ASSIGNMENT - 4

MAHENDRA ENGINEERING COLLEGE FOR WOMEN

NAME : KOWSALYA. M

CLASS : 4th YEAR ECE

SUBJECT : IBM

REGISTER NO : 611419106033

1.importlibraries

```
#importlibrary

importpandasas
pdimportnumpyas np
importmatplotlib.pyplotaspltimp
ortseabornas sns
importwarningswarnings.filterwarn
ings("ignore")
```

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()
```

```
   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
```

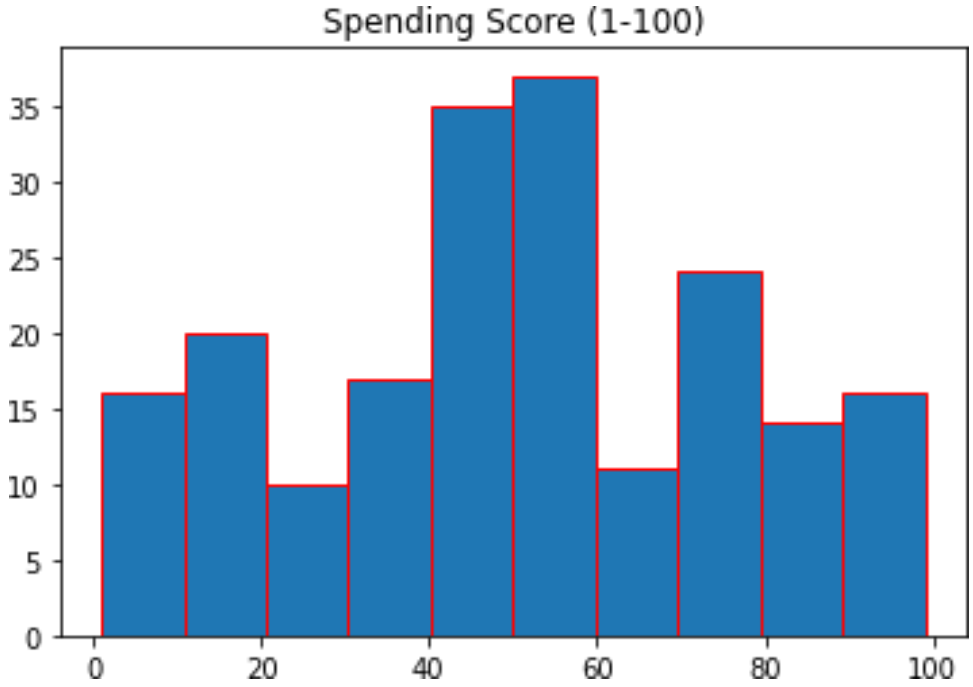
```
40.0

#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

.264721165271244

#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.pyplotaspltcust
omer.boxplot(column=['SpendingScore(1-
100)'],grid=False,color='blue')
```

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

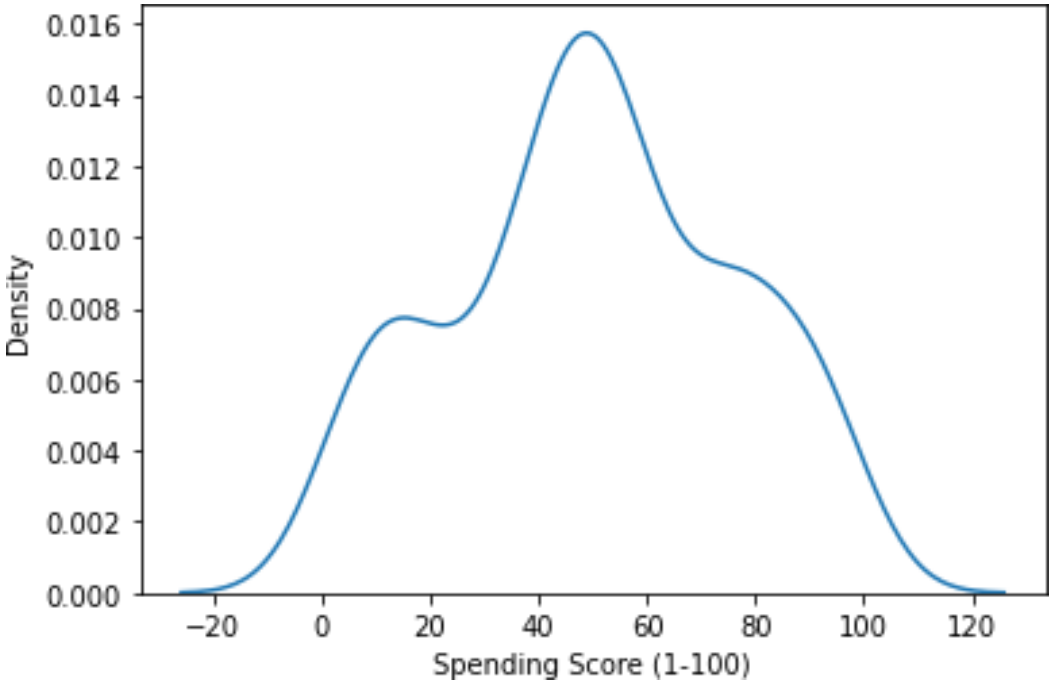

```
#to create histogram for the 'Spending Score'
variablecustomer.hist(column='Spending Score(1-
100)',grid=False,edgecolor='red')
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object
at0x7fc3b982a490>]],
      dtype=object)
```



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

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



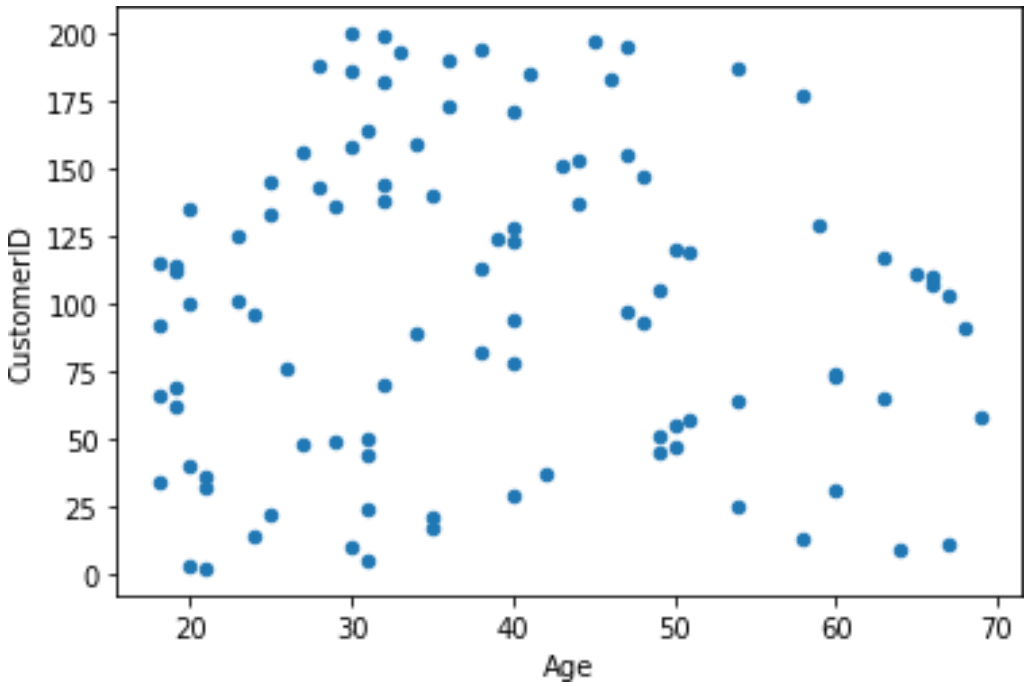

```
#informationofdataset
customer.info()
```

```
<class
'pandas.core.frame.DataFrame'>RangeIn
dex:200entries,0to199Datacolumns(tota
l 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

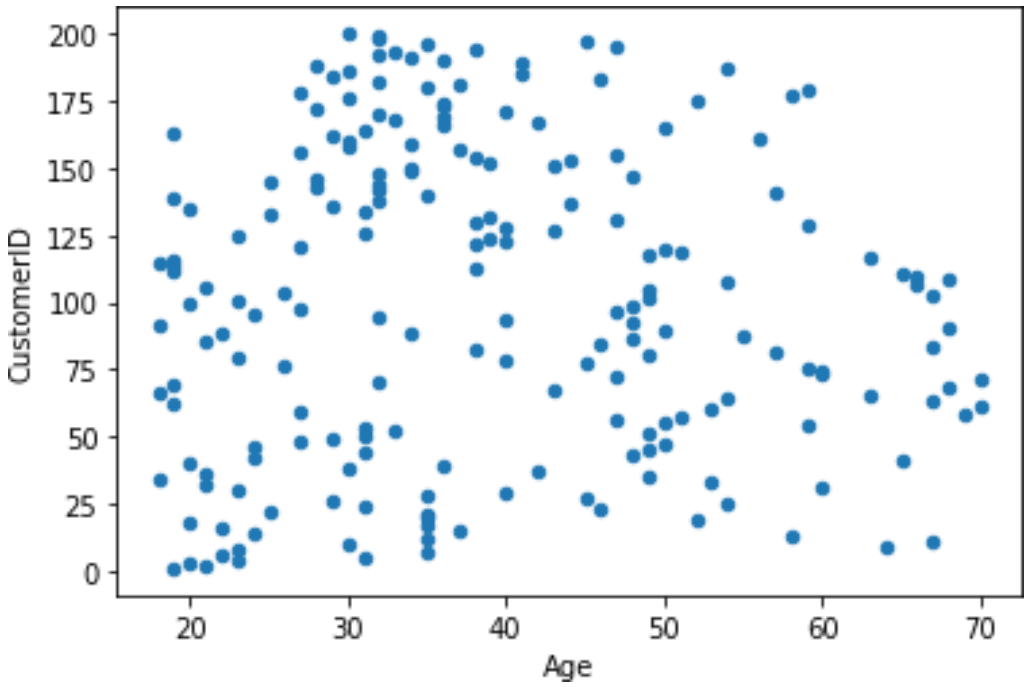
```
#ScatterPlot
customer[customer['Spending Score(1-
100)']<100].sample(100).plot.scatter(x='Age',y='CustomerID')
```

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



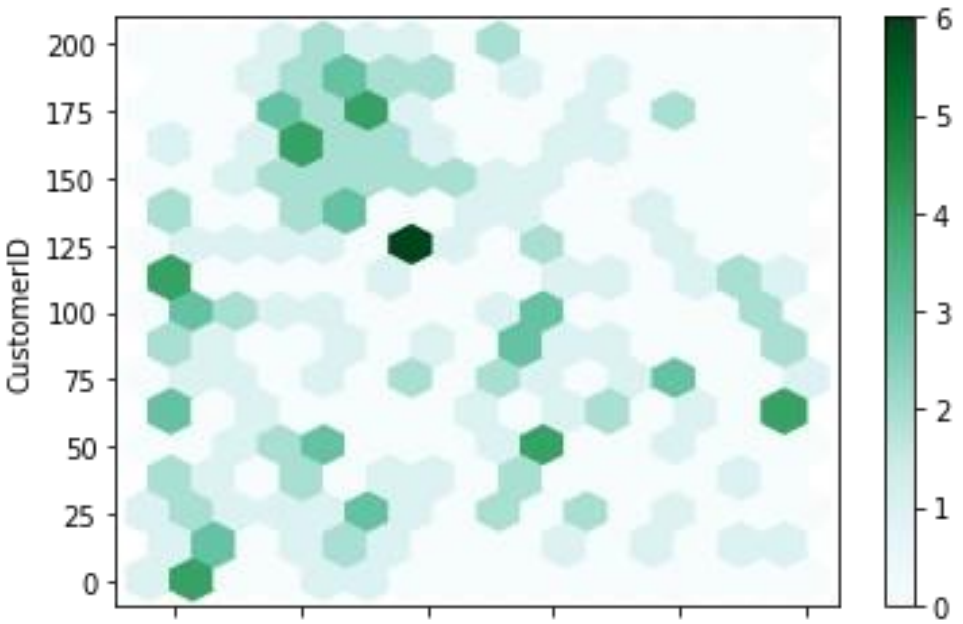

```
customer[customer['Spending Score(1-
100)']<100].plot.scatter(x='Age',y='CustomerID')
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8eb2b10>
```



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

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8dc0310>
```

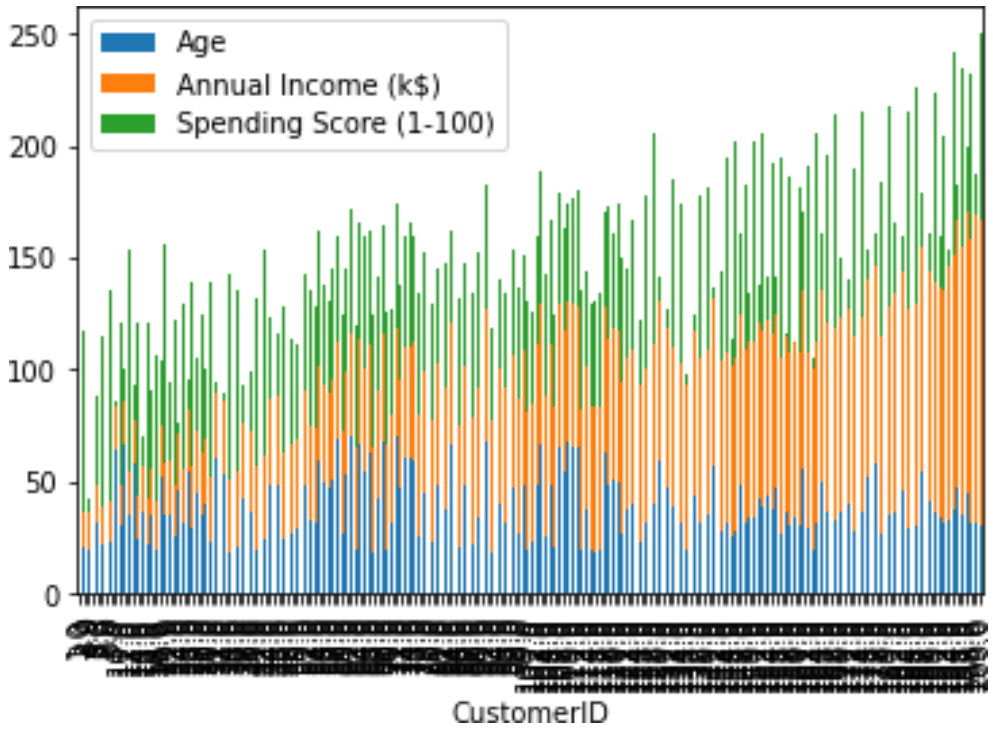



```
#stackedplot
customer_count=pd.read_excel("Mall_Customers.xlsx",index_col=0)customer
_count.head()
```

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

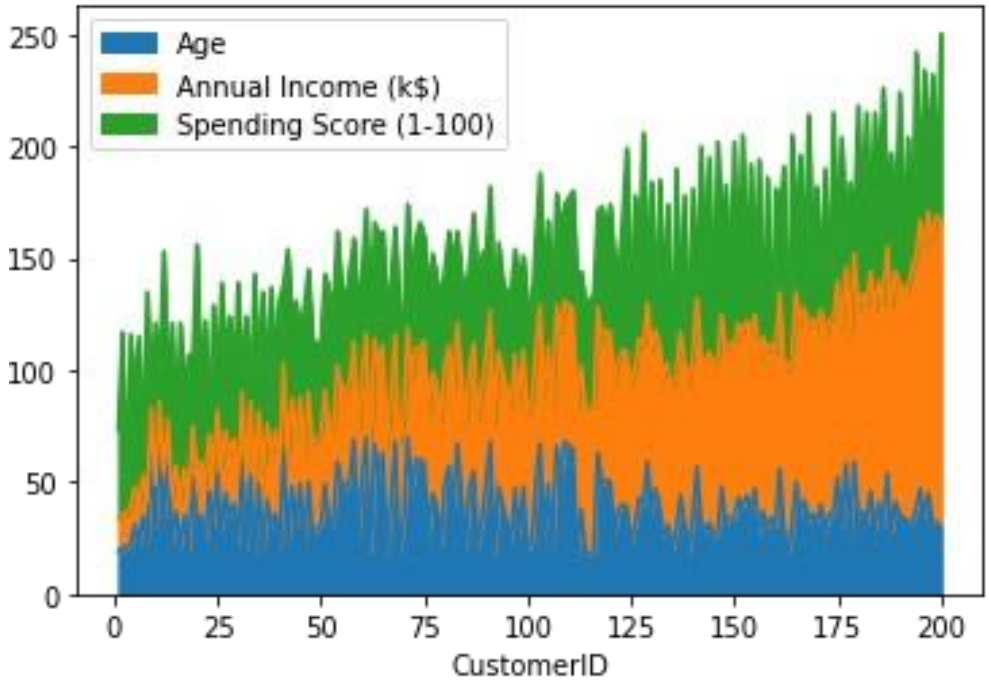
```
customer_count.plot.bar(stacked=True)
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8ead250>
```



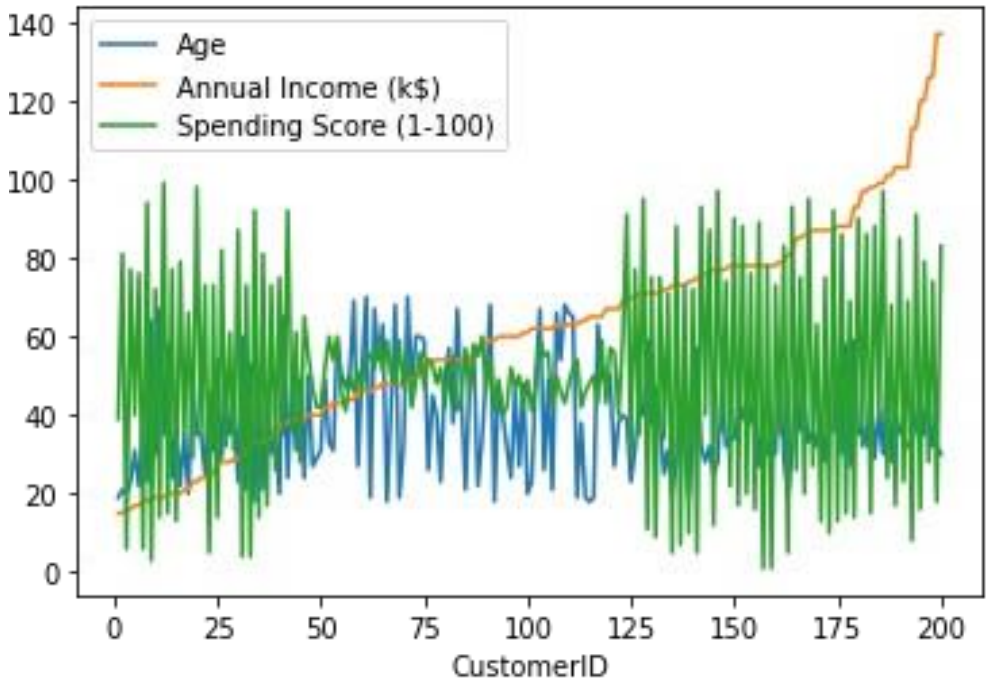

```
customer_count.plot.area()
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b832b8d0>
```

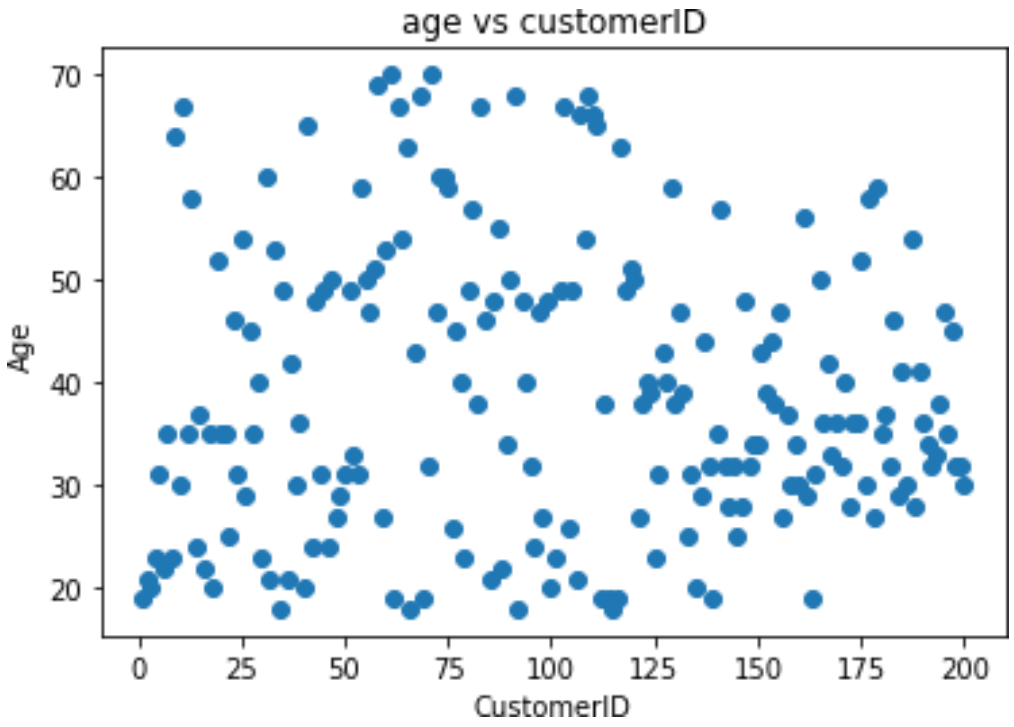


```
#Bivariate linechart
customer_count.plot.line()
```

```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3b8338290>
```




```
#createscatterplot
ofAnnualIncomevsSpendingScoreplt.scatter(customer.Cust
omerID,customer.Age)plt.title('agevscustomerID')plt.xl
abel('CustomerID')
plt.ylabel('Age')Te

xt(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.	

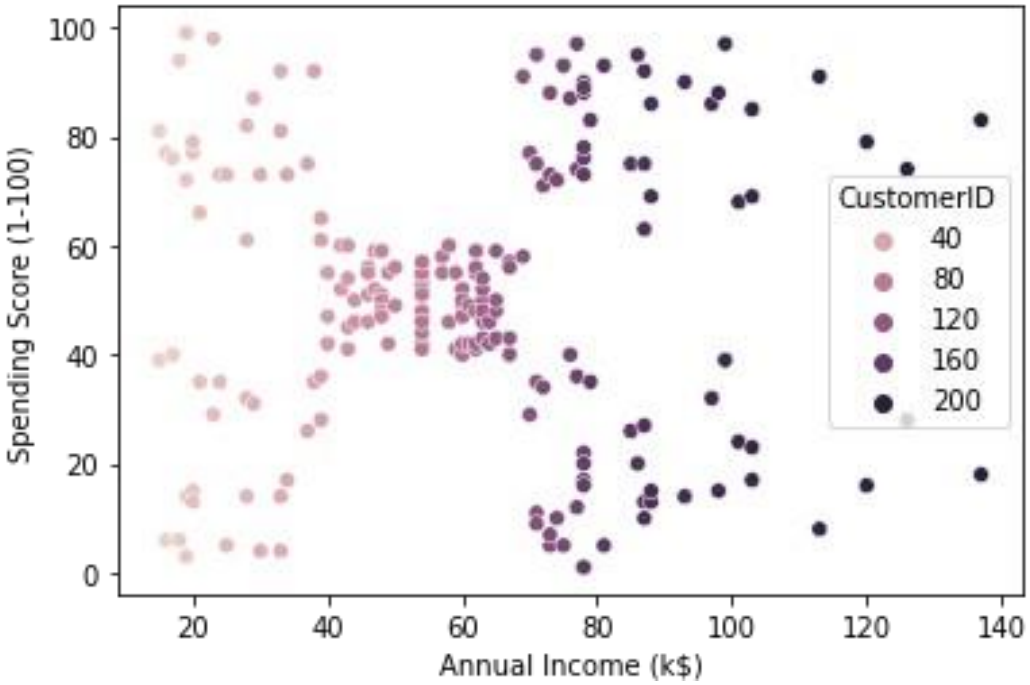
```
122.
==============================================================================
========

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:Passthefollowingvaria
blesaskeywordargs:x,y.Fromversion0.12,theonlyvalidpositionalargumentwi
llbe`data`,andpassing otherargumentswithout an explicitkeyword
willresult inan errorormisinterpretation.
  FutureWarning
```

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

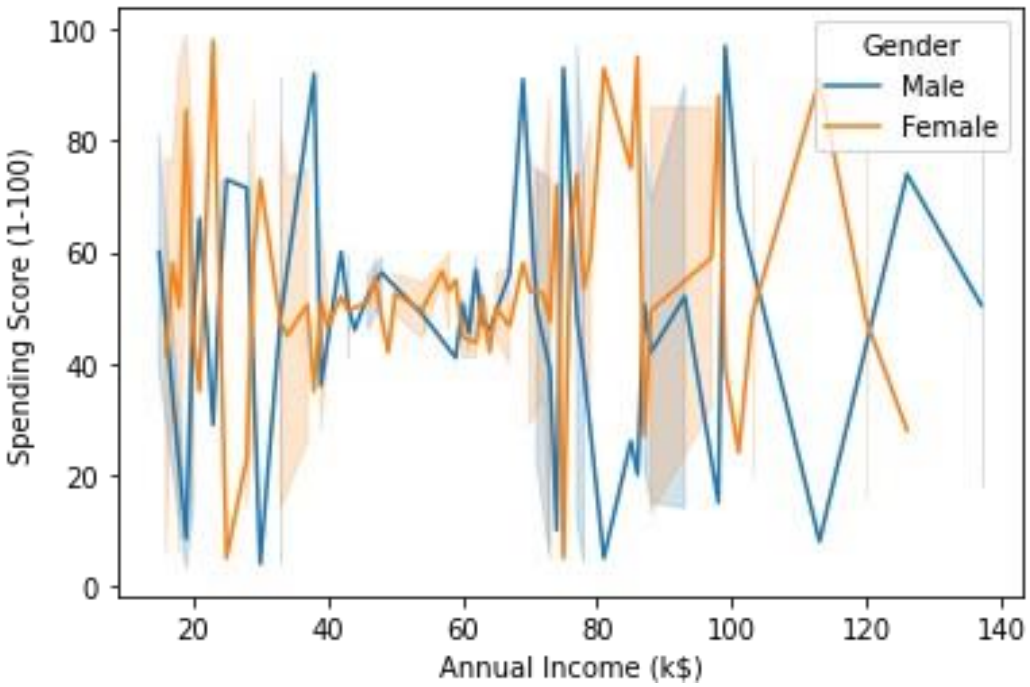



```
sns.lineplot(customer["Annual Income (k$)"],customer["Spending
Score(1-100)"],hue=customer["Gender"])
```

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

```
anerrororormisinterpretation.
  FutureWarning
```

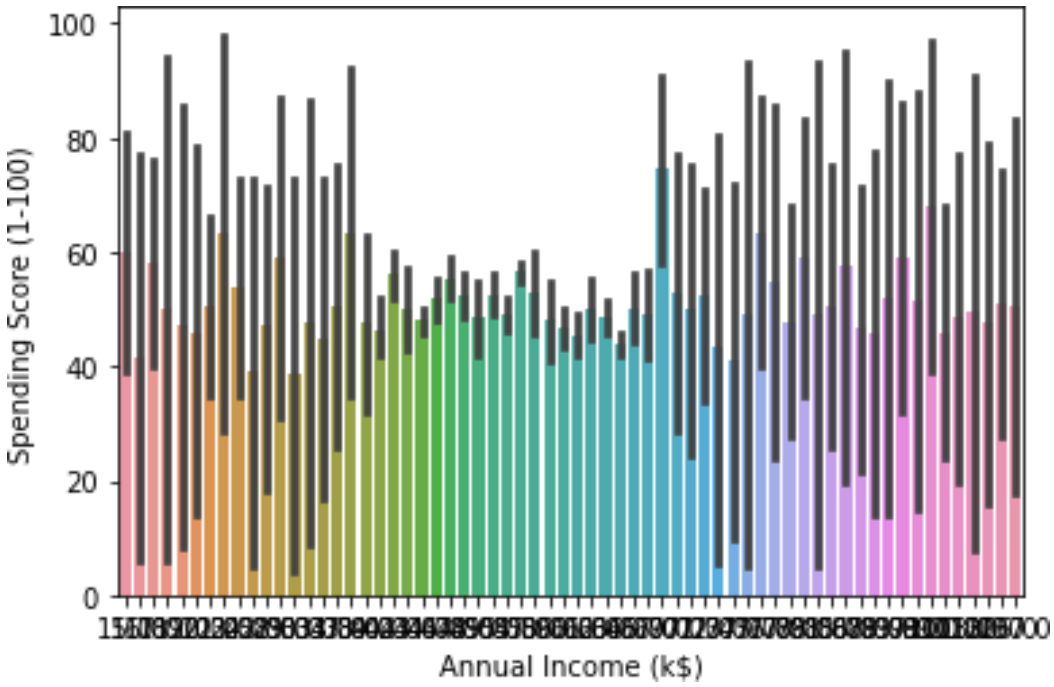
```
<matplotlib.axes._subplots.AxesSubplotat0x7fc3ac4aee90>
```




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

```
/usr/local/lib/python3.7/dist-
packages/seaborn/_decorators.py:43:FutureWarning:Passthefollowingvaria
blesaskeywordargs:x,y.Fromversion0.12,theonlyvalidpositionalargumentwi
llbe`data`,andpassing otherargumentswithout an explicitkeyword
willresult inan errororormisinterpretation.
  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_count
s().values
```

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

```
edgeat0x7fc3a615b150>,
  <matplotlib.patches.Wedgeat0x7fc3a615b610>,
  <matplotlib.patches.Wedgeat0x7fc3a615bd50>,
  <matplotlib.patches.Wedgeat0x7fc3a61643d0>,
  <matplotlib.patches.Wedgeat0x7fc3a6164cd0>,
  <matplotlib.patches.Wedgeat0x7fc3a6176450>,
  <matplotlib.patches.Wedgeat0x7fc3a6176890>,
  <matplotlib.patches.Wedgeat0x7fc3a6176210>,
  <matplotlib.patches.Wedgeat0x7fc3a6164a10>,
```

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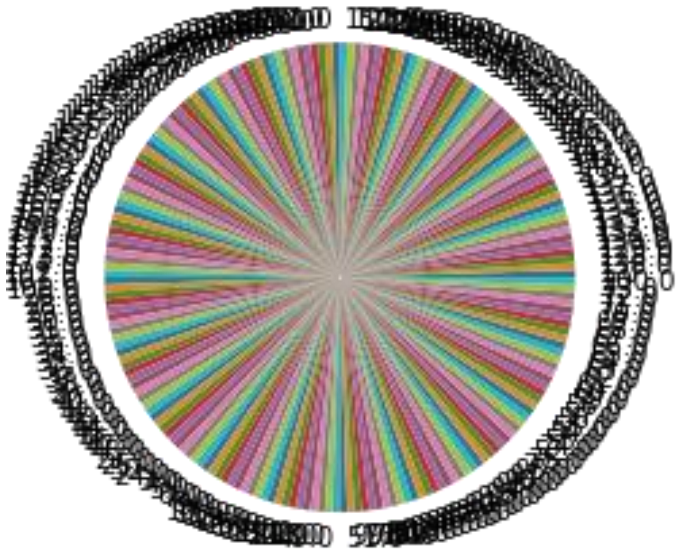

```
sns.heatmap(customer.corr(),annot=True)
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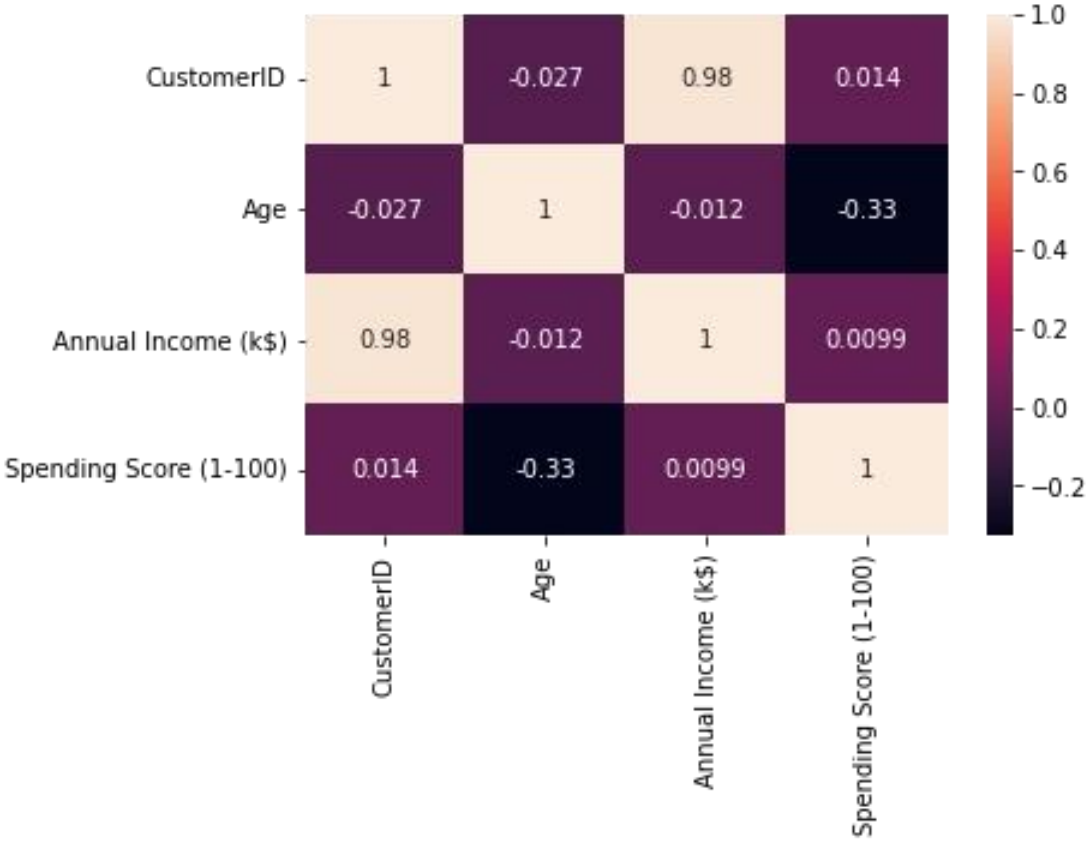


```
sns.pairplot(customer)
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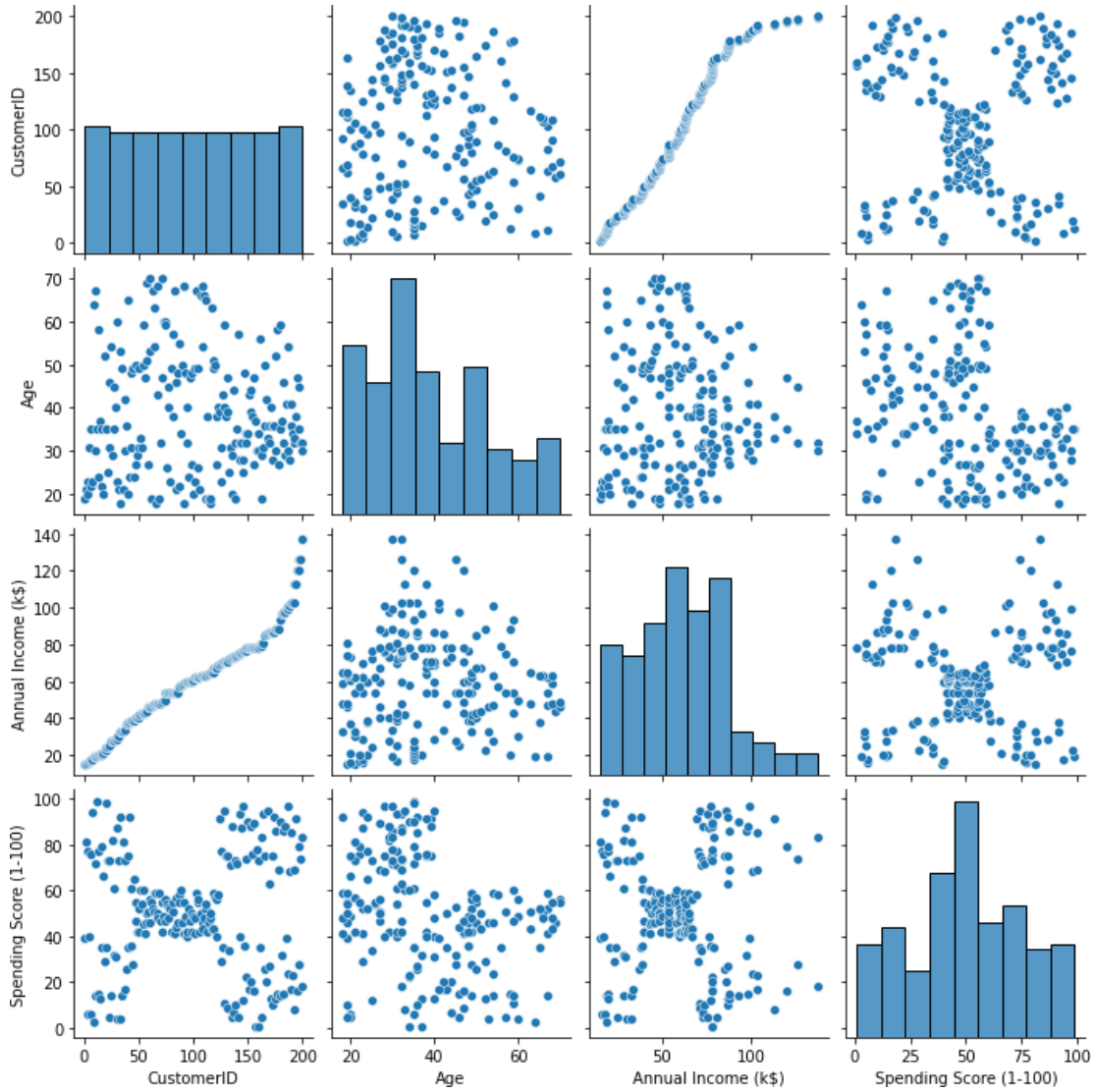

6.Performdescriptivestatisticsonthedataset

```
#Createa DataFrame
df =

pd.DataFrame(customer)df
```

```
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100)
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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.su

m()
```

```
CustomerID
20100.0
GenderMaleMaleFemaleFemaleFemaleFemaleFemaleFemale
Ma...Age
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
```

```
.min()
```

```
CustomerID                   1.0
Gender                    Female
Age                         18.0
AnnualIncome(k$)            15.0
SpendingScore (1-100)        1.0
dtype:objectcustome
```

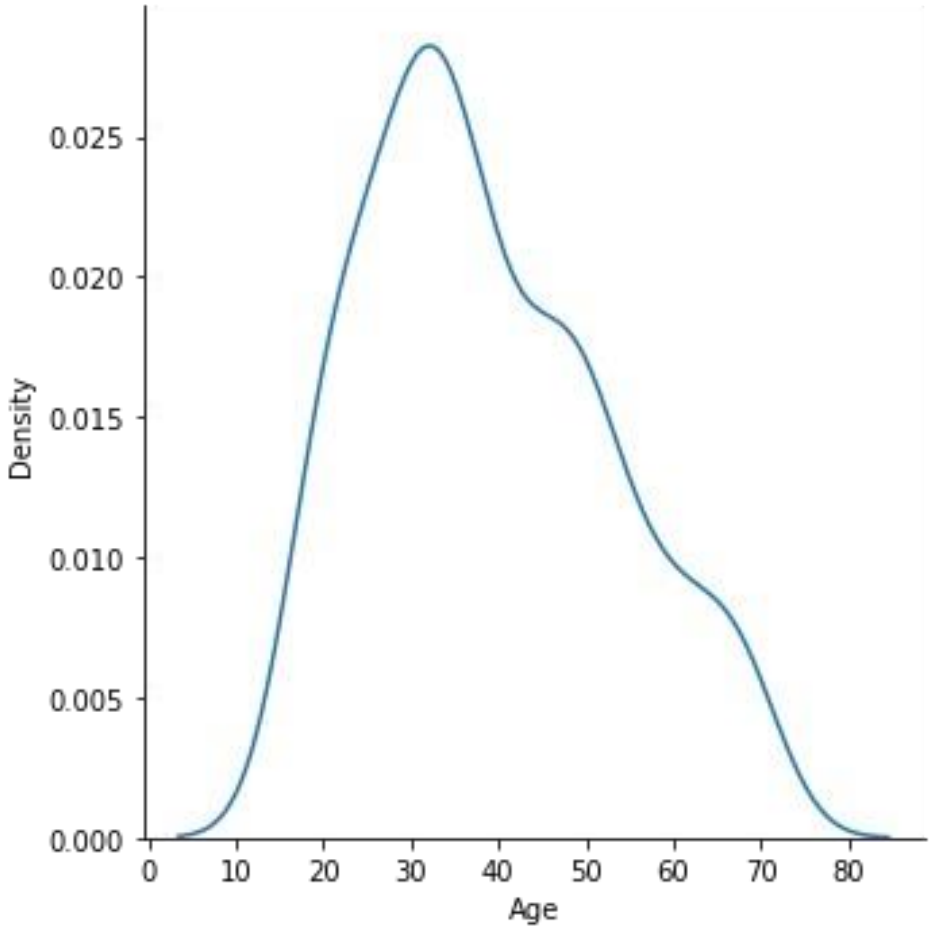
```
r.kurtosis()
```

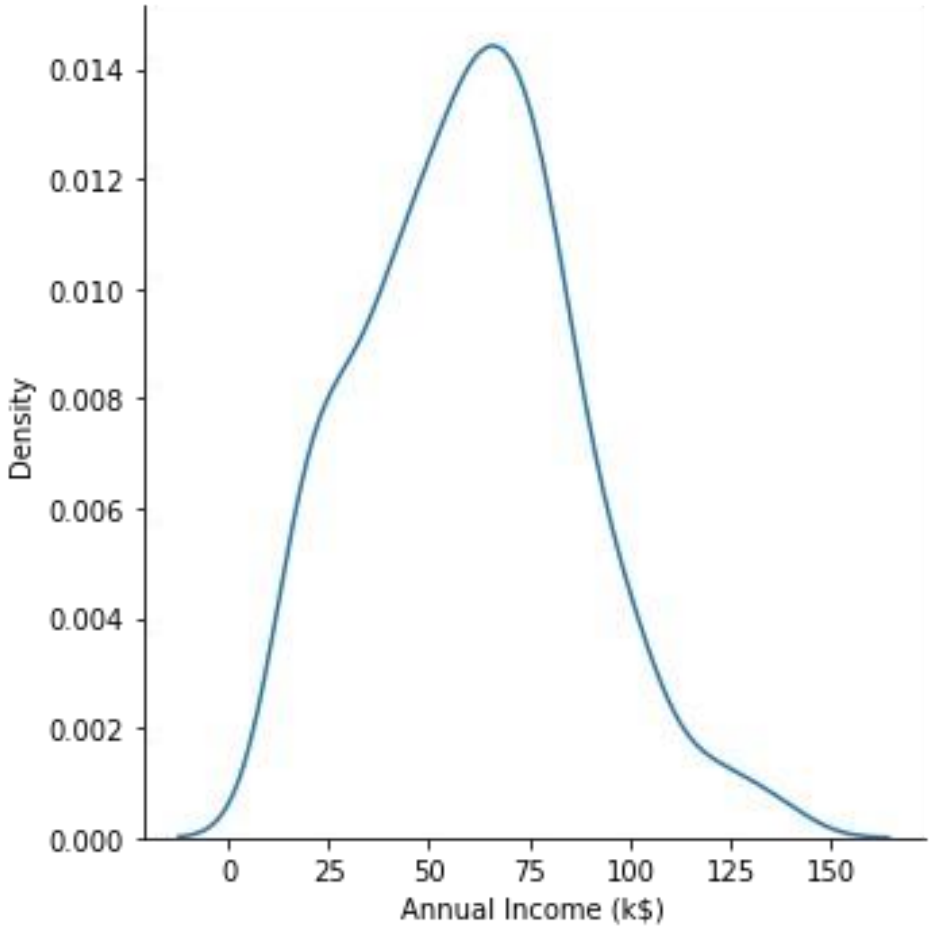
```
CustomerID              -1.200000
Age                     -0.671573
Annual Income(k$)       -0.098487
```

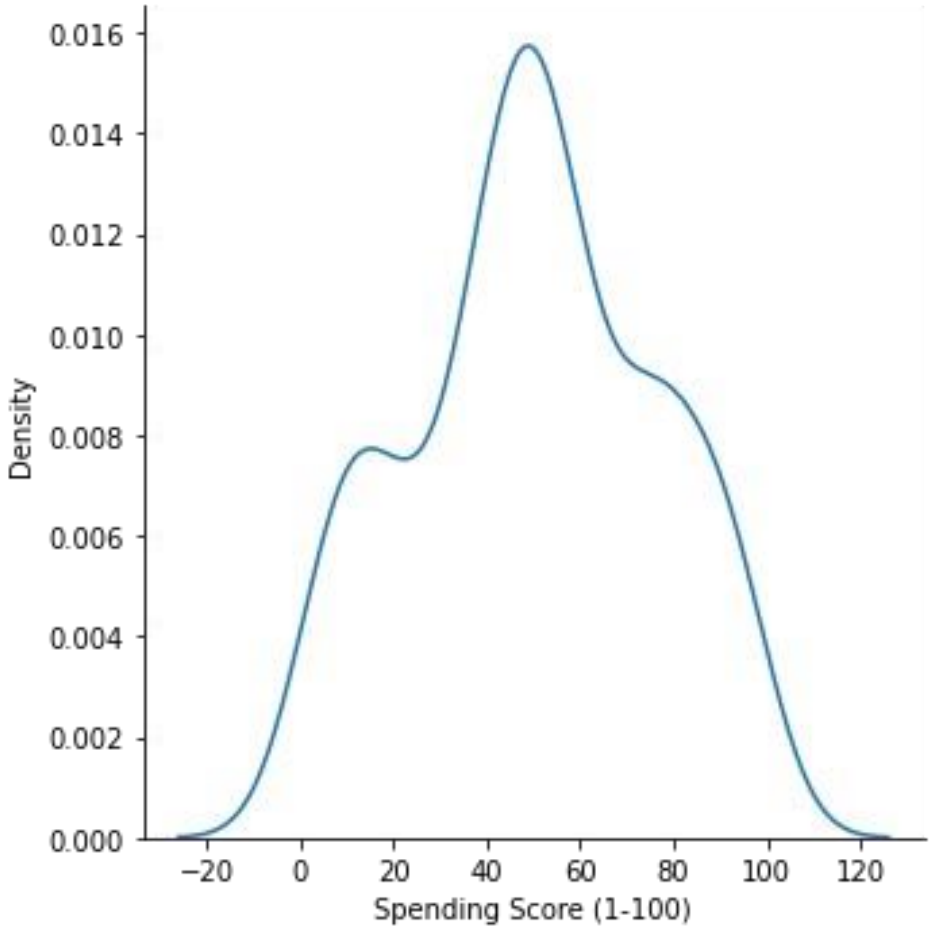
```
SpendingScore(1-100)      -
0.826629dtype:float64
```

```
print(sns.displot(customer["Age"],kind="kde")),print(sns.displot(custom
er["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
```

```
.mean()
```

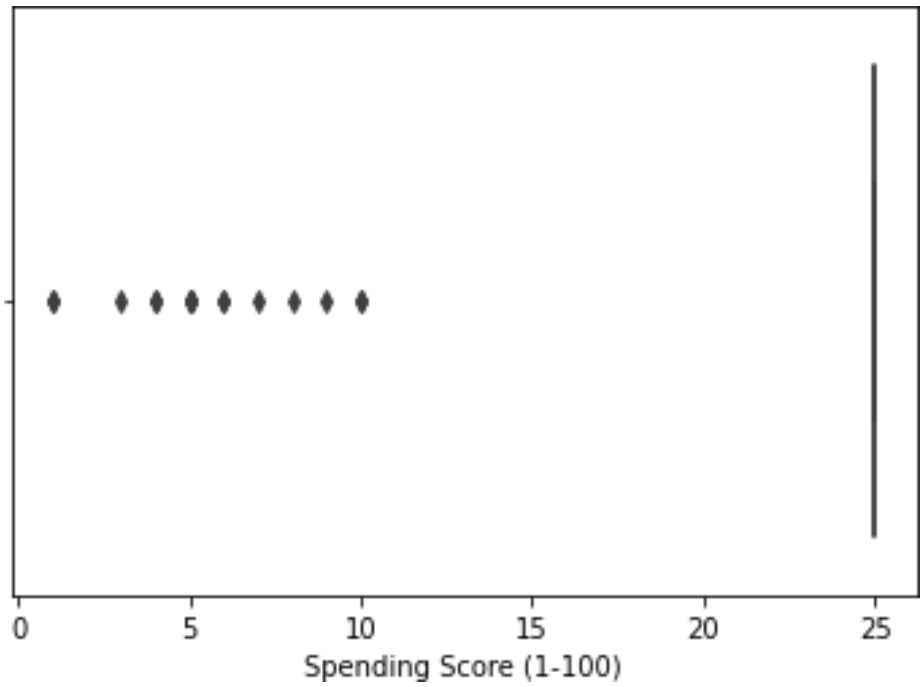
```
CustomerID                100.50
Age                        38.85
AnnualIncome(k$)           60.56
SpendingScore (1-100)      50.20
dtype:float64
```

```
###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(custo
```

```
mer['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("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(marr
y_values[-10:]))

Theinversefromtheencodingresult:['Female''Female''Male''Female''Fema
le''Female''Female' 'Male'
 'Male''Male']

residence_encoder=LabelEncoder()re
sidence_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])AfterE

ncoding:[01234]
```

```
print("Theinversefrom
theencodingresult:",residence_encoder.inverse_transform(residence_value
s[: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_enco
ded.shape)df_categorical_encoded.he
ad()
```

```
(200,2)
```

```
   GenderAge01
        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)
```

```
   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

   GenderAge01
        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()

   CustomerIDGender     AgeAnnual 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   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
```

10. Scalingthedata

```
customer.columns

Index(['CustomerID', 'Gender', 'Age', 'Annual Income
       (k$)','SpendingScore(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()

    AgeCustomerID01
9.0             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],
[-1.49633548, -0.14722616],
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#normalisation
from sklearn.preprocessingimport MinMaxScaler

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

norm

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#robustscaler
fromsklearn.preprocessingimport

RobustScalerRscale=RobustScaler()

RS =

Rscale.fit_transform(x)RS

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[0.          ,  0.72864322],
[0.          ,  0.73869347],
[0.79012346,   0.74874372],
[-0.2962963,   0.75879397],
[1.08641975,   0.76884422],
[-0.44444444,  0.77889447],
[1.13580247,   0.78894472],
[-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
    _state=10,init="k-
    means++",n_init=20,
    max_iter=200
)

importwarningswarnings.filterwarn
ings("ignore")

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)
```

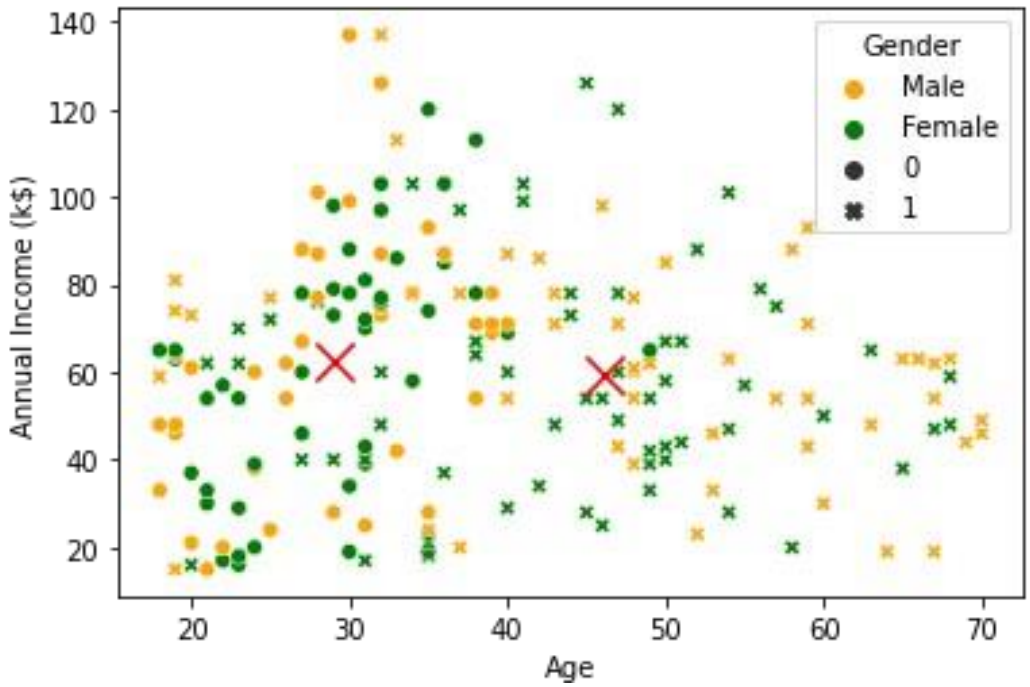
```
df.head()
```

```
    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
```

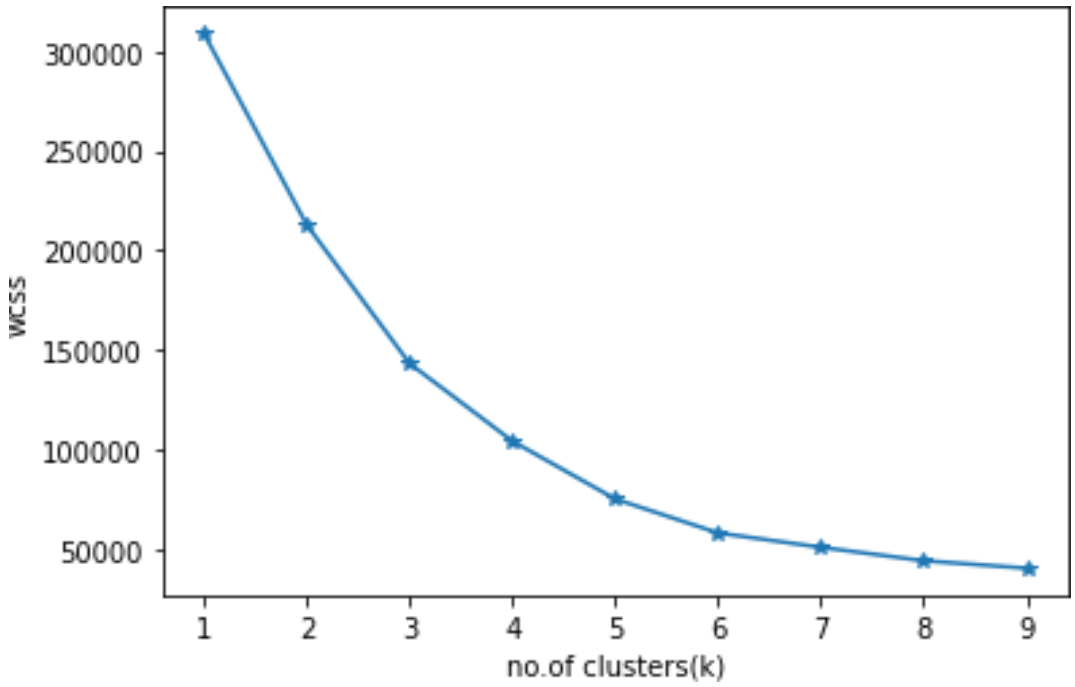
```
sns.scatterplot(
        x="Age",
        y=
        "AnnualIncome(k$)",data=d
        f,
        hue= yes,
        style=km.labels_,palette=["
        orange","green"]
)
```

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

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



```
from sklearn.metrics import
silhouette_scorefromsklearnimportcluster

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=[]

forkinrange(1,10):
    km=KMeans(n_clusters=k,random_state=1,init="k-
means++",n_init=10)
    km.fit(df)
    error =
    km.inertia_wcss.app
    end(error)


plt.plot(range(1,10),wcss,marker="*")plt
.xlabel("no.ofclusters(k)")plt.ylabel("w
css")
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_data
0               0
1               0
2               0
3               0
4               0
```

13. Splitthedataintodependentandindependentvariables

```
df.head(0)Empty

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

c[:,1:2]
```

```
x
```

```
     Gender
0      Male
1      Male
2    Female
3    Female
4    Female
..1     ...
95   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]
```

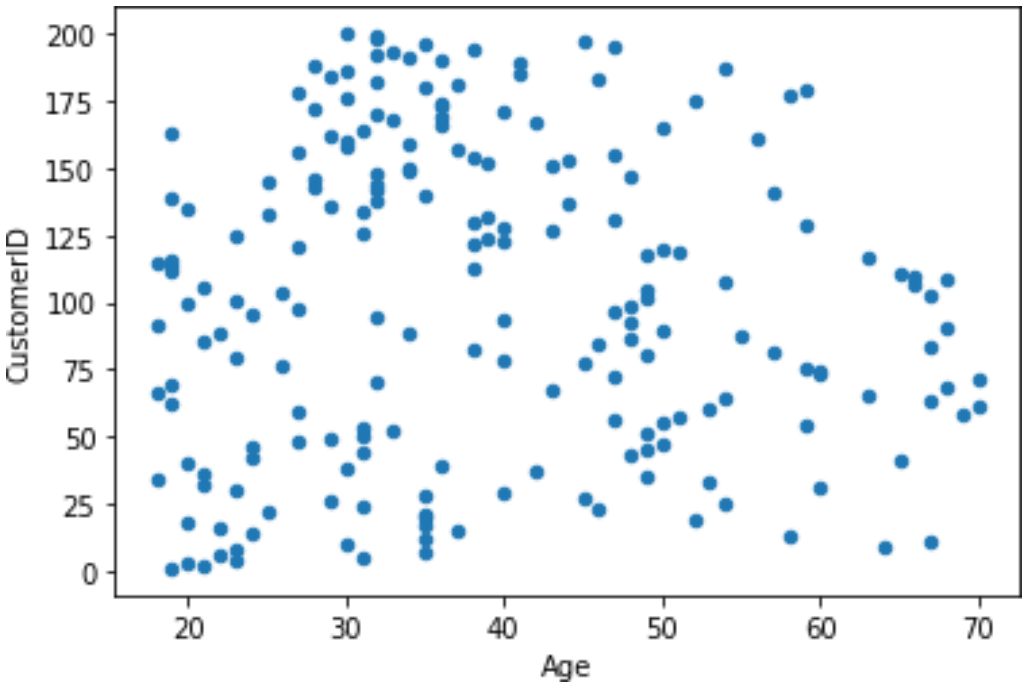
14. Splitthedataintotrainingandtesting

```
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
152Female
61     Male
125Female
180Female
154Female
80     Male
7    Female
33     Male
130    Male
37   Female
74     Male
183Female
145    Male
45   Female
159Female
60     Male
123    Male
179    Male
185    Male
122Female
44   Female
16   Female
55     Male
150    Male
111Female
22   Female
189Female
129    Male
4    Female
83   Female
106Female
```

15. Buildthemodel

```
from sklearn.linear_model import

LinearRegressionlr=LinearRegression()df.plot.scatter("A

ge","CustomerID")

<matplotlib.axes._subplots.AxesSubplotat0x7f46f13ccd10>
```




```
from sklearn.linear_model

importLinearRegressionmodel=LinearRegression()

model.fit(x,y)LinearRegr

ession()predict=model.pr

edict(x)predict
```

```
array([[19.        , 61.02272279, 62.20768706,  1.08321414],
       [21.        , 60.97610085, 60.99784453,  1.07785252],
       [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],
       [30.        ,  60.7663021, 55.55355317,   1.0537252],
       [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],
```

```
[52.        , 60.25346072, 42.2452854,   0.99474731],
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[35.        , 60.64974724, 52.52894686,  1.04032113],
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[29.        , 60.78961307, 56.15847443,  1.05640601],
[45.        , 60.41663752, 46.47973424,   1.013513],
[35.        , 60.64974724, 52.52894686,  1.04032113],
[40.        , 60.53319238, 49.50434055,  1.02691706],
[23.        ,  60.9294789, 59.78800201,  1.07249089],
[60.        , 60.06697295, 37.4059153,    0.9733008],
[21.        , 60.97610085, 60.99784453,  1.07785252],
[53.        , 60.23014975, 41.64036414,  0.99206649],
[18.        , 61.04603376, 62.81260832,  1.08589496],
[49.        , 60.32339364, 44.06004919,  1.00278975],
[21.        , 60.97610085, 60.99784453,  1.07785252],
[42.        , 60.48657044, 48.29449802,  1.02155544],
[30.        ,  60.7663021, 55.55355317,   1.0537252],
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[65.        , 59.95041809, 34.38130899,  0.95989673],
[24.        , 60.90616793, 59.18308075,  1.06981008],
[48.        , 60.34670461, 44.66497045,  1.00547056],
[31.        , 60.74299113, 54.94863191,  1.05104438],
[49.        , 60.32339364, 44.06004919,  1.00278975],
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[18.        , 61.04603376, 62.81260832,  1.08589496],
[43.        , 60.46325947, 47.68957676,  1.01887462],
[68.        , 59.88048517, 32.5665452,   0.95185429],
```

```
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[60.        , 60.06697295, 37.4059153,    0.9733008],
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[68.        , 59.88048517, 32.5665452,   0.95185429],
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```

```
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[28.        , 60.81292404, 56.7633957,   1.05908682],
[48.        , 60.34670461, 44.66497045,  1.00547056],
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[34.        , 60.67305821, 53.13386812,  1.04300194],
[43.        , 60.46325947, 47.68957676,  1.01887462],
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[38.        , 60.57981433, 50.71418307,  1.03227869],
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```

```
       [36.        , 60.62643627, 51.9240256,   1.03764032],
       [32.        , 60.71968016, 54.34371065,  1.04836357],
       [40.        , 60.53319238, 49.50434055,  1.02691706],
       [28.        , 60.81292404, 56.7633957,   1.05908682],
       [36.        , 60.62643627, 51.9240256,   1.03764032],
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       [52.        , 60.25346072, 42.2452854,   0.99474731],
       [30.        ,  60.7663021, 55.55355317,  1.0537252],
       [58.        , 60.11359489, 38.61575783,  0.97866243],
       [27.        , 60.83623502, 57.36831696,  1.06176764],
       [59.        , 60.09028392, 38.01083656,  0.97598161],
       [35.        , 60.64974724, 52.52894686,  1.04032113],
       [37.        ,  60.6031253, 51.31910434,  1.0349595],
       [32.        , 60.71968016, 54.34371065,  1.04836357],
       [46.        , 60.39332655, 45.87481297,  1.01083219],
       [29.        , 60.78961307, 56.15847443,  1.05640601],
       [41.        , 60.50988141, 48.89941929,  1.02423625],
       [30.        ,  60.7663021, 55.55355317,  1.0537252],
       [54.        , 60.20683878, 41.03544287,  0.98938568],
       [28.        , 60.81292404, 56.7633957,   1.05908682],
       [41.        , 60.50988141, 48.89941929,  1.02423625],
       [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_stat`

`e=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],
       [27.        , 60.83623502, 57.36831696,  1.06176764],
       [34.        , 60.67305821, 53.13386812,  1.04300194],
       [54.        , 60.20683878, 41.03544287,  0.98938568],
       [60.        , 60.06697295, 37.4059153,    0.9733008],
       [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],
[49.        , 60.32339364, 44.06004919,  1.00278975],
[25.        , 60.88285696, 58.57815948,  1.06712926],
[50.        , 60.30008266, 43.45512792,  1.00010893],
[66.        , 59.92710712, 33.77638773,  0.95721592],
[37.        ,  60.6031253, 51.31910434,   1.0349595],
[35.        , 60.64974724, 52.52894686,  1.04032113],
[32.        , 60.71968016, 54.34371065,  1.04836357],
[28.        , 60.81292404, 56.7633957,   1.05908682],
[50.        , 60.30008266, 43.45512792,  1.00010893],
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[68.        , 59.88048517, 32.5665452,   0.95185429],
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[45.        , 60.41663752, 46.47973424,   1.013513],
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[30.        ,  60.7663021, 55.55355317,   1.0537252],
[43.        , 60.46325947, 47.68957676,  1.01887462],
[40.        , 60.53319238, 49.50434055,  1.02691706],
[38.        , 60.57981433, 50.71418307,  1.03227869],
[34.        , 60.67305821, 53.13386812,  1.04300194],
[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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[24.        , 60.90616793, 59.18308075,  1.06981008],
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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],
[19.        , 61.02272279, 62.20768706,  1.08321414],
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[38.        , 60.57981433, 50.71418307,  1.03227869],
[27.        , 60.83623502, 57.36831696,  1.06176764],
[28.        , 60.81292404, 56.7633957,   1.05908682],
[37.        ,  60.6031253, 51.31910434,   1.0349595],
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[48.        , 60.34670461, 44.66497045,  1.00547056],
[21.        , 60.97610085, 60.99784453,  1.07785252],
[25.        , 60.88285696, 58.57815948,  1.06712926],
[36.        , 60.62643627, 51.9240256,   1.03764032],
[20.        , 60.99941182, 61.6027658,   1.08053333],
[36.        , 60.62643627, 51.9240256,   1.03764032],
[31.        , 60.74299113, 54.94863191,  1.05104438],
[59.        , 60.09028392, 38.01083656,  0.97598161],
[30.        ,  60.7663021, 55.55355317,   1.0537252],
[59.        , 60.09028392, 38.01083656,  0.97598161],
[49.        , 60.32339364, 44.06004919,  1.00278975],
[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],
[42.        , 60.48657044, 48.29449802,  1.02155544],
[40.        , 60.53319238, 49.50434055,  1.02691706],
[58.        , 60.11359489, 38.61575783,  0.97866243],
[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],
       [67.        , 59.90379614, 33.17146646,  0.95453511],
       [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],
        [70.        , 59.83386323, 31.35670268,  0.94649267],
        [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.pyplotaspltimp
ortseabornas sns
importwarningswarnings.filterwarn
ings("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 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.f
```

```
it(x_train,y_train)Linear
```

```
Regression()lr.coef_,lr.i
```

```
ntercept_
```

```
(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
```