

## 1.import libraries

```
# import library
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
```

## 2.Load the dataset

```
# load dataset
```

```
from google.colab import files
upload=files.upload()
```

```
<IPython.core.display.HTML object>
```

```
Saving Mall_Customers.xlsx to Mall_Customers (1).xlsx
```

```
customer=pd.read_excel("Mall_Customers.xlsx")
```

## 3.Univariate Analysis

```
df=pd.read_excel("Mall_Customers.xlsx")
```

```
#view first five rows of DataFrame
```

```
df.head()
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1.0	Male	19.0	15.0	39.0
1	2.0	Male	21.0	15.0	81.0
2	3.0	Female	20.0	16.0	6.0
3	4.0	Female	23.0	16.0	77.0
4	5.0	Female	31.0	17.0	40.0

```
#calculate mean of 'Annual Income (K$)'
```

```
df["Annual Income (k$)"].mean()
```

```
60.56
```

```
#calculate median of 'Annual Income (K$)'
```

```
df["Annual Income (k$)"].median()
```

```
61.5
```

```
#calculate standard deviation of 'Annual Income (K$)'  
df["Annual Income (k$)"].std()
```

```
26.264721165271244
```

```
#calculate mode of 'Annual Income (K$)'  
df["Annual Income (k$)"].mode()
```

```
0    54.0  
1    78.0  
dtype: float64
```

```
#create frequency table for 'Annual Income (k$)'  
df["Annual Income (k$)"].value_counts()
```

```
54.0    12  
78.0    12  
48.0     6  
71.0     6  
63.0     6  
..  
58.0     2  
59.0     2  
16.0     2  
64.0     2  
137.0    2
```

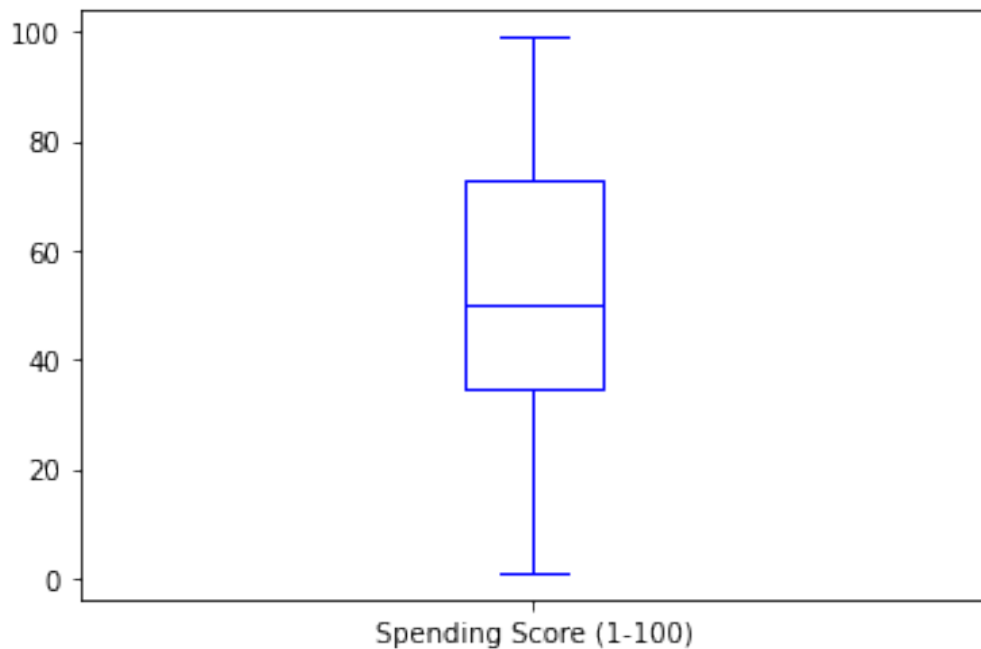
```
Name: Annual Income (k$), Length: 64, dtype: int64
```

```
#view last five rows of DataFrame  
df.tail()
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
195	196.0	Female	35.0	120.0	79.0
196	197.0	Female	45.0	126.0	28.0
197	198.0	Male	32.0	126.0	74.0
198	199.0	Male	32.0	137.0	18.0
199	200.0	Male	30.0	137.0	83.0

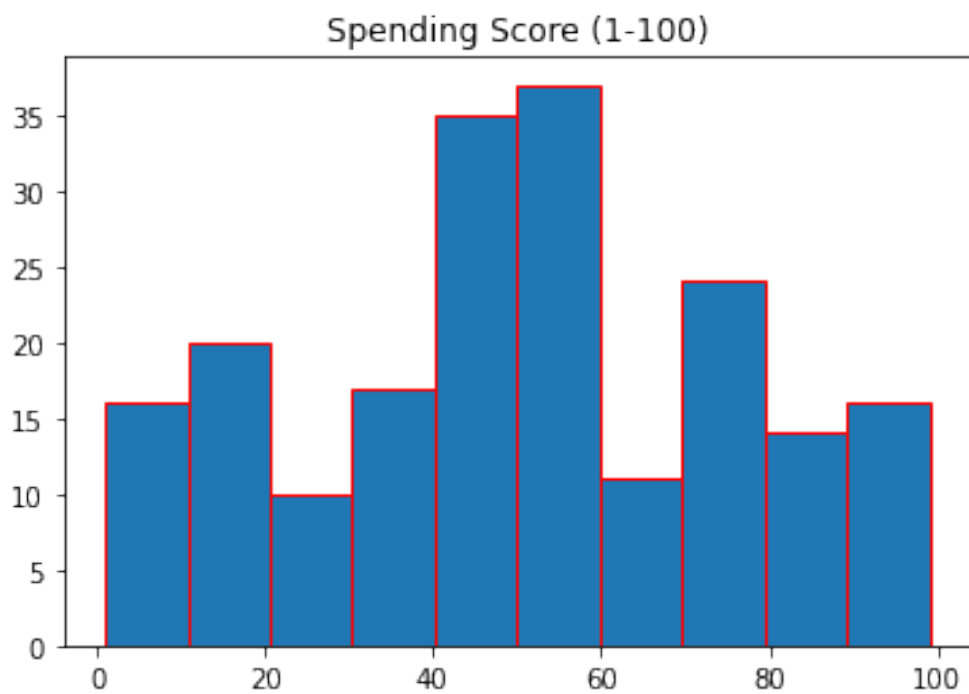
```
#create a boxplot for the 'Spending Score' variable  
import matplotlib.pyplot as plt  
customer.boxplot(column=['Spending Score (1-100)'],grid=False,color='blue')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b924e850>
```



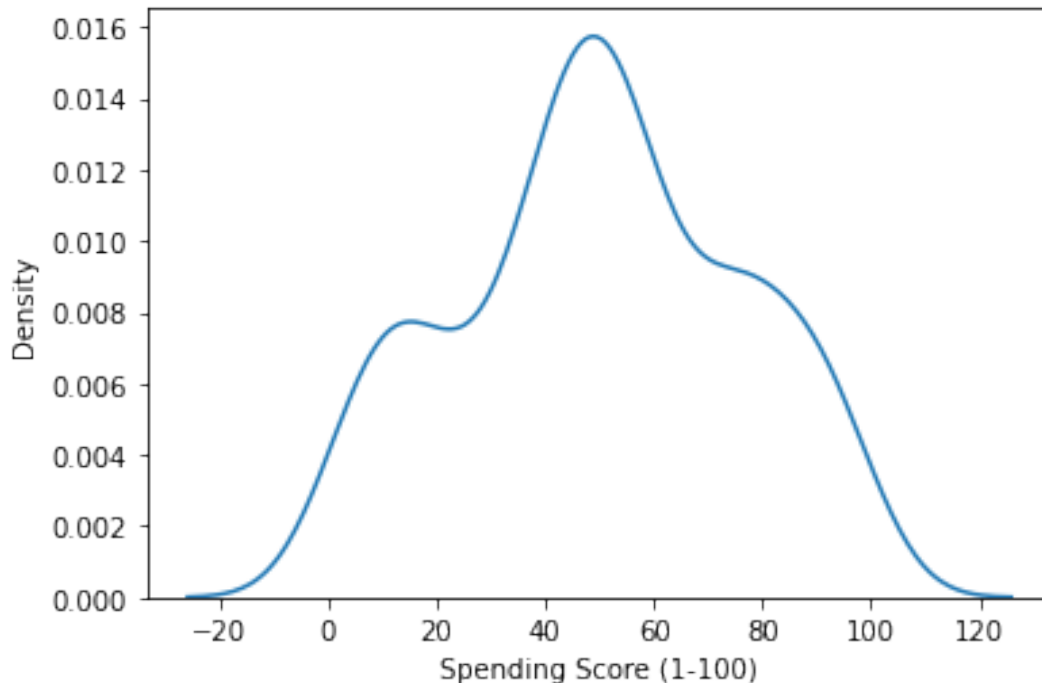
```
#to create histogram for the 'Spending Score' variable  
customer.hist(column='Spending Score (1-  
100)',grid=False,edgecolor='red')
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object at  
0x7fc3b982a490>]],  
      dtype=object)
```



```
#to create a density curve for the 'Spending Score' variable
sns.kdeplot(customer['Spending Score (1-100)'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b9255f10>
```



```
#information of dataset
```

```
customer.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	float64
1	Gender	200 non-null	object
2	Age	200 non-null	float64
3	Annual Income (k\$)	200 non-null	float64
4	Spending Score (1-100)	200 non-null	float64

```
dtypes: float64(4), object(1)
```

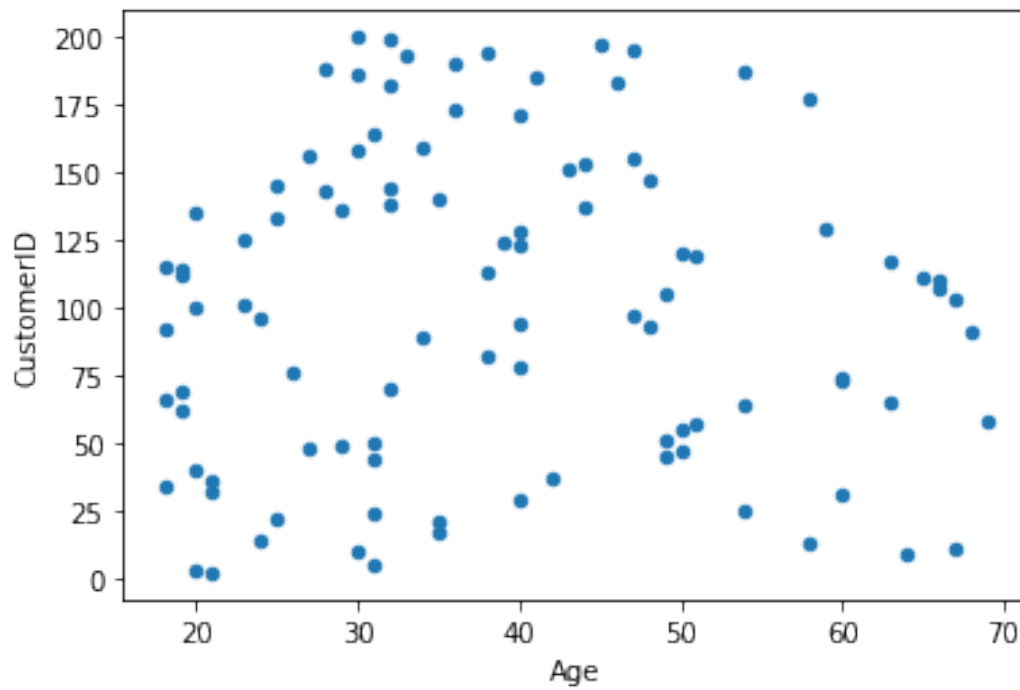
```
memory usage: 7.9+ KB
```

#### 4.Bi-Variate Analysis

```
#Scatter Plot
```

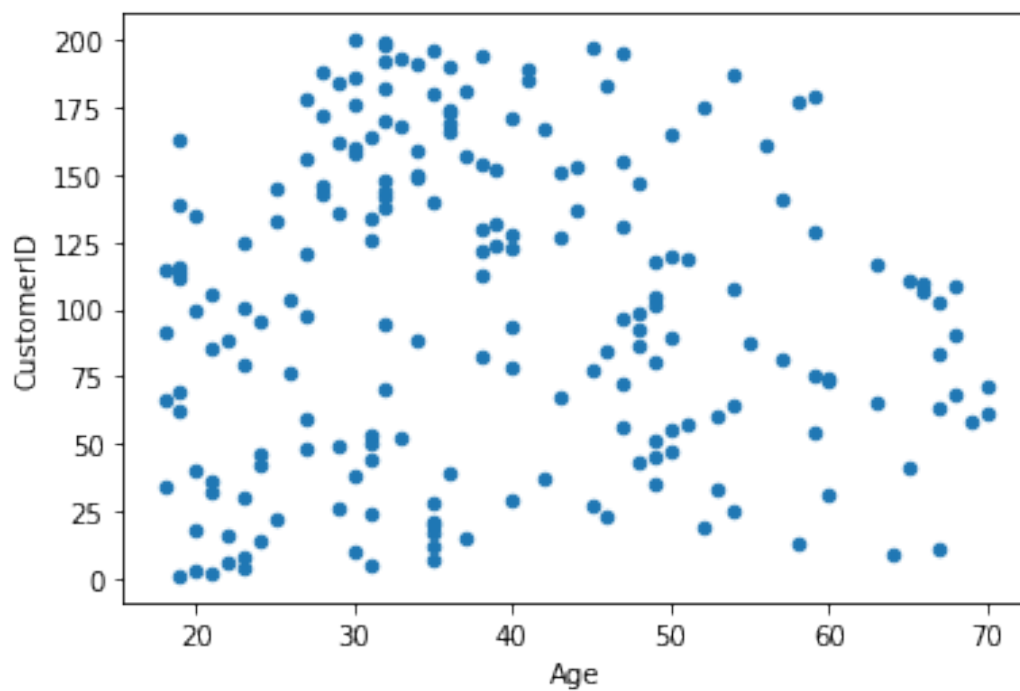
```
customer[customer['Spending Score (1-100)'] <
100].sample(100).plot.scatter(x='Age', y='CustomerID')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b8f1e4d0>
```

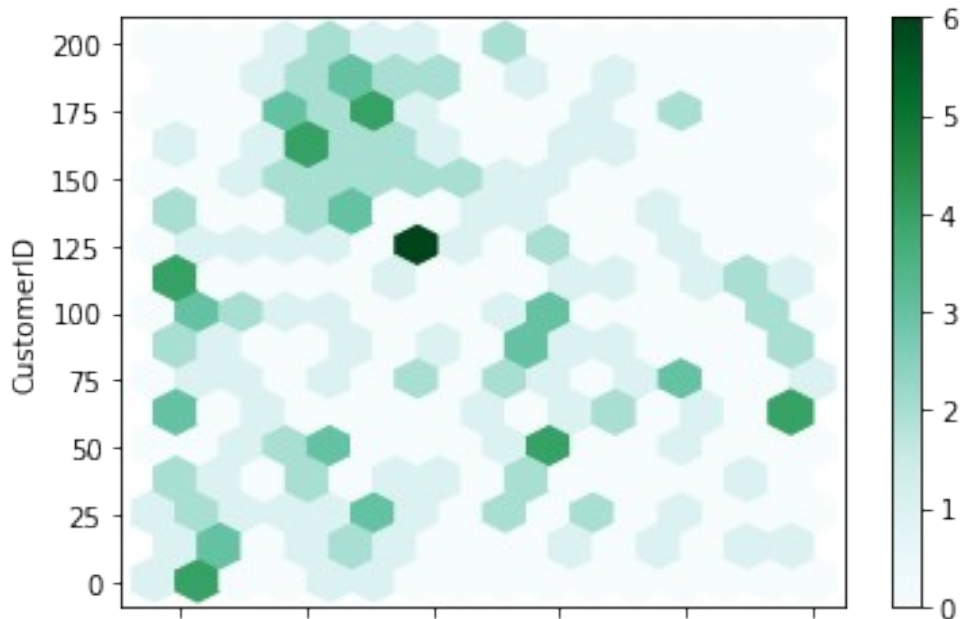


```
customer[customer['Spending Score (1-100)'] < 100].plot.scatter(x='Age', y='CustomerID')
```

<matplotlib.axes.\_subplots.AxesSubplot at 0x7fc3b8eb2b10>



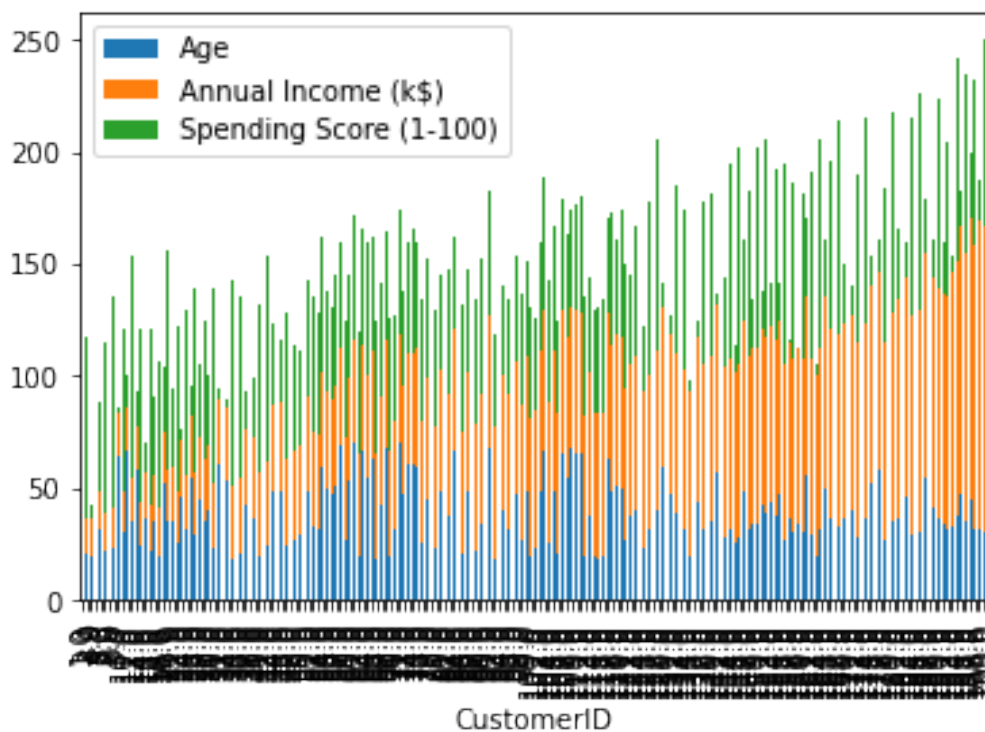
```
#Hex Plot
customer[customer['Spending Score (1-100)'] <
100].plot.hexbin(x='Age', y='CustomerID', gridsize=15)
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b8dc0310>
```



```
#stacked plot
customer_count=pd.read_excel("Mall_Customers.xlsx",index_col=0)
customer_count.head()

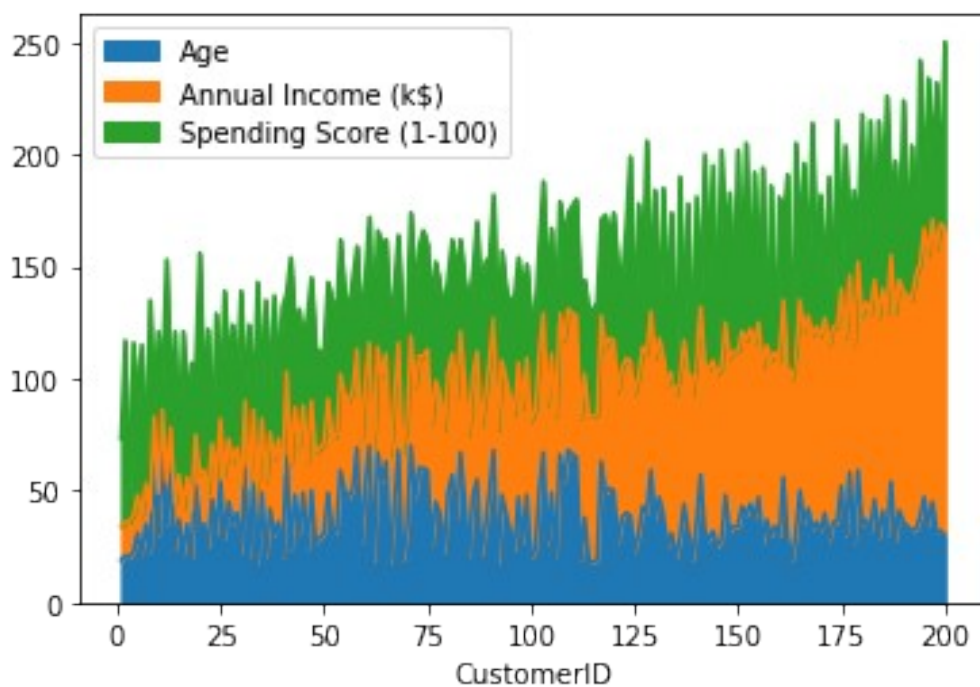
CustomerID      Gender  Age  Annual Income (k$)  Spending Score (1-100)
1.0             Male   19.0             15.0             39.0
2.0             Male   21.0             15.0             81.0
3.0            Female   20.0             16.0              6.0
4.0            Female   23.0             16.0             77.0
5.0            Female   31.0             17.0             40.0

customer_count.plot.bar(stacked=True)
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b8ead250>
```



```
customer_count.plot.area()
```

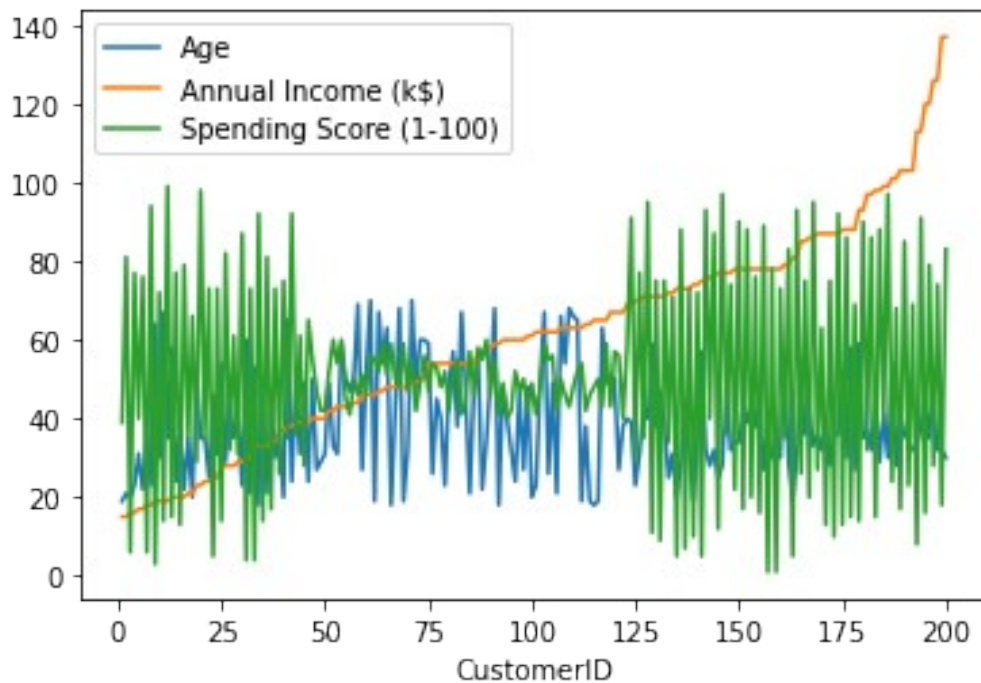
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b832b8d0>
```



```
#Bivariate line chart
```

```
customer_count.plot.line()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc3b8338290>
```



```
#create scatterplot of Annual Income vs Spending Score
```

```
plt.scatter(customer.CustomerID,customer.Age)
```

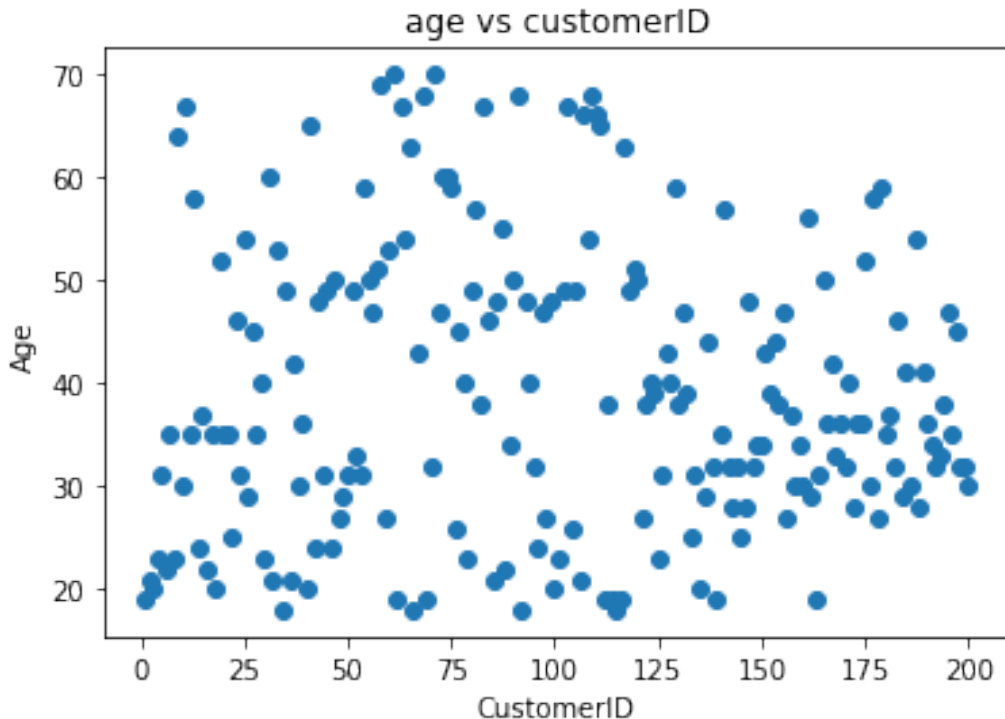
```
plt.title('age vs customerID')
```

```
plt.xlabel('CustomerID')
```

```
plt.ylabel('Age')
```

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





```
#create correlation matrix
customer.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

```
import statsmodels.api as sm
```

```
#define response variable
y=customer['CustomerID']
```

```
#define response variable
x=customer['Age']
```

```
#add constant to predictor variables
x=sm.add_constant(x)
```

```
/usr/local/lib/python3.7/dist-packages/statsmodels/tsa/
tsatools.py:142: FutureWarning: In a future version of pandas all
arguments of concat except for the argument 'objs' will be keyword-
```

```

only
x = pd.concat(x[:,order], 1)

#fit linear regression model
model=sm.OLS(y,x).fit()

#view model summary
print(model.summary())

```

## OLS Regression Results

```

=====
=====
Dep. Variable:          CustomerID    R-squared:
0.001
Model:                  OLS          Adj. R-squared:
-0.004
Method:                 Least Squares    F-statistic:
0.1419
Date:                   Sat, 22 Oct 2022    Prob (F-statistic):
0.707
Time:                   14:53:57          Log-Likelihood:
-1094.9
No. Observations:       200              AIC:
2194.
Df Residuals:           198              BIC:
2200.
Df Model:                1

Covariance Type:        nonrobust

=====
=====

```

	coef	std err	t	P> t	[0.025
const	104.8081	12.149	8.627	0.000	80.850
Age	-0.1109	0.294	-0.377	0.707	-0.691

```

-----
-----
Omnibus:                84.500    Durbin-Watson:
0.002
Prob(Omnibus):          0.000    Jarque-Bera (JB):
11.691
Skew:                   -0.014    Prob(JB):
0.00289
Kurtosis:               1.816    Cond. No.

```

122.

=====

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

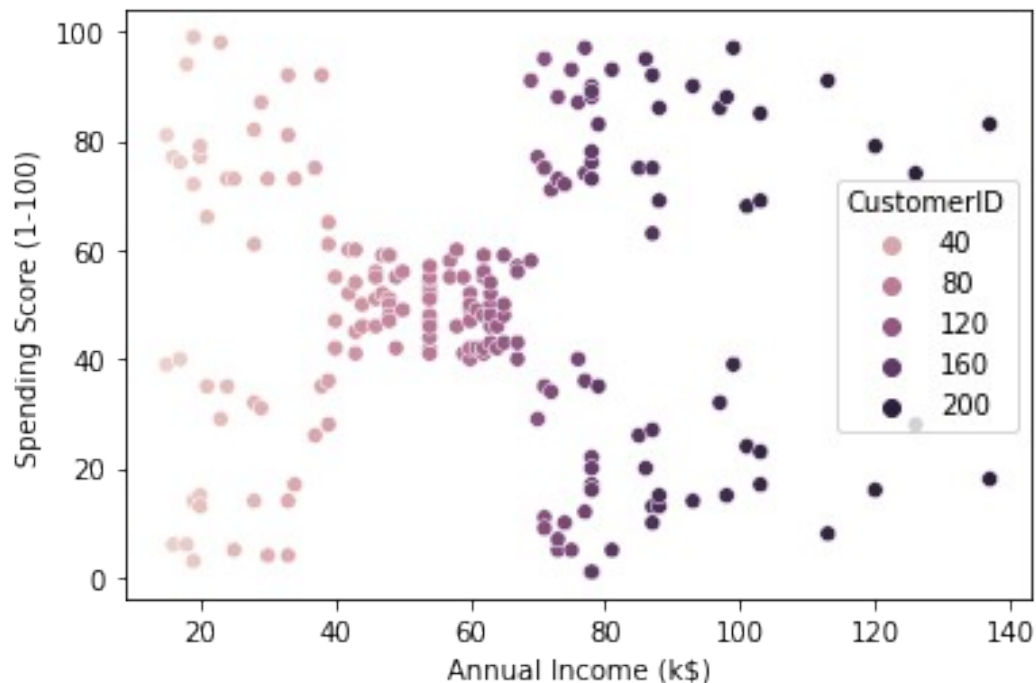
## 5.Multi-Variate Analysis

```
sns.scatterplot(customer["Annual Income (k$)"],customer["Spending Score (1-100)"],hue=customer["CustomerID"])
```

/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 0x7fc3ac87c410>

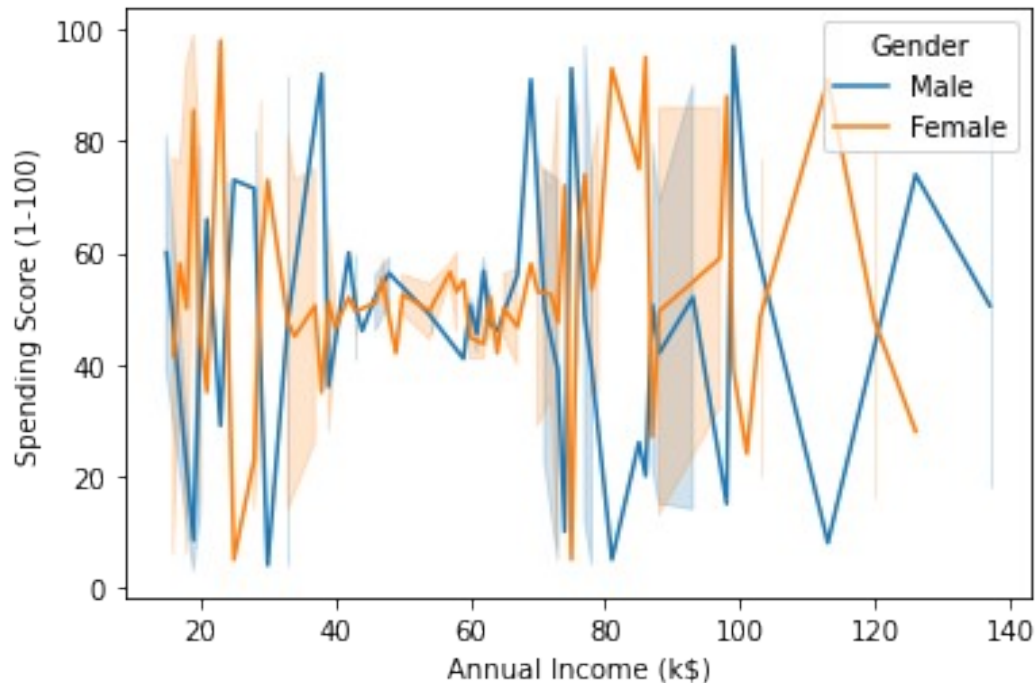


```
sns.lineplot(customer["Annual Income (k$)"],customer["Spending Score (1-100)"],hue=customer["Gender"])
```

/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

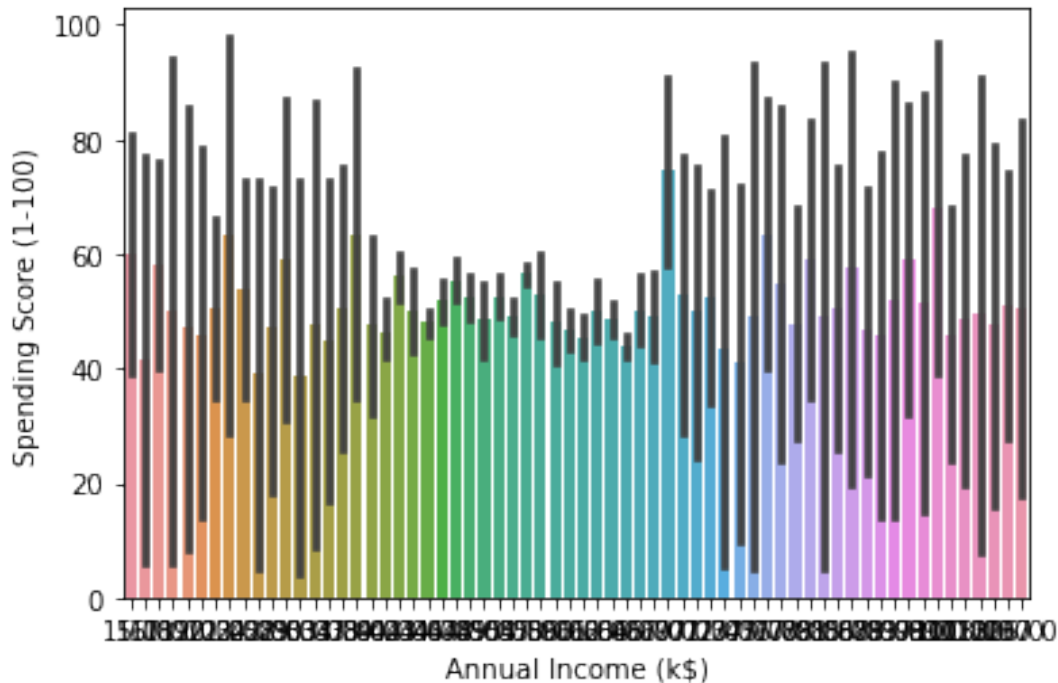
<matplotlib.axes.\_subplots.AxesSubplot at 0x7fc3ac4aee90>



```
sns.barplot(customer["Annual Income (k$)"],customer["Spending Score  
(1-100)"])
```

/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 0x7fc3ac102f10>



```
customer.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
```

```
label=df.CustomerID.value_counts().index
count=df.CustomerID.value_counts().values
```

```
plt.pie(count,labels=label)
```

```
([<matplotlib.patches.Wedge at 0x7fc3a615b150>,
<matplotlib.patches.Wedge at 0x7fc3a615b610>,
<matplotlib.patches.Wedge at 0x7fc3a615bd50>,
<matplotlib.patches.Wedge at 0x7fc3a61643d0>,
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```

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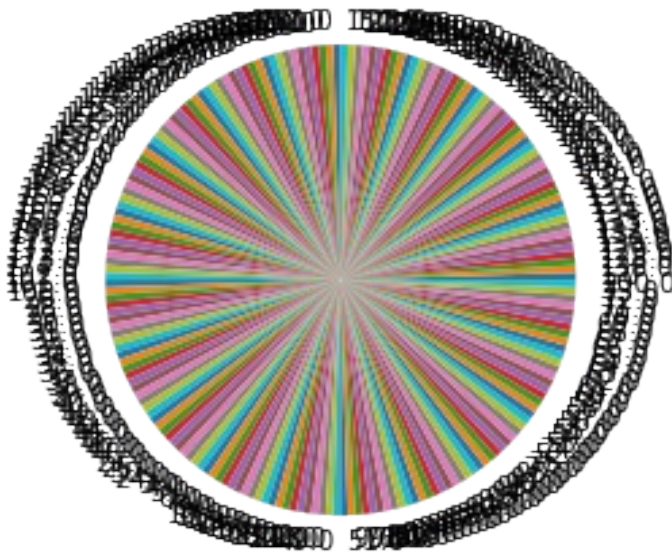
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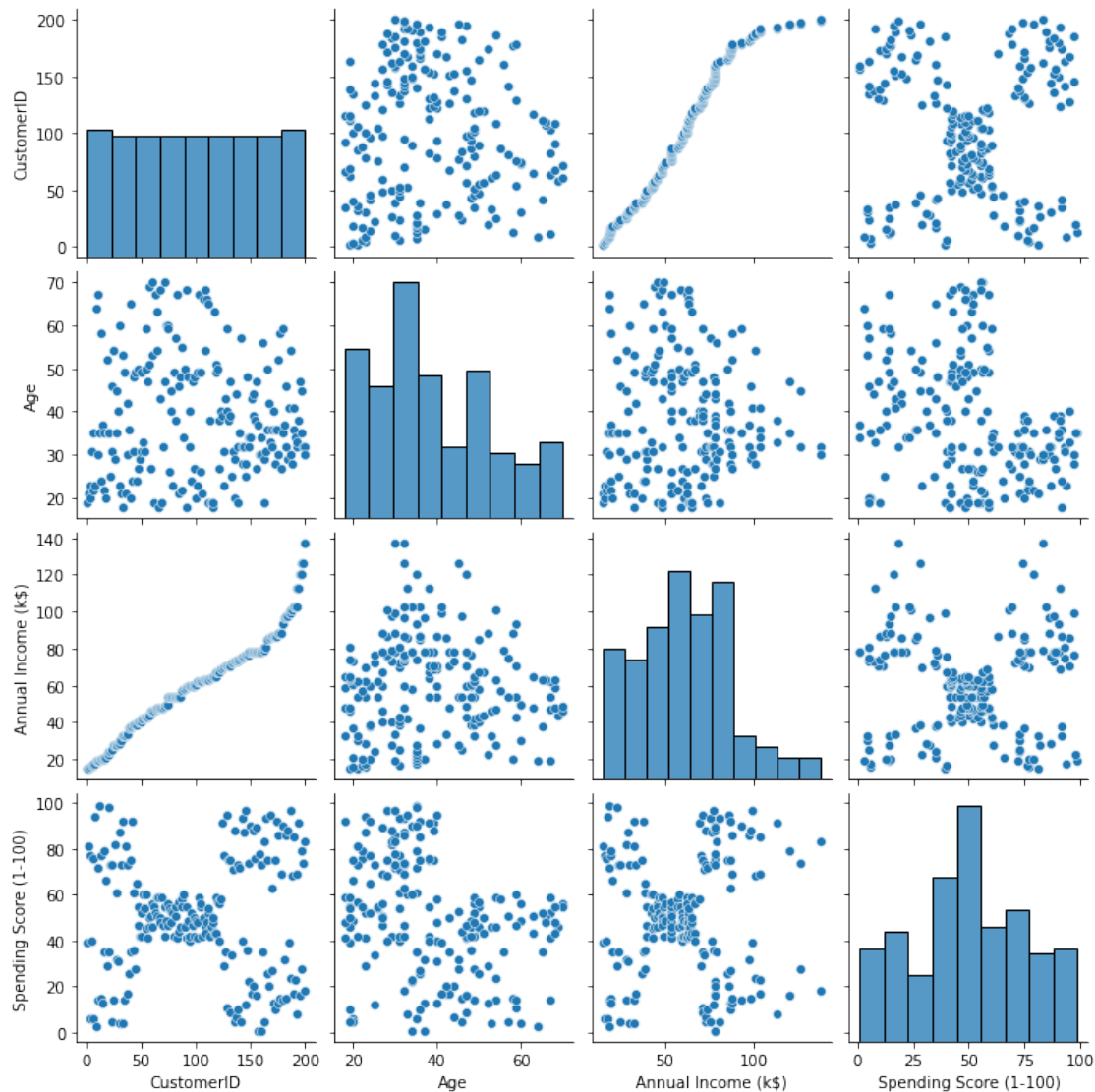
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## 6.Perform descriptive statistics on the dataset

*#Create a DataFrame*

```
df = pd.DataFrame(customer)
```

df

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
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1	2.0	Male	21.0	15.0	81.0
2	3.0	Female	20.0	16.0	6.0

```

3          4.0  Female  23.0          16.0
77.0
4          5.0  Female  31.0          17.0
40.0
..          ...      ...      ...      ...
...
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79.0
196        197.0  Female  45.0        126.0
28.0
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18.0
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83.0

```

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

```
#Create a DataFrame
```

```
df = pd.DataFrame(customer)
```

```
df.sum()
```

```
CustomerID
```

```
20100.0
```

```
Gender
```

```
MaleMaleFemaleFemaleFemaleFemaleFemaleFemaleMale...
```

```
Age
```

```
7770.0
```

```
Annual Income (k$)
```

```
12112.0
```

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

```
10040.0
```

```
dtype: object
```

```
#axis=1
```

```
df.sum(1)
```

```
0          74.0
```

```
1         119.0
```

```
2          45.0
```

```
3         120.0
```

```
4          93.0
```

```
...
```

```
195        430.0
```

```
196        396.0
```

```
197        430.0
```

```
198        386.0
```

```
199        450.0
```

```
Length: 200, dtype: float64
```



```
df.mean()
```

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

```
df.std()
```

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

```
df.describe()
```

```
      CustomerID      Age  Annual Income (k$)  Spending Score (1-
100)
count  200.000000  200.000000          200.000000
mean   100.500000   38.850000          60.560000
std     57.879185   13.969007          26.264721
min      1.000000   18.000000          15.000000
25%     50.750000   28.750000          41.500000
50%     100.500000  36.000000          61.500000
75%     150.250000  49.000000          78.000000
max     200.000000  70.000000         137.000000
```

```
df.describe(include=['object'])
```

```
      Gender
count      200
unique       2
top    Female
freq       112
```

```
df. describe(include='all')
```

```
      CustomerID  Gender      Age  Annual Income (k$)  \
count  200.000000      200  200.000000          200.000000
unique      NaN        2        NaN              NaN
top        NaN    Female      NaN              NaN
freq        NaN      112      NaN              NaN
```

mean	100.500000	NaN	38.850000	60.560000
std	57.879185	NaN	13.969007	26.264721
min	1.000000	NaN	18.000000	15.000000
25%	50.750000	NaN	28.750000	41.500000
50%	100.500000	NaN	36.000000	61.500000
75%	150.250000	NaN	49.000000	78.000000
max	200.000000	NaN	70.000000	137.000000

	Spending Score (1-100)
count	200.000000
unique	NaN
top	NaN
freq	NaN
mean	50.200000
std	25.823522
min	1.000000
25%	34.750000
50%	50.000000
75%	73.000000
max	99.000000

```
customer["Age"].mean()
```

```
38.85
```

```
customer["Annual Income (k$)"].median()
```

```
61.5
```

```
customer.max()
```

CustomerID	200.0
Gender	Male
Age	70.0
Annual Income (k\$)	137.0
Spending Score (1-100)	99.0
dtype:	object

```
customer.min()
```

CustomerID	1.0
Gender	Female
Age	18.0
Annual Income (k\$)	15.0
Spending Score (1-100)	1.0
dtype:	object

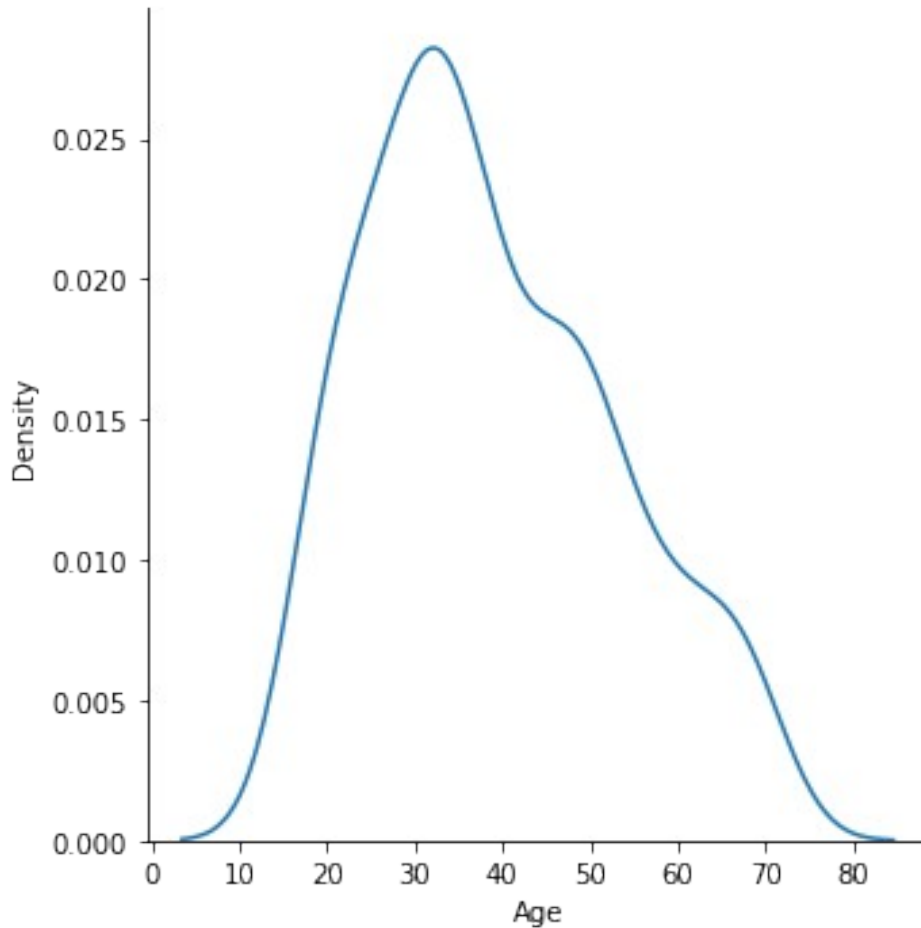
```
customer.kurtosis()
```

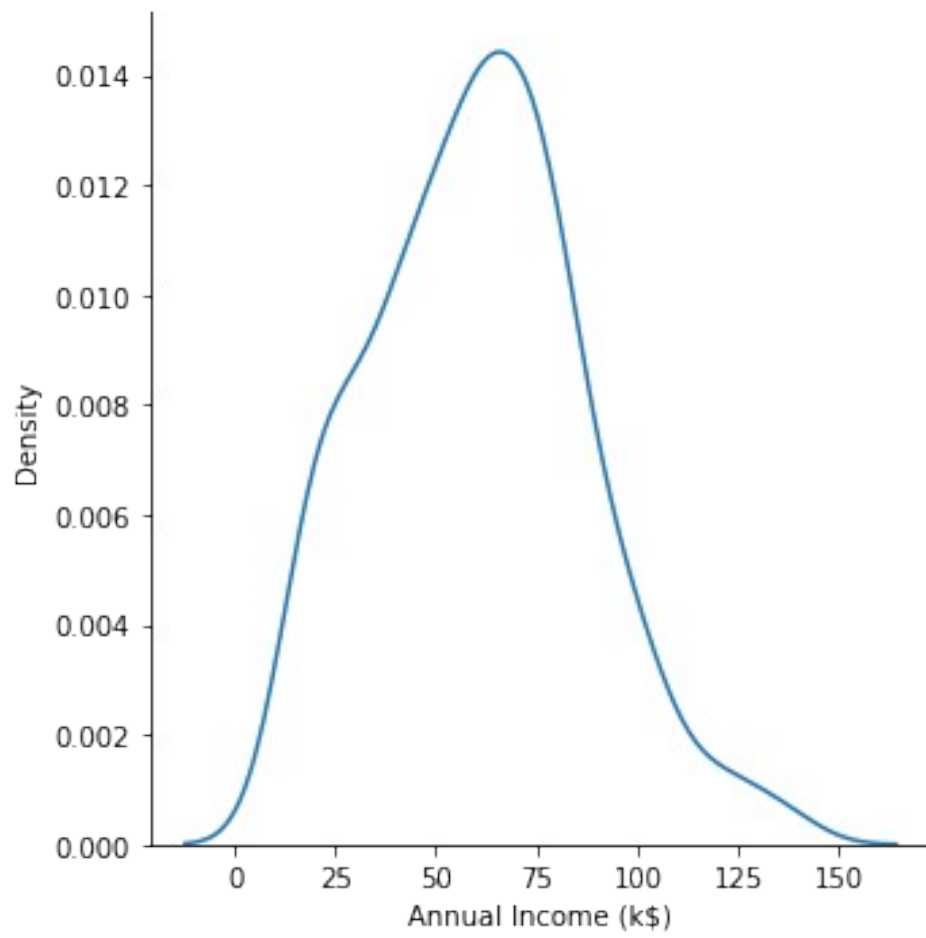
CustomerID	-1.200000
Age	-0.671573
Annual Income (k\$)	-0.098487

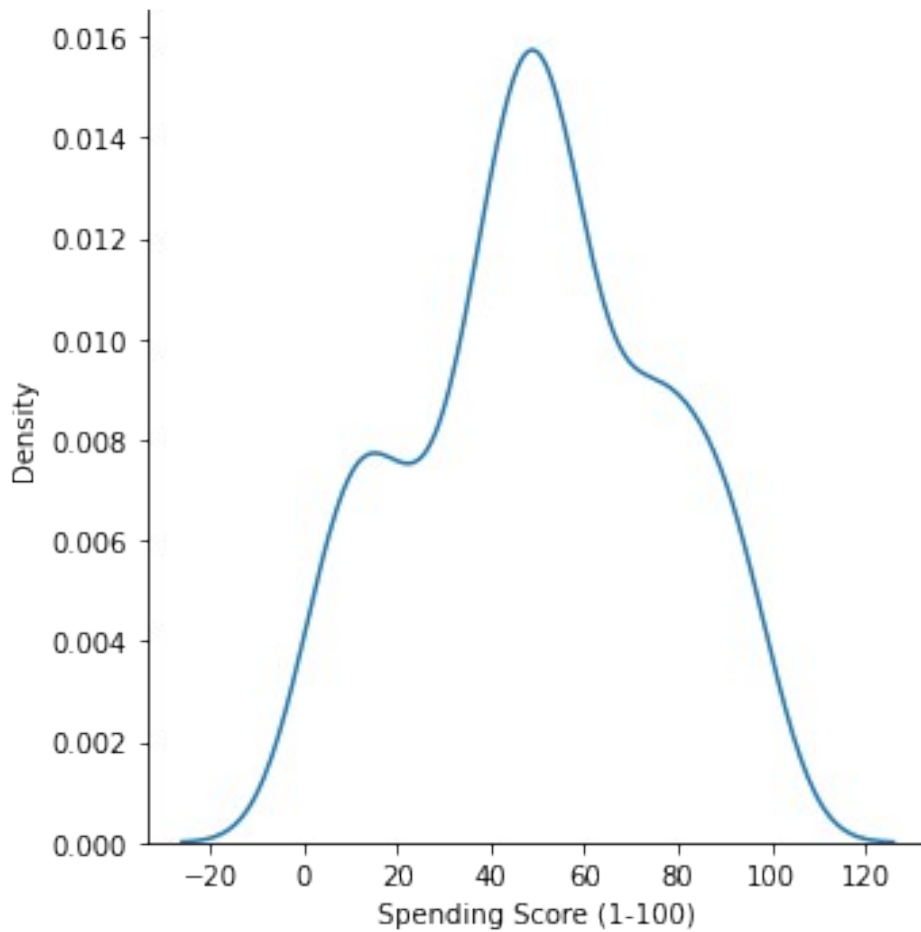
```
Spending Score (1-100)    -0.826629  
dtype: float64
```

```
print(sns.displot(customer["Age"],kind = "kde")),  
print(sns.displot(customer["Annual Income (k$)"],kind = "kde")),  
print(sns.displot(customer["Spending Score (1-100)"],kind = "kde"))
```

```
<seaborn.axisgrid.FacetGrid object at 0x7f7e9c366c50>  
<seaborn.axisgrid.FacetGrid object at 0x7f7e9e0fc410>  
<seaborn.axisgrid.FacetGrid object at 0x7f7e9c30bf50>
```







## 7.Check with missing value and deal with them

```
df.fillna(value = 100)
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1.0	Male	19.0	15.0	
1	2.0	Male	21.0	15.0	
2	3.0	Female	20.0	16.0	
3	4.0	Female	23.0	16.0	
4	5.0	Female	31.0	17.0	
...	...	...	...	...	...
195	196.0	Female	35.0	120.0	
196	197.0	Female	45.0	126.0	

```

28.0
197      198.0    Male  32.0      126.0
74.0
198      199.0    Male  32.0      137.0
18.0
199      200.0    Male  30.0      137.0
83.0

```

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

```
df
```

```

      CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-
100)
0           1.0    Male  19.0      15.0
39.0
1           2.0    Male  21.0      15.0
81.0
2           3.0  Female  20.0      16.0
6.0
3           4.0  Female  23.0      16.0
77.0
4           5.0  Female  31.0      17.0
40.0
..           ...      ...      ...
...
195          196.0  Female  35.0      120.0
79.0
196          197.0  Female  45.0      126.0
28.0
197          198.0    Male  32.0      126.0
74.0
198          199.0    Male  32.0      137.0
18.0
199          200.0    Male  30.0      137.0
83.0

```

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

```
df["Age"].mean()
```

```
38.85
```

```
df["Age"].median()
```

```
36.0
```

```
df["Age"].fillna(df["Age"].mean(),inplace = True)
```

```
df
```

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1.0	Male	19.0	15.0	39.0
1	2.0	Male	21.0	15.0	81.0
2	3.0	Female	20.0	16.0	6.0
3	4.0	Female	23.0	16.0	77.0
4	5.0	Female	31.0	17.0	40.0
...	...	...	...	...	...
195	196.0	Female	35.0	120.0	79.0
196	197.0	Female	45.0	126.0	28.0
197	198.0	Male	32.0	126.0	74.0
198	199.0	Male	32.0	137.0	18.0
199	200.0	Male	30.0	137.0	83.0

[200 rows x 5 columns]

```
df["Annual Income (k$)"].fillna(df["Annual Income (k$)"].median(),inplace = True)
```

df

	CustomerID	Gender	Age	Annual Income (k\$)	Spending Score (1-100)
0	1.0	Male	19.0	15.0	39.0
1	2.0	Male	21.0	15.0	81.0
2	3.0	Female	20.0	16.0	6.0
3	4.0	Female	23.0	16.0	77.0
4	5.0	Female	31.0	17.0	40.0
...	...	...	...	...	...
195	196.0	Female	35.0	120.0	79.0
196	197.0	Female	45.0	126.0	28.0
197	198.0	Male	32.0	126.0	

```

74.0
198      199.0    Male  32.0      137.0
18.0
199      200.0    Male  30.0      137.0
83.0

```

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

```
df= df.replace("Male",np.nan)
```

```
df
```

```

      CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-
100)
0           1.0     NaN  19.0           15.0
39.0
1           2.0     NaN  21.0           15.0
81.0
2           3.0  Female  20.0           16.0
6.0
3           4.0  Female  23.0           16.0
77.0
4           5.0  Female  31.0           17.0
40.0
..          ...     ...   ...           ...
...
195         196.0  Female  35.0          120.0
79.0
196         197.0  Female  45.0          126.0
28.0
197         198.0     NaN  32.0          126.0
74.0
198         199.0     NaN  32.0          137.0
18.0
199         200.0     NaN  30.0          137.0
83.0

```

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

## 8.Find the outlier and replace them

```
### Method to outlier detection
```

```
qnt = customer.quantile(q = (0.25,0.75))
qnt
```

```

      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

```

```
iqr = qnt.loc[0.75] - qnt.loc[0.25] # IQR = Q3 - Q1
```

```
iqr
```



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

```
lower = qnt.loc[0.25] - 1.5 * iqr
lower
```

```
CustomerID          -98.500
Age                 -1.625
Annual Income (k$)  -13.250
Spending Score (1-100) -22.625
dtype: float64
```

```
upper = qnt.loc[0.75] + 1.5 * iqr
upper
```

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

```
customer.mean()
```

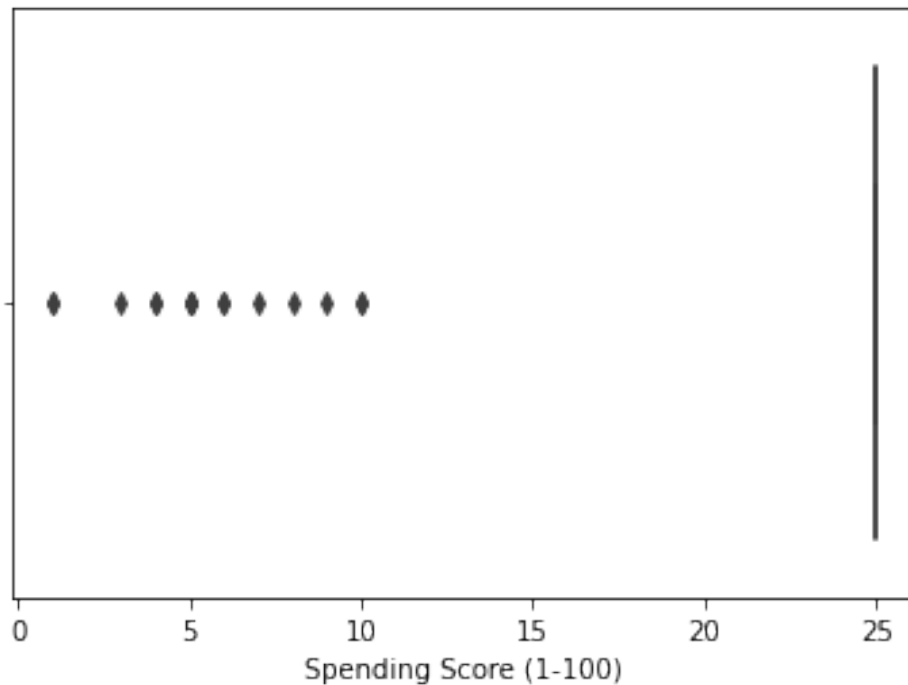
```
CustomerID          100.50
Age                 38.85
Annual Income (k$)  60.56
Spending Score (1-100) 50.20
dtype: float64
```

```
### replacing outlier
```

```
customer["Spending Score (1-100)"] = np.where(customer["Spending Score (1-100)"] > 10,25, customer["Spending Score (1-100)"])
```

```
sns.boxplot(customer["Spending Score (1-100)"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f7ea0febbd0>
```



```
customer.isnull().sum()
```

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

```
customer = customer.dropna(axis = 0)
```

```
customer.isnull().sum()
```

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

## 9. Check for Categorical columns and perform encoding

```
customer['Gender'].unique()
```

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

```
from sklearn.preprocessing import LabelEncoder
```

```
gender = LabelEncoder()
```

```
gender.fit(customer['Gender'])
```

```

LabelEncoder()

marry_values = gender.transform(customer['Gender'])

print("Before Encoding:", list(customer['Gender'][-10:]))

Before Encoding: ['Female', 'Female', 'Male', 'Female', 'Female',
'Female', 'Female', 'Male', 'Male', 'Male']

print("After Encoding:", customer[-10:])

After Encoding:
CustomerID  Gender  Age  Annual Income (k$)
Spending Score (1-100)
190      191.0  Female  34.0      103.0
23.0
191      192.0  Female  32.0      103.0
69.0
192      193.0   Male  33.0      113.0
8.0
193      194.0  Female  38.0      113.0
91.0
194      195.0  Female  47.0      120.0
16.0
195      196.0  Female  35.0      120.0
79.0
196      197.0  Female  45.0      126.0
28.0
197      198.0   Male  32.0      126.0
74.0
198      199.0   Male  32.0      137.0
18.0
199      200.0   Male  30.0      137.0
83.0

print("The inverse from the encoding result:",
gender.inverse_transform(marry_values[-10:]))

The inverse from the encoding result: ['Female' 'Female' 'Male'
'Female' 'Female' 'Female' 'Female' 'Male'
'Male' 'Male']

residence_encoder = LabelEncoder()
residence_values =
residence_encoder.fit_transform(customer['CustomerID'])

print("Before Encoding:", list(customer['CustomerID'][:5]))

Before Encoding: [1.0, 2.0, 3.0, 4.0, 5.0]

print("After Encoding:", residence_values[:5])

After Encoding: [0 1 2 3 4]

```

```
# For 'gender' column
gender = pd.DataFrame(gender_values.toarray(), columns=['Female',
'Male'])
```

```
# Combine all categorical columns as one dataframe
df_categorical_encoded = pd.concat([Gender, Age], axis=1)
```

```
# The preview
print(df_categorical_encoded.shape)
df_categorical_encoded.head()
```

```
(200, 2)
```

```
   Gender  Age
0        1    0
1        1    1
2        0    2
3        0    3
4        0    4
```

```
df_new = pd.concat([customer, df_categorical_encoded], axis=1)
```

```
print(df_new.shape)
df_new.head()
```

```
(200, 7)
```

```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-
100) \
0           1.0   Male  19.0                15.0
39.0
1           2.0   Male  21.0                15.0
81.0
2           3.0  Female  20.0                16.0
6.0
3           4.0  Female  23.0                16.0
77.0
4           5.0  Female  31.0                17.0
40.0
```

```
   Gender  Age
0        1    0
1        1    1
2        0    2
3        0    3
4        0    4
```

```
df_categorical_encoded = pd.get_dummies(customer, drop_first=True)
df_categorical_encoded.head()
```

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

```

0      1.0  19.0      15.0      39.0
1
1      2.0  21.0      15.0      81.0
1
2      3.0  20.0      16.0        6.0
0
3      4.0  23.0      16.0      77.0
0
4      5.0  31.0      17.0      40.0
0

```

```

df_new = pd.concat([customer, df_categorical_encoded], axis=1)
df_new.head()

```

```

      CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-
100) \
0      1.0      Male  19.0      15.0
39.0
1      2.0      Male  21.0      15.0
81.0
2      3.0  Female  20.0      16.0
6.0
3      4.0  Female  23.0      16.0
77.0
4      5.0  Female  31.0      17.0
40.0

```

```

      CustomerID  Age  Annual Income (k$)  Spending Score (1-100)
Gender_Male
0      1.0  19.0      15.0      39.0
1
1      2.0  21.0      15.0      81.0
1
2      3.0  20.0      16.0        6.0
0
3      4.0  23.0      16.0      77.0
0
4      5.0  31.0      17.0      40.0
0

```

## 10. Scaling the data

```
customer.columns
```

```

Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
      'Spending Score (1-100)'],
      dtype='object')

```

```
x=customer[["Age", "CustomerID"]]
```

```
x
```

	Age	CustomerID
0	19.0	1.0
1	21.0	2.0
2	20.0	3.0
3	23.0	4.0
4	31.0	5.0
...	...	...
195	35.0	196.0
196	45.0	197.0
197	32.0	198.0
198	32.0	199.0
199	30.0	200.0

[200 rows x 2 columns]

x.head()

	Age	CustomerID
0	19.0	1.0
1	21.0	2.0
2	20.0	3.0
3	23.0	4.0
4	31.0	5.0

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

```
scale = StandardScaler()
```

```
st_scale = scale.fit_transform(x)
```

```
st_scale
```

```
array([[ -1.42456879,  -1.7234121 ],
       [ -1.28103541,  -1.70609137],
       [ -1.3528021 ,  -1.68877065],
       [ -1.13750203,  -1.67144992],
       [ -0.56336851,  -1.6541292 ],
       [ -1.20926872,  -1.63680847],
       [ -0.27630176,  -1.61948775],
       [ -1.13750203,  -1.60216702],
       [  1.80493225,  -1.5848463 ],
       [ -0.6351352 ,  -1.56752558],
       [  2.02023231,  -1.55020485],
       [ -0.27630176,  -1.53288413],
       [  1.37433211,  -1.5155634 ],
       [ -1.06573534,  -1.49824268],
       [ -0.13276838,  -1.48092195],
       [ -1.20926872,  -1.46360123],
       [ -0.27630176,  -1.4462805 ],
       [ -1.3528021 ,  -1.42895978],
       [  0.94373197,  -1.41163905],
       [ -0.27630176,  -1.39431833],
```

[-0.27630176, -1.3769976 ],  
[-0.99396865, -1.35967688],  
[ 0.51313183, -1.34235616],  
[-0.56336851, -1.32503543],  
[ 1.08726535, -1.30771471],  
[-0.70690189, -1.29039398],  
[ 0.44136514, -1.27307326],  
[-0.27630176, -1.25575253],  
[ 0.08253169, -1.23843181],  
[-1.13750203, -1.22111108],  
[ 1.51786549, -1.20379036],  
[-1.28103541, -1.18646963],  
[ 1.01549866, -1.16914891],  
[-1.49633548, -1.15182818],  
[ 0.7284319 , -1.13450746],  
[-1.28103541, -1.11718674],  
[ 0.22606507, -1.09986601],  
[-0.6351352 , -1.08254529],  
[-0.20453507, -1.06522456],  
[-1.3528021 , -1.04790384],  
[ 1.87669894, -1.03058311],  
[-1.06573534, -1.01326239],  
[ 0.65666521, -0.99594166],  
[-0.56336851, -0.97862094],  
[ 0.7284319 , -0.96130021],  
[-1.06573534, -0.94397949],  
[ 0.80019859, -0.92665877],  
[-0.85043527, -0.90933804],  
[-0.70690189, -0.89201732],  
[-0.56336851, -0.87469659],  
[ 0.7284319 , -0.85737587],  
[-0.41983513, -0.84005514],  
[-0.56336851, -0.82273442],  
[ 1.4460988 , -0.80541369],  
[ 0.80019859, -0.78809297],  
[ 0.58489852, -0.77077224],  
[ 0.87196528, -0.75345152],  
[ 2.16376569, -0.73613079],  
[-0.85043527, -0.71881007],  
[ 1.01549866, -0.70148935],  
[ 2.23553238, -0.68416862],  
[-1.42456879, -0.6668479 ],  
[ 2.02023231, -0.64952717],  
[ 1.08726535, -0.63220645],  
[ 1.73316556, -0.61488572],  
[-1.49633548, -0.597565 ],  
[ 0.29783176, -0.58024427],  
[ 2.091999 , -0.56292355],  
[-1.42456879, -0.54560282],  
[-0.49160182, -0.5282821 ],



[ 2.23553238, -0.51096138],  
[ 0.58489852, -0.49364065],  
[ 1.51786549, -0.47631993],  
[ 1.51786549, -0.4589992 ],  
[ 1.4460988 , -0.44167848],  
[-0.92220196, -0.42435775],  
[ 0.44136514, -0.40703703],  
[ 0.08253169, -0.3897163 ],  
[-1.13750203, -0.37239558],  
[ 0.7284319 , -0.35507485],  
[ 1.30256542, -0.33775413],  
[-0.06100169, -0.3204334 ],  
[ 2.02023231, -0.30311268],  
[ 0.51313183, -0.28579196],  
[-1.28103541, -0.26847123],  
[ 0.65666521, -0.25115051],  
[ 1.15903204, -0.23382978],  
[-1.20926872, -0.21650906],  
[-0.34806844, -0.19918833],  
[ 0.80019859, -0.18186761],  
[ 2.091999 , -0.16454688],  
[-1.49633548, -0.14722616],  
[ 0.65666521, -0.12990543],  
[ 0.08253169, -0.11258471],  
[-0.49160182, -0.09526399],  
[-1.06573534, -0.07794326],  
[ 0.58489852, -0.06062254],  
[-0.85043527, -0.04330181],  
[ 0.65666521, -0.02598109],  
[-1.3528021 , -0.00866036],  
[-1.13750203, 0.00866036],  
[ 0.7284319 , 0.02598109],  
[ 2.02023231, 0.04330181],  
[-0.92220196, 0.06062254],  
[ 0.7284319 , 0.07794326],  
[-1.28103541, 0.09526399],  
[ 1.94846562, 0.11258471],  
[ 1.08726535, 0.12990543],  
[ 2.091999 , 0.14722616],  
[ 1.94846562, 0.16454688],  
[ 1.87669894, 0.18186761],  
[-1.42456879, 0.19918833],  
[-0.06100169, 0.21650906],  
[-1.42456879, 0.23382978],  
[-1.49633548, 0.25115051],  
[-1.42456879, 0.26847123],  
[ 1.73316556, 0.28579196],  
[ 0.7284319 , 0.30311268],  
[ 0.87196528, 0.3204334 ],  
[ 0.80019859, 0.33775413],

[-0.85043527, 0.35507485],  
[-0.06100169, 0.37239558],  
[ 0.08253169, 0.3897163 ],  
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*# normalisation*

```
from sklearn.preprocessing import MinMaxScaler
```

```
min_max = MinMaxScaler(feature_range=(0,1))
```

```
norm = min_max.fit_transform(x)
```

```
norm
```

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```

```
# robust scaler
```

```
from sklearn.preprocessing import RobustScaler
```

```
Rscale = RobustScaler()
```

```
RS = Rscale.fit_transform(x)
```

```
RS
```

```
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## 11. Perform any of the clustering algorithms

[illegible]

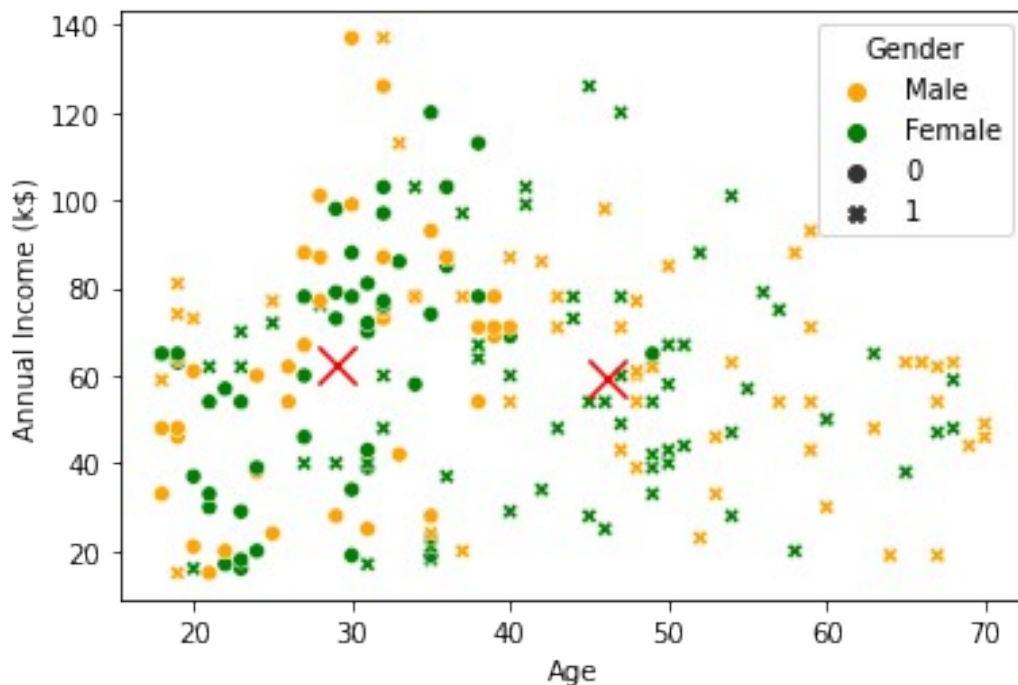
```
df.head()
```

	Age	Annual Income (k\$)	Spending Score (1-100)
0	19.0	15.0	39.0
1	21.0	15.0	81.0
2	20.0	16.0	6.0
3	23.0	16.0	77.0
4	31.0	17.0	40.0

```
sns.scatterplot(  
    x = "Age",  
    y = "Annual Income (k$)",  
    data = df,  
    hue = yes,  
    style = km.labels_,  
    palette= ["orange","green"]  
)
```

```
plt.scatter(  
    km.cluster_centers_[:,0],  
    km.cluster_centers_[:,1],  
    marker= "x",  
    s = 200,  
    c = "red"  
)
```

<matplotlib.collections.PathCollection at 0x7f8402caf450>



```

from sklearn.metrics import silhouette_score
from sklearn import cluster

silhouette_score(df, km.labels_)

0.293166070535953

k_means_model=cluster.KMeans(n_clusters=3,init='k-means+
+',random_state=0)

k_means_model.fit(df)

KMeans(n_clusters=3, random_state=0)

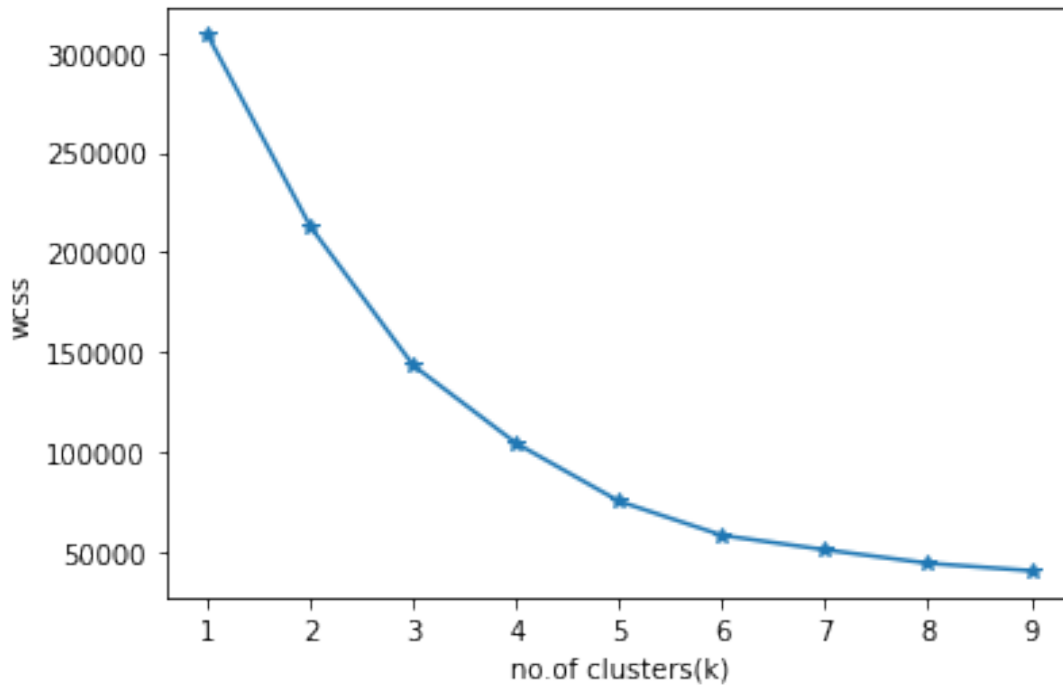
clustered_data =k_means_model.predict(df)

#Elbow Graph
wcss = []

for k in range(1,10):
    km = KMeans(n_clusters= k ,random_state=1,init = "k-means++",
n_init = 10)
    km.fit(df)
    error = km.inertia_
    wcss.append(error)

plt.plot(range(1,10),wcss,marker = "*")
plt.xlabel("no.of clusters(k)")
plt.ylabel("wcss")
plt.show()

```



## 12. Add Cluster data with primary set

```
df['Clustered_data'] = pd.Series(clustered_data)
df.head()
```

	CustomerID	Age	Annual Income (k\$)	Spending Score (1-100)	\
0	1.0	19.0	15.0	39.0	
1	2.0	21.0	15.0	81.0	
2	3.0	20.0	16.0	6.0	
3	4.0	23.0	16.0	77.0	
4	5.0	31.0	17.0	40.0	

	Clustered_data
0	0
1	0
2	0
3	0
4	0

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

```
df.head(0)
```

```
Empty DataFrame
Columns: [CustomerID, Gender, Age, Annual Income (k$), Spending Score (1-100)]
Index: []
```

```
x=df.iloc[:,1:2]
```

x

```
      Gender
0      Male
1      Male
2    Female
3    Female
4    Female
..      ...
195  Female
196  Female
197    Male
198    Male
199    Male
```

[200 rows x 1 columns]

```
y=df.iloc[:,1:]
```

y

```
      Age  Annual Income (k$)  Spending Score (1-100)  Clustered_data
0    19.0             15.0             39.0             0
1    21.0             15.0             81.0             0
2    20.0             16.0              6.0             0
3    23.0             16.0             77.0             0
4    31.0             17.0             40.0             0
..      ...             ...             ...             ...
195  35.0            120.0             79.0             2
196  45.0            126.0             28.0             2
197  32.0            126.0             74.0             2
198  32.0            137.0             18.0             2
199  30.0            137.0             83.0             2
```

[200 rows x 4 columns]

#### 14.Split the data into training and testing

```
from sklearn.model_selection import train_test_split
```

```
df=df.rename(columns={'fit':'fit-feature'})
```

```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

```
x_train.shape,x_test.shape,y_train.shape,y_test.shape
```

```
((160, 1), (40, 1), (160, 4), (40, 4))
```

```
x_test
```



	Gender
18	Male
170	Male
107	Male
98	Male
177	Male
182	Male
5	Female
146	Male
12	Female
152	Female
61	Male
125	Female
180	Female
154	Female
80	Male
7	Female
33	Male
130	Male
37	Female
74	Male
183	Female
145	Male
45	Female
159	Female
60	Male
123	Male
179	Male
185	Male
122	Female
44	Female
16	Female
55	Male
150	Male
111	Female
22	Female
189	Female
129	Male
4	Female
83	Female
106	Female

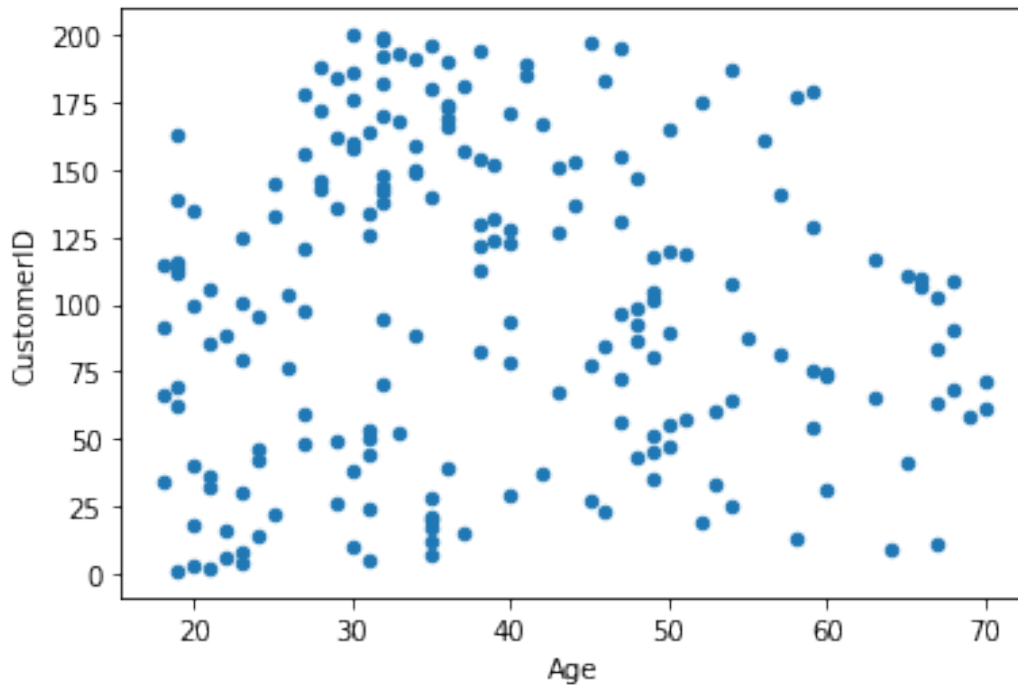
## 15.Build the model

```
from sklearn.linear_model import LinearRegression

lr=LinearRegression()

df.plot.scatter("Age","CustomerID")

<matplotlib.axes._subplots.AxesSubplot at 0x7f46f13ccd10>
```



```
from sklearn.linear_model import LinearRegression
```

```
model=LinearRegression()
```

```
model.fit(x,y)
```

```
LinearRegression()
```

```
predict=model.predict(x)
```

```
predict
```

```
array([[19.          , 61.02272279, 62.20768706, 1.08321414],
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       [20.          , 60.99941182, 61.6027658 , 1.08053333],
       [23.          , 60.9294789 , 59.78800201, 1.07249089],
       [31.          , 60.74299113, 54.94863191, 1.05104438],
       [22.          , 60.95278987, 60.39292327, 1.0751717 ],
       [35.          , 60.64974724, 52.52894686, 1.04032113],
       [23.          , 60.9294789 , 59.78800201, 1.07249089],
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       [37.          , 60.6031253 , 51.31910434, 1.0349595 ],
       [22.          , 60.95278987, 60.39292327, 1.0751717 ],
       [35.          , 60.64974724, 52.52894686, 1.04032113],
       [20.          , 60.99941182, 61.6027658 , 1.08053333],
```

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[30.      , 60.7663021 , 55.55355317, 1.0537252 ]]
```

## 16. Train the model

```
train=df.sample(frac=0.8,random_state=200)
```

```
train
```

	CustomerID	Age	Annual Income (k\$)	Spending Score (1-100)	\
121	122.0	38.0	67.0	40.0	
169	170.0	32.0	87.0	63.0	
194	195.0	47.0	120.0	16.0	
125	126.0	31.0	70.0	77.0	
36	37.0	42.0	34.0	17.0	
..	...	...	...	...	
90	91.0	68.0	59.0	55.0	
162	163.0	19.0	81.0	5.0	
3	4.0	23.0	16.0	77.0	
120	121.0	27.0	67.0	56.0	
95	96.0	24.0	60.0	52.0	

	Clustered_data
121	1
169	2
194	2
125	1
36	0
..	...
90	1
162	2
3	0
120	1
95	1

[160 rows x 5 columns]

```
pred_train = model.predict(x_train)
pred_train
```

```
array([[20.      , 60.99941182, 61.6027658 , 1.08053333],
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       [36.      , 60.62643627, 51.9240256 , 1.03764032],
       [54.      , 60.20683878, 41.03544287, 0.98938568],
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[27.      , 60.83623502, 57.36831696, 1.06176764],
[36.      , 60.62643627, 51.9240256 , 1.03764032]])
```

## 17.Test the Model

y\_test

	Age	Annual Income (k\$)	Spending Score (1-100)	Clustered_data
18	52.0	23.0	29.0	0
170	40.0	87.0	13.0	2
107	54.0	63.0	46.0	1
98	48.0	61.0	42.0	1
177	27.0	88.0	69.0	2
182	46.0	98.0	15.0	2
5	22.0	17.0	76.0	0
146	48.0	77.0	36.0	2
12	58.0	20.0	15.0	0
152	44.0	78.0	20.0	2
61	19.0	46.0	55.0	0
125	31.0	70.0	77.0	1
180	37.0	97.0	32.0	2
154	47.0	78.0	16.0	2
80	57.0	54.0	51.0	1
7	23.0	18.0	94.0	0

33	18.0	33.0	92.0	0
130	47.0	71.0	9.0	1
37	30.0	34.0	73.0	0
74	59.0	54.0	47.0	1
183	29.0	98.0	88.0	2
145	28.0	77.0	97.0	2
45	24.0	39.0	65.0	0
159	30.0	78.0	73.0	2
60	70.0	46.0	56.0	0
123	39.0	69.0	91.0	1
179	35.0	93.0	90.0	2
185	30.0	99.0	97.0	2
122	40.0	69.0	58.0	1
44	49.0	39.0	28.0	0
16	35.0	21.0	35.0	0
55	47.0	43.0	41.0	0
150	43.0	78.0	17.0	2
111	19.0	63.0	54.0	1
22	46.0	25.0	5.0	0
189	36.0	103.0	85.0	2
129	38.0	71.0	75.0	1
4	31.0	17.0	40.0	0
83	46.0	54.0	44.0	1
106	66.0	63.0	50.0	1

```
pred_test=model.predict(x_test)
pred_test
```

```
array([[52.      , 60.25346072, 42.2452854 , 0.99474731],
       [40.      , 60.53319238, 49.50434055, 1.02691706],
       [54.      , 60.20683878, 41.03544287, 0.98938568],
       [48.      , 60.34670461, 44.66497045, 1.00547056],
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       [19.      , 61.02272279, 62.20768706, 1.08321414],
       [31.      , 60.74299113, 54.94863191, 1.05104438],
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       [47.      , 60.37001558, 45.26989171, 1.00815137],
       [30.      , 60.7663021 , 55.55355317, 1.0537252 ],
       [59.      , 60.09028392, 38.01083656, 0.97598161],
       [29.      , 60.78961307, 56.15847443, 1.05640601],
       [28.      , 60.81292404, 56.7633957 , 1.05908682],
       [24.      , 60.90616793, 59.18308075, 1.06981008],
```

```
[30.      , 60.7663021 , 55.55355317, 1.0537252 ],
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[46.      , 60.39332655, 45.87481297, 1.01083219],
[36.      , 60.62643627, 51.9240256 , 1.03764032],
[38.      , 60.57981433, 50.71418307, 1.03227869],
[31.      , 60.74299113, 54.94863191, 1.05104438],
[46.      , 60.39332655, 45.87481297, 1.01083219],
[66.      , 59.92710712, 33.77638773, 0.95721592]])
```

```
from sklearn.linear_model import LinearRegression
```

```
lr = LinearRegression()
```

## 18.Measure the performance using evaluation metrics

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")

customer= pd.read_excel("Mall_Customers.xlsx")

x=df.iloc[:,1:]
```

x

	Age	Annual Income (k\$)	Spending Score (1-100)
0	19.0	15.0	39.0
1	21.0	15.0	81.0
2	20.0	16.0	6.0
3	23.0	16.0	77.0
4	31.0	17.0	40.0
...	...	...	...
195	35.0	120.0	79.0
196	45.0	126.0	28.0
197	32.0	126.0	74.0
198	32.0	137.0	18.0
199	30.0	137.0	83.0

[200 rows x 3 columns]

```
y=df.iloc[:,1:]
```

y

	Age	Annual Income (k\$)	Spending Score (1-100)
0	19.0	15.0	39.0
1	21.0	15.0	81.0
2	20.0	16.0	6.0
3	23.0	16.0	77.0
4	31.0	17.0	40.0
...	...	...	...
195	35.0	120.0	79.0
196	45.0	126.0	28.0
197	32.0	126.0	74.0
198	32.0	137.0	18.0
199	30.0	137.0	83.0

[200 rows x 3 columns]

```
from sklearn.model_selection import train_test_split
```

```
df=df.rename(columns={'fit':'fit-feature'})
```

```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

```
x_train.shape,x_test.shape,y_train.shape,y_test.shape
```

```
((160, 3), (40, 3), (160, 3), (40, 3))
```

```
x_test
```

	Age	Annual Income (k\$)	Spending Score (1-100)
18	52.0	23.0	29.0
170	40.0	87.0	13.0
107	54.0	63.0	46.0
98	48.0	61.0	42.0
177	27.0	88.0	69.0
182	46.0	98.0	15.0
5	22.0	17.0	76.0
146	48.0	77.0	36.0
12	58.0	20.0	15.0
152	44.0	78.0	20.0
61	19.0	46.0	55.0
125	31.0	70.0	77.0
180	37.0	97.0	32.0
154	47.0	78.0	16.0
80	57.0	54.0	51.0
7	23.0	18.0	94.0
33	18.0	33.0	92.0
130	47.0	71.0	9.0
37	30.0	34.0	73.0
74	59.0	54.0	47.0
183	29.0	98.0	88.0
145	28.0	77.0	97.0
45	24.0	39.0	65.0
159	30.0	78.0	73.0
60	70.0	46.0	56.0
123	39.0	69.0	91.0
179	35.0	93.0	90.0
185	30.0	99.0	97.0
122	40.0	69.0	58.0
44	49.0	39.0	28.0
16	35.0	21.0	35.0
55	47.0	43.0	41.0
150	43.0	78.0	17.0
111	19.0	63.0	54.0
22	46.0	25.0	5.0
189	36.0	103.0	85.0
129	38.0	71.0	75.0
4	31.0	17.0	40.0

83	46.0	54.0	44.0
106	66.0	63.0	50.0

```
from sklearn.metrics import r2_score
```

```
from sklearn.linear_model import LinearRegression
```

```
lr = LinearRegression()
```

```
df = df.replace("Male",2)
```

```
lr.fit(x_train,y_train)
```

```
LinearRegression()
```

```
lr.coef_ , lr.intercept_
```

```
(array([[ 1.00000000e+00,  1.32312315e-17, -7.16567384e-18],
        [-1.26527940e-16,  1.00000000e+00, -3.33066907e-16],
        [ 3.03558876e-17,  0.00000000e+00,  1.00000000e+00]]),
 array([-1.42108547e-14,  4.26325641e-14, -1.42108547e-14]))
```

```
y_pred = lr.predict(x_test)
```

```
y_pred
```

```
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```

```
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[ 46.,  54.,  44.],  
[ 66.,  63.,  50.]])
```

```
score = r2_score(y_test,y_pred)
```

```
score
```

```
1.0
```