AssignmentDate	
StudentName	CHEJARLA VINAY KARTHIK
StudentRollNumber	111519104017
MaximumMarks	2 Marks

#**ProblemStatement:CustomerSegmentationAnalysis**

###**Description:** *You own the mall and want to understand the customers who can quicklyconverge[TargetCustomers]sothattheinsightcanbegiventothemarketingteamandplanthestrategyaccordingly.*

DownloadandloadDataset

```
importnumpyas
npimportpandasas pd
importmatplotlib.pyplotaspltimportseabor
nas sns
import matplotlib asrcParams
```

```
df=pd.read_csv('Mall_Customers.csv') #No Target Column - UnsupervisedMachine Learning
df.head()
```

```
     CustomerIDGenderAgeAnnualIncome(k$)SpendingScore (1-100)0          1
Male          19     15      39
1             2      Male    21          15          81
2             3Female        20          16           6
3             4Female        23          16          77
4             5Female        31          17          40
```

```
df=df.rename(columns={'AnnualIncome(k$)':'Annual_Income','Spending Score(1-
100)':'Spending_Score'})df.head()
```

```
     CustomerIDGenderAgeAnnual_IncomeSpending_Score0          1
Male          19     15      39
1             2      Male    21          15          81
2             3Female        20          16           6
3             4Female        23          16          77
4             5Female        31          17          40
```

```
df.shape(2

00,5)
```

```
df.info()
```

```
<class
'pandas.core.frame.DataFrame'>RangeIndex:200e
ntries,0to199Datacolumns(total 5 columns):
 #    Column            Non-NullCountDtype
---   ----------------------------   ------
 0    CustomerID        200non-null         int64
 1    Gender            200non-null         object
```

2	Age	200non-null	int64
3	Annual_Income	200non-null	int64
4	Spending_Score	200non-null	int64

dtypes: int64(4),
object(1)memoryusage:7.9+ KB

df.Gender.unique()

array(['Male', 'Female'], dtype=object)df.Age.unique()

array([19,54, 29, 51, 21, 20, 23, 31, 22, 35, 64, 30, 67, 58, 24, 37, 52, 25, 46, 69, 41]) 45, 40, 60, 53, 18, 49, 42, 36, 65, 48, 50, 27, 33, 59, 47,

70, 63, 43, 68, 32, 26, 57, 38, 55, 34, 66, 39, 44, 28, 56,

df.Gender.value_counts()Female

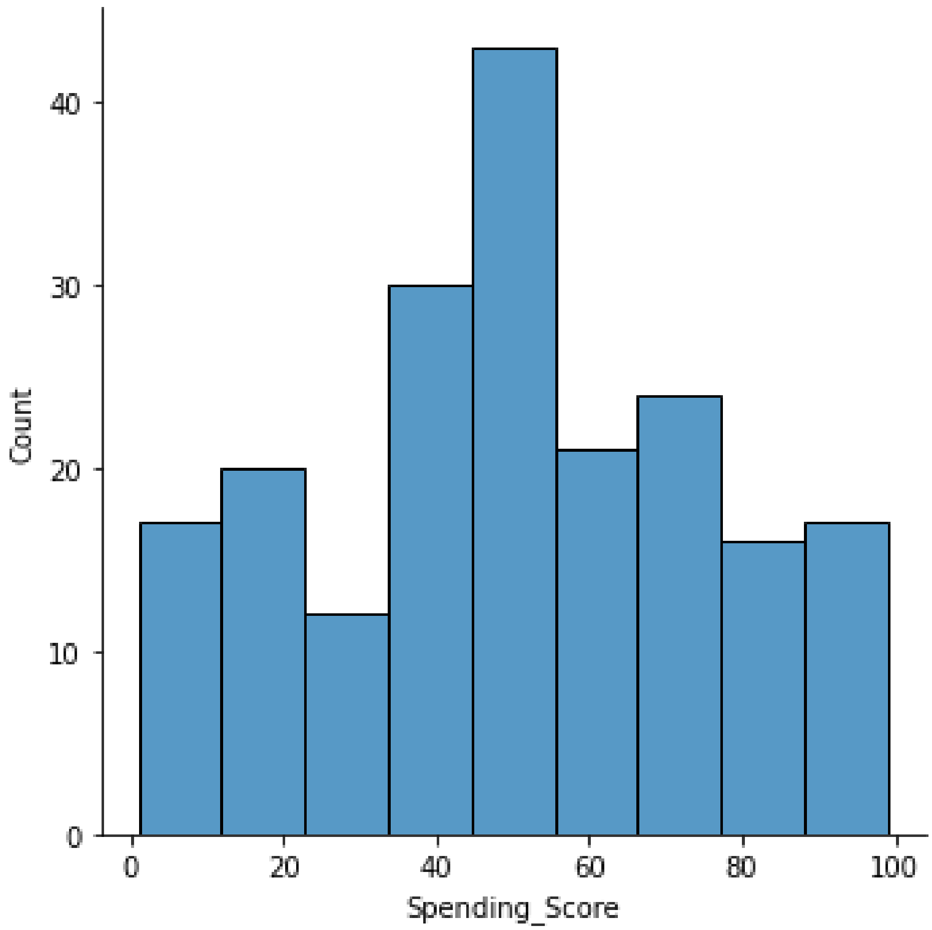
112
Male 88
Name: Gender, dtype:int64

Visualizations

UnivariateAnalysis

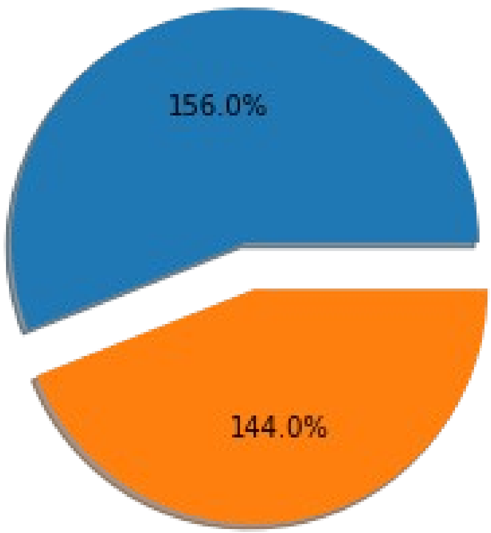
sns.displot(df.Spending_Score)

<seaborn.axisgrid.FacetGridat0x7f700626b950>



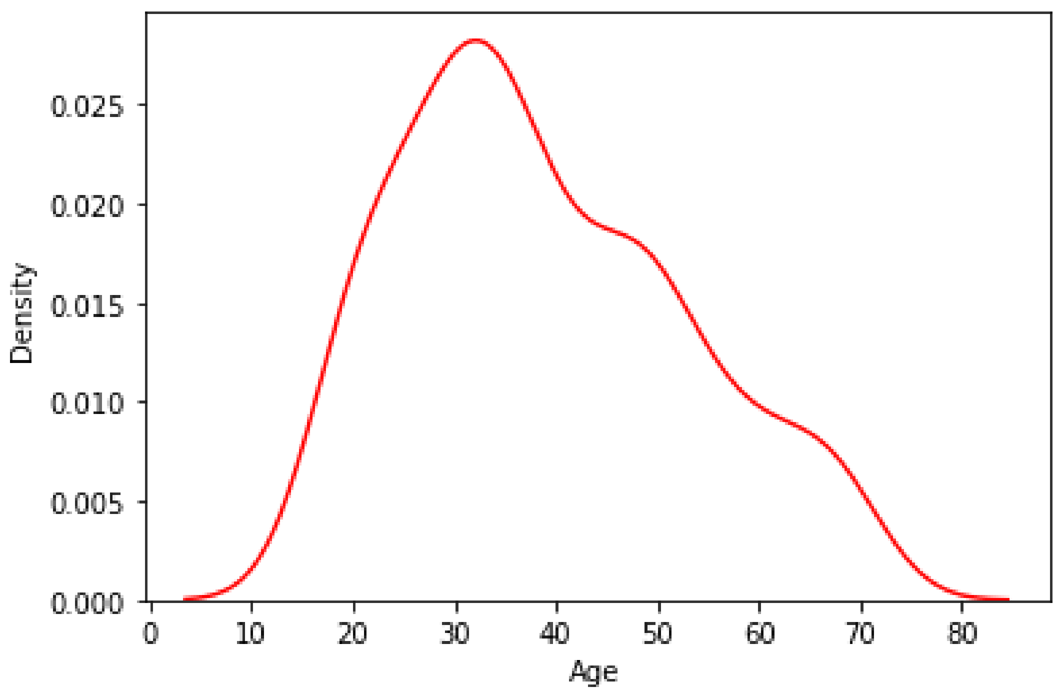

```
plt.pie(df.Gender.value_counts(),[0,0.2],shadow='True',autopct="1%.1f%
%")          #categorialcolumn
```

```
([<matplotlib.patches.Wedgeat0x7f7005485ed0>,
   <matplotlib.patches.Wedge at 0x7f7005492950>],[Text(-
 0.20611945413751356,1.080515974257694,"),
   Text(0.24359571852615253,-1.2769734241227293, ")],
 [Text(-0.11242879316591647,0.5893723495951058,'156.0%'),
   Text(0.14990505755455538,-0.7858297994601411,'144.0%')])
```



sns.kdeplot(df.Age,color="red")

<matplotlib.axes._subplots.AxesSubplotat0x7f700549a450>



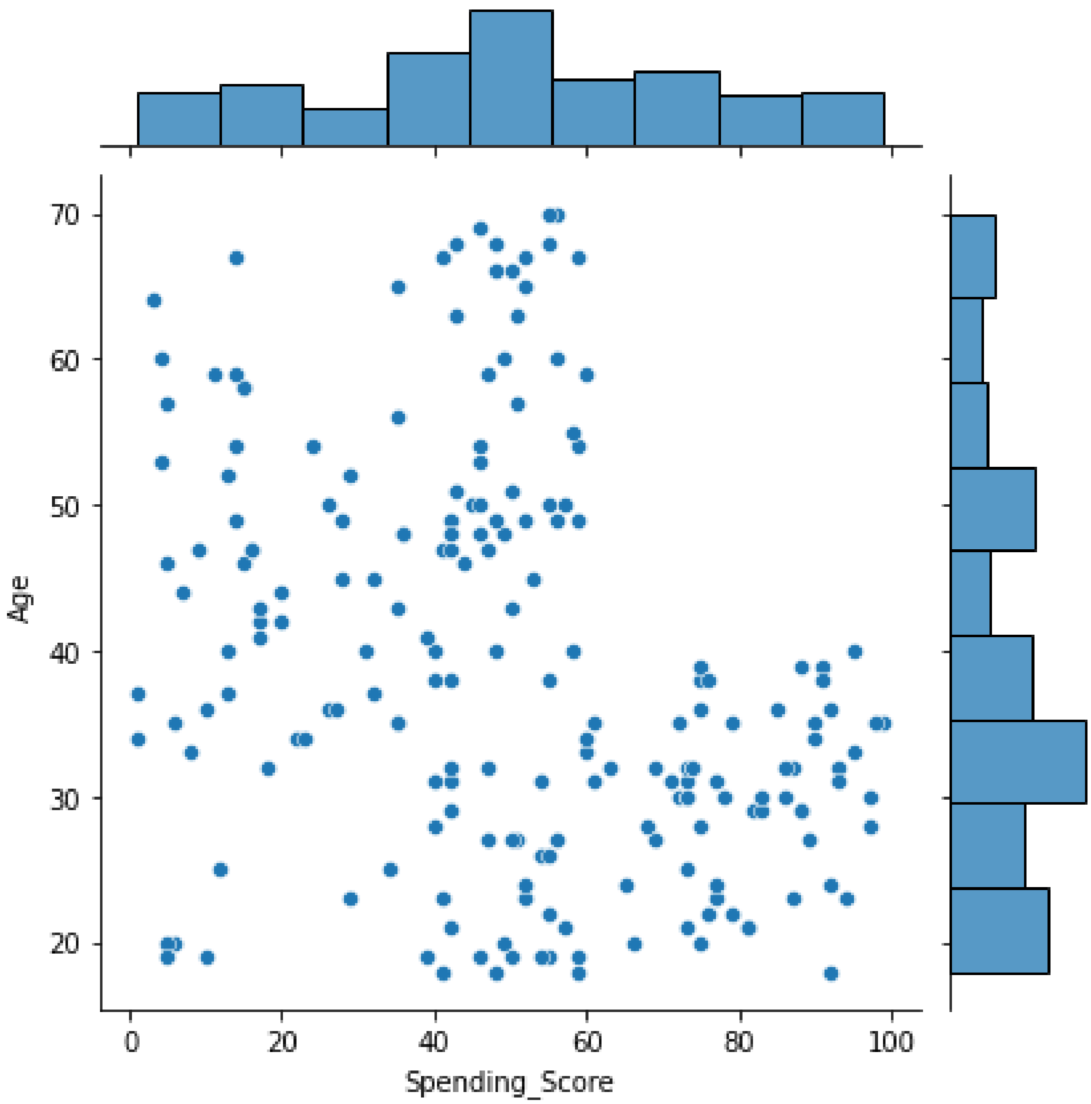
Bi-variateAnalysis

sns.jointplot(df.Spending_Score,df.Age)

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:FutureWarning:Pass the followingvariables askeywordargs:x,y.From version0.12,theonlyvalidpositionalargumentwillbe`data`,

andpassing otherargumentswithout an explicitkeyword willresult inan errorormisinterpretation.
    FutureWarning

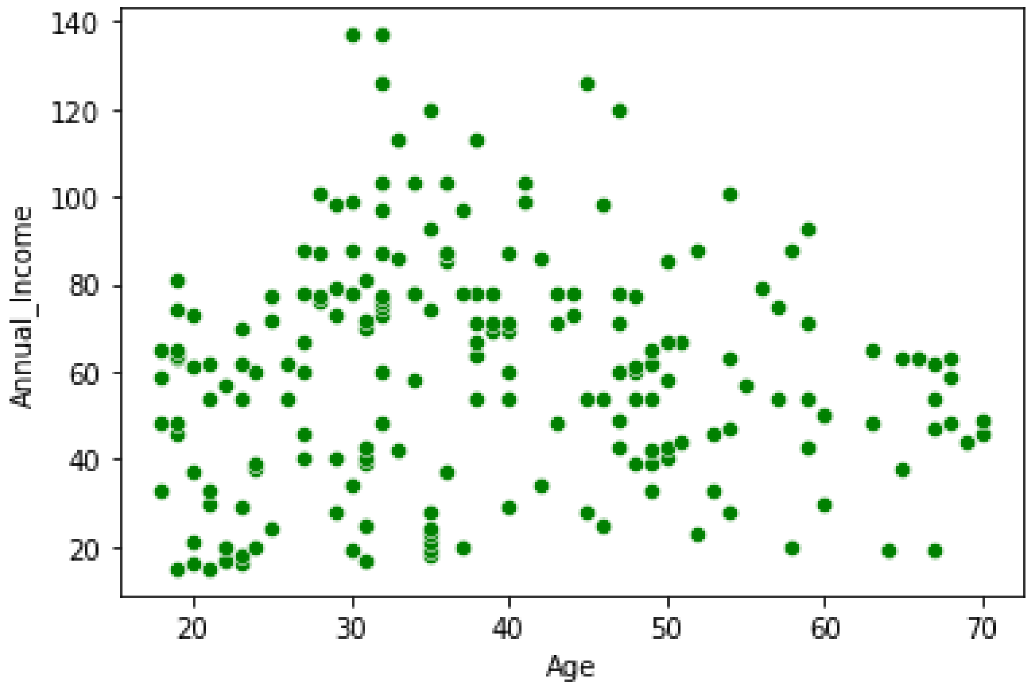
<seaborn.axisgrid.JointGridat0x7f7005459c50>



sns.scatterplot(df.Age,df.Annual_Income,color="green")

/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

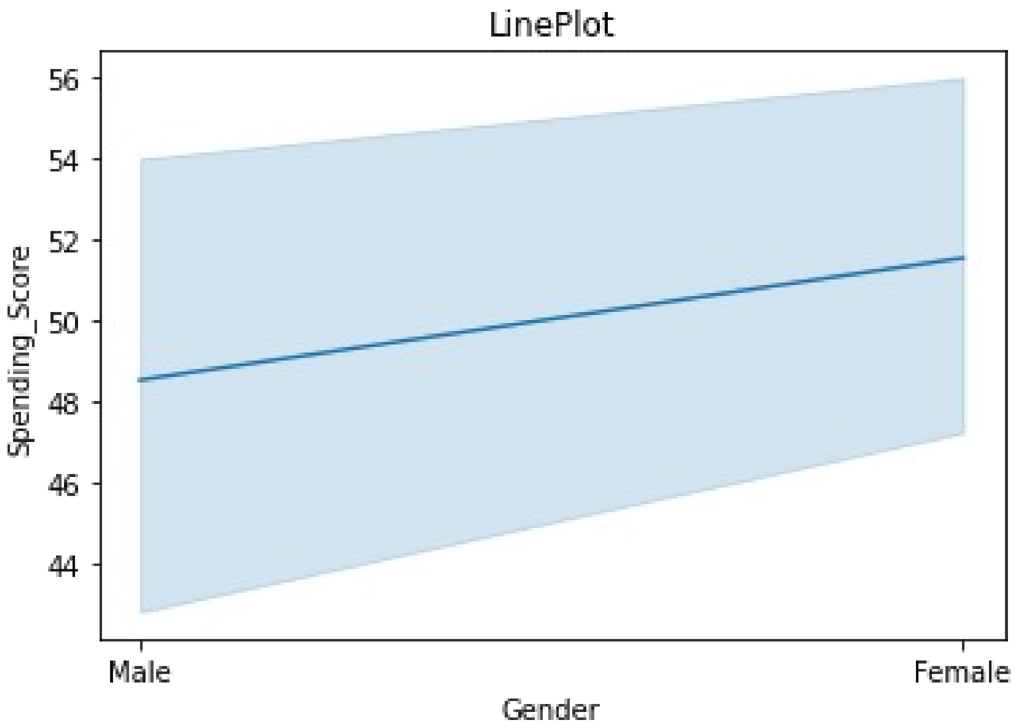
<matplotlib.axes._subplots.AxesSubplotat0x7f7005268410>



sns.lineplot(df.Gender,df.Spending_Score)plt.xlabel('Ge
nder')plt.ylabel('Spending_Score')plt.title('LinePlot')

/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

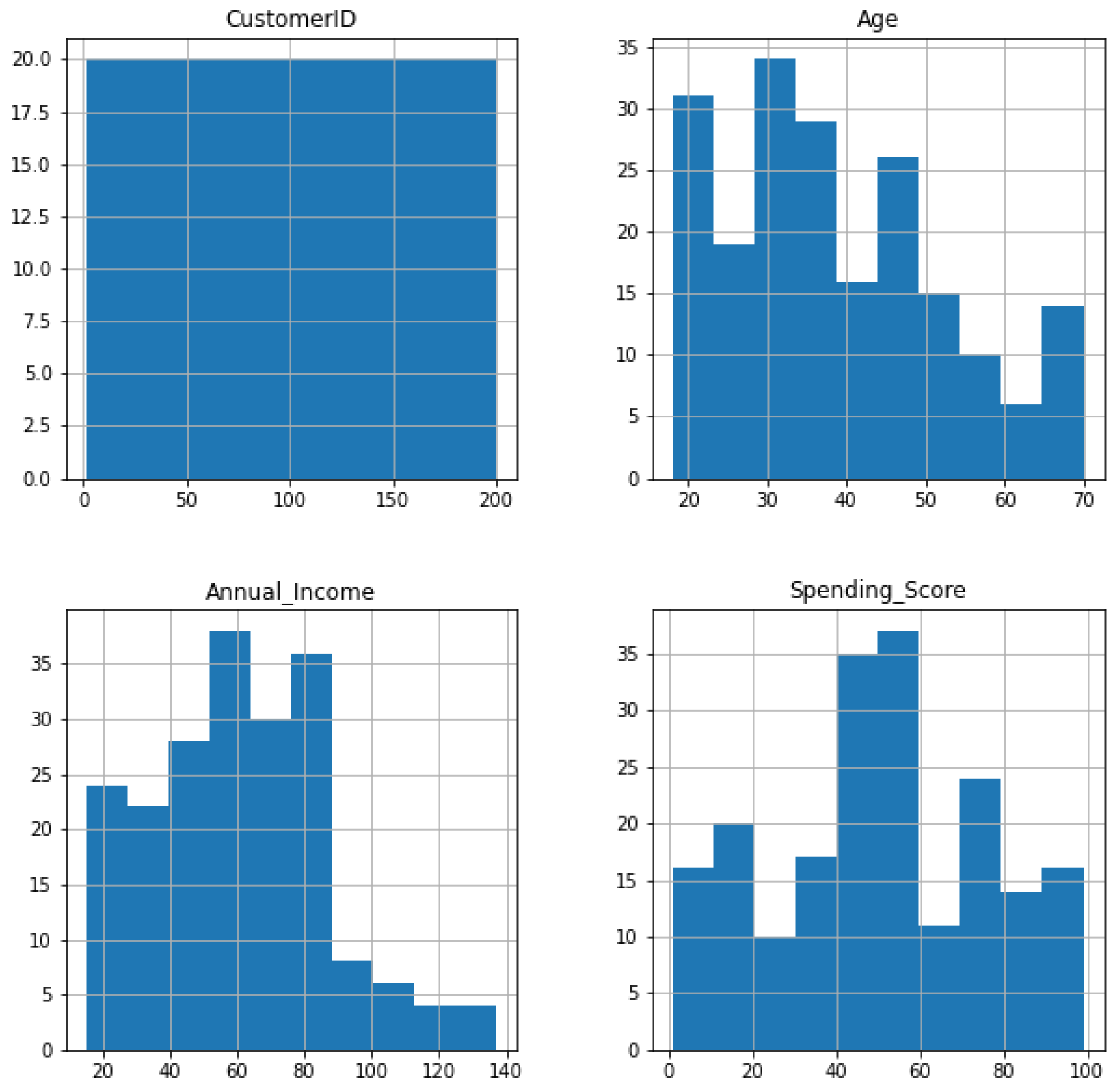
Text(0.5, 1.0,'LinePlot')



Multi-variateAnalysis

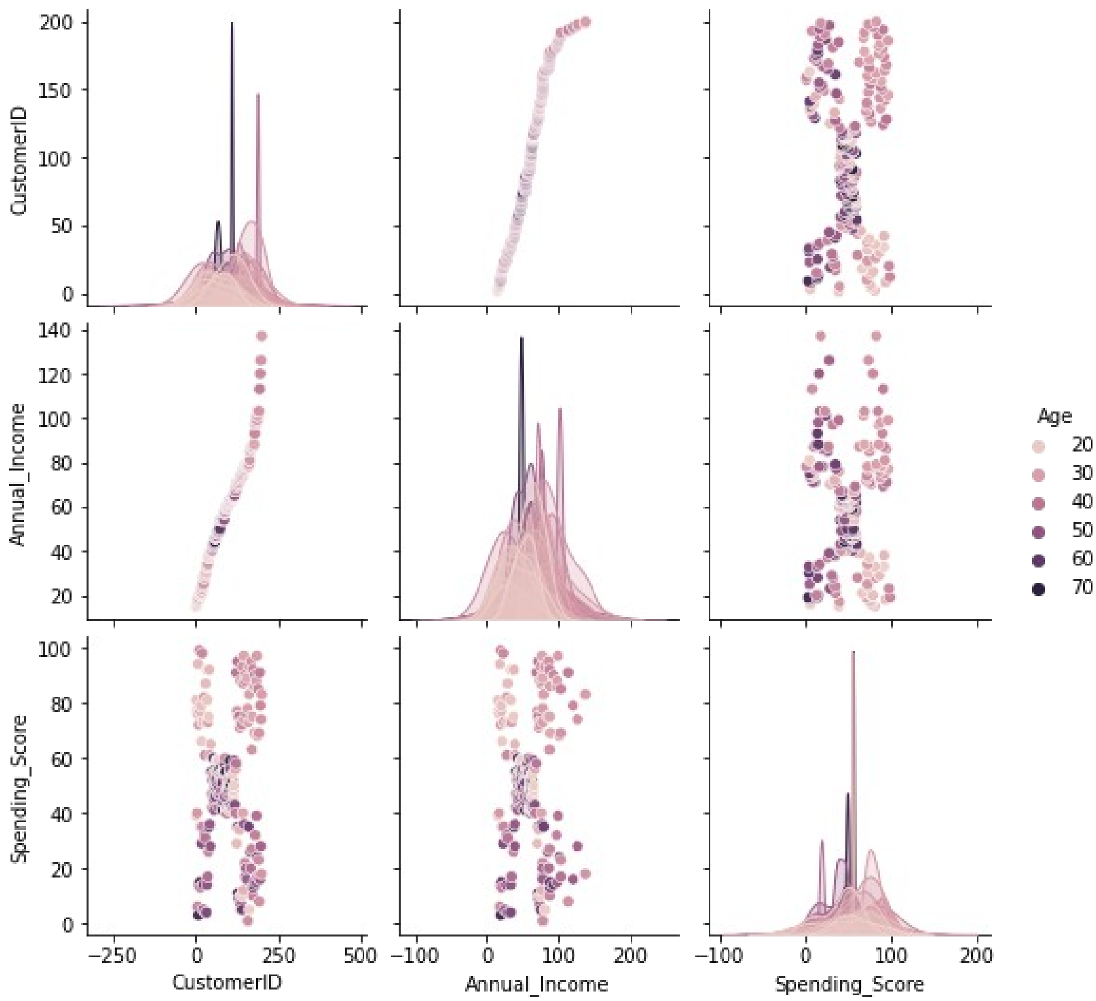
df.hist(figsize=(10,10))

array([[<matplotlib.axes._subplots.AxesSubplot object at0x7f7005203910>,
<matplotlib.axes._subplots.AxesSubplot object at0x7f70051db810>],
[<matplotlib.axes._subplots.AxesSubplot object at0x7f7005191c90>,
<matplotlib.axes._subplots.AxesSubplot object at0x7f70051541d0>]],
dtype=object)



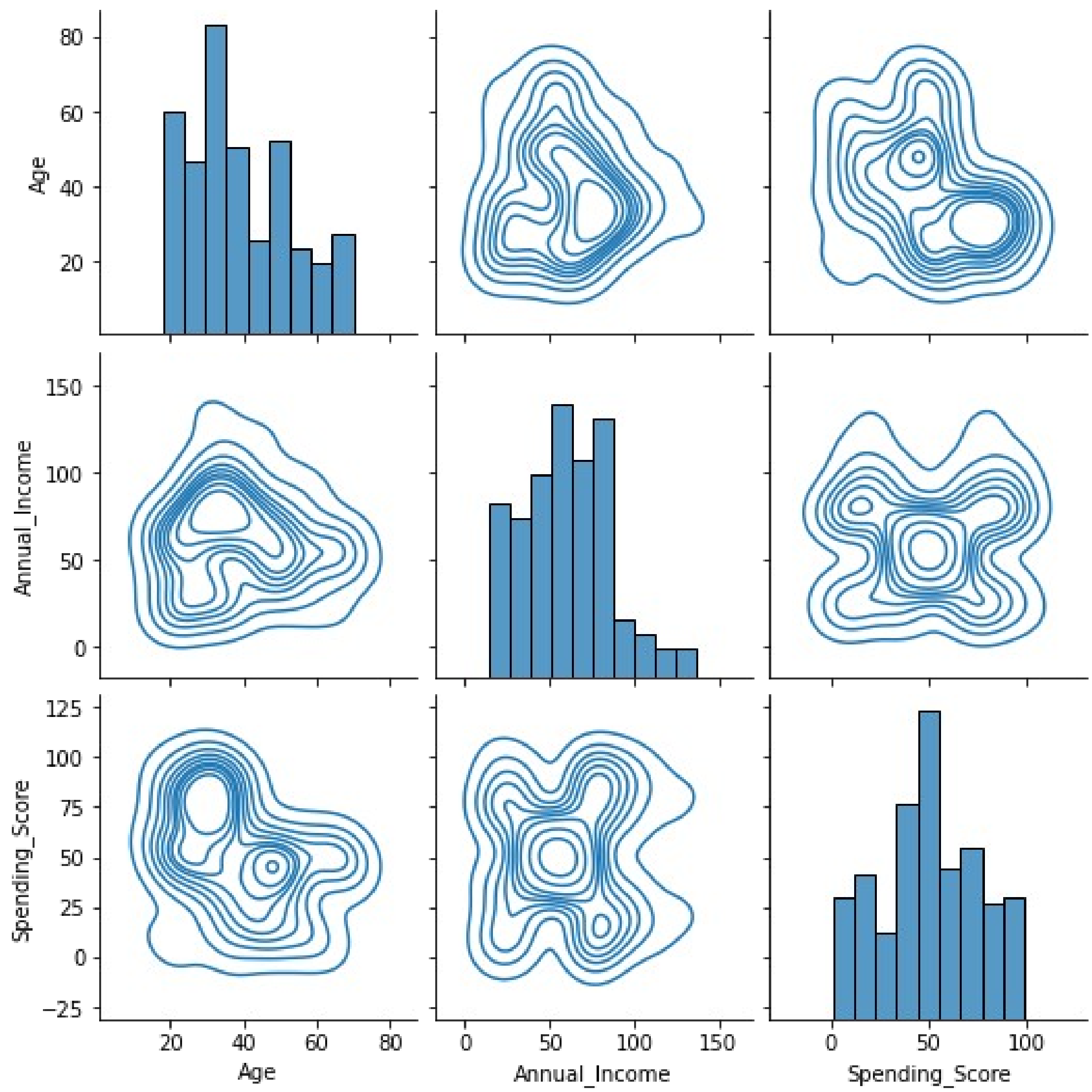

```
sns.pairplot(df,kind='scatter',hue='Age')
```

```
<seaborn.axisgrid.PairGrid at0x7f700510cd90>
```



sns.pairplot(data=df[['Age','Annual_Income','Spending_Score']],kind='kde',diag_kind='hist')

<seaborn.axisgrid.PairGrid at0x7f7004bd3cd0>



Descriptivestatistics

df.describe()

	CustomerID	Age	Annual_Income	Spending_Score
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

Handlemissingdata

df.isnull().any() *#no missing data*

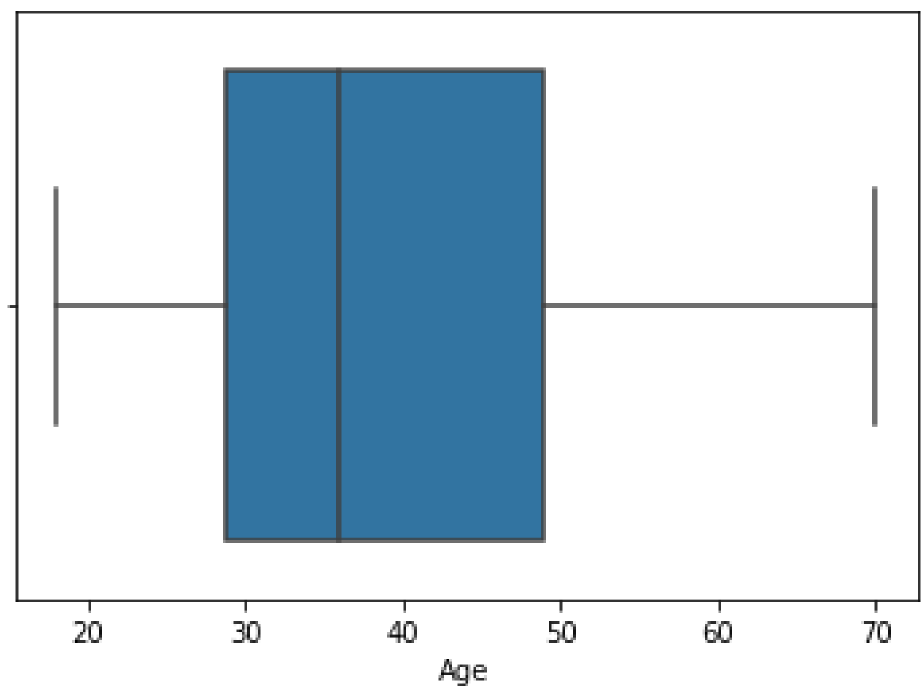
CustomerID False
Gender False
Age False
Annual_IncomeFalseSpending_
ScoreFalsedtype:bool

#OutliersReplacement

sns.boxplot(df.Age) *#nooutliers*

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:FutureWarning:Pass the followingvariableas akeywordarg:x.Fromversion0.12,theonly validpositional argumentwill be `data`,andpassingotherarguments without anexplicit keyword willresultin anerrorormisinterpretation.
FutureWarning

<matplotlib.axes._subplots.AxesSubplotat0x7f7004604090>



CheckforCategoricalcolumnandperformencoding

fromsklearn.preprocessingimport LabelEncoderle

=LabelEncoder()

df.Gender=le.fit_transform(df.Gender)df.head()

	CustomerID	Gender	Age	Annual_Income	Spending_Score
0	1	1	19	15	39
1	2	1	21	15	81
2	3	0	20	16	6
3	4	0	23	16	77
4	5	0	31	17	40

Performclusteringalgorithm

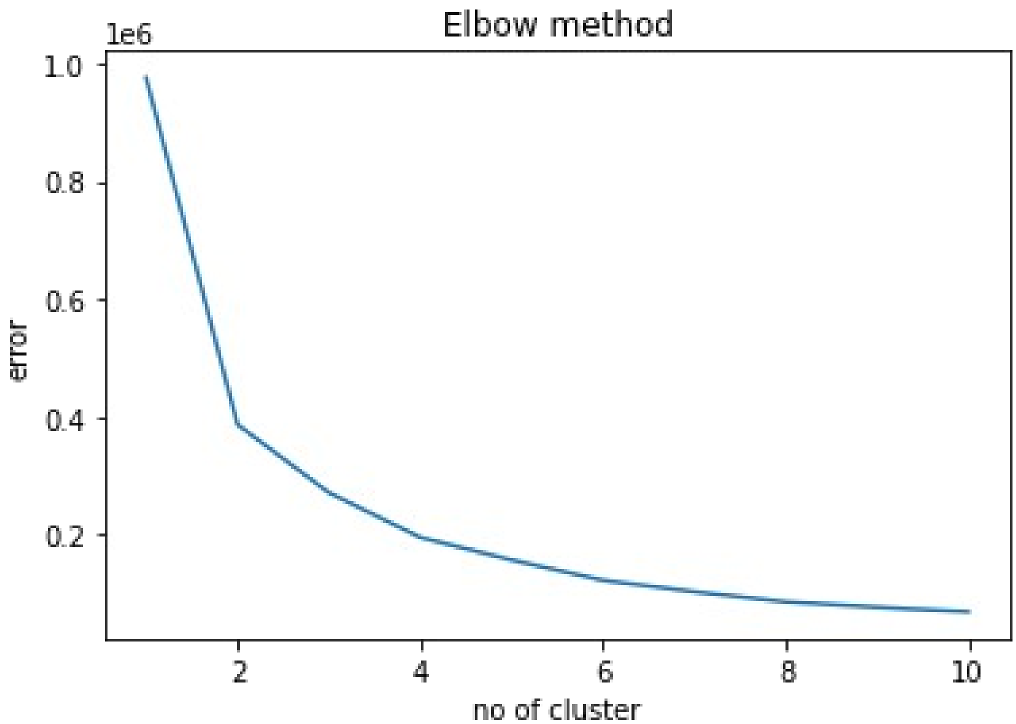
```
from sklearn import cluster

error=[]
foriinrange(1,11):kmeans=cluster.KMeans(n_clusters=i,init='k-means+
+',random_state=0)kmeans.fit(df)error.appe
    nd(kmeans.inertia_)

error[975512.060000000

3,
 387065.71377137717,
 271384.508782868,
 195401.19855991466,
 157157.7579059829,
 122625.19813553878,
 103233.01724386725,
 86053.67444777445,
 76938.97565600359,
 69231.33607611558]

importmatplotlib.pyplotaspltplt.plot(range
(1,11),error)plt.title('Elbowmethod')plt.xlab
el('noofcluster')plt.ylabel('error')
plt.show()
```




```
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)
```

Addtheclusterdatawiththeprimarydataset

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

	CustomerID	Gender	Age	Annual_Income	Spending_Score	Clustered_data
0	1	1	19	15	39	0
1	2	1	21	15	81	0
2	3	0	20	16	6	0
3	4	0	23	16	77	0
4	5	0	31	17	40	0

Splitthedataintodependentandindependentvariables

```
y=df['Clustered_data']
y                                  #y - target columns

0      0
1      0
2      0
3      0
4      0
      ..
195    2
196    2
197    2
198    2
199    2
Name:  Clustered_data, Length: 200,dtype:int32

X=df.drop(columns=['Clustered_data'],axis=1)
X.head()                                                   #X-predictingcolumns
```

	CustomerID	Gender	Age	Annual_Income	Spending_Score
0	1	1	19	15	39
1	2	1	21	15	81
2	3	0	20	16	6
3	4	0	23	16	77
4	5	0	31	17	40

Scaletheindependentvariables

```
from sklearn.preprocessingimport scale

data=pd.DataFrame(scale(X),columns=X.columns)data.head()
```

	CustomerID	Gender	Age	Annual_Income	Spending_Score
0	-1.723412	1.128152	-1.424569	-1.738999	-0.434801
1	-1.706091	1.128152	-1.281035	-1.738999	1.195704
2	-1.688771	-0.886405	-1.352802	-1.700830	-1.715913
3	-1.671450	-0.886405	-1.137502	-1.700830	1.040418
4	-1.654129	-0.886405	-0.563369	-1.662660	-0.395980

Splitthedataintotrainingandtesting

```
fromsklearn.model_selectionimporttrain_test_splitX_train,X_test,y_train,y_test=train_test_split(da
ta,y,test_size=0.3,random_state=1)

X_train.shape,X_test.shape((140,5),

(60,5))
```

y_train.shape,y_test.shape((140,),(6

0,))

Buildthemodel

from sklearn.neighbors import
KNeighborsClassifiermodel=KNeighborsClassifier()

model.fit(X_train,y_train) *#K -Nearest Neighbourmodel (KNN)*

KNeighborsClassifier()

Trainthemodel

pred_train= model.predict(X_train)pred_train

```
array([1,   1, 1, 0, 0, 0, 2, 1, 0, 1, 0, 1, 2, 2, 2, 1, 0, 1, 1, 1, 2,
1,
        1, 1, 2, 0, 1, 1, 2, 0, 1, 0, 2, 2, 2, 1, 2, 2, 2, 2, 1, 0, 1,
2,
1,     0, 1, 1, 2, 0, 1, 0, 2, 1, 1, 1, 2, 1, 2, 0, 1, 1, 1, 2, 2, 2,

2,      2, 2, 2, 0, 0, 1, 2, 1, 2, 0, 2, 0, 2, 1, 2, 2, 1, 2, 1, 0, 0,

1,      1, 1, 0, 0, 1, 0, 0, 0, 2, 0, 2, 1, 2, 0, 1, 1, 2, 0, 1, 2, 0,

        0, 1, 1, 0, 2, 2, 1, 1, 1, 0, 2, 2, 2, 2, 2, 1, 0, 2, 0, 2, 1,
2,
        2, 2, 1, 2, 2, 1, 2, 0],dtype=int32)
```

Testthedata

y_test

```
58     0
40     0
34     0
102    1
184    2
198    2
95     1
4      0
29     0
168    2
171    2
18     0
11     0
89     1
```

```
110    1
118    1
159    2
35     0
136    2
59     0
51     0
16     0
44     0
94     1
31     0
162    2
38     0
28     0
193    2
27     0
47     0
165    2
194    2
177    2
176    2
97     1
174    2
73     1
69     1
172    2
108    1
107    1
189    2
14     0
56     0
19     0
114    1
39     0
185    2
124    1
98     1
123    1
119    1
53     0
33     0
179    2
181    2
106    1
199    2
138    2
Name:   Clustered_data,     dtype:int32
```

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

```
array([0,0,    1,  0,  1,  2,  2,  1,  0,  0,  2,  2,  0,  0,  1,  1,  1, 2,0,2,1,1,
       0,
0,             1,  0,  2,  0,  0,  2,  0,  0,  2,  2,  2,  2,  1,  2,  1, 0,2,1,1,2,
       0,
               0,  1,  0,  2,  1,  1,  1,  1,  1,  0,  2,  2,  1,  2,  2],dtype=int32)
pred=
pd.DataFrame({'Actual_value':y_test,'Predicted_value_using_KNN':pred_test})
pred.head()
```

	Actual_value	Predicted_value_using_KNN
58	0	0
40	0	1
34	0	0
102	1	1
184	2	2

Measuretheperformanceusingmetrics

```
fromsklearn.metricsimportaccuracy_score,confusion_matrix,classification_report

#Accuracy Score
print('Training accuracy:
',accuracy_score(y_train,pred_train))print('Testingaccuracy:',accuracy_score(y_test,pred_test))
```

Training accuracy:0.9214285714285714
Testingaccuracy:0.9166666666666666

```
#ConfusionMatrix
pd.crosstab(y_test,pred_test)
```

col_0Clustered_data	0	1	2
0	19	4	0
1	1	16	0
2	0	0	20

```
#ClassificationReport
print(classification_report(y_test,pred_test))
```

	precision	recall	f1-score	support
0	0.95	0.83	0.88	23
1	0.80	0.94	0.86	17
2	1.00	1.00	1.00	20
accuracy			0.92	60
macroavg	0.92	0.92	0.92	60

weightedavg	0.92	0.92	0.92	60