| | |
|---|---|
| Assignment Date | |
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| Student Roll Number | 111519104038 |
| Maximum Marks | 2 Marks |

#**Problem Statement: Customer Segmentation Analysis**

###**Description:** *You own the mall and want to understand the customers who can quickly converge [Target Customers] so that the insight can be given to the marketing team and plan the strategy accordingly.*

## Download and load Dataset

import numpy as np import
pandas as pd
import matplotlib.pyplot as pltimport
seaborn as sns
import matplotlib as rcParams

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

```
      CustomerID   Gender   Age   Annual Income (k$)   Spending Score (1-100)0            1
                   Male    19        15                        39
1                  2        Male     21                        15                     81
2                  3   Female        20                        16                      6
3                  4   Female        23                        16                     77
4                  5   Female        31                        17                     40
```

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

```
      CustomerID   Gender   Age   Annual_Income   Spending_Score0         1
                   Male    19        15                 39
1                  2        Male     21                 15          81
2                  3   Female        20                 16           6
3                  4   Female        23                 16          77
4                  5   Female        31                 17          40
```

df.shape

(200, 5)

df.info()

```
<class 'pandas.core.frame.DataFrame'>RangeIndex:
200 entries, 0 to 199 Data columns (total 5 columns):
 #      Column                  Non-Null Count    Dtype
-----   ------------------------------------------   -----------
 0      CustomerID              200 non-null      int64
 1      Gender                  200 non-null      object
```

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

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

df.Gender.unique()

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

array([19,54,
29, 21, 20, 23, 31, 22, 35, 64, 30, 67, 58, 24, 37, 52, 25, 46,
51,
69, 45, 40, 60, 53, 18, 49, 42, 36, 65, 48, 50, 27, 33, 59, 47,
41])
70, 63, 43, 68, 32, 26, 57, 38, 55, 34, 66, 39, 44, 28, 56,

df.Gender.value_counts()Female

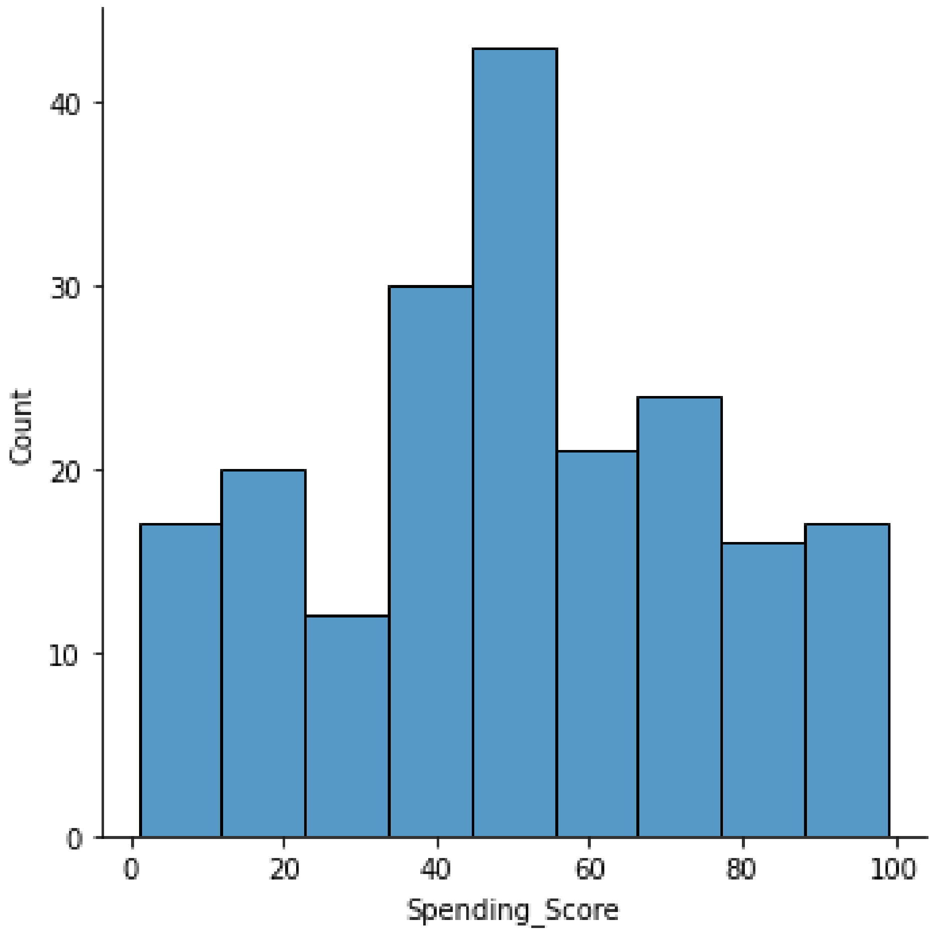
112
Male 88
Name: Gender, dtype: int64

# Visualizations

### Univariate Analysis

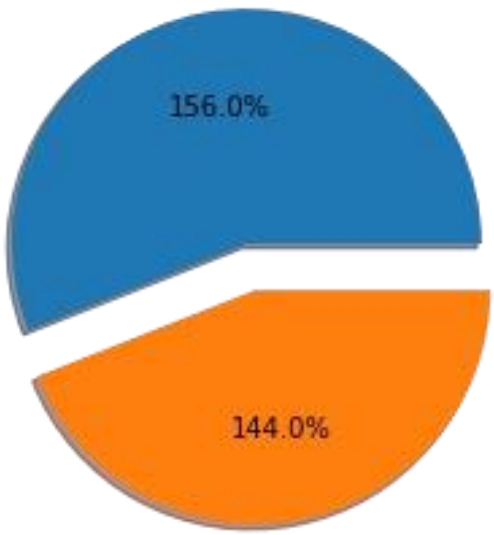
sns.displot(df.Spending_Score)

<seaborn.axisgrid.FacetGrid at 0x7f700626b950>



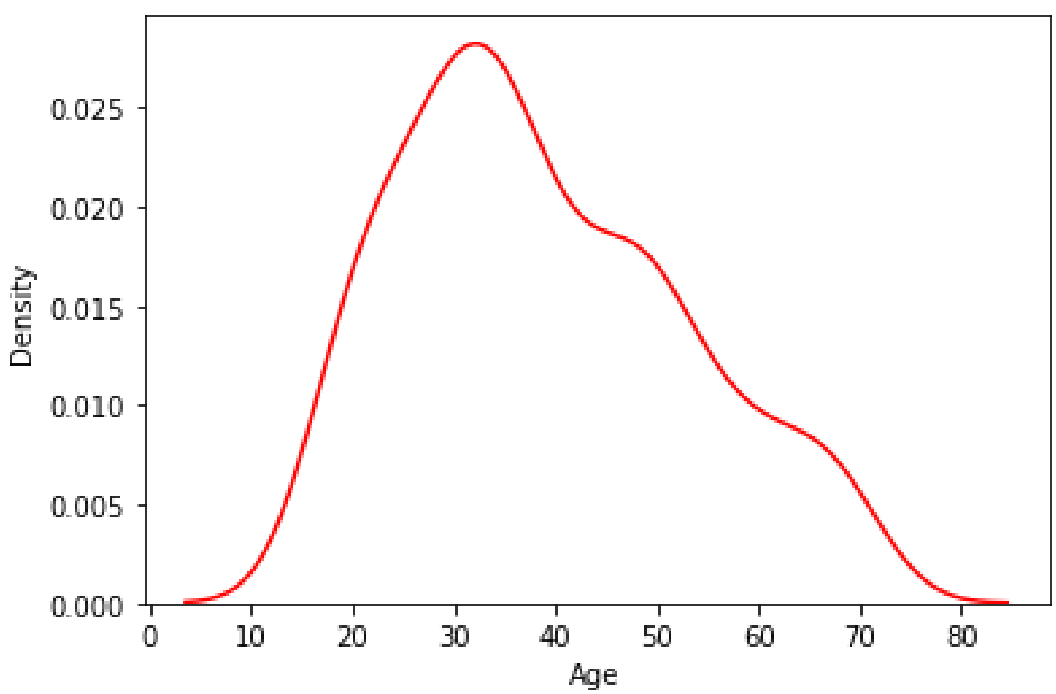

```
plt.pie(df.Gender.value_counts(),[0,0.2],shadow='True',autopct="1%.1f%%")        #categorial column
```

```
([<matplotlib.patches.Wedge at 0x7f7005485ed0>,
   <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.AxesSubplot at 0x7f700549a450>



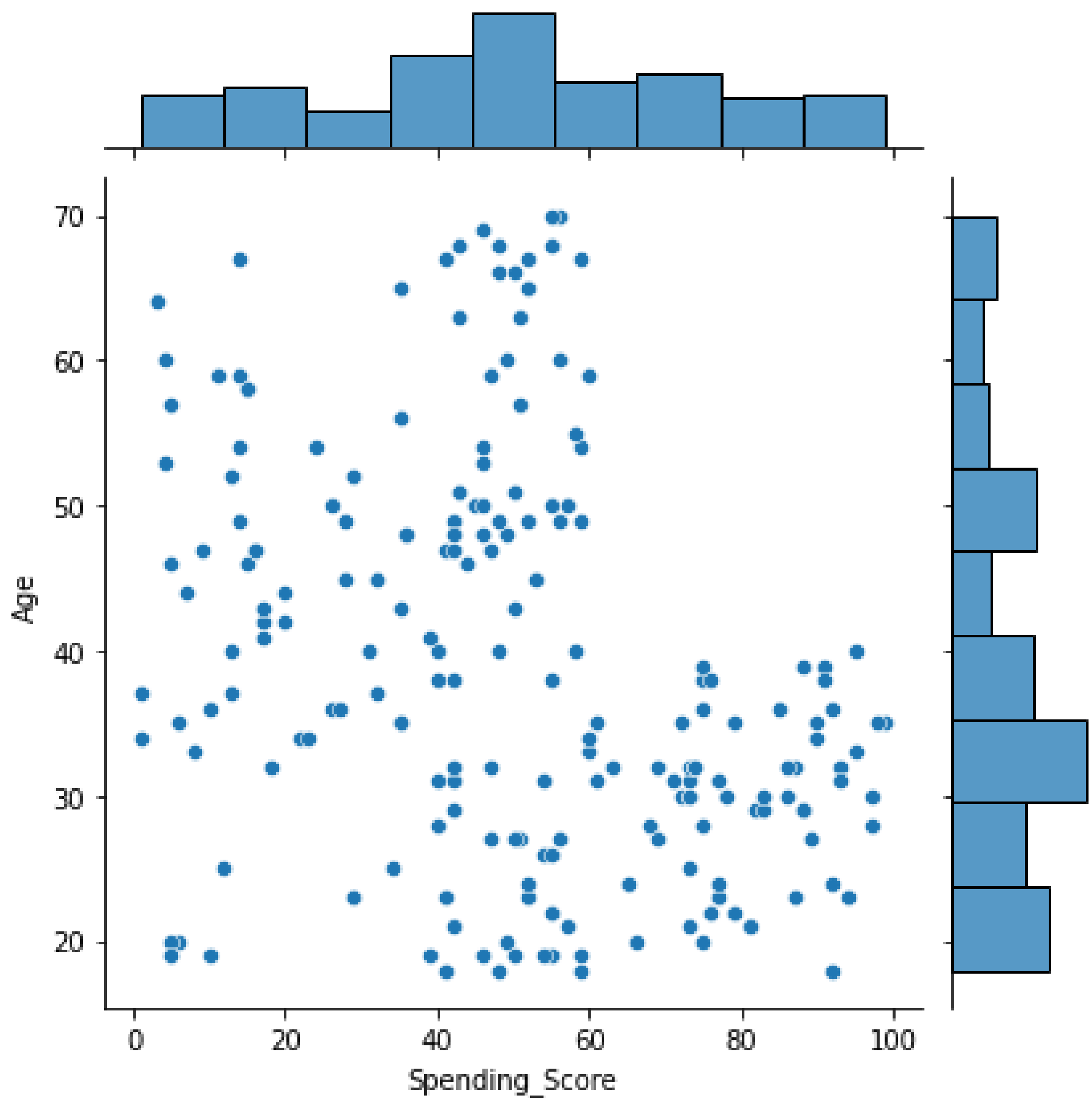

## Bi-variate Analysis

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

/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`,

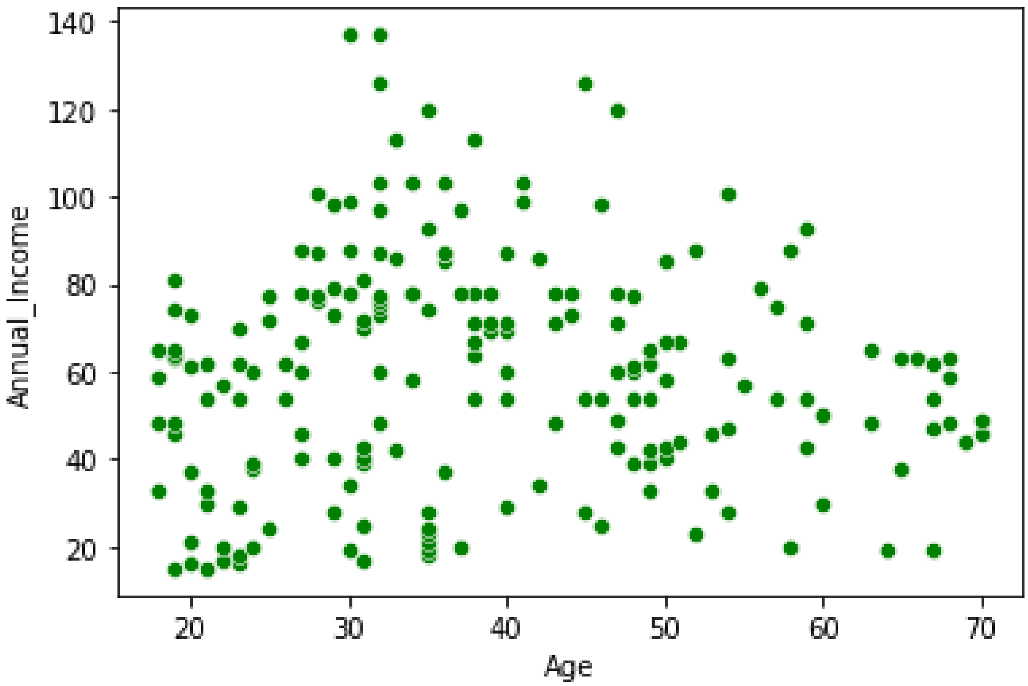
and passing other arguments without an explicit keyword will result inan error or misinterpretation.
  FutureWarning

<seaborn.axisgrid.JointGrid at 0x7f7005459c50>




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

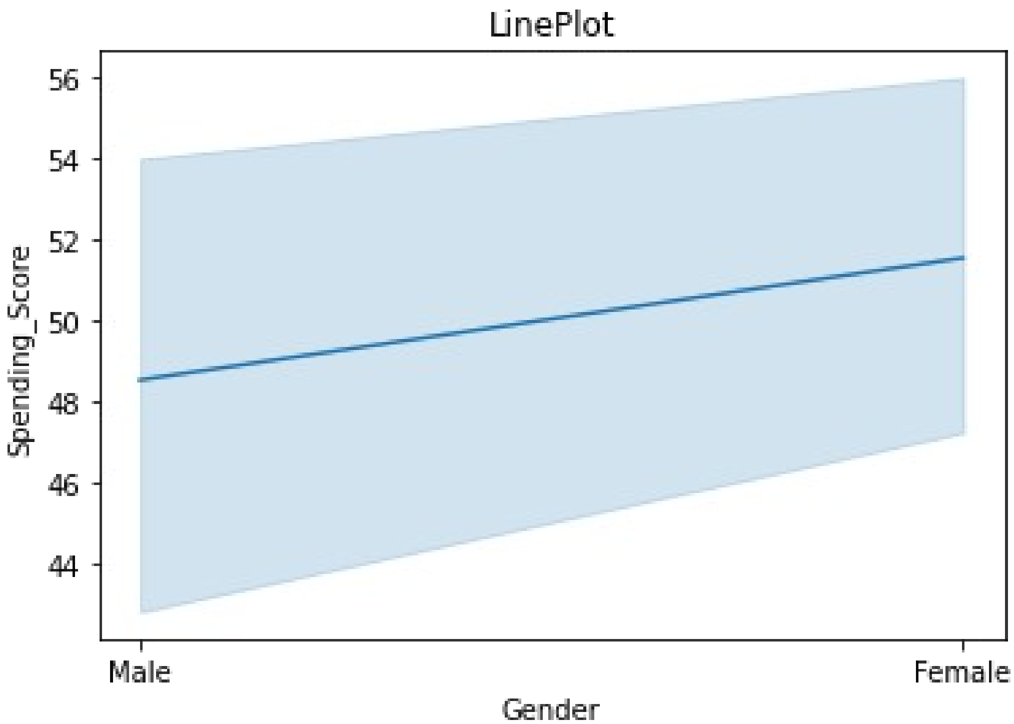
```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
FutureWarning: Pass the following variables as keyword args: x, y.
From version 0.12, the only valid positional argument will be `data`,
and passing other arguments without an explicit keyword will result in
an error or misinterpretation.
  FutureWarning

<matplotlib.axes._subplots.AxesSubplot at 0x7f7005268410>
```




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

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result inan error or misinterpretation.
  FutureWarning
```

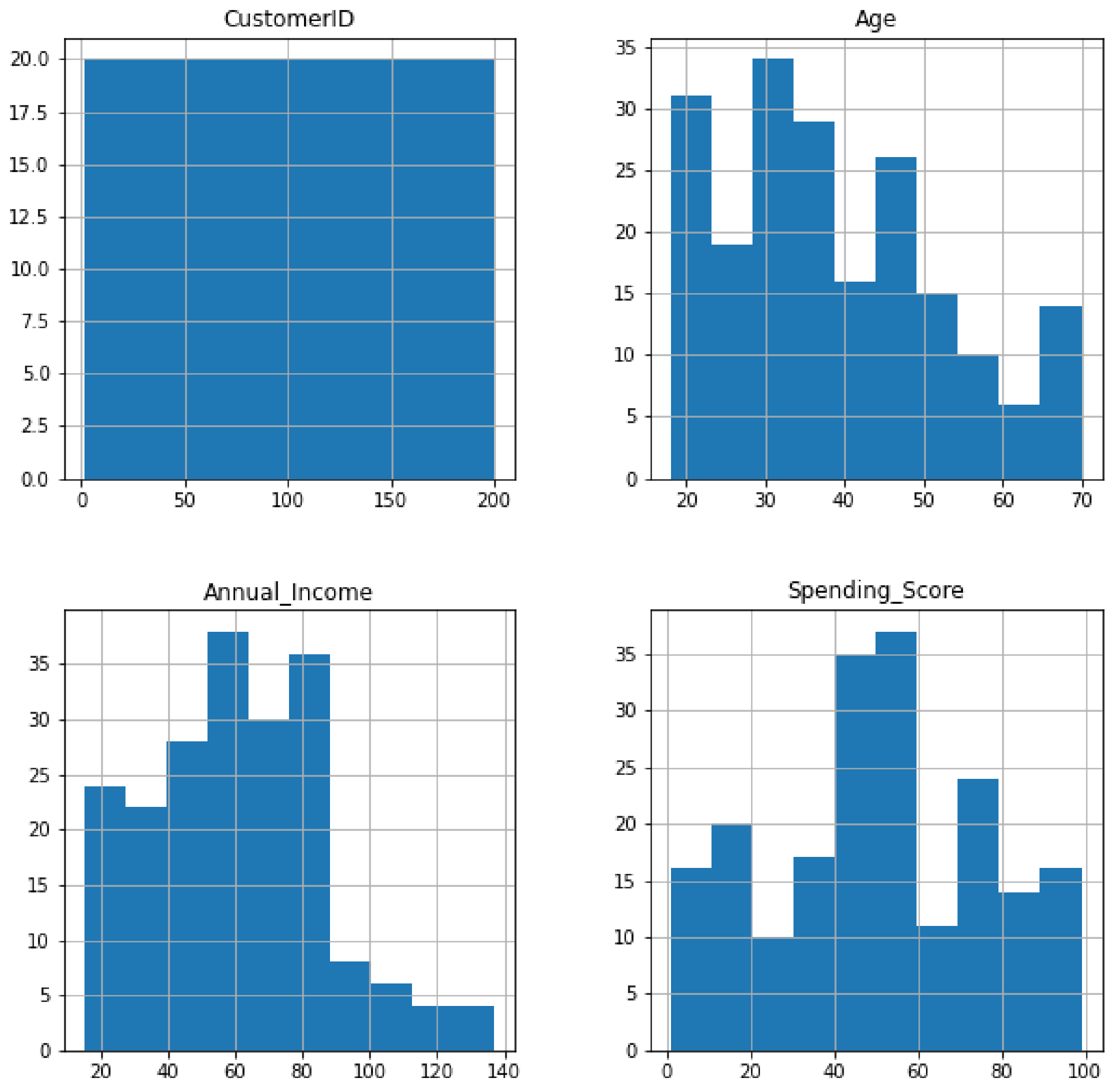
```
Text(0.5, 1.0, 'LinePlot')
```




**Multi-variate Analysis**

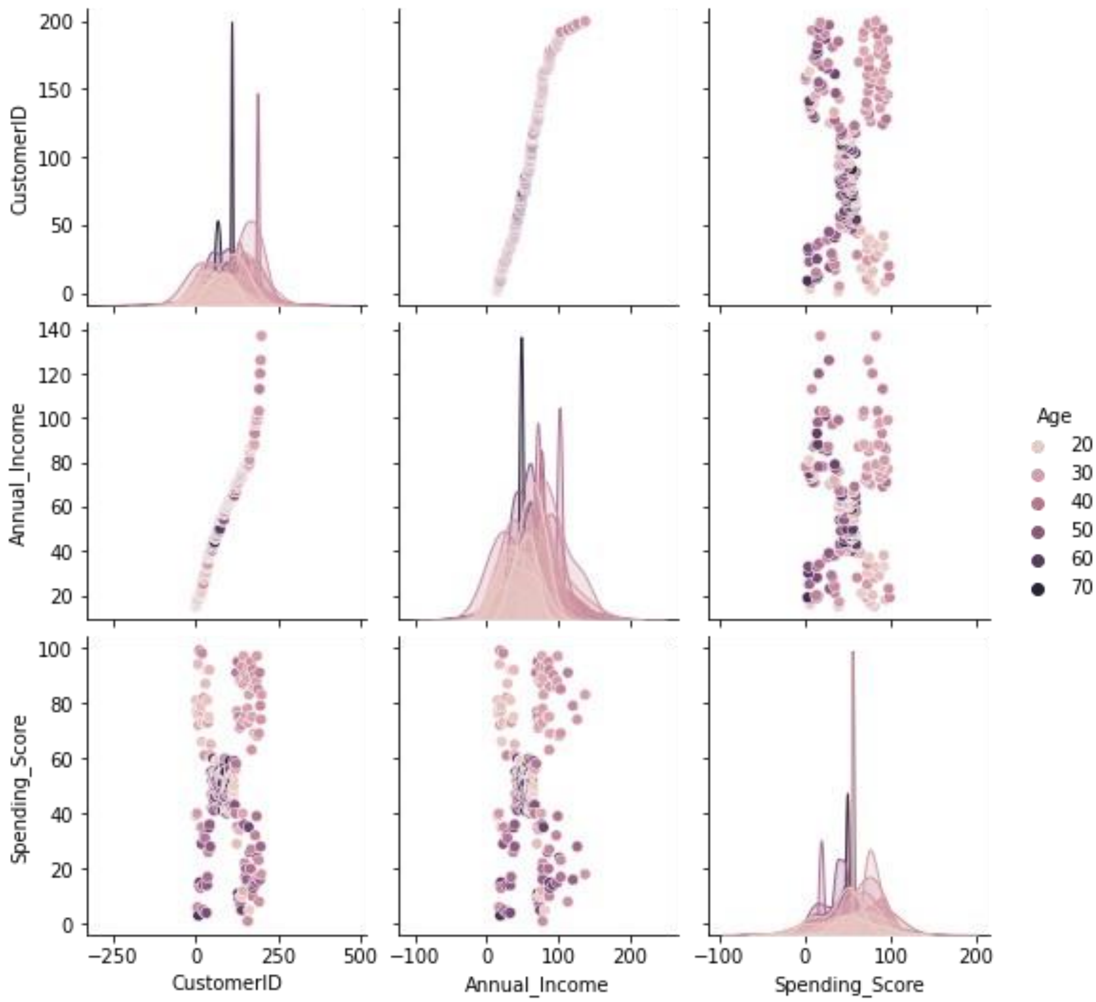
```
df.hist(figsize=(10,10))
```

```
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)
```



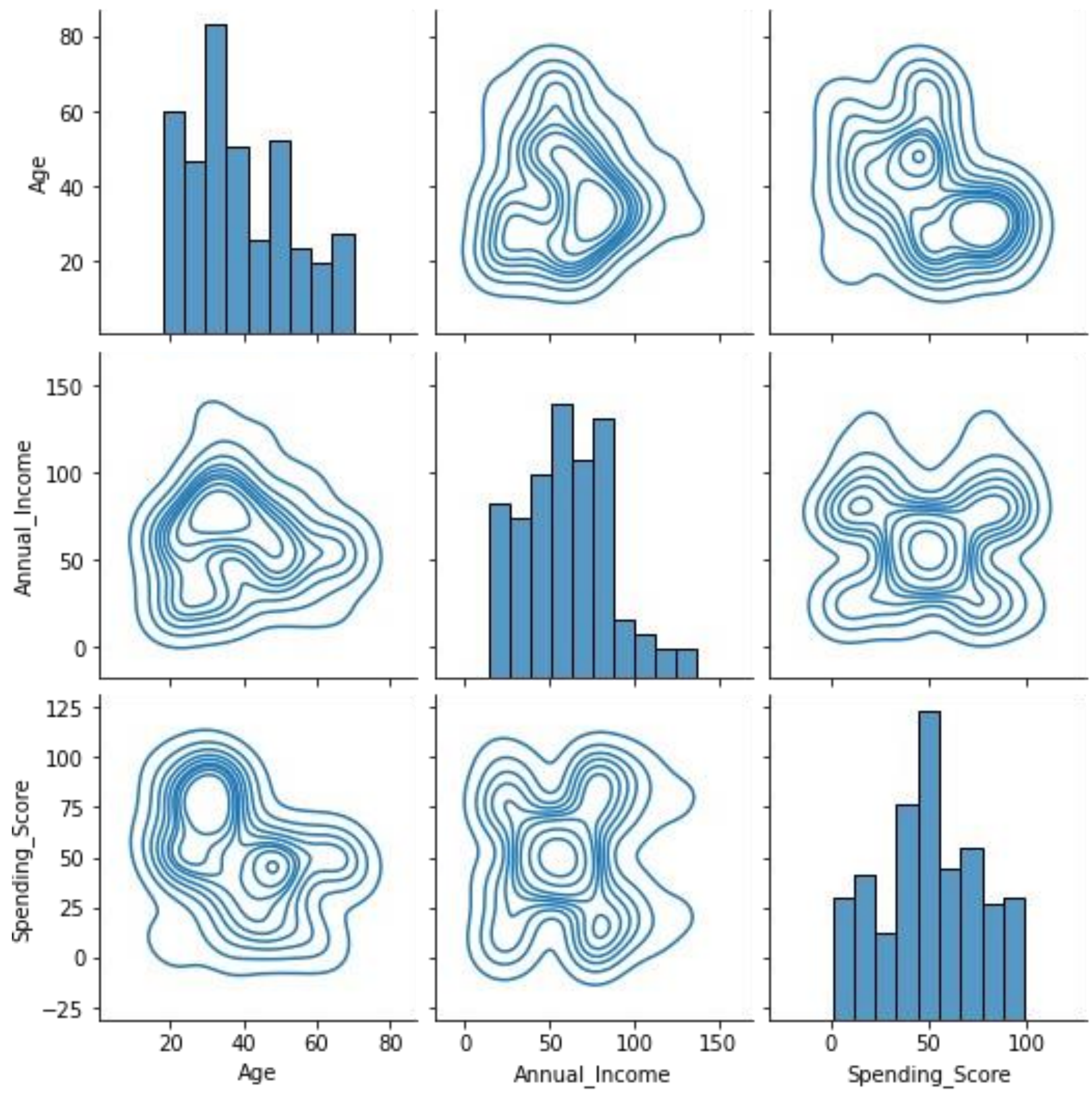

```
sns.pairplot(df,kind='scatter',hue='Age')
```

```
<seaborn.axisgrid.PairGrid at 0x7f700510cd90>
```




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

<seaborn.axisgrid.PairGrid at 0x7f7004bd3cd0>




## Descriptive statistics

```
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 |

## Handle missing data

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

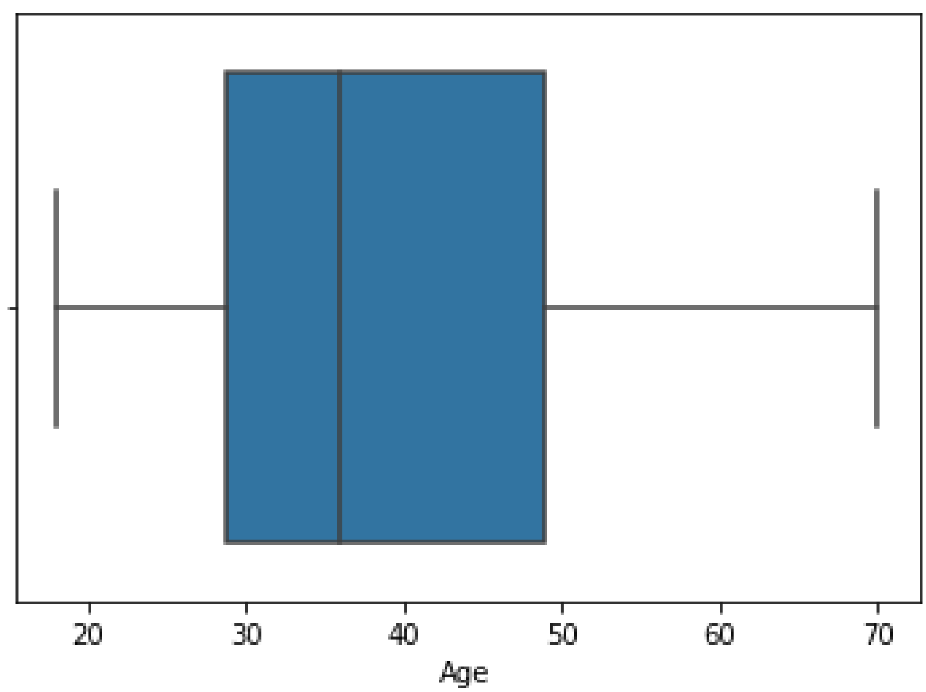
```
CustomerID        False
Gender            False
Age               False
Annual_Income     False
Spending_Score    False
dtype: bool
```

**#Outliers Replacement**

```
sns.boxplot(df.Age) #no outliers
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
FutureWarning: Pass the following variable as a keyword arg: x. From
version 0.12, the only valid positional argument will be `data`, and
passing other arguments without an explicit keyword will result in an
error or misinterpretation.
  FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f7004604090>
```




## Check for Categorical column and perform encoding

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

```
le = 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
```

## Perform clustering algorithm

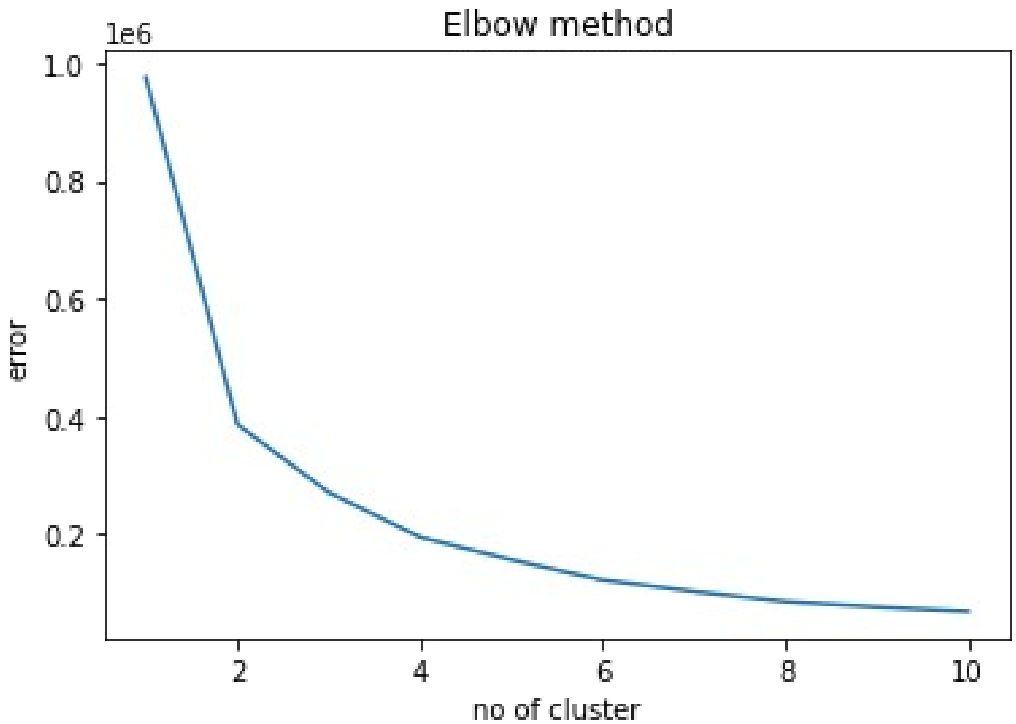
```
from sklearn import cluster
```

```
error =[]
for i in range(1,11):
    kmeans=cluster.KMeans(n_clusters=i,init='k-means+
+',random_state=0)
    kmeans.fit(df)
    error.append(kmeans.inertia_)
```

```
error
```

```
[975512.0600000003,
 387065.71377137717,
 271384.508782868,
 195401.19855991466,
 157157.7579059829,
 122625.19813553878,
 103233.01724386725,
 86053.67444777445,
 76938.97565600359,
 69231.33607611558]
```

```
import matplotlib.pyplot as plt
plt.plot(range(1,11),error)
plt.title('Elbow method')
plt.xlabel('no of cluster')
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)
```

## Add the cluster data with the primary dataset

```
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
```

## Split the data into dependent and independent variables

```
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 - predicting columns
```

| | 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 |

## Scale the independent variables

```
from sklearn.preprocessing import 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 |

## Split the data into training and testing

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(data,y,test_size=0.3,ra
ndom_state=1)
```

```
X_train.shape,X_test.shape
```

```
((140, 5), (60, 5))
```

```
y_train.shape,y_test.shape
```

```
((140,), (60,))
```

## Build the model

```
from sklearn.neighbors import KNeighborsClassifier
model = KNeighborsClassifier()

model.fit(X_train,y_train)    # K - Nearest Neighbour model (KNN)
```

```
KNeighborsClassifier()
```

## Train the model

```
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,
       0, 1, 1, 2, 0, 1, 0, 2, 1, 1, 1, 2, 1, 2, 0, 1, 1, 1, 2, 2, 2,
1,
       2, 2, 2, 0, 0, 1, 2, 1, 2, 0, 2, 0, 2, 1, 2, 2, 1, 2, 1, 0, 0,
2,
       1, 1, 0, 0, 1, 0, 0, 0, 2, 0, 2, 1, 2, 0, 1, 1, 2, 0, 1, 2, 0,
1,
       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)
```

## Test the data

```
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, 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, 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_t
est})
pred.head()
```

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

## Measure the performance using metrics

```
from sklearn.metrics import
accuracy_score,confusion_matrix,classification_report
```

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

```
Training accuracy:  0.9214285714285714
Testing accuracy:  0.9166666666666666
```

```
#Confusion Matrix
pd.crosstab(y_test,pred_test)
```

| col_0 | 0 | 1 | 2 |
|---|---|---|---|
| Clustered_data | | | |
| 0 | 19 | 4 | 0 |
| 1 | 1 | 16 | 0 |
| 2 | 0 | 0 | 20 |

```
#Classification Report
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 |
| macro avg | 0.92 | 0.92 | 0.92 | 60 |

| | | | | |
|---|---|---|---|---|
| weighted avg | 0.92 | 0.92 | 0.92 | 60 |