ASSIGNMENT - 4

MAHENDRA ENGINEERING COLLEGE FOR WOMEN

NAME : BABYSHALINI T

CLASS : 4th YEAR ECE

SUBJECT : IBM

REGISTER NO : 611419106013

## 1.importlibraries

```
#importlibrary

importpandasas
pdimportnumpyas np
importmatplotlib.pyplotaspltimportseabor
nas sns
importwarningswarnings.filterwarnings("ign
ore")
```

## 2.Loadthedataset

```
#loaddataset
from google.colab import
filesupload=files.upload()
```

<IPython.core.display.HTMLobject>

Saving Mall_Customers.xlsx to Mall_Customers

```
(1).xlsxcustomer=pd.read_excel("Mall_Customers.xlsx")
```

## 3.Univariate Analysis

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

#viewfirstfiverowsofDataFrame
df.head()
```

| | CustomerID | Gender | Age | AnnualIncome(k$) | SpendingScore(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 meanof'AnnualIncome(K$)'
df["Annual Income (k$)"].mean()60.56

#calculate medianof'Annual Income(K$)'
df["Annual Income (k$)"].median()61.5

#calculate standarddeviationof'AnnualIncome(K$)'
df["AnnualIncome(k$)"].std()26.2647211

65271244

#calculate modeof'AnnualIncome(K$)'
df["AnnualIncome(k$)"].mode()

0       54.0
1       78.0
dtype:float64

#createfrequencytablefor 'AnnualIncome(k$)'
df["AnnualIncome (k$)"].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

#viewlast fiverowsofDataFrame
df.tail()

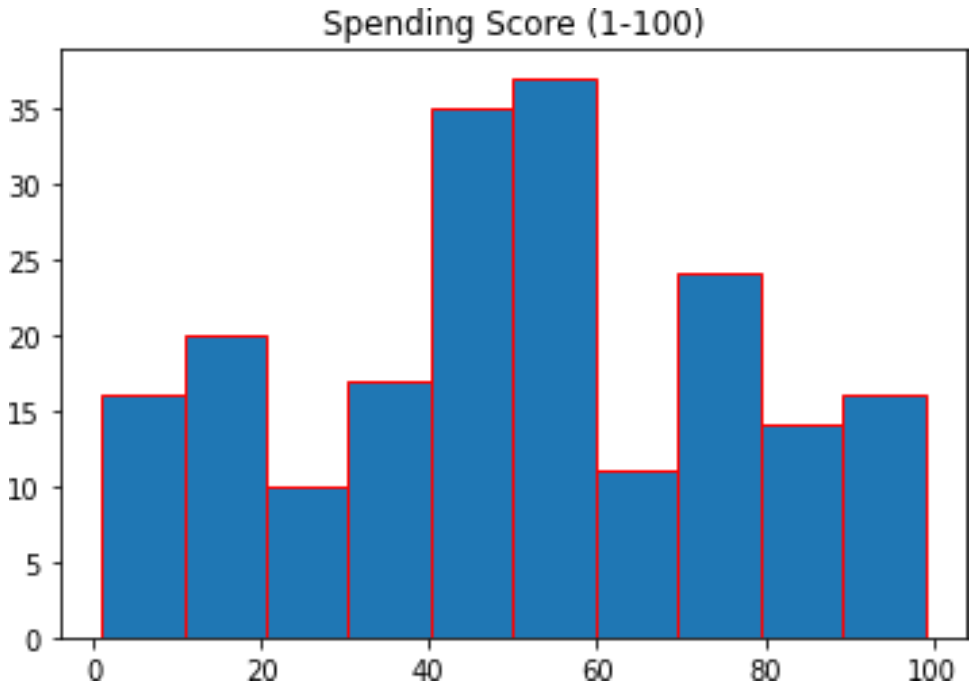
          CustomerID      Gender     Age   Annual       Income (k$)    Spending     Score(1-
100)
195           196.0      Female    35.0                    120.0
79.0
196           197.0      Female    45.0                    126.0
28.0
197           198.0        Male    32.0                    126.0
74.0
198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

#createaboxplotforthe
'SpendingScore'variableimportmatplotlib.pyplotaspltcustomer.boxplot(col
umn=['SpendingScore(1-100)'],grid=False,color='blue')

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b924e850>
```

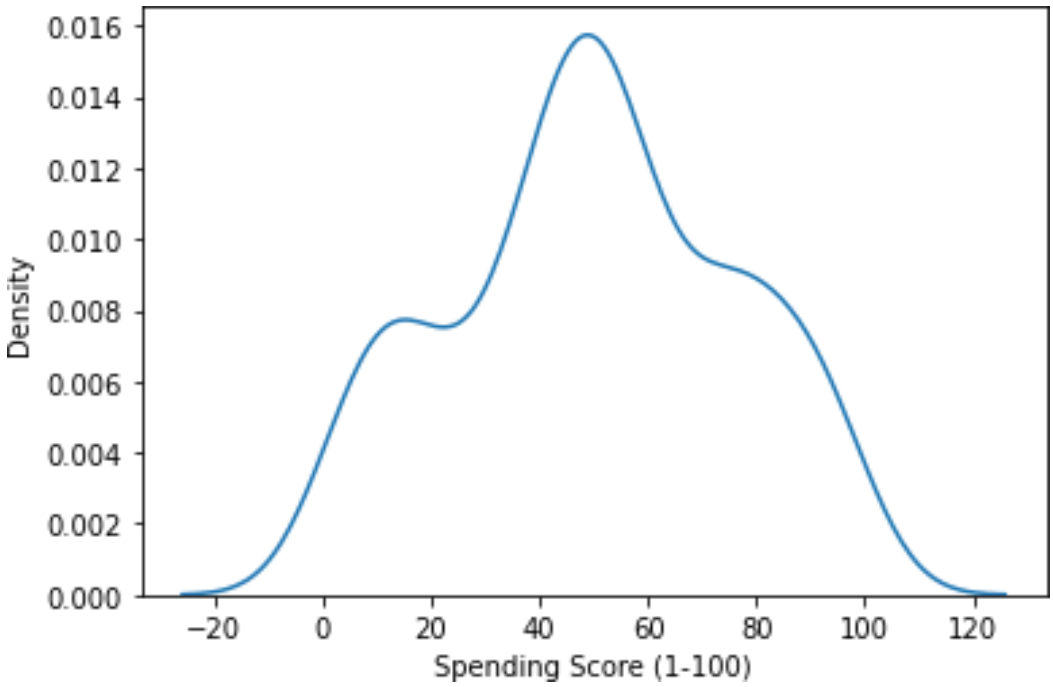

```
#to create histogram for the 'Spending Score' variable
customer.hist(column='Spending Score(1-100)',grid=False,edgecolor='red')
```

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



```
#tocreatea densitycurve forthe'SpendingScore'variable
sns.kdeplot(customer['SpendingScore(1-100)'])
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b9255f10>
```



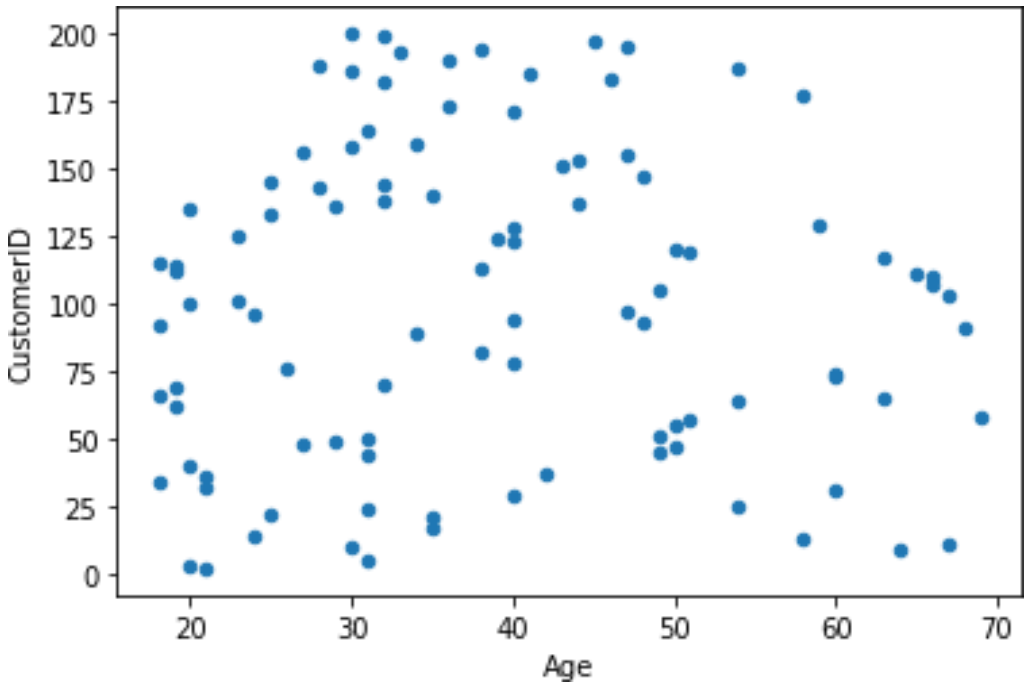

```
#informationofdataset
customer.info()
```

```
<class
'pandas.core.frame.DataFrame'>RangeIndex:200e
ntries,0to199Datacolumns(total 5 columns):
 #    Column                  Non-NullCountDtype
---  ------                  --------------  -----
 0    CustomerID              200non-null     float64
 1    Gender                  200non-null     object
 2    Age                     200non-null     float64
 3    AnnualIncome(k$)        200non-null     float64
 4    Spending Score(1-100)   200non-null     float64
dtypes: float64(4),
object(1)memoryusage:7.9+KB
```

## 4. Bi-VariateAnalysis

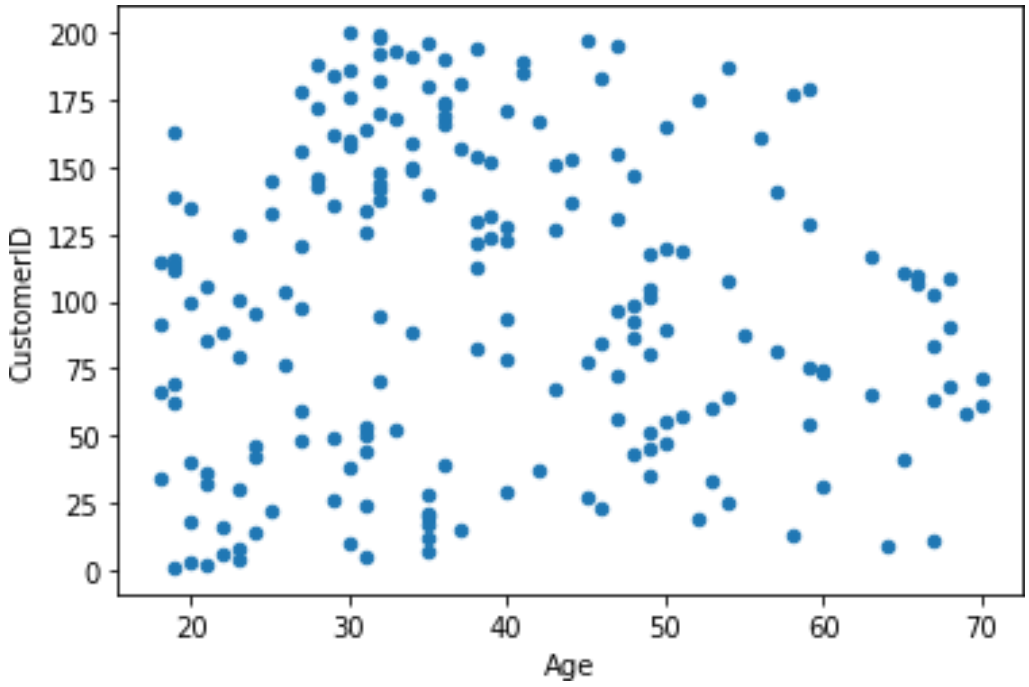
```
#ScatterPlot
customer[customer['Spending Score(1-
100)']<100].sample(100).plot.scatter(x='Age',y='CustomerID')
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8f1e4d0>
```



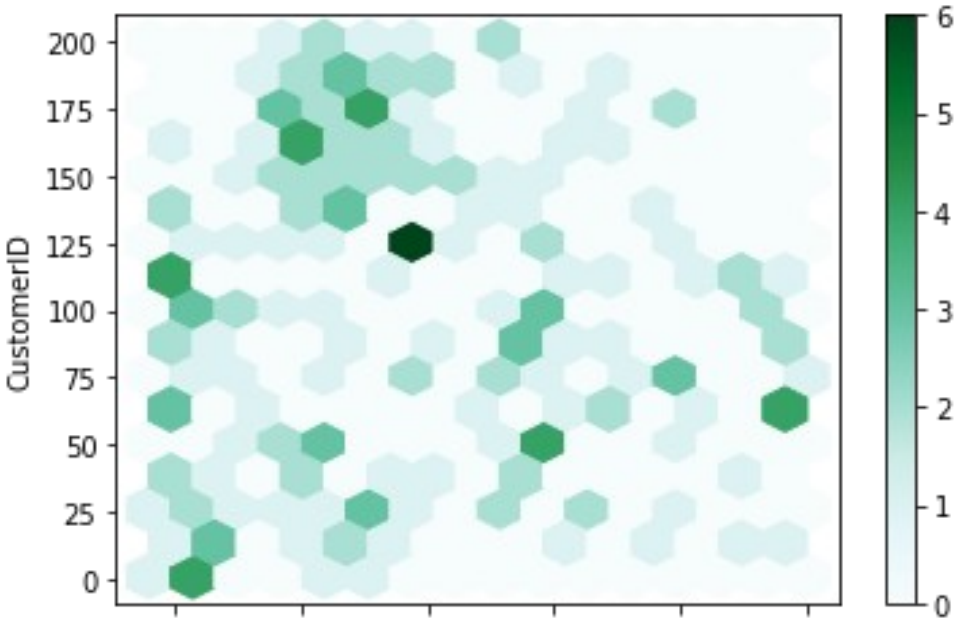

```
customer[customer['Spending Score(1-100)']<100].plot.scatter(x='Age',y='CustomerID')
```

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8eb2b10>



```
#HexPlot
customer[customer['Spending Score(1-
100)']<100].plot.hexbin(x='Age',y='CustomerID', gridsize=15)
```

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8dc0310>

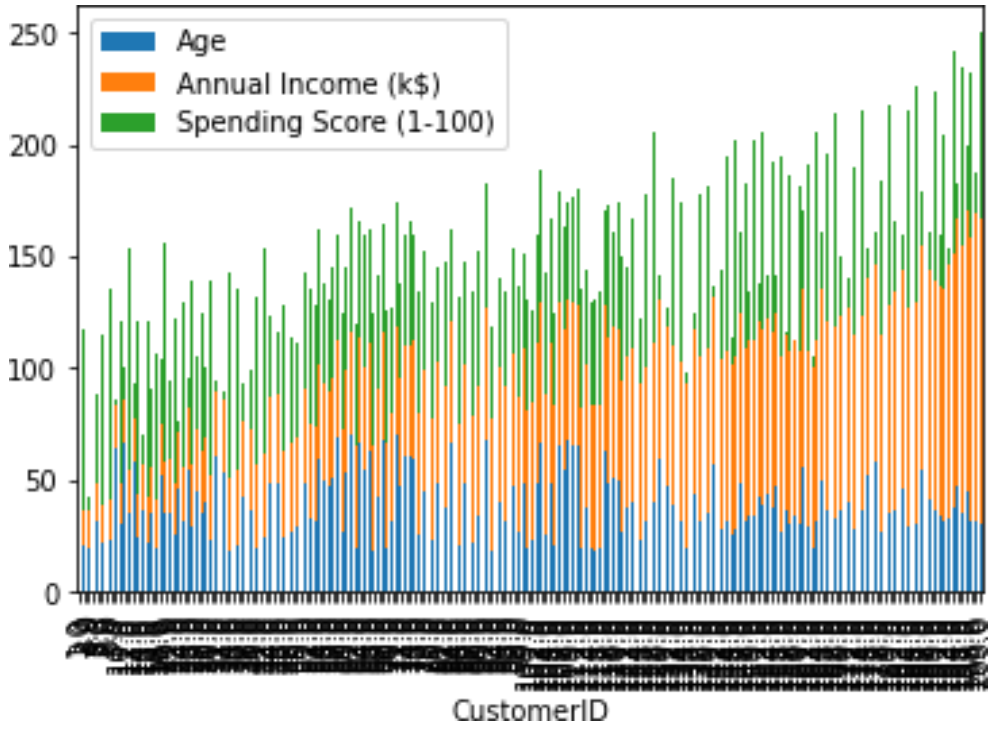



```
#stackedplot
customer_count=pd.read_excel("Mall_Customers.xlsx",index_col=0)customer_count.head()
```

| 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 |

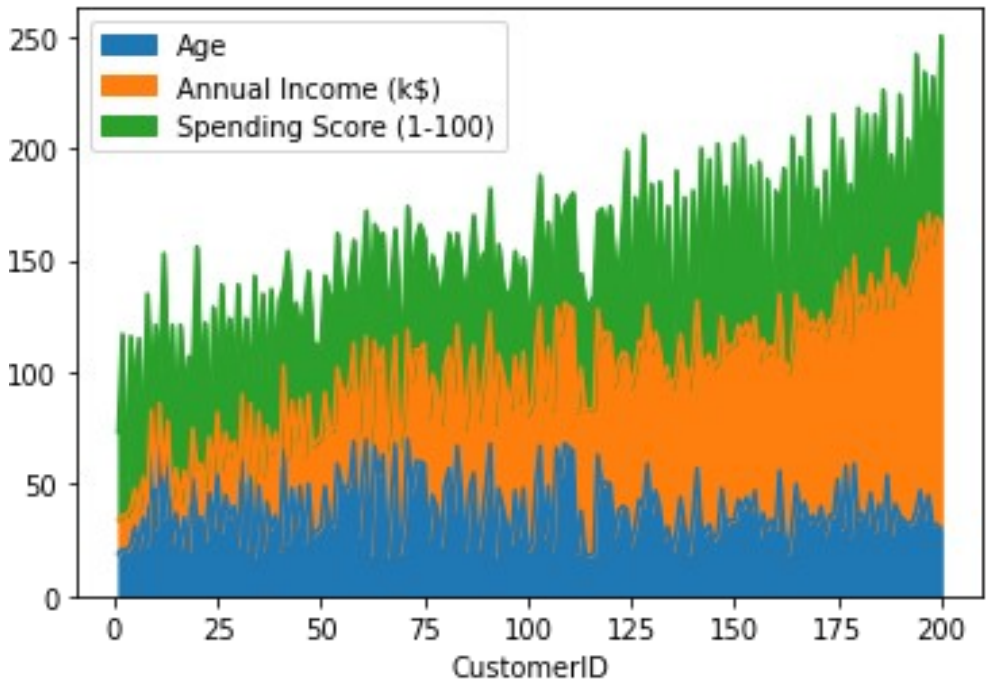
```
customer_count.plot.bar(stacked=True)
```

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8ead250>



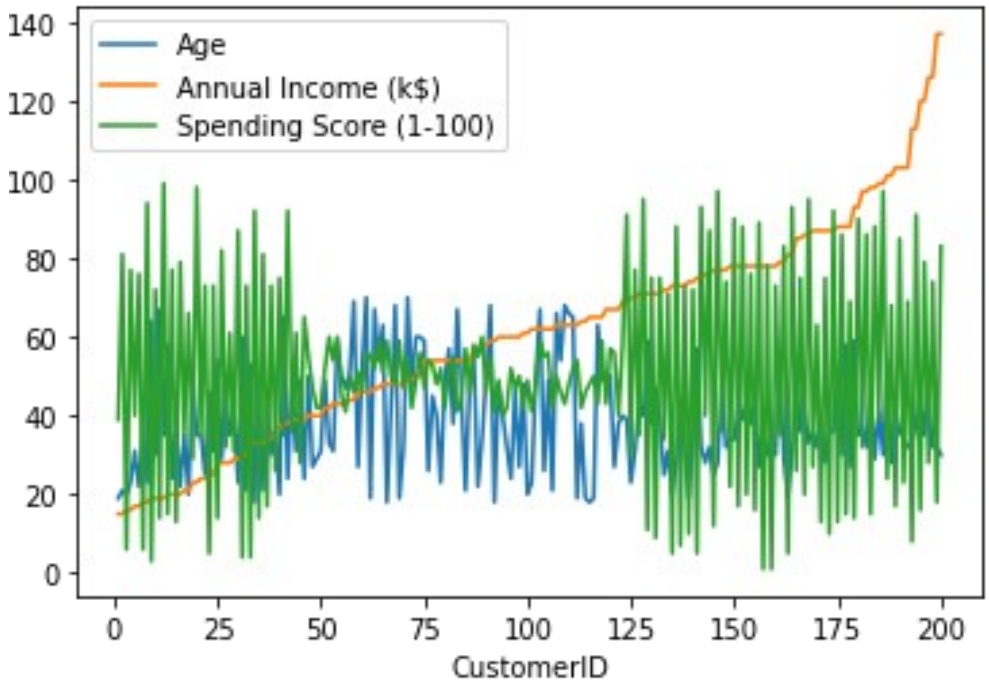

customer_count.plot.area()

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b832b8d0>



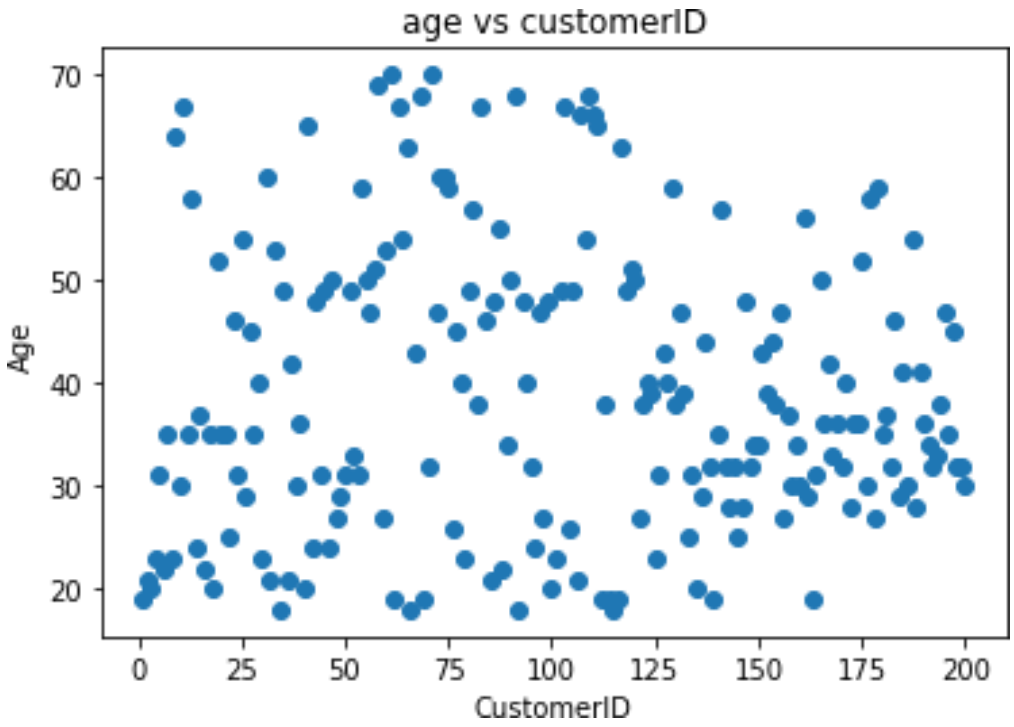
*#Bivariate linechart*
customer_count.plot.line()

<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8338290>




*#createscatterplot ofAnnualIncomevsSpendingScore*plt.scatter(customer.CustomerID,customer.Age)plt.title('agevscustomerID')plt.xlabel('CustomerID')
plt.ylabel('Age')Text(0,0.5,

'Age')




```
#createcorrelationmatrix
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 | |
| SpendingScore(1-100) | 0.013835 | -0.327227 | | 0.009903 | |

| | Spending | Score(1-100) |
|---|---|---|
| CustomerID | | 0.013835 |
| Age | | -0.327227 |
| Annual Income(k$) | | 0.009903 |
| SpendingScore(1-100) | | 1.000000 |

```
importstatsmodels.apiassm

#defineresponsevariable
y=customer['CustomerID']

#defineresponsevariable
x=customer['Age']

#add constanttopredictorvariables
x=sm.add_constant(x)
```

/usr/local/lib/python3.7/dist-packages/statsmodels/tsa/tsatools.py:142:FutureWarning: In a future version of pandasallargumentsofconcat exceptfor theargument 'objs'will bekeyword
-

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

```
#fit linearregressionmodel
model=sm.OLS(y,x).fit()

#viewmodelsummary
print(model.summary())
```

OLSRegression Results

| | | | |
|---|---|---|---|
| Dep.Variable: | CustomerID | R-squared: | 0.001 |
| Model: | OLS | Adj. R-squared: | -0.004 |
| Method: | LeastSquares | 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. |
| DfResiduals: | 198 | BIC: | 2200. |
| DfModel: | 1 | | |
| Covariance Type: | nonrobust | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| const | 104.8081 | 12.149 | 8.627 | 0.000 | 80.850 | 128.766 |
| Age | -0.1109 | 0.294 | -0.377 | 0.707 | -0.691 | 0.470 |

| | | | |
|---|---|---|---|
| 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.
==========
========

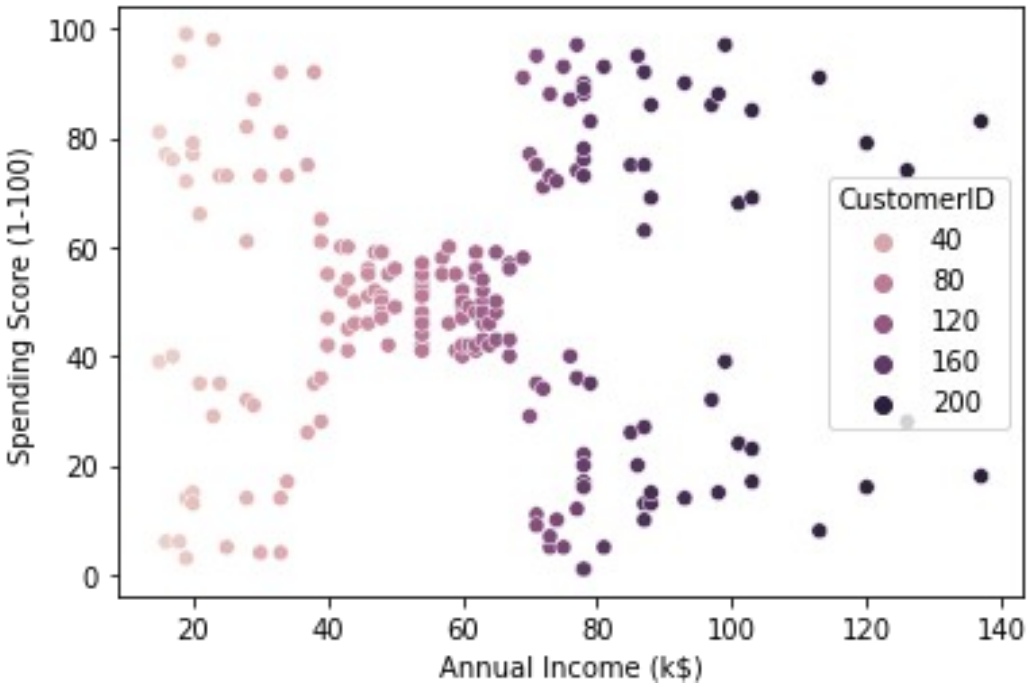
Notes:
[1]StandardErrors assumethat thecovariancematrixofthe errorsiscorrectlyspecified.

## 5. Multi-VariateAnalysis

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

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:FutureWarning:Passthefollowingvariablesaskeywordargs: x,y.Fromversion0.12,theonlyvalidpositionalargumentwillbe`data`,andpassing otherargumentswithout an explicitkeyword willresult inan errorormisinterpretation.
  FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3ac87c410>
```

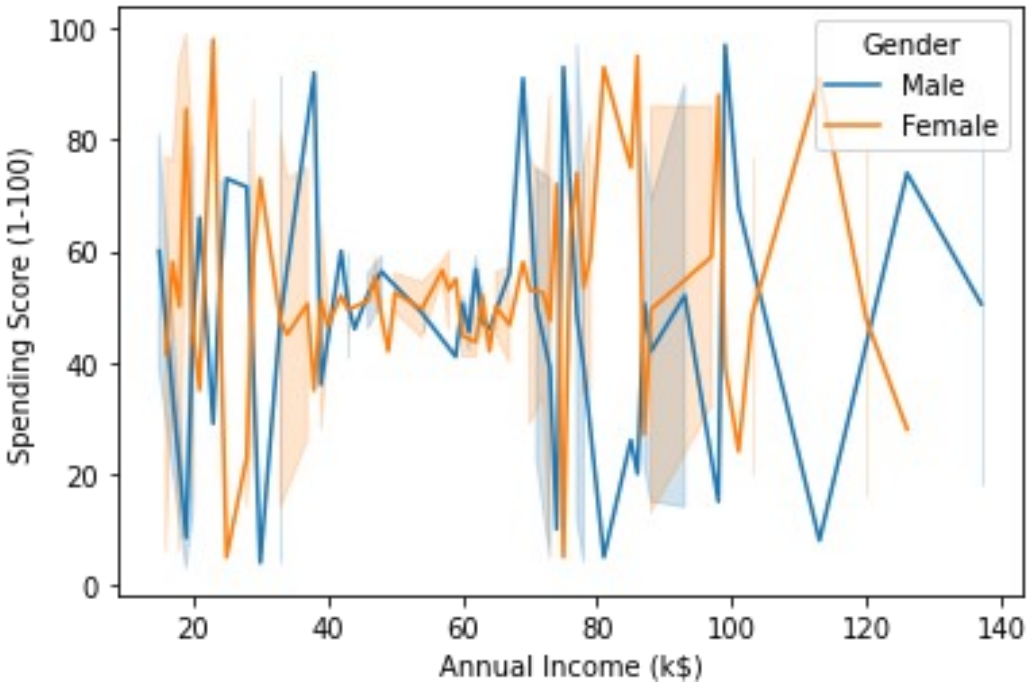



```
sns.lineplot(customer["Annual Income (k$)"],customer["Spending Score(1-100)"],hue=customer["Gender"])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:FutureWarning:Passthefollowingvariablesaskeywordargs: x,y.Fromversion0.12,theonlyvalidpositionalargumentwillbe`data`,andpassing otherargumentswithout an explicitkeyword willresult in
```

anerrorormisinterpretation.
  FutureWarning

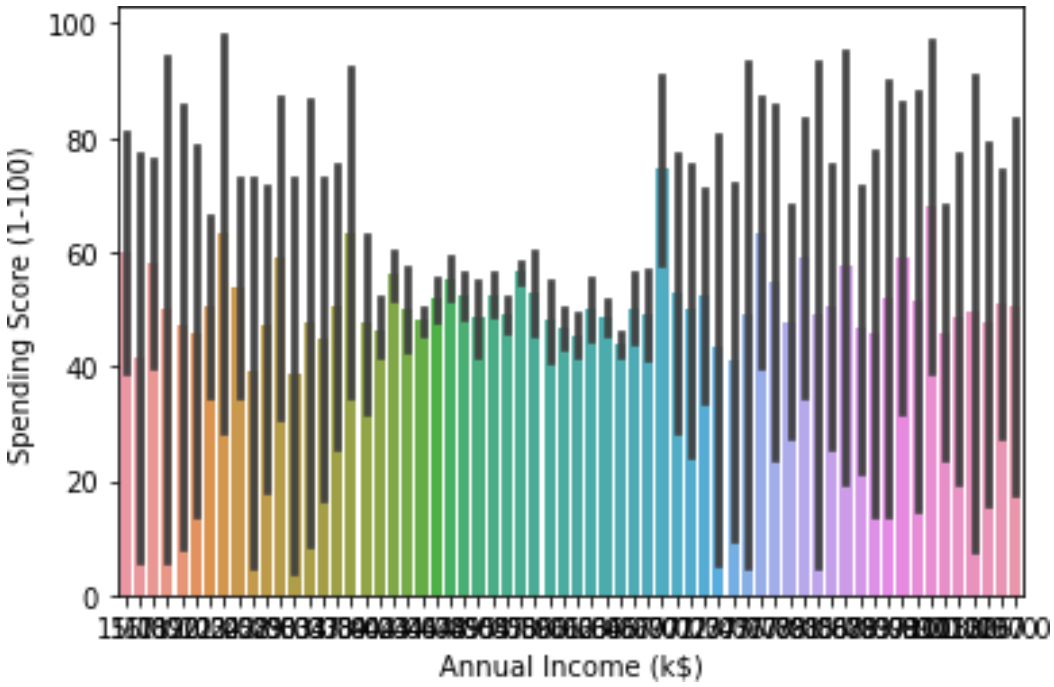
<matplotlib.axes._subplots.AxesSubplotat0x7fc3ac4aee90>




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

/usr/local/lib/python3.7/dist-
packages/seaborn/_decorators.py:43:FutureWarning:Passthefollowingvariablesaskeywordargs:
x,y.Fromversion0.12,theonlyvalidpositionalargumentwillbe`data`,andpassing
otherargumentswithout an explicitkeyword willresult inan errorormisinterpretation.
  FutureWarning

<matplotlib.axes._subplots.AxesSubplotat0x7fc3ac102f10>




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')isdeprecated;in afutureversionthiswillraiseTypeError.Selectonly validcolumnsbeforecallingthereduction.
"""Entry point forlaunching anIPython kernel.

CustomerID 0.000000
Age 0.485569
AnnualIncome(k$) 0.321843
SpendingScore(1-100) -
0.047220dtype:float64

label=df.CustomerID.value_counts().indexcount=df.CustomerID.value_counts().values

plt.pie(count,labels=label)([<matplotlib.patches.Wedgeat0x7fc3a615

b150>,
<matplotlib.patches.Wedgeat0x7fc3a615b610>,
<matplotlib.patches.Wedgeat0x7fc3a615bd50>,
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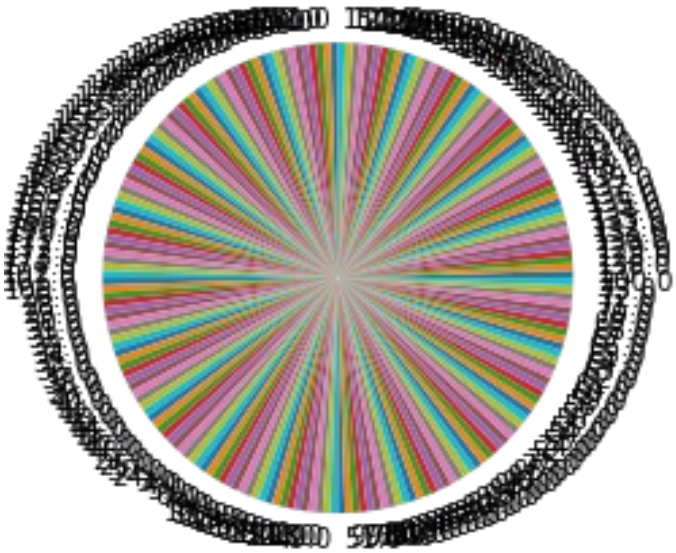

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sns.heatmap(customer.corr(),annot=True)
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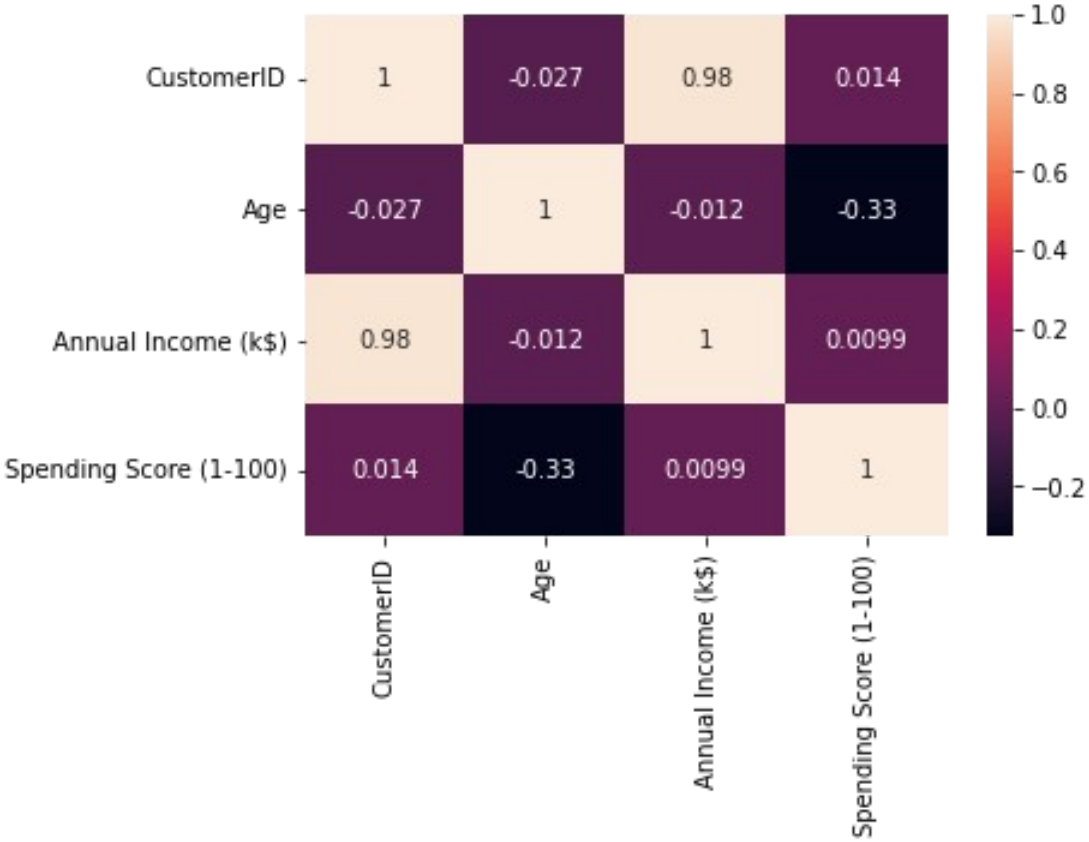


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sns.pairplot(customer)
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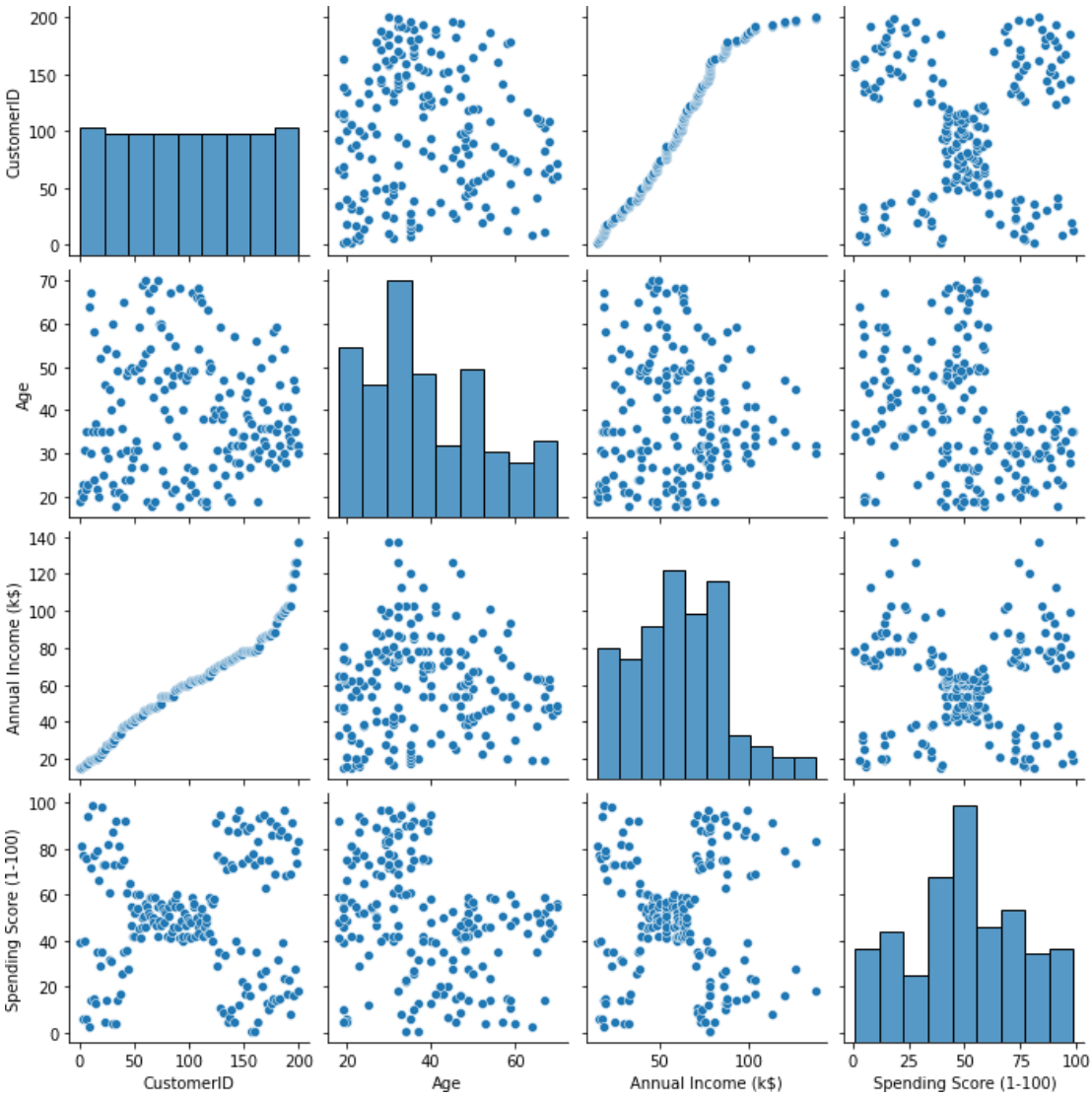



## 6.Performdescriptivestatisticsonthedataset

*#Createa DataFrame*
df = pd.DataFrame(customer)df

| | CustomerID | Gender | Age | Annual | Income | (k$) | SpendingScore(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

[200rows x5 columns]
```

```
#Createa DataFrame
df =

pd.DataFrame(customer)df.sum()

CustomerID2
0100.0
GenderMaleMaleFemaleFemaleFemaleFemaleFemaleFemaleMa...A
ge
7770.0
Annual Income
(k$)12112.0
SpendingScore(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-               50.20
100)dtype:float64

df.std()

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

df.describe()

            CustomerID                  AgeAnnual       Income (k$)       Spending    Score    (1-
100)
count200.000000200.000000                           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.describe(include=['object'])

             Gender
count           200
unique            2
top          Female
freq            112

df.describe(include='all')

            CustomerIDGender                  AgeAnnualIncome(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 |
| AnnualIncome(k$) | 137.0 |
| SpendingScore (1-100) | 99.0 |

dtype:

objectcustomer.mi

n()

| | |
|---|---|
| CustomerID | 1.0 |
| Gender | Female |
| Age | 18.0 |
| AnnualIncome(k$) | 15.0 |
| SpendingScore (1-100) | 1.0 |

dtype:objectcustomer.kur

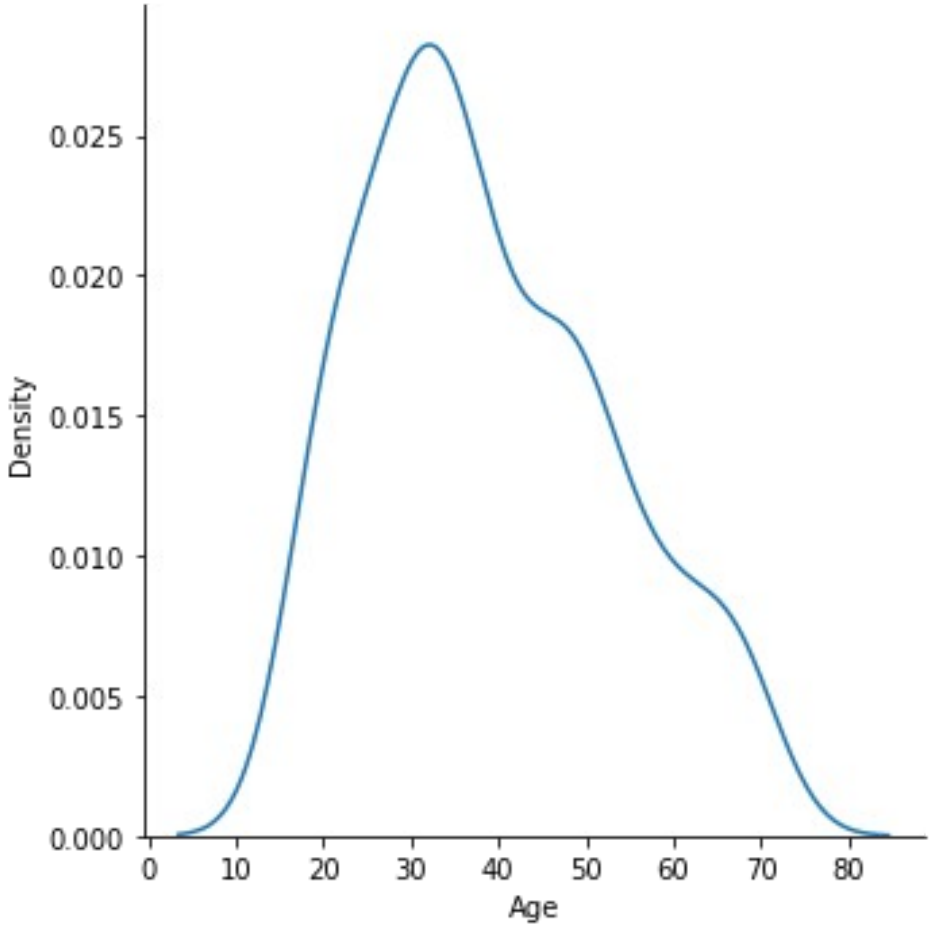
tosis()

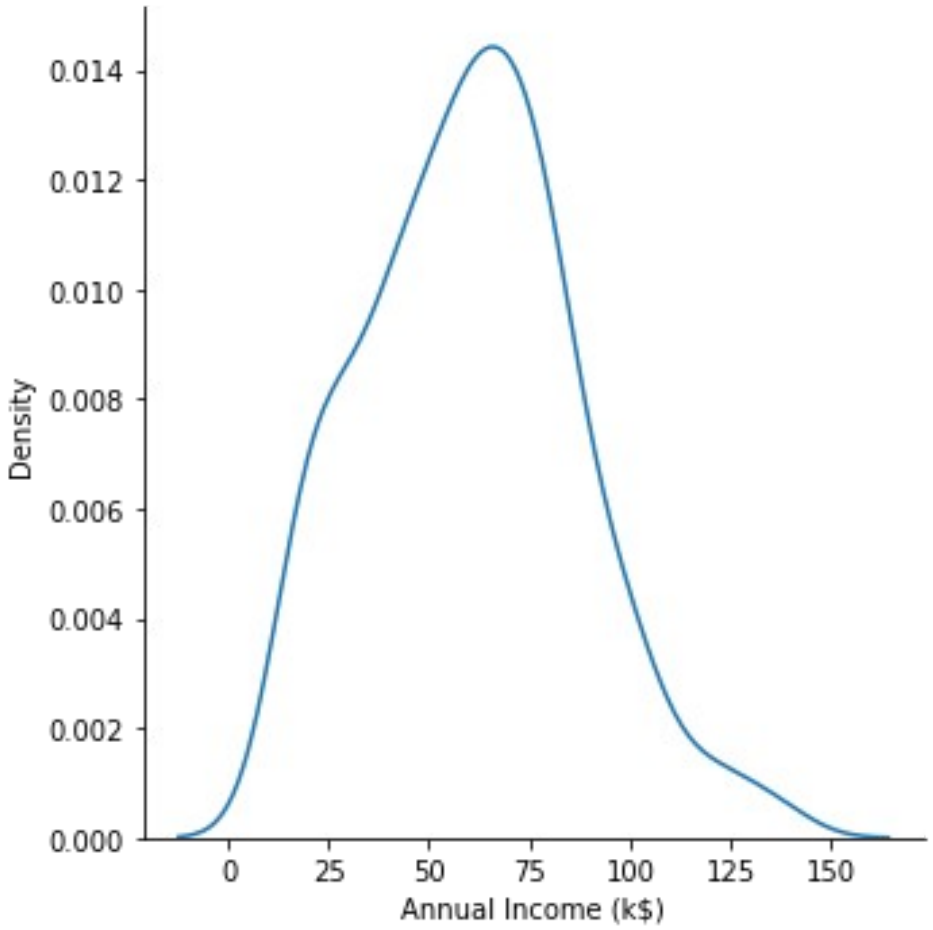
| | |
|---|---|
| CustomerID | -1.200000 |
| Age | -0.671573 |
| Annual Income(k$) | -0.098487 |

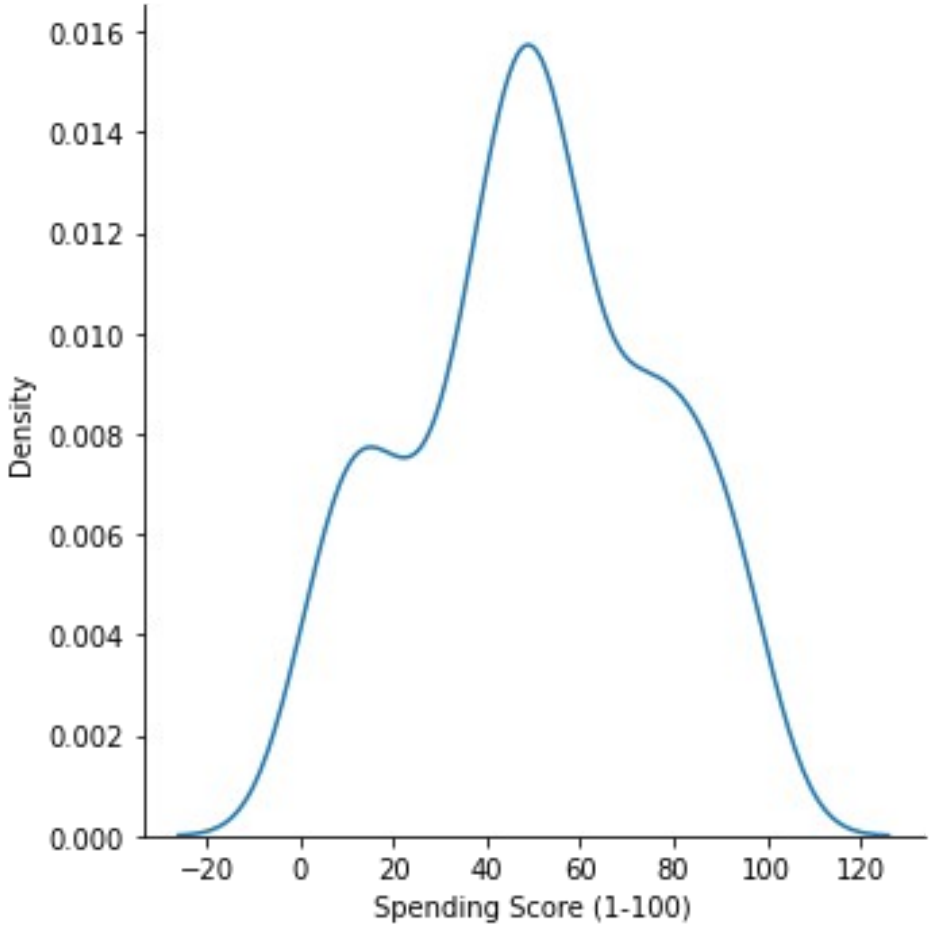
SpendingScore(1-100) -
0.826629dtype:float64

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

<seaborn.axisgrid.FacetGridobject at0x7f7e9c366c50>
<seaborn.axisgrid.FacetGridobject at0x7f7e9e0fc410>
<seaborn.axisgrid.FacetGridobject at0x7f7e9c30bf50>




0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Density
0
25
50
75
100
125
150
Annual Income (k$)




## 7.Checkwithmissingvalueanddealwiththem

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

| | CustomerID | Gender | Age | Annual | Income | (k$) | SpendingScore(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

| | 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 |

[200rows x5 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

[200rows x5 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

[200rows x5 columns]

## 8. Findtheoutlierandreplacethem

*###Methodtooutlierdetection*
qnt = customer.quantile(q= (0.25,0.75))qnt

| | CustomerID | Age | AnnualIncome(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
AnnualIncome(k$)              36.50
SpendingScore (1-100)         38.25
dtype:float64
```

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

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

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

```
CustomerID                   299.500
Age                           79.375
AnnualIncome(k$)             132.750
SpendingScore (1-100)        130.375
dtype:
```

```
float64customer.me
```

```
an()
```

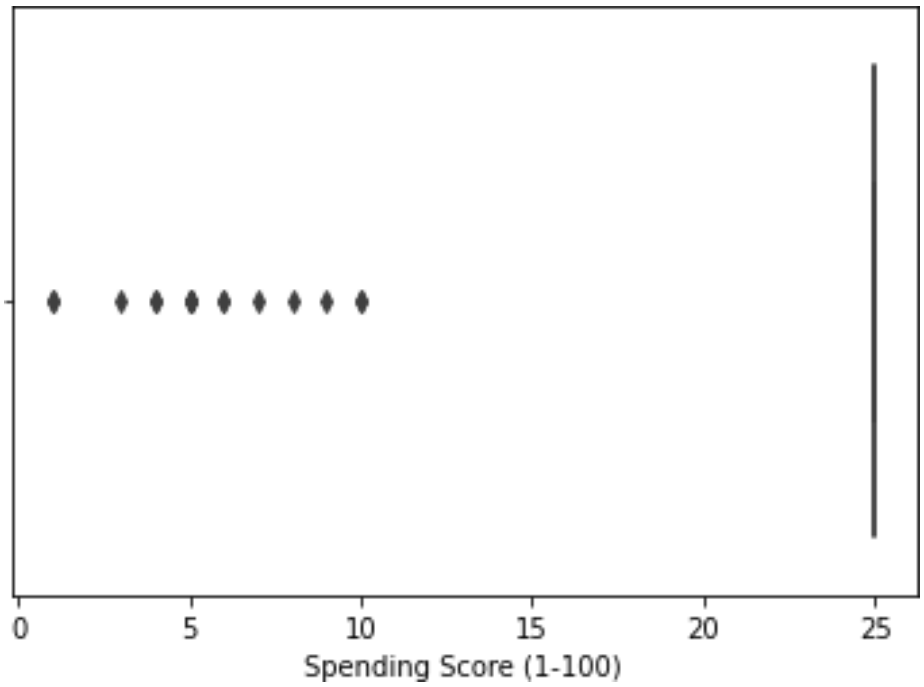
```
CustomerID                   100.50
Age                           38.85
AnnualIncome(k$)              60.56
SpendingScore (1-100)         50.20
dtype:float64
```

*###replacingoutlier*

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

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

```
<matplotlib.axes._subplots.AxesSubplotat0x7f7ea0febbd0>
```




customer.isnull().sum()

| | |
|---|---|
| CustomerID | 0 |
| Gender | 0 |
| Age | 0 |
| AnnualIncome(k$) | 0 |
| SpendingScore (1-100) | 0 |

dtype: int64

customer= customer.dropna(axis=0)customer.isnull().sum()

| | |
|---|---|
| CustomerID | 0 |
| Gender | 0 |
| Age | 0 |
| AnnualIncome (k$) | 0 |
| SpendingScore (1-100) | 0 |

dtype: int64

### 9. CheckforCategoricalcolumnsandperformencoding

customer['Gender'].unique()array(['Male','Female'],dtype

=object)

from sklearn.preprocessingimport LabelEncoder

gender=

LabelEncoder()gender.fit(customer['Gen

der'])

```
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("AfterEncoding:",customer[-10:])

After Encoding:                 CustomerID  Gender
AgeAnnualIncome(k$)SpendingScore(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("Theinversefromthe
encodingresult:",gender.inverse_transform(marry_values[-10:]))

Theinversefromtheencodingresult:['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]))BeforeEncoding:[1.0,2.0, 3.0,4.0, 5.0]

print("AfterEncoding:",residence_values[:5])AfterEncoding:[01234]
```

```
print("Theinversefrom
theencodingresult:",residence_encoder.inverse_transform(residence_values[:5]))
```

Theinverse fromthe encodingresult:[1. 2. 3.4.

5.]fromsklearn.preprocessingimportOneHotEncoder

```
gender_encoder=OneHotEncoder()
```

```
from sklearn.preprocessing import
OneHotEncoderimportnumpyasnp

gender_encoder=OneHotEncoder()
gender_reshaped=np.array(customer['Gender']).reshape(-1,1)gender_values
=gender_encoder.fit_transform(gender_reshaped)

print(customer['Gender'][:5])print()print(gender_
values.toarray()[:5])print()
print(gender_encoder.inverse_transform(gender_values)[:5])
```

```
0       Male
1       Male
2     Female
3     Female
4     Female
Name: Gender, dtype: object

    [[0.1.]
     [0.1.]
     [1.0.]
     [1.0.]
      [1.0.]]

   [['Male']
    ['Male']
  ['Female']
  ['Female']
  ['Female']]
```

```
#Create the encoded dataframe#For
'ever_married'column
Gender= pd.DataFrame(marry_values,columns=['Gender'])

#For'residence_type'column
Age = pd.DataFrame(residence_values,columns=['Age'])

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

```
#Combineallcategoricalcolumnsasonedataframe
df_categorical_encoded= pd.concat([Gender,Age],axis=1)

#
Thepreviewprint(df_categorical_encoded.shape)
df_categorical_encoded.head()
```

(200,2)

```
    GenderAge0  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_ne
w.head()
```

(200,7)

```
    CustomerIDGender            Age  AnnualIncome(k$)SpendingScore(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
```

```
    GenderAge0  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        AgeAnnual Income(k$)  SpendingScore (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$) | SpendingScore (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$) | SpendingScore (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. Scalingthedata

```
customer.columns
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)','SpendingScore(1-100)'],
      dtype='object')x=customer[["Age","C
```

```
ustomerID"]]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()

| | AgeCustomerID019. |
|---|---|
| 0 | 1.0 |
| 121.0 | 2.0 |
| 220.0 | 3.0 |
| 323.0 | 4.0 |
| 431.0 | 5.0 |

from sklearn.preprocessing import

StandardScalerscale=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],
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#normalisation
from sklearn.preprocessingimport MinMaxScaler

min_max=MinMaxScaler(feature_range=(0,1))norm=min_max.
fit_transform(x)

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```
#robustscaler
fromsklearn.preprocessingimport

RobustScalerRscale=RobustScaler()

RS = Rscale.fit_transform(x)RS

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[-0.04938272,       0.79899497],
[0.04938272,        0.80904523],
[-0.19753086,       0.81909548],
[0.49382716,        0.82914573],
[-0.34567901,       0.83919598],
[0.24691358,        0.84924623],
[-0.2962963,        0.85929648],
[0.88888889,        0.86934673],
[-0.39506173,       0.87939698],
[0.24691358,        0.88944724],
[0.                 , 0.89949749],
[-0.09876543,       0.90954774],
[-0.19753086,       0.91959799],
[-0.14814815,       0.92964824],
[0.09876543,        0.93969849],
[0.54320988,        0.94974874],
[-0.04938272,       0.95979899],
[0.44444444,        0.96984925],
[-0.19753086,       0.9798995],
[-0.19753086,       0.98994975],
[-0.2962963,        1.                ]])
```

11. Performanyoftheclusteringalgorithms

```
#K-MEANS CLUSTERING
yes = df.Gender

df = df.drop("Gender",axis= 1)df.head()

        AgeAnnual Income(k$)  SpendingScore (1-100)019.0          15.0
39.0
121.0                           15.0                            81.0
220.0                           16.0                             6.0
323.0                           16.0                            77.0
431.0                           17.0                            40.0

fromsklearn.clusterimport KMeanskm

=KMeans(
        n_clusters=2,random_stat
        e=10,init="k-
        means++",n_init=20,max_
        iter=200
)

importwarningswarnings.filterwarnings("ign
ore")

km.fit(df)

KMeans(max_iter=200, n_clusters=2, n_init=20, random_state=10)km.labels_

array([1,0,1,0,1, 0,1,0,1, 0,1,0,1, 0,1,0,1, 0,1,0,1,
0,
                1, 0,1,0,1,0,1,0,1,0,1,0,1,0, 1,0,1,0,1,0,1,
0,
                1, 0,1,1,1,1,1,0,0,1,1,1,1,1, 0,1,1,0,1,1,1,
0,
                1, 1,0,1,1,1,1,1,1,0,1,1,0,1, 1,0,1,1,0,1,1,
0,
                0, 1,1,1,1,1,1,0,1,0,1,0,1,1, 1,0,1,1,1,1,1,
1,
                1, 0,1,0,0,0,1,0,1,1,0,1,0,0, 1,0,1,0,1,0,1,
0,
                1, 0,1,0,1,0,1,0,1,0,1,0,1,0, 1,0,1,0,1,0,1,
0,
                1, 0,1,0,1,0,1,0,1,0,1,0,1,0, 1,0,1,0,1,0,1,
0,
                1, 0,1,0,1,0,1,0,1,0,1,0,1,0, 1,0,1,0,1,0,1,
0,
                1,0],dtype=int32)
```

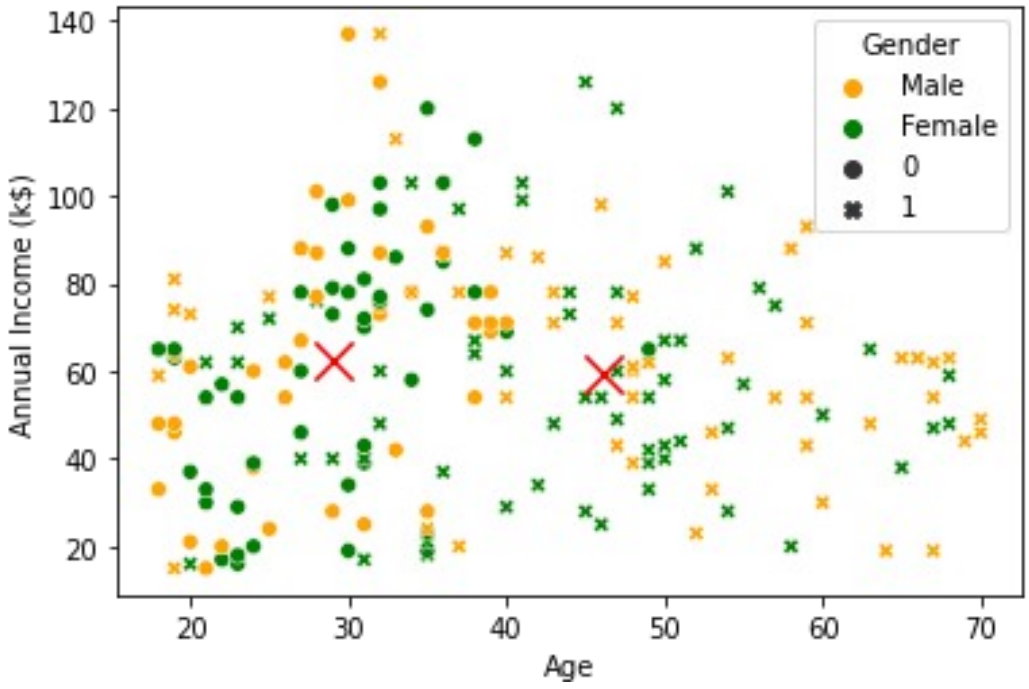
```
df.head()
```

```
      AgeAnnual Income(k$)  SpendingScore (1-100)019.0        15.0
39.0
121.0                         15.0                          81.0
220.0                         16.0                           6.0
323.0                         16.0                          77.0
431.0                         17.0                          40.0
```

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

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

```
<matplotlib.collections.PathCollectionat0x7f8402caf450>
```



```
from sklearn.metrics import
silhouette_scorefromsklearnimportcluster

silhouette_score(df,km.labels_)0.2931660

70535953

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

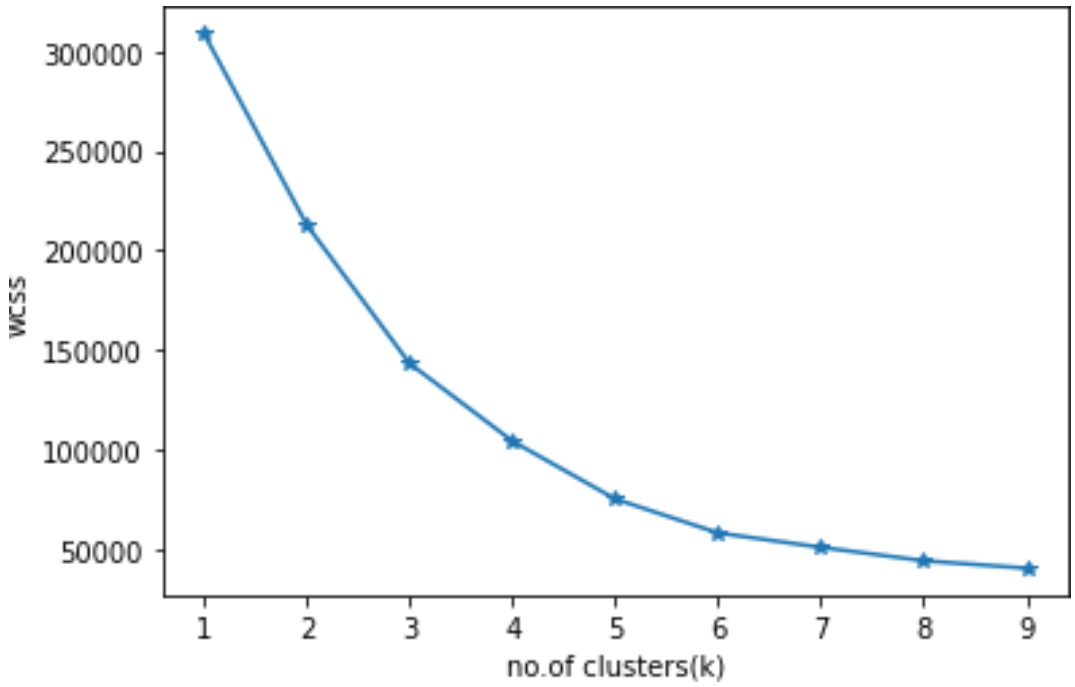
_clusters=3,random_state=0)

clustered_data =k_means_model.predict(df)

#Elbow Graph
wcss=[]

forkinrange(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.ofcl
usters(k)")plt.ylabel("wcss")
plt.show()
```




## 12. AddClusterdatawithprimaryset

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

| | CustomerID | AgeAnnual Income(k$)SpendingScore(1-100)\0 | | 1.019.0 |
|---|---|---|---|---|
| 15.0 | 39.0 | | | |
| 1 | 2.021.0 | | 15.0 | 81.0 |
| 2 | 3.020.0 | | 16.0 | 6.0 |
| 3 | 4.023.0 | | 16.0 | 77.0 |
| 4 | 5.031.0 | | 17.0 | 40.0 |

| | Clustered_data0 |
|---|---|
| 1 | 0 |
| 2 | 0 |
| 3 | 0 |
| 4 | 0 |

## 13. Splitthedataintodependentandindependentvariables

df.head(0)EmptyDat

aFrame
Columns: [CustomerID,Gender,Age,AnnualIncome(k$),SpendingScore
(1-100)]
Index:[]x=df.iloc[:,1:2]

x

| | Gender |
|---|---|
| 0 | Male |
| 1 | Male |
| 2 | Female |
| 3 | Female |
| 4 | Female |
| ..19 | ... |
| 5 | Female |
| 196 | Female |
| 197 | Male |
| 198 | Male |
| 199 | Male |

[200 rows x 1columns]

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 x4 columns]

### 14. Splitthedataintotrainingandtesting

fromsklearn.model_selectionimporttrain_test_splitdf=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

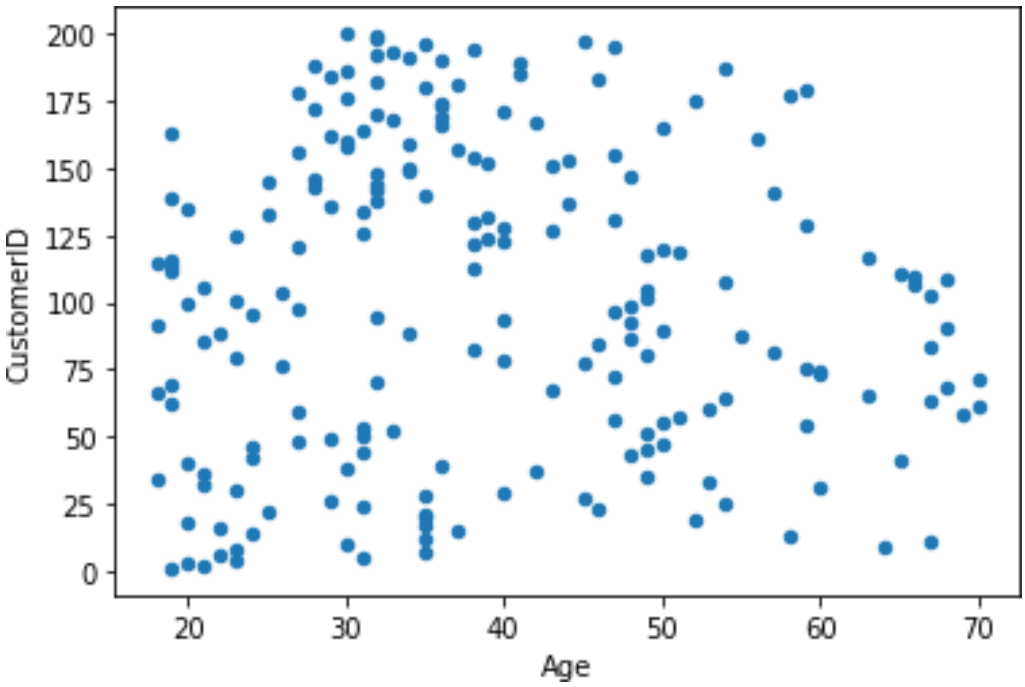
| | Gender |
|---|---|
| 18 | Male |
| 170 | Male |
| 107 | Male |
| 98 | Male |
| 177 | Male |
| 182 | Male |
| 5 | Female |
| 146 | Male |
| 12 | Female |
| 152 | Female |
| 61 | Male |
| 125 | Female |
| 180 | Female |
| 154 | Female |
| 80 | Male |
| 7 | Female |
| 33 | Male |
| 130 | Male |
| 37 | 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. Buildthemodel

from sklearn.linear_model import

LinearRegressionlr=LinearRegression()df.plot.scatter("Age","CustomerID")

<matplotlib.axes._subplots.AxesSubplotat0x7f46f13ccd10>




```
from sklearn.linear_model importLinearRegressionmodel=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],
       [64.        , 59.97372906, 34.98623025,  0.96257755],
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       [67.        , 59.90379614, 33.17146646,  0.95453511],
       [35.        , 60.64974724, 52.52894686,  1.04032113],
       [58.        , 60.11359489, 38.61575783,  0.97866243],
       [24.        , 60.90616793, 59.18308075,  1.06981008],
       [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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```

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[28.        , 60.81292404, 56.7633957 , 1.05908682],
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[36.        , 60.62643627, 51.9240256 , 1.03764032],
[34.        , 60.67305821, 53.13386812, 1.04300194],
[32.        , 60.71968016, 54.34371065, 1.04836357],
[33.        , 60.69636918, 53.73878938, 1.04568276],
[38.        , 60.57981433, 50.71418307, 1.03227869],
[47.        , 60.37001558, 45.26989171, 1.00815137],
[35.        , 60.64974724, 52.52894686, 1.04032113],
[45.        , 60.41663752, 46.47973424, 1.013513  ],
[32.        , 60.71968016, 54.34371065, 1.04836357],
[32.        , 60.71968016, 54.34371065, 1.04836357],
[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 |

[160rows x5 columns]

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

```
array([[20.        , 60.99941182, 61.6027658 , 1.08053333],
       [43.        , 60.46325947, 47.68957676, 1.01887462],
       [45.        , 60.41663752, 46.47973424, 1.013513],
       [19.        , 61.02272279, 62.20768706, 1.08321414],
       [36.        , 60.62643627, 51.9240256 , 1.03764032],
       [54.        , 60.20683878, 41.03544287, 0.98938568],
       [64.        , 59.97372906, 34.98623025, 0.96257755],
       [26.        , 60.85954599, 57.97323822, 1.06444845],
       [51.        , 60.27677169, 42.85020666, 0.99742812],
       [32.        , 60.71968016, 54.34371065, 1.04836357],
       [47.        , 60.37001558, 45.26989171, 1.00815137],
       [23.        , 60.9294789 , 59.78800201, 1.07249089],
       [41.        , 60.50988141, 48.89941929, 1.02423625],
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       [56.        , 60.16021683, 39.82560035, 0.98402405],
       [65.        , 59.95041809, 34.38130899, 0.95989673],
       [51.        , 60.27677169, 42.85020666, 0.99742812],
       [39.        , 60.55650335, 50.10926181, 1.02959788],
       [47.        , 60.37001558, 45.26989171, 1.00815137],
       [32.        , 60.71968016, 54.34371065, 1.04836357],
       [35.        , 60.64974724, 52.52894686, 1.04032113],
       [38.        , 60.57981433, 50.71418307, 1.03227869],
       [48.        , 60.34670461, 44.66497045, 1.00547056],
       [50.        , 60.30008266, 43.45512792, 1.00010893],
       [31.        , 60.74299113, 54.94863191, 1.05104438],
       [33.        , 60.69636918, 53.73878938, 1.04568276],
       [55.        , 60.18352781, 40.43052161, 0.98670487],
       [35.        , 60.64974724, 52.52894686, 1.04032113],
```

[68. , 59.88048517, 32.5665452, 0.95185429],
[32. , 60.71968016, 54.34371065, 1.04836357],
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[25. , 60.88285696, 58.57815948, 1.06712926],
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[32. , 60.71968016, 54.34371065, 1.04836357],
[49. , 60.32339364, 44.06004919, 1.00278975],
[19. , 61.02272279, 62.20768706, 1.08321414],
[32. , 60.71968016, 54.34371065, 1.04836357],
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[33. , 60.69636918, 53.73878938, 1.04568276],
[24. , 60.90616793, 59.18308075, 1.06981008],
[32. , 60.71968016, 54.34371065, 1.04836357],
[31. , 60.74299113, 54.94863191, 1.05104438],
[29. , 60.78961307, 56.15847443, 1.05640601],
[48. , 60.34670461, 44.66497045, 1.00547056],
[24. , 60.90616793, 59.18308075, 1.06981008],
[29. , 60.78961307, 56.15847443, 1.05640601],
[31. , 60.74299113, 54.94863191, 1.05104438],
[54. , 60.20683878, 41.03544287, 0.98938568],
[29. , 60.78961307, 56.15847443, 1.05640601],
[35. , 60.64974724, 52.52894686, 1.04032113],
[22. , 60.95278987, 60.39292327, 1.0751717],

```
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[50.        ,  60.30008266, 43.45512792,  1.00010893],
[32.        ,  60.71968016, 54.34371065,  1.04836357],
[35.        ,  60.64974724, 52.52894686,  1.04032113],
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[27.        ,  60.83623502, 57.36831696,  1.06176764],
[28.        ,  60.81292404, 56.7633957,  1.05908682],
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[36.        ,  60.62643627, 51.9240256,  1.03764032],
[31.        ,  60.74299113, 54.94863191,  1.05104438],
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[40.        ,  60.53319238, 49.50434055,  1.02691706],
[18.        ,  61.04603376, 62.81260832,  1.08589496],
[39.        ,  60.55650335, 50.10926181,  1.02959788],
[21.        ,  60.97610085, 60.99784453,  1.07785252],
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[53.        ,  60.23014975, 41.64036414,  0.99206649],
[28.        ,  60.81292404, 56.7633957,  1.05908682],
[32.        ,  60.71968016, 54.34371065,  1.04836357],
[32.        ,  60.71968016, 54.34371065,  1.04836357],
[23.        ,  60.9294789, 59.78800201,  1.07249089],
```

```
[20.          ,  60.99941182,  61.6027658,   1.08053333],
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[49.          ,  60.32339364,  44.06004919,  1.00278975],
[19.          ,  61.02272279,  62.20768706,  1.08321414],
[34.          ,  60.67305821,  53.13386812,  1.04300194],
[38.          ,  60.57981433,  50.71418307,  1.03227869],
[60.          ,  60.06697295,  37.4059153,   0.9733008],
[40.          ,  60.53319238,  49.50434055,  1.02691706],
[29.          ,  60.78961307,  56.15847443,  1.05640601],
[36.          ,  60.62643627,  51.9240256,   1.03764032],
[38.          ,  60.57981433,  50.71418307,  1.03227869],
[41.          ,  60.50988141,  48.89941929,  1.02423625],
[52.          ,  60.25346072,  42.2452854,   0.99474731],
[34.          ,  60.67305821,  53.13386812,  1.04300194],
[20.          ,  60.99941182,  61.6027658,   1.08053333],
[27.          ,  60.83623502,  57.36831696,  1.06176764],
[57.          ,  60.13690586,  39.22067909,  0.98134324],
[34.          ,  60.67305821,  53.13386812,  1.04300194],
[70.          ,  59.83386323,  31.35670268,  0.94649267],
[22.          ,  60.95278987,  60.39292327,  1.0751717],
[42.          ,  60.48657044,  48.29449802,  1.02155544],
[25.          ,  60.88285696,  58.57815948,  1.06712926],
[30.          ,   60.7663021,  55.55355317,  1.0537252],
[26.          ,  60.85954599,  57.97323822,  1.06444845],
[68.          ,  59.88048517,  32.5665452,   0.95185429],
[33.          ,  60.69636918,  53.73878938,  1.04568276],
[49.          ,  60.32339364,  44.06004919,  1.00278975],
[27.          ,  60.83623502,  57.36831696,  1.06176764],
[36.          ,  60.62643627,  51.9240256,   1.03764032]])
```

## 17. TesttheModel

y_test

| | Age | Annual | Income | (k$) | SpendingScore(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],
       [27.        , 60.83623502, 57.36831696, 1.06176764],
       [46.        , 60.39332655, 45.87481297, 1.01083219],
       [22.        , 60.95278987, 60.39292327, 1.0751717 ],
       [48.        , 60.34670461, 44.66497045, 1.00547056],
       [58.        , 60.11359489, 38.61575783, 0.97866243],
       [44.        , 60.4399485 , 47.0846555 , 1.01619381],
       [19.        , 61.02272279, 62.20768706, 1.08321414],
       [31.        , 60.74299113, 54.94863191, 1.05104438],
       [37.        , 60.6031253 , 51.31910434, 1.0349595 ],
       [47.        , 60.37001558, 45.26989171, 1.00815137],
       [57.        , 60.13690586, 39.22067909, 0.98134324],
       [23.        , 60.9294789 , 59.78800201, 1.07249089],
       [18.        , 61.04603376, 62.81260832, 1.08589496],
       [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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[39.          ,   60.55650335,  50.10926181,   1.02959788],
[35.          ,   60.64974724,  52.52894686,   1.04032113],
[30.          ,   60.7663021,  55.55355317,   1.0537252],
[40.          ,   60.53319238,  49.50434055,   1.02691706],
[49.          ,   60.32339364,  44.06004919,   1.00278975],
[35.          ,   60.64974724,  52.52894686,   1.04032113],
[47.          ,   60.37001558,  45.26989171,   1.00815137],
[43.          ,   60.46325947,  47.68957676,   1.01887462],
[19.          ,   61.02272279,  62.20768706,   1.08321414],
[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 LinearRegressionlr

=LinearRegression()
```

## 18. Measuretheperformanceusingevaluationmetrics

```
importpandasas
pdimportnumpyas np
importmatplotlib.pyplotaspltimportseabor
nas sns
importwarningswarnings.filterwarnings("ign
ore")

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   x3 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 |

```
[200rows x3 columns]

fromsklearn.model_selectionimporttrain_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 |

```
fromsklearn.metricsimport r2_score

from sklearn.linear_model import LinearRegressionlr

=LinearRegression()

df

=df.replace("Male",2)lr.fit(x_train,y

_train)LinearRegression()lr.coef_,l

r.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


array([[ 52.,  23.,  29.],
       [ 40.,  87.,  13.],
       [ 54.,  63.,  46.],
       [ 48.,  61.,  42.],
       [ 27.,  88.,  69.],
       [ 46.,  98.,  15.],
       [ 22.,  17.,  76.],
       [ 48.,  77.,  36.],
       [ 58.,  20.,  15.],
       [ 44.,  78.,  20.],
       [ 19.,  46.,  55.],
       [ 31.,  70.,  77.],
       [ 37.,  97.,  32.],
       [ 47.,  78.,  16.],
       [ 57.,  54.,  51.],
       [ 23.,  18.,  94.],
       [ 18.,  33.,  92.],
       [ 47.,  71.,   9.],
       [ 30.,  34.,  73.],
       [ 59.,  54.,  47.],
       [ 29.,  98.,  88.],
       [ 28.,  77.,  97.],
       [ 24.,  39.,  65.],
       [ 30.,  78.,  73.],
       [ 70.,  46.,  56.],
       [ 39.,  69.,  91.],
       [ 35.,  93.,  90.],
```

```
       [  30.,   99.,   97.],
       [  40.,   69.,   58.],
       [  49.,   39.,   28.],
       [  35.,   21.,   35.],
       [  47.,   43.,   41.],
       [  43.,   78.,   17.],
       [  19.,   63.,   54.],
       [  46.,   25.,    5.],
       [  36.,  103.,   85.],
       [  38.,   71.,   75.],
       [  31.,   17.,   40.],
       [  46.,   54.,   44.],
       [  66.,   63.,   50.]])
```

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

```
1.0
```