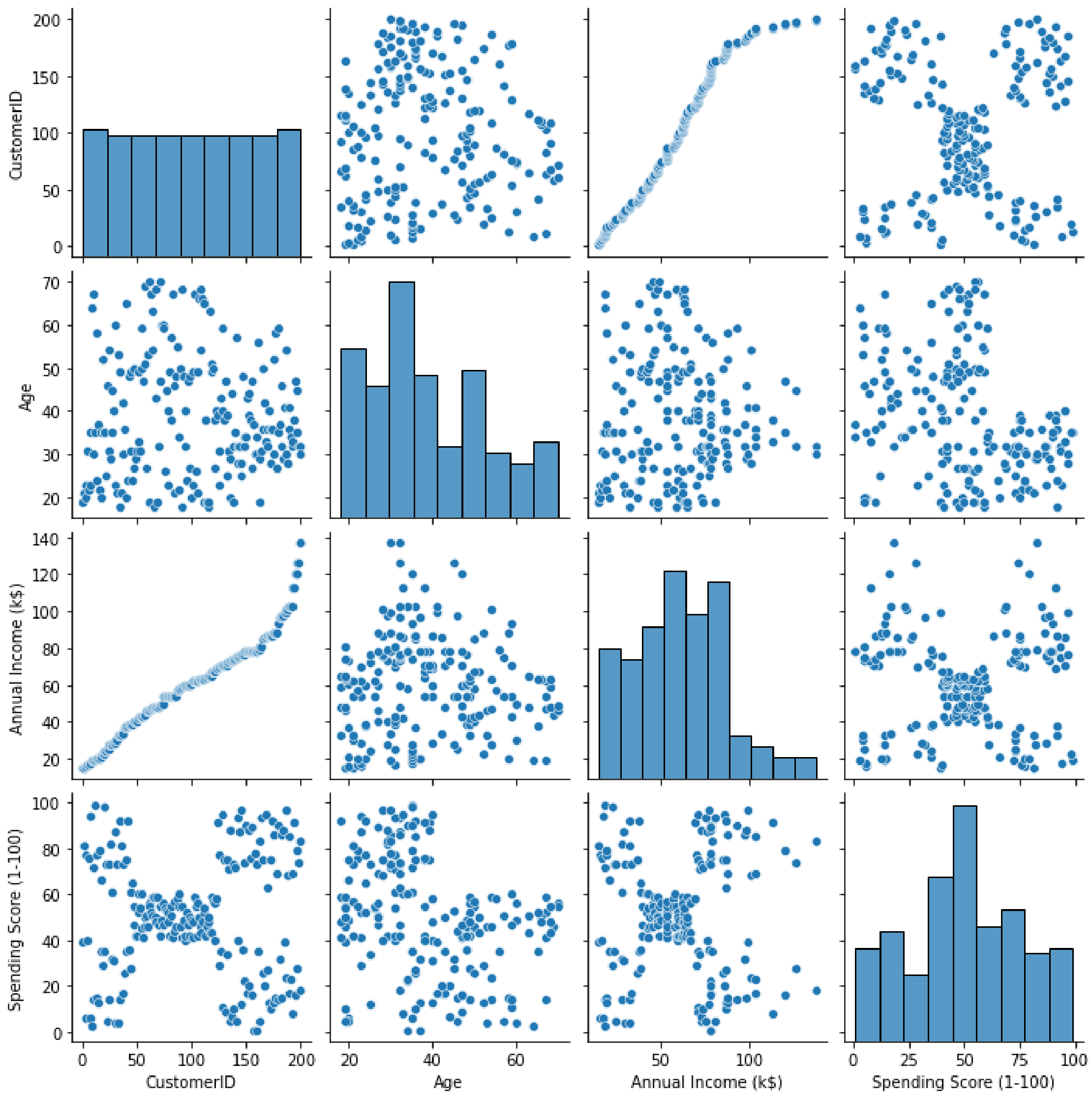
```
<AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>
```



```
#Multivariate Analysis
```

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

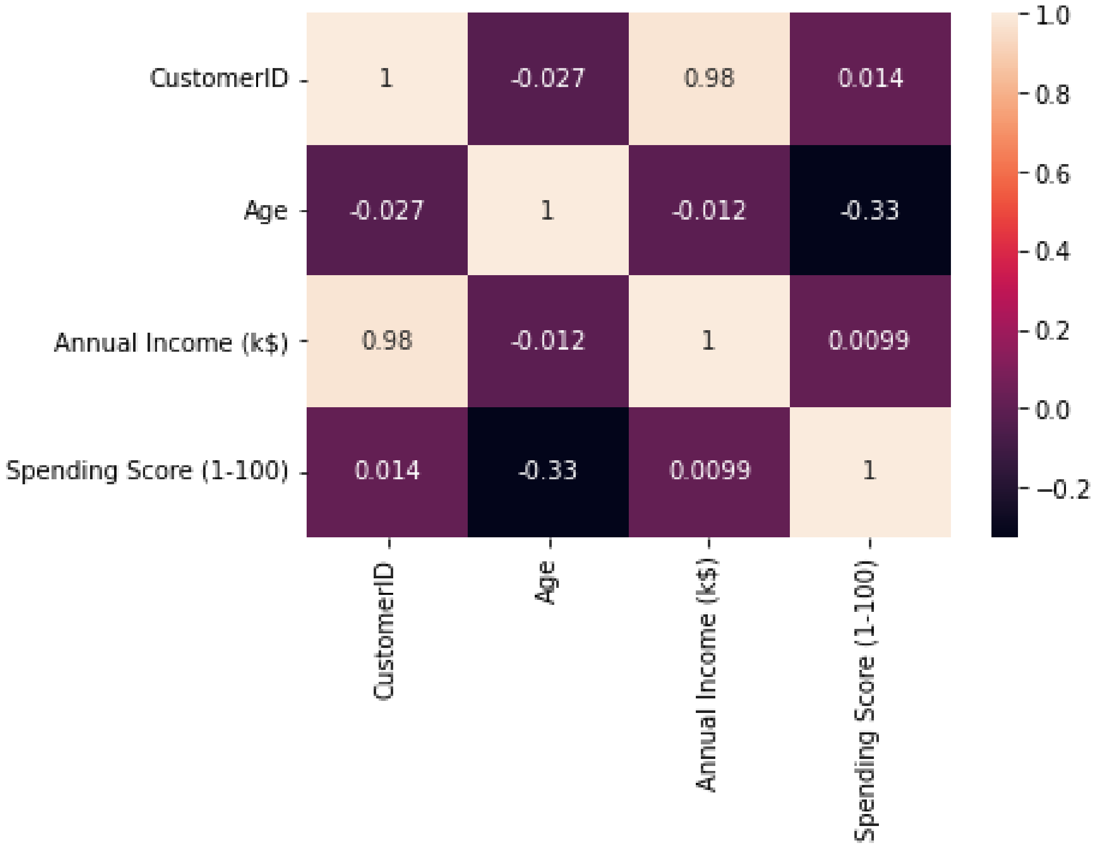
```
<seaborn.axisgrid.PairGrid at 0x20892de1430>
```



```
#Descriptive Statistics
```

```
sns.heatmap(df.corr(),annot=True)
```

```
<AxesSubplot:>
```



```
df.shape
```

```
(200, 5)
```

```
df.isnull().sum()
```

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

```
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    object
 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(4), object(1)
memory usage: 7.9+ KB
```

```
df.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
```

```
df.mean()
```

```
C:\Users\91948\AppData\Local\Temp\ipykernel_6316\3698961737.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.
  df.mean()
```

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

```
df.median()
```

```
C:\Users\91948\AppData\Local\Temp\ipykernel_6316\530051474.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.
  df.median()
```

```
CustomerID                100.5
Age                        36.0
Annual Income (k$)         61.5
Spending Score (1-100)     50.0
dtype: float64
```

```
df.mode()
```

```
     CustomerID  Gender   Age  Annual Income (k$)  Spending Score (1-100)
0             1  Female  32.0                54.0                    42.0
1             2     NaN   NaN                78.0                     NaN
2             3     NaN   NaN                 NaN                     NaN
3             4     NaN   NaN                 NaN                     NaN
4             5     NaN   NaN                 NaN                     NaN
..          ...     ...   ...                 ...                     ...
```

```
195         196     NaN   NaN                 NaN                     NaN
196         197     NaN   NaN                 NaN                     NaN
197         198     NaN   NaN                 NaN                     NaN
198         199     NaN   NaN                 NaN                     NaN
199         200     NaN   NaN                 NaN                     NaN

[200 rows x 5 columns]
```

```
df['Gender'].value_counts()
```

```
Female    112
Male       88
Name: Gender, dtype: int64
```

```
#check fo Missing values
```

```
df.isna().sum()
```

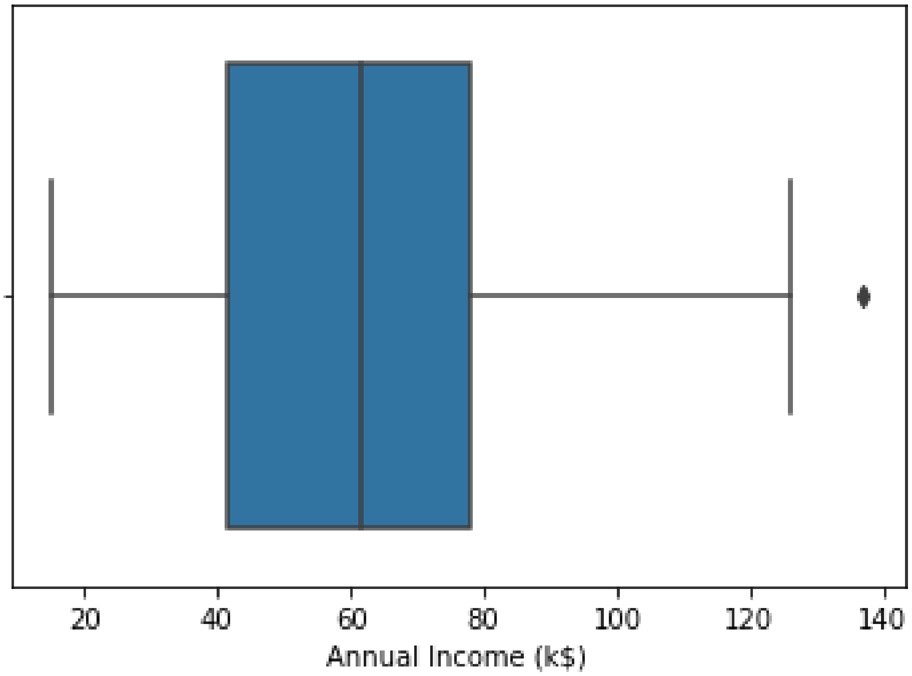
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

```
#Handling Outliers
```

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

```
C:\Users\91948\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
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.
  warnings.warn(
```

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```

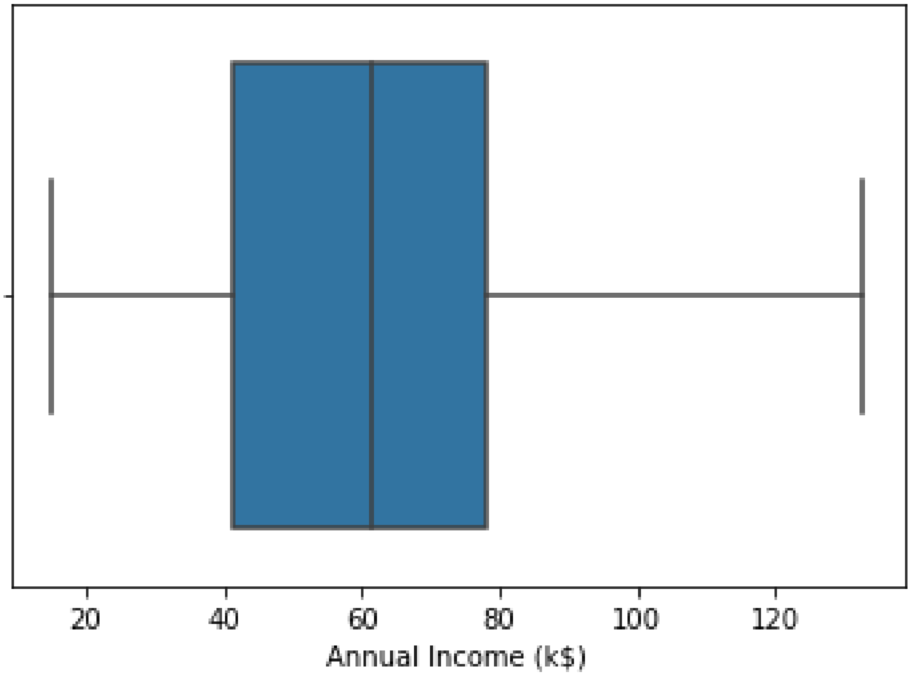


```
Q1 = df['Annual Income (k$)'].quantile(0.25)
Q3 = df['Annual Income (k$)'].quantile(0.75)
IQR = Q3 - Q1
whisker_width = 1.5
lower_whisker = Q1 -(whisker_width*IQR)
upper_whisker = Q3 +(whisker_width*IQR)
df['Annual Income (k$)']=np.where(df['Annual Income
(k$)']>upper_whisker,upper_whisker,np.where(df['Annual Income
(k$)']<lower_whisker,lower_whisker,df['Annual Income (k$)']))
```

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

```
C:\Users\91948\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
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.
  warnings.warn(
```

```
<AxesSubplot:xlabel='Annual Income (k$)'>
```



```
#Encoding Categorical Values

numeric_data = df.select_dtypes(include=[np.number])
categorical_data = df.select_dtypes(exclude=[np.number])
print("Number of numerical variables: ", numeric_data.shape[1])
print("Number of categorical variables: ", categorical_data.shape[1])
```

```
Number of numerical variables:  4
Number of categorical variables:  1
```

```
print("Number of categorical variables: ", categorical_data.shape[1])
Categorical_variables = list(categorical_data.columns)
Categorical_variables
```

```
Number of categorical variables:  1
```

```
['Gender']
```

```
df['Gender'].value_counts()
```

```
Female    112
Male       88
Name: Gender, dtype: int64
```

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
label = le.fit_transform(df['Gender'])
df["Gender"] = label
```

```
df['Gender'].value_counts()
```

```
0    112
1     88
Name: Gender, dtype: int64
```

```
#Scaling the data

X = df.drop("Age",axis=1)
Y = df['Age']

from sklearn.preprocessing import StandardScaler
object= StandardScaler()
scale = object.fit_transform(X)
print(scale)
```

```
[[-1.7234121   1.12815215 -1.74542941 -0.43480148]
 [-1.70609137  1.12815215 -1.74542941  1.19570407]
 [-1.68877065 -0.88640526 -1.70708307 -1.71591298]
 [-1.67144992 -0.88640526 -1.70708307  1.04041783]
 [-1.6541292  -0.88640526 -1.66873673 -0.39597992]
 [-1.63680847 -0.88640526 -1.66873673  1.00159627]
 [-1.61948775 -0.88640526 -1.6303904  -1.71591298]
 [-1.60216702 -0.88640526 -1.6303904   1.70038436]
 [-1.5848463   1.12815215 -1.59204406 -1.83237767]
 [-1.56752558 -0.88640526 -1.59204406  0.84631002]
 [-1.55020485  1.12815215 -1.59204406 -1.4053405 ]
 [-1.53288413 -0.88640526 -1.59204406  1.89449216]
 [-1.5155634  -0.88640526 -1.55369772 -1.36651894]
 [-1.49824268 -0.88640526 -1.55369772  1.04041783]
 [-1.48092195  1.12815215 -1.55369772 -1.44416206]
 [-1.46360123  1.12815215 -1.55369772  1.11806095]
 [-1.4462805  -0.88640526 -1.51535138 -0.59008772]
 [-1.42895978  1.12815215 -1.51535138  0.61338066]
 [-1.41163905  1.12815215 -1.43865871 -0.82301709]
 [-1.39431833 -0.88640526 -1.43865871  1.8556706 ]
 [-1.3769976   1.12815215 -1.40031237 -0.59008772]
 [-1.35967688  1.12815215 -1.40031237  0.88513158]
 [-1.34235616 -0.88640526 -1.36196603 -1.75473454]
 [-1.32503543  1.12815215 -1.36196603  0.88513158]
 [-1.30771471 -0.88640526 -1.24692702 -1.4053405 ]
 [-1.29039398  1.12815215 -1.24692702  1.23452563]
 [-1.27307326 -0.88640526 -1.24692702 -0.7065524 ]
 [-1.25575253  1.12815215 -1.24692702  0.41927286]
 [-1.23843181 -0.88640526 -1.20858069 -0.74537397]
 [-1.22111108 -0.88640526 -1.20858069  1.42863343]
 [-1.20379036  1.12815215 -1.17023435 -1.7935561 ]
 [-1.18646963 -0.88640526 -1.17023435  0.88513158]
 [-1.16914891  1.12815215 -1.05519534 -1.7935561 ]
 [-1.15182818  1.12815215 -1.05519534  1.62274124]
 [-1.13450746 -0.88640526 -1.05519534 -1.4053405 ]
 [-1.11718674 -0.88640526 -1.05519534  1.19570407]
 [-1.09986601 -0.88640526 -1.016849   -1.28887582]
```

```
[-1.08254529 -0.88640526 -1.016849    0.88513158]
[-1.06522456 -0.88640526 -0.90180999 -0.93948177]
[-1.04790384 -0.88640526 -0.90180999  0.96277471]
[-1.03058311 -0.88640526 -0.86346365 -0.59008772]
[-1.01326239  1.12815215 -0.86346365  1.62274124]
[-0.99594166  1.12815215 -0.82511731 -0.55126616]
[-0.97862094 -0.88640526 -0.82511731  0.41927286]
[-0.96130021 -0.88640526 -0.82511731 -0.86183865]
[-0.94397949 -0.88640526 -0.82511731  0.5745591 ]
[-0.92665877 -0.88640526 -0.78677098  0.18634349]
[-0.90933804 -0.88640526 -0.78677098 -0.12422899]
[-0.89201732 -0.88640526 -0.78677098 -0.3183368 ]
[-0.87469659 -0.88640526 -0.78677098 -0.3183368 ]
[-0.85737587 -0.88640526 -0.7100783   0.06987881]
[-0.84005514  1.12815215 -0.7100783   0.38045129]
[-0.82273442 -0.88640526 -0.67173196  0.14752193]
[-0.80541369  1.12815215 -0.67173196  0.38045129]
[-0.78809297 -0.88640526 -0.67173196 -0.20187212]
[-0.77077224  1.12815215 -0.67173196 -0.35715836]
[-0.75345152 -0.88640526 -0.63338563 -0.00776431]
[-0.73613079  1.12815215 -0.63338563 -0.16305055]
[-0.71881007 -0.88640526 -0.55669295  0.03105725]
[-0.70148935  1.12815215 -0.55669295 -0.16305055]
[-0.68416862  1.12815215 -0.55669295  0.22516505]
[-0.6668479   1.12815215 -0.55669295  0.18634349]
[-0.64952717 -0.88640526 -0.51834661  0.06987881]
[-0.63220645 -0.88640526 -0.51834661  0.34162973]
[-0.61488572  1.12815215 -0.48000028  0.03105725]
[-0.597565    1.12815215 -0.48000028  0.34162973]
[-0.58024427 -0.88640526 -0.48000028 -0.00776431]
[-0.56292355 -0.88640526 -0.48000028 -0.08540743]
[-0.54560282  1.12815215 -0.48000028  0.34162973]
[-0.5282821  -0.88640526 -0.48000028 -0.12422899]
[-0.51096138  1.12815215 -0.44165394  0.18634349]
[-0.49364065 -0.88640526 -0.44165394 -0.3183368 ]
[-0.47631993 -0.88640526 -0.4033076  -0.04658587]
[-0.4589992  -0.88640526 -0.4033076   0.22516505]
[-0.44167848  1.12815215 -0.24992225 -0.12422899]
[-0.42435775  1.12815215 -0.24992225  0.14752193]
[-0.40703703 -0.88640526 -0.24992225  0.10870037]
[-0.3897163   1.12815215 -0.24992225 -0.08540743]
[-0.37239558 -0.88640526 -0.24992225  0.06987881]
[-0.35507485 -0.88640526 -0.24992225 -0.3183368 ]
[-0.33775413  1.12815215 -0.24992225  0.03105725]
[-0.3204334   1.12815215 -0.24992225  0.18634349]
[-0.30311268  1.12815215 -0.24992225 -0.35715836]
[-0.28579196 -0.88640526 -0.24992225 -0.24069368]
[-0.26847123 -0.88640526 -0.24992225  0.26398661]
[-0.25115051  1.12815215 -0.24992225 -0.16305055]
[-0.23382978 -0.88640526 -0.13488324  0.30280817]
```

```
[-0.21650906 -0.88640526 -0.13488324  0.18634349]
[-0.19918833 -0.88640526 -0.0965369   0.38045129]
[-0.18186761 -0.88640526 -0.0965369  -0.16305055]
[-0.16454688 -0.88640526 -0.05819057  0.18634349]
[-0.14722616  1.12815215 -0.05819057 -0.35715836]
[-0.12990543  1.12815215 -0.01984423 -0.04658587]
[-0.11258471 -0.88640526 -0.01984423 -0.39597992]
[-0.09526399 -0.88640526 -0.01984423 -0.3183368 ]
[-0.07794326  1.12815215 -0.01984423  0.06987881]
[-0.06062254 -0.88640526 -0.01984423 -0.12422899]
[-0.04330181 -0.88640526 -0.01984423 -0.00776431]
[-0.02598109  1.12815215  0.01850211 -0.3183368 ]
[-0.00866036  1.12815215  0.01850211 -0.04658587]
[ 0.00866036 -0.88640526  0.05684845 -0.35715836]
[ 0.02598109 -0.88640526  0.05684845 -0.08540743]
[ 0.04330181  1.12815215  0.05684845  0.34162973]
[ 0.06062254  1.12815215  0.05684845  0.18634349]
[ 0.07794326  1.12815215  0.05684845  0.22516505]
[ 0.09526399 -0.88640526  0.05684845 -0.3183368 ]
[ 0.11258471 -0.88640526  0.09519478 -0.00776431]
[ 0.12990543  1.12815215  0.09519478 -0.16305055]
[ 0.14722616  1.12815215  0.09519478 -0.27951524]
[ 0.16454688  1.12815215  0.09519478 -0.08540743]
[ 0.18186761  1.12815215  0.09519478  0.06987881]
[ 0.19918833 -0.88640526  0.09519478  0.14752193]
[ 0.21650906 -0.88640526  0.13354112 -0.3183368 ]
[ 0.23382978  1.12815215  0.13354112 -0.16305055]
[ 0.25115051 -0.88640526  0.17188746 -0.08540743]
[ 0.26847123 -0.88640526  0.17188746 -0.00776431]
[ 0.28579196 -0.88640526  0.17188746 -0.27951524]
[ 0.30311268 -0.88640526  0.17188746  0.34162973]
[ 0.3204334  -0.88640526  0.24858013 -0.27951524]
[ 0.33775413 -0.88640526  0.24858013  0.26398661]
[ 0.35507485  1.12815215  0.24858013  0.22516505]
[ 0.37239558 -0.88640526  0.24858013 -0.39597992]
[ 0.3897163  -0.88640526  0.32527281  0.30280817]
[ 0.40703703  1.12815215  0.32527281  1.58391968]
[ 0.42435775 -0.88640526  0.36361914 -0.82301709]
[ 0.44167848 -0.88640526  0.36361914  1.04041783]
[ 0.4589992   1.12815215  0.40196548 -0.59008772]
[ 0.47631993  1.12815215  0.40196548  1.73920592]
[ 0.49364065  1.12815215  0.40196548 -1.52180518]
[ 0.51096138  1.12815215  0.40196548  0.96277471]
[ 0.5282821   1.12815215  0.40196548 -1.5994483 ]
[ 0.54560282  1.12815215  0.40196548  0.96277471]
[ 0.56292355 -0.88640526  0.44031182 -0.62890928]
[ 0.58024427 -0.88640526  0.44031182  0.80748846]
[ 0.597565    1.12815215  0.47865816 -1.75473454]
[ 0.61488572 -0.88640526  0.47865816  1.46745499]
[ 0.63220645 -0.88640526  0.47865816 -1.67709142]
[ 0.64952717  1.12815215  0.47865816  0.88513158]
[ 0.6668479   1.12815215  0.51700449 -1.56062674]
[ 0.68416862 -0.88640526  0.51700449  0.84631002]
[ 0.70148935 -0.88640526  0.55535083 -1.75473454]
[ 0.71881007  1.12815215  0.55535083  1.6615628 ]
[ 0.73613079 -0.88640526  0.59369717 -0.39597992]
[ 0.75345152 -0.88640526  0.59369717  1.42863343]
[ 0.77077224  1.12815215  0.6320435  -1.48298362]
[ 0.78809297  1.12815215  0.6320435   1.81684904]
[ 0.80541369  1.12815215  0.6320435  -0.55126616]
[ 0.82273442 -0.88640526  0.6320435   0.92395314]
[ 0.84005514 -0.88640526  0.67038984 -1.09476801]
[ 0.85737587  1.12815215  0.67038984  1.54509812]
[ 0.87469659  1.12815215  0.67038984 -1.28887582]
[ 0.89201732  1.12815215  0.67038984  1.46745499]
[ 0.90933804 -0.88640526  0.67038984 -1.17241113]
[ 0.92665877 -0.88640526  0.67038984  1.00159627]
[ 0.94397949 -0.88640526  0.67038984 -1.32769738]
[ 0.96130021 -0.88640526  0.67038984  1.50627656]
[ 0.97862094  1.12815215  0.67038984 -1.91002079]
[ 0.99594166 -0.88640526  0.67038984  1.07923939]
[ 1.01326239  1.12815215  0.67038984 -1.91002079]
[ 1.03058311 -0.88640526  0.67038984  0.88513158]
[ 1.04790384 -0.88640526  0.70873618 -0.59008772]
[ 1.06522456 -0.88640526  0.70873618  1.27334719]
[ 1.08254529  1.12815215  0.78542885 -1.75473454]
[ 1.09986601 -0.88640526  0.78542885  1.6615628 ]
[ 1.11718674  1.12815215  0.9388142  -0.93948177]
[ 1.13450746 -0.88640526  0.9388142   0.96277471]
[ 1.15182818  1.12815215  0.97716054 -1.17241113]
[ 1.16914891 -0.88640526  0.97716054  1.73920592]
[ 1.18646963 -0.88640526  1.01550688 -0.90066021]
[ 1.20379036  1.12815215  1.01550688  0.49691598]
[ 1.22111108  1.12815215  1.01550688 -1.44416206]
[ 1.23843181  1.12815215  1.01550688  0.96277471]
[ 1.25575253  1.12815215  1.01550688 -1.56062674]
[ 1.27307326  1.12815215  1.01550688  1.62274124]
[ 1.29039398 -0.88640526  1.05385321 -1.44416206]
[ 1.30771471 -0.88640526  1.05385321  1.38981187]
[ 1.32503543  1.12815215  1.05385321 -1.36651894]
[ 1.34235616  1.12815215  1.05385321  0.72984534]
[ 1.35967688  1.12815215  1.2455849  -1.4053405 ]
[ 1.3769976   1.12815215  1.2455849   1.54509812]
[ 1.39431833 -0.88640526  1.39897025 -0.7065524 ]
[ 1.41163905 -0.88640526  1.39897025  1.38981187]
[ 1.42895978  1.12815215  1.43731659 -1.36651894]
[ 1.4462805  -0.88640526  1.43731659  1.46745499]
[ 1.46360123 -0.88640526  1.47566292 -0.43480148]
[ 1.48092195  1.12815215  1.47566292  1.81684904]
[ 1.49824268 -0.88640526  1.5523556  -1.01712489]
```

```
 [ 1.5155634   1.12815215  1.5523556   0.69102378]
 [ 1.53288413 -0.88640526  1.62904827 -1.28887582]
 [ 1.55020485 -0.88640526  1.62904827  1.35099031]
 [ 1.56752558 -0.88640526  1.62904827 -1.05594645]
 [ 1.5848463  -0.88640526  1.62904827  0.72984534]
 [ 1.60216702  1.12815215  2.01251165 -1.63826986]
 [ 1.61948775 -0.88640526  2.01251165  1.58391968]
 [ 1.63680847 -0.88640526  2.28093601 -1.32769738]
 [ 1.6541292  -0.88640526  2.28093601  1.11806095]
 [ 1.67144992 -0.88640526  2.51101403 -0.86183865]
 [ 1.68877065  1.12815215  2.51101403  0.92395314]
 [ 1.70609137  1.12815215  2.76985181 -1.25005425]
 [ 1.7234121   1.12815215  2.76985181  1.27334719]]
```

```
X_scaled  = pd.DataFrame(scale, columns = X.columns)
X_scaled
```

```
     CustomerID    Gender  Annual Income (k$)  Spending Score (1-100)
0     -1.723412  1.128152           -1.745429               -0.434801
1     -1.706091  1.128152           -1.745429                1.195704
2     -1.688771 -0.886405           -1.707083               -1.715913
3     -1.671450 -0.886405           -1.707083                1.040418
4     -1.654129 -0.886405           -1.668737               -0.395980
..          ...       ...                 ...                     ...
195    1.654129 -0.886405            2.280936                1.118061
196    1.671450 -0.886405            2.511014               -0.861839
197    1.688771  1.128152            2.511014                0.923953
198    1.706091  1.128152            2.769852               -1.250054
199    1.723412  1.128152            2.769852                1.273347

[200 rows x 4 columns]
```

```
#train test split
from sklearn.model_selection import train_test_split
# split the dataset
X_train, X_test, Y_train, Y_test = train_test_split(X_scaled, Y,
test_size=0.20, random_state=0)
```

```
X_train.shape
```

```
(160, 4)
```

```
X_test.shape
```

```
(40, 4)
```

```
Y_train.shape
```

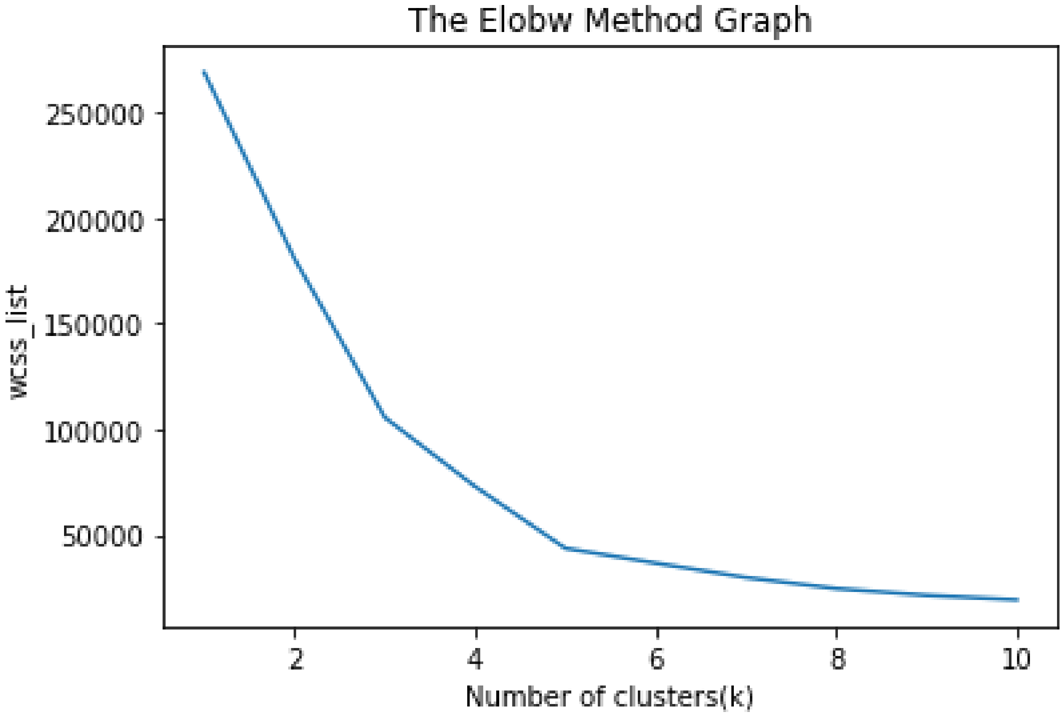
```
(160,)
```

```
Y_test.shape
```

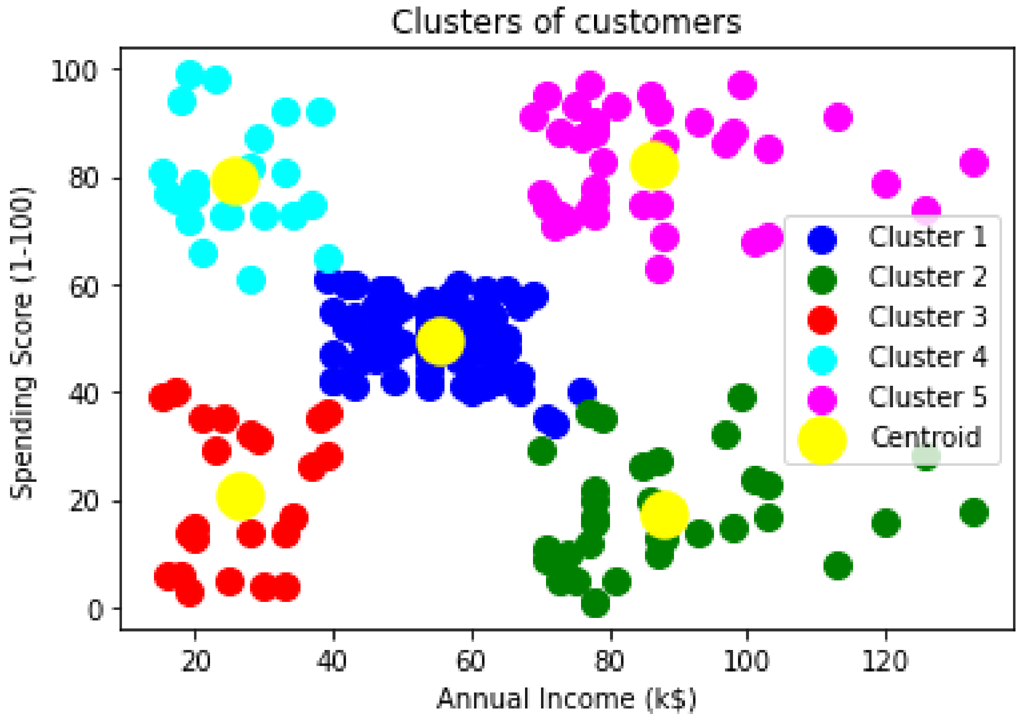
```
(40,)
```

```
#Clustering Algorithm

x = df.iloc[:, [3, 4]].values

#finding optimal number of clusters using the elbow method
from sklearn.cluster import KMeans
wcss_list= []  #Initializing the list for the values of WCSS

#Using for loop for iterations from 1 to 10.
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state= 42)
    kmeans.fit(x)
    wcss_list.append(kmeans.inertia_)
plt.plot(range(1, 11), wcss_list)
plt.title('The Elobw Method Graph')
plt.xlabel('Number of clusters(k)')
plt.ylabel('wcss_list')
plt.show()
```

```
C:\Users\91948\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036:
UserWarning: KMeans is known to have a memory leak on Windows with MKL, when
there are less chunks than available threads. You can avoid it by setting the
environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```



```
#training the K-means model on a dataset
kmeans = KMeans(n_clusters=5, init='k-means++', random_state= 42)
y_predict= kmeans.fit_predict(x)

#visulaizing the clusters
plt.scatter(x[y_predict == 0, 0], x[y_predict == 0, 1], s = 100, c = 'blue',
label = 'Cluster 1') #for first cluster
plt.scatter(x[y_predict == 1, 0], x[y_predict == 1, 1], s = 100, c = 'green',
label = 'Cluster 2') #for second cluster
plt.scatter(x[y_predict== 2, 0], x[y_predict == 2, 1], s = 100, c = 'red',
label = 'Cluster 3') #for third cluster
plt.scatter(x[y_predict == 3, 0], x[y_predict == 3, 1], s = 100, c = 'cyan',
label = 'Cluster 4') #for fourth cluster
plt.scatter(x[y_predict == 4, 0], x[y_predict == 4, 1], s = 100, c =
'magenta', label = 'Cluster 5') #for fifth cluster
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s =
300, c = 'yellow', label = 'Centroid')
plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```



```
#the End
```