1.Download the dataset

2.Load the dataset

```
import pandas as pd
```

```
dataframe = pd.read_csv('Mall_Customers.csv')
dataframe.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
```

Dataset is loaded

```
dataframe.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 (k$)      200 non-null    int64
 4   Spending Score (1-100)  200 non-null    int64
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

```
dataframe.rename(columns = {'Annual Income (k$)':'annual_income'},
inplace = True)
```

```
dataframe.rename(columns = {'Spending Score (1-
100)':'spending_score'}, inplace = True)
```

3.Visualizations (Univariant , Bivariant , Multivariant)

A.Univariant Analysis

```
dataframe["annual_income"].mean()
```

```
60.56
```

```
dataframe["annual_income"].std()
```

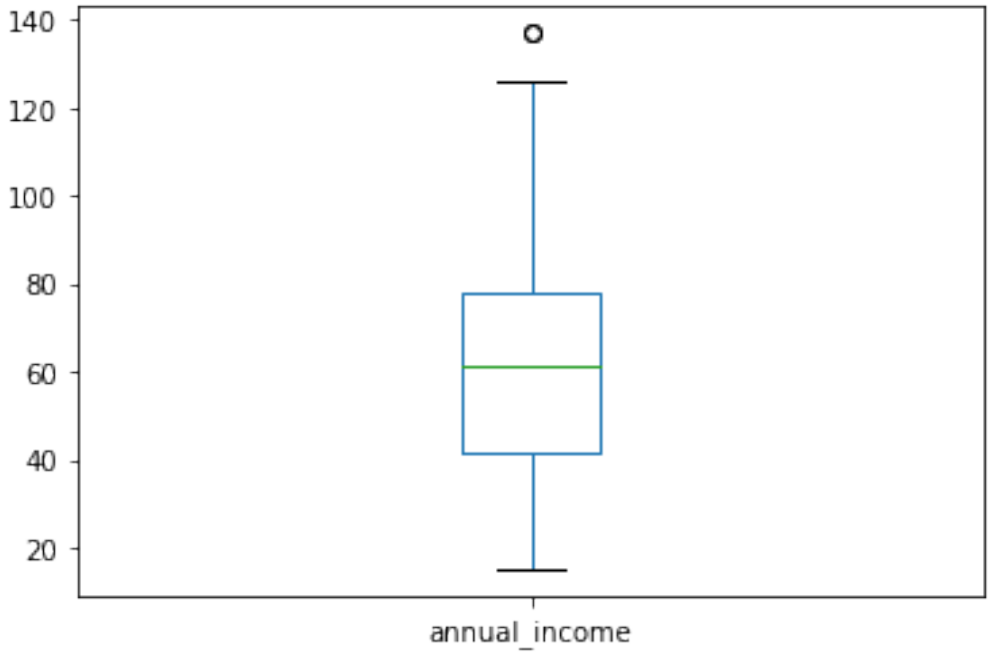
```
26.264721165271244
```

```
dataframe['annual_income'].value_counts()
```

```
54     12
78     12
48      6
71      6
63      6
       ..
58      2
59      2
16      2
64      2
137     2
Name: annual_income, Length: 64, dtype: int64
```

```
import matplotlib.pyplot as plt
dataframe.boxplot(column=['annual_income'],grid=False)
```

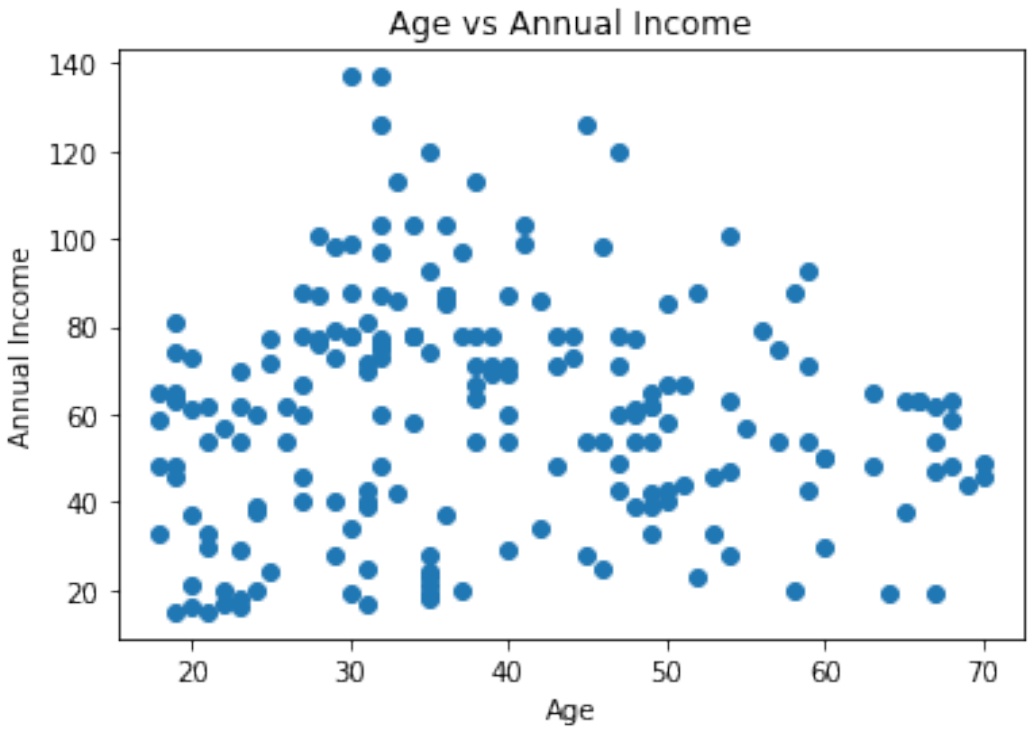
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f58638f1a50>
```



B.Bivariant Analysis

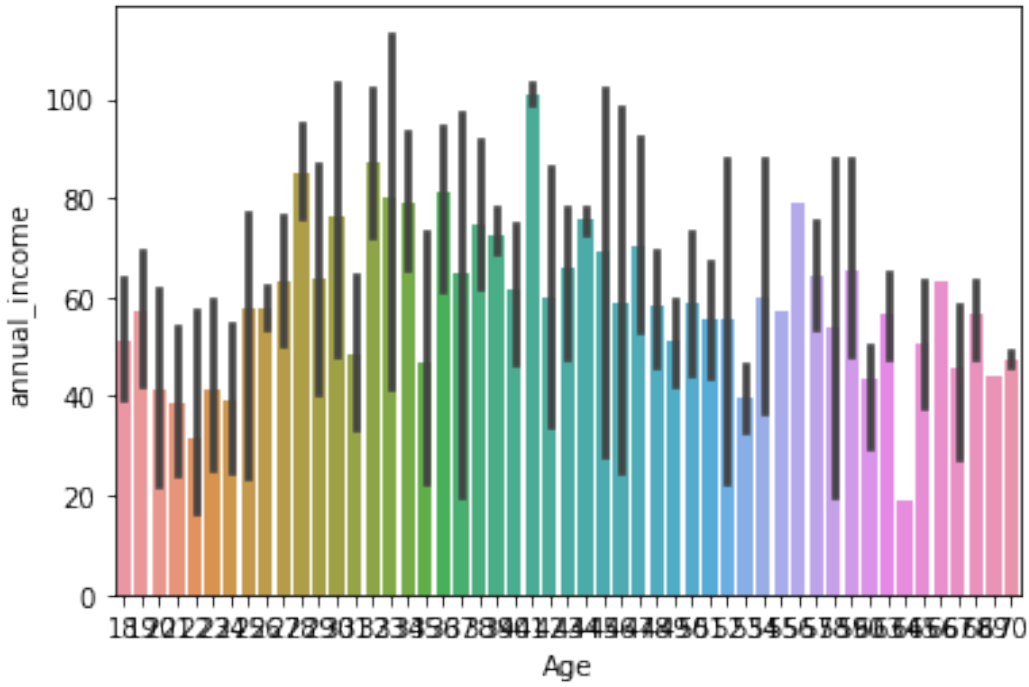
```
plt.scatter(dataframe.Age,dataframe.annual_income)
plt.title('Age vs Annual Income')
plt.xlabel('Age')
plt.ylabel('Annual Income')
```

```
Text(0, 0.5, 'Annual Income')
```



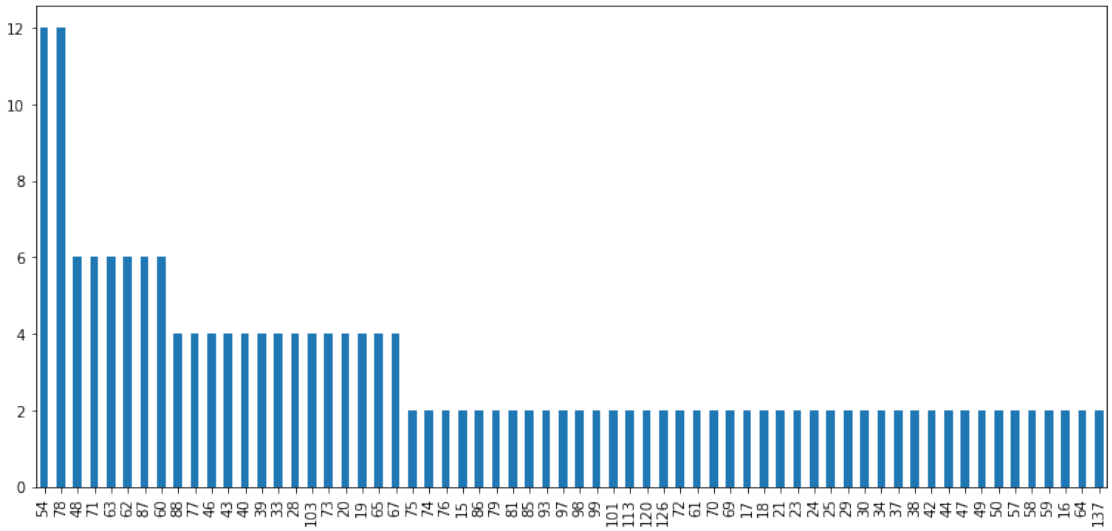

```
import seaborn as sns
sns.barplot(x='Age',y='annual_income',data = dataframe)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5855660550>
```



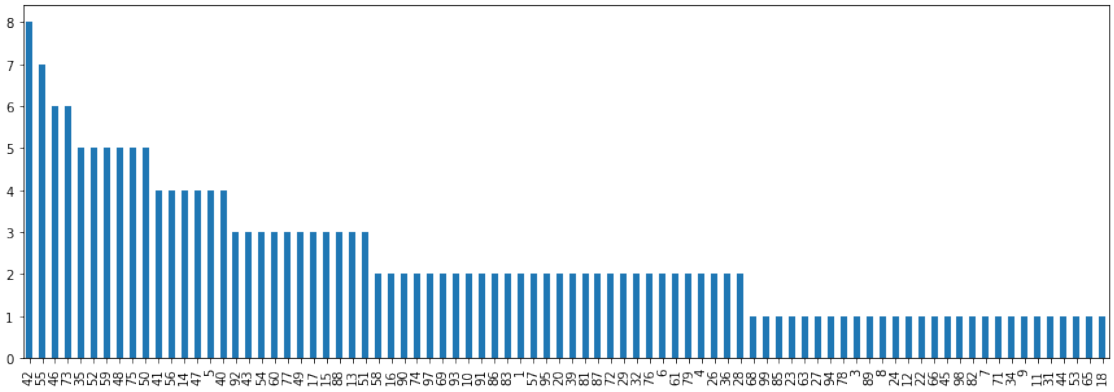

```
dataframe['annual_income'].value_counts().plot.bar(figsize = (13, 6))
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f584fb5bcd0>
```



```
dataframe['spending_score'].value_counts().plot.bar(figsize = (15, 5))
```

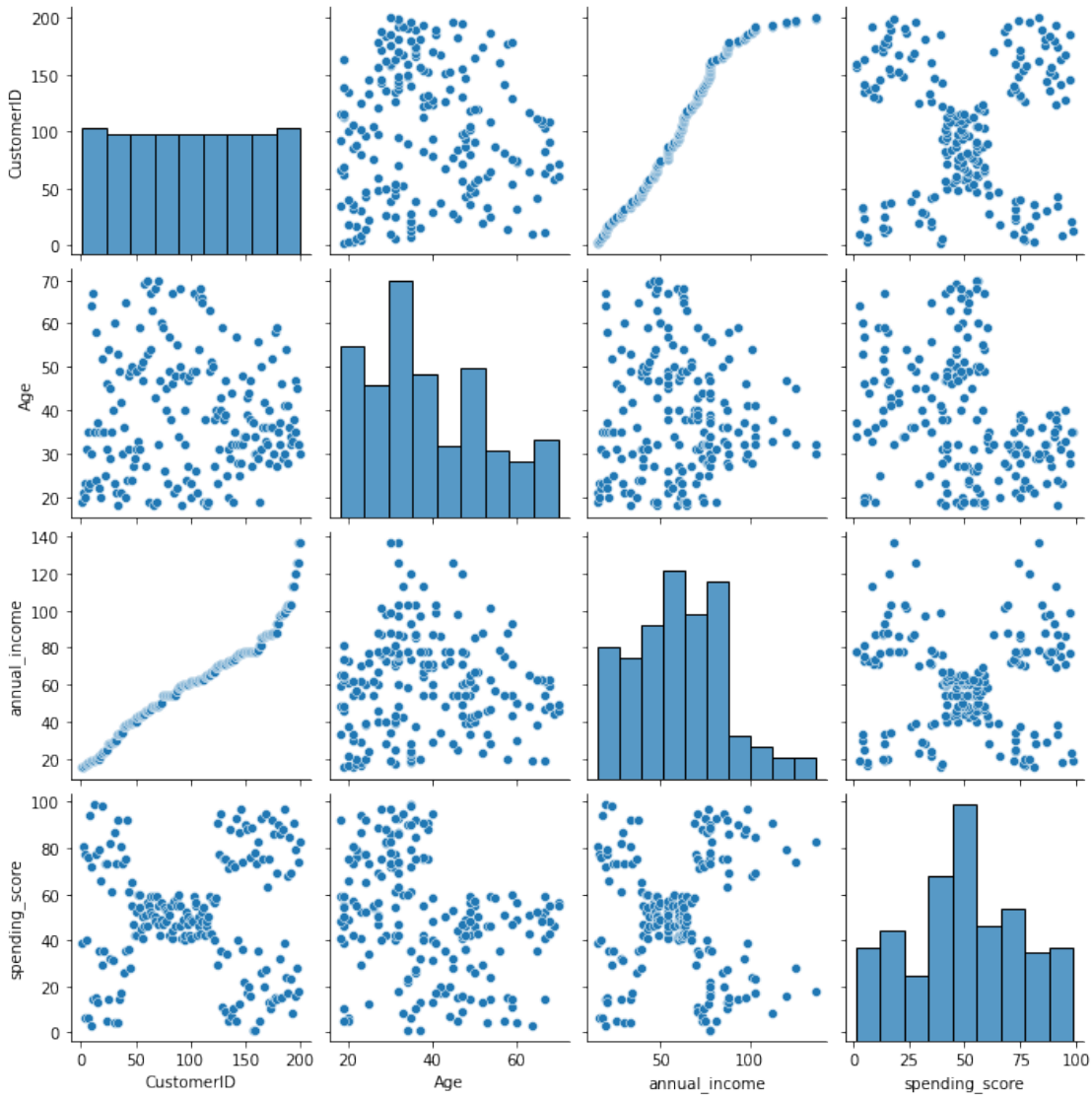
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f584f8c10d0>
```



C.Multi-Variate Analysis

```
sns.pairplot(dataframe)
```

```
<seaborn.axisgrid.PairGrid at 0x7f5854d87a90>
```



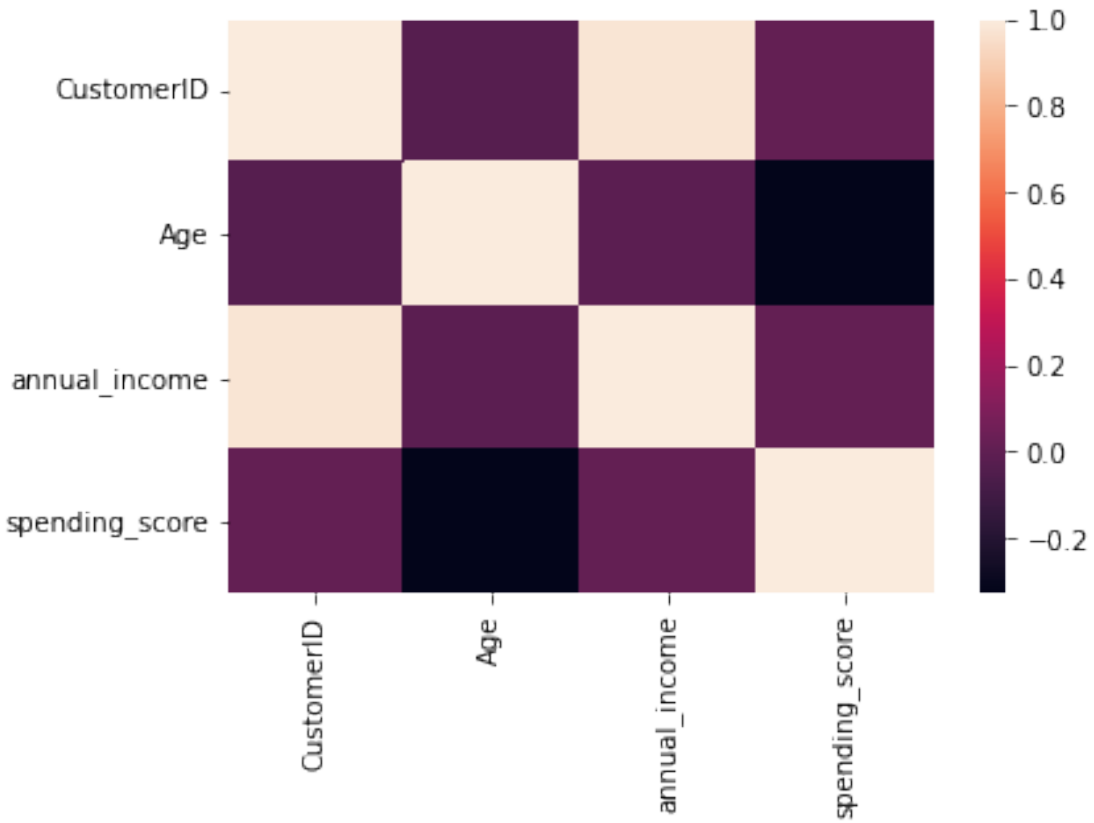
1. Perform descriptive statistics on the dataset

```
dataframe.corr()
```

	CustomerID	Age	annual_income	spending_score
CustomerID	1.000000	-0.026763	0.977548	0.013835
Age	-0.026763	1.000000	-0.012398	-0.327227
annual_income	0.977548	-0.012398	1.000000	0.009903
spending_score	0.013835	-0.327227	0.009903	1.000000

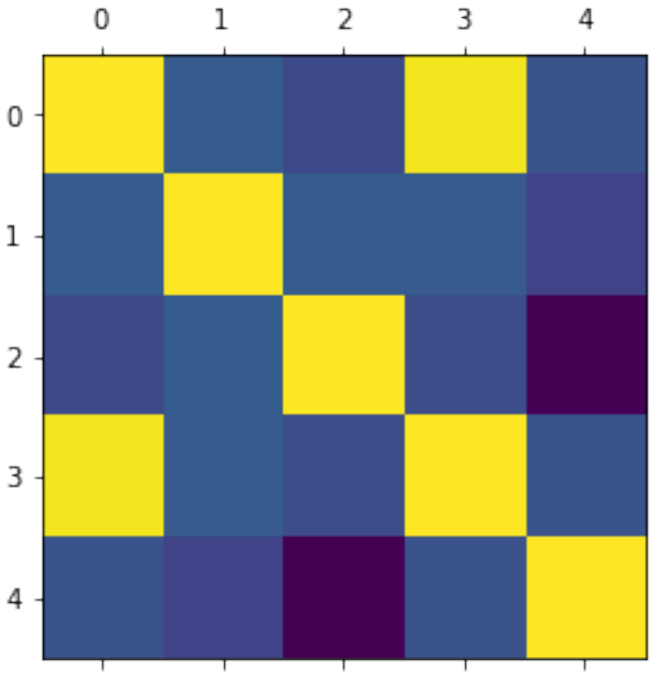
```
sns.heatmap(dataframe.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f58611c8690>
```




```
plt.matshow(dataframe.corr())
```

```
<matplotlib.image.AxesImage at 0x7f584f639ed0>
```



5.Check for Missing values and deal with them.

```
dataframe.isnull().any()
```

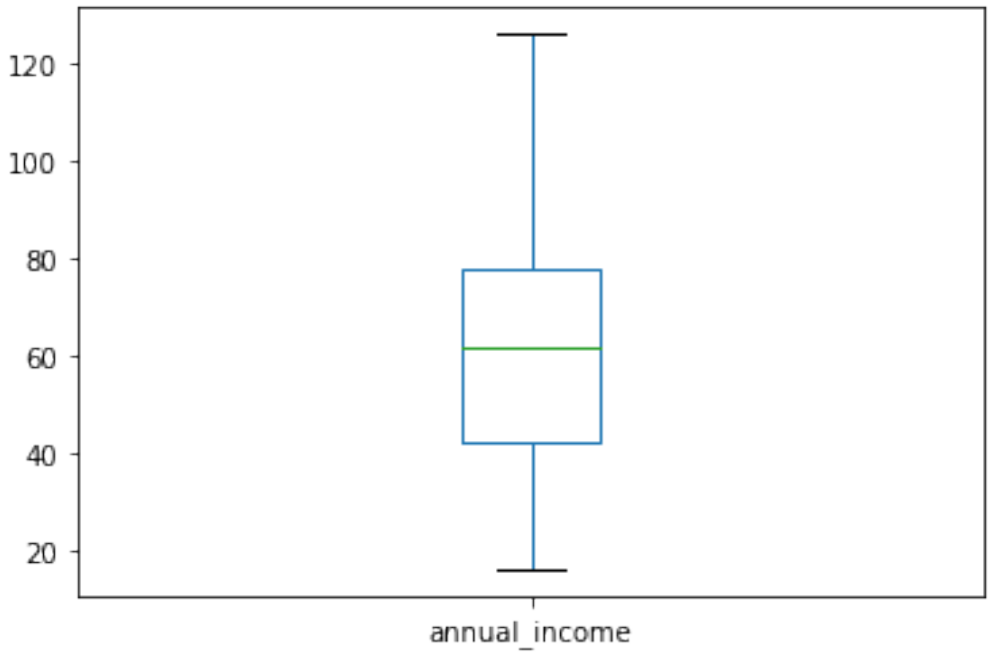
```
CustomerID        False
Gender            False
Age               False
annual_income     False
spending_score    False
dtype: bool
```

There are no missing values in this dataset . So there is no need to handle the missing values .

6.Find the outliers and replace them outliers

```
q_low = dataframe["annual_income"].quantile(0.01)
q_hi  = dataframe["annual_income"].quantile(0.99)

df_filtered = dataframe[(dataframe["annual_income"] < q_hi) &
(dataframe["annual_income"] > q_low)]
df_filtered.boxplot(column=['annual_income'],grid=False)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f585031e8d0>
```



7.Check for Categorical columns and perform encoding.

```
dataframe["Gender"]
```

```
0        Male
1        Male
```

```
2      Female
3      Female
4      Female
        ...
195    Female
196    Female
197      Male
198      Male
199      Male
Name: Gender, Length: 200, dtype: object
```

```
from sklearn import preprocessing
```

```
label_encoder = preprocessing.LabelEncoder()
dataframe['Gender'] = label_encoder.fit_transform(dataframe['Gender'])
```

```
dataframe["Gender"]
```

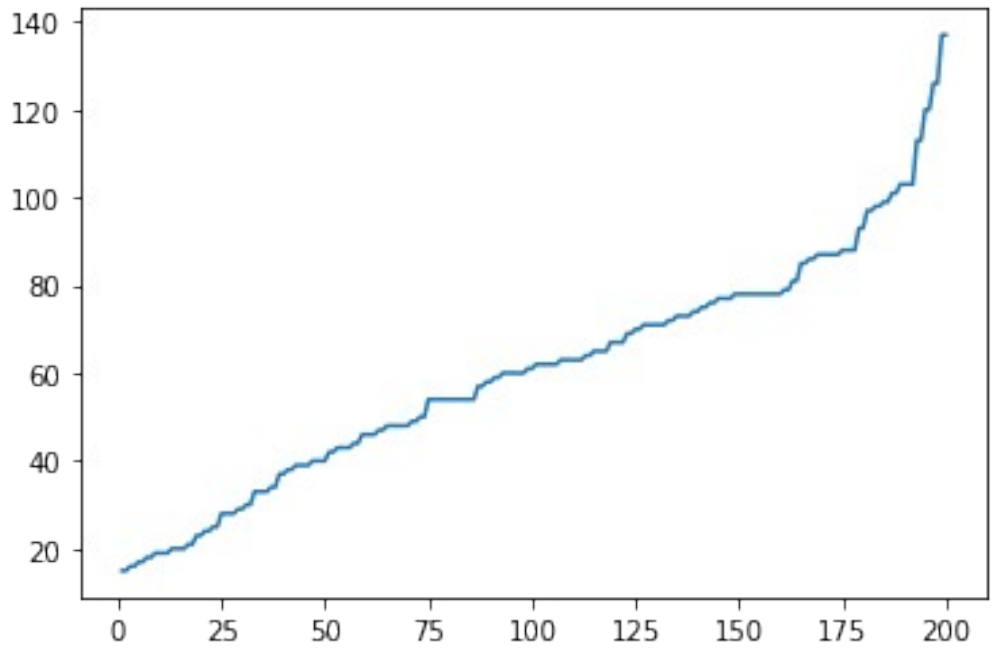
```
0      1
1      1
2      0
3      0
4      0
      ..
195    0
196    0
197    1
198    1
199    1
Name: Gender, Length: 200, dtype: int64
```

8.Split the data into dependent and independent variables.

```
x = dataframe['CustomerID']
y = dataframe['annual_income']
```

```
plt.plot(x, y)
```

```
[<matplotlib.lines.Line2D at 0x7f584f5b6210>]
```

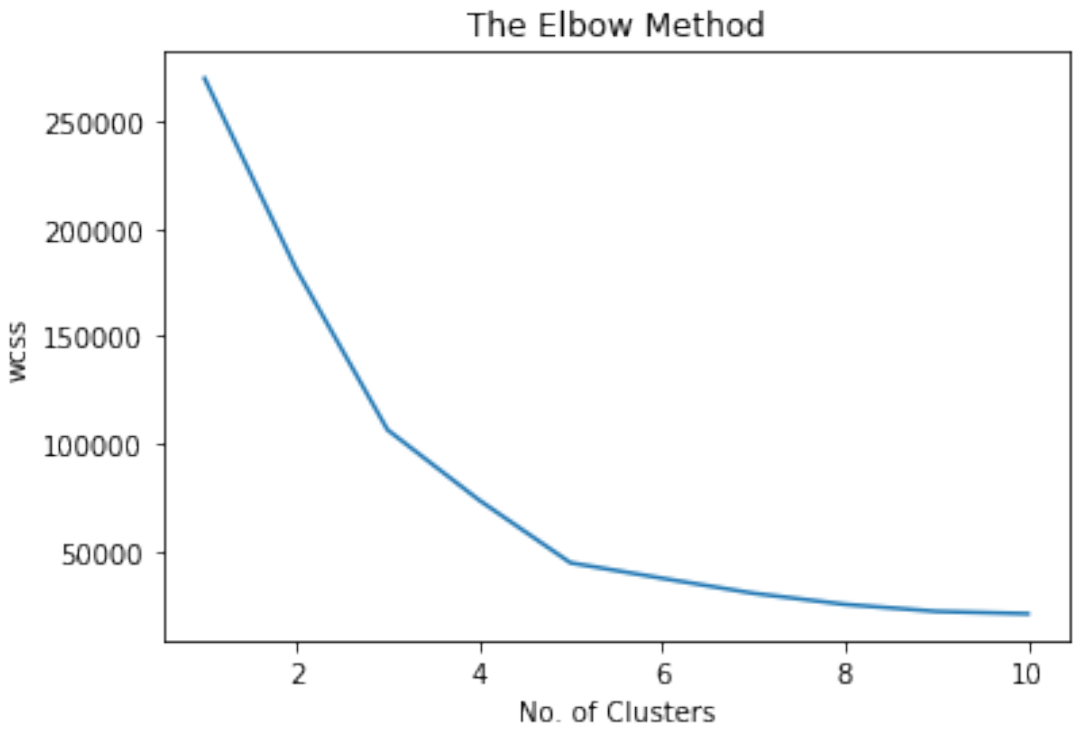



```
x = dataframe.iloc[:, [3, 4]].values

print(x.shape)
```

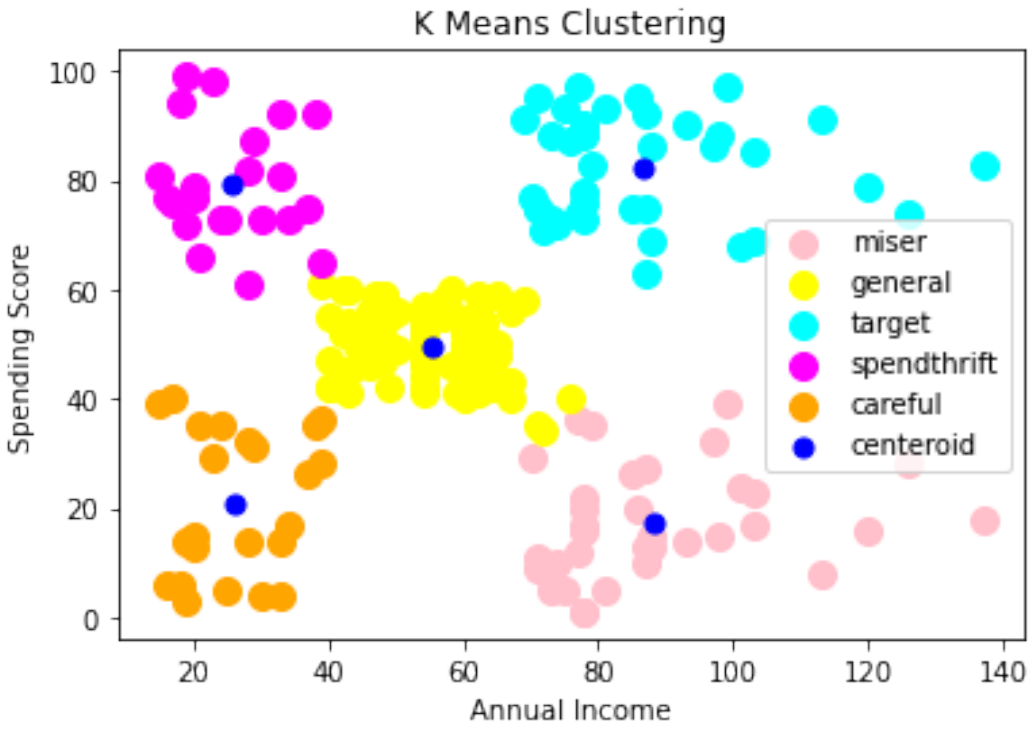
```
(200, 2)
```

1. Perform any of the clustering algorithms

```
from sklearn.cluster import KMeans

wcss = []
for i in range(1, 11):
  km = KMeans(n_clusters = i, init = 'k-means++', max_iter = 300,
n_init = 10, random_state = 0)
  km.fit(x)
  wcss.append(km.inertia_)

plt.plot(range(1, 11), wcss)
plt.title('The Elbow Method')
plt.xlabel('No. of Clusters')
plt.ylabel('wcss')
plt.show()
```




```
km = KMeans(n_clusters = 5, init = 'k-means++', max_iter = 300, n_init
= 10, random_state = 0)
y_means = km.fit_predict(x)

plt.scatter(x[y_means == 0, 0], x[y_means == 0, 1], s = 100, c =
'pink', label = 'miser')
plt.scatter(x[y_means == 1, 0], x[y_means == 1, 1], s = 100, c =
'yellow', label = 'general')
plt.scatter(x[y_means == 2, 0], x[y_means == 2, 1], s = 100, c =
'cyan', label = 'target')
plt.scatter(x[y_means == 3, 0], x[y_means == 3, 1], s = 100, c =
'magenta', label = 'spendthrift')
plt.scatter(x[y_means == 4, 0], x[y_means == 4, 1], s = 100, c =
'orange', label = 'careful')
plt.scatter(km.cluster_centers_[:,0], km.cluster_centers_[:, 1], s =
50, c = 'blue' , label = 'centeroid')

plt.title('K Means Clustering')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.legend()
plt.show()
```



1. Split the data into dependent and independent variables.

```
df1=dataframe[["CustomerID","Gender","Age","annual_income","spending_score"]]
X=df1[["annual_income","spending_score"]]
```

1. Split the data into training and testing
2. Build the Model

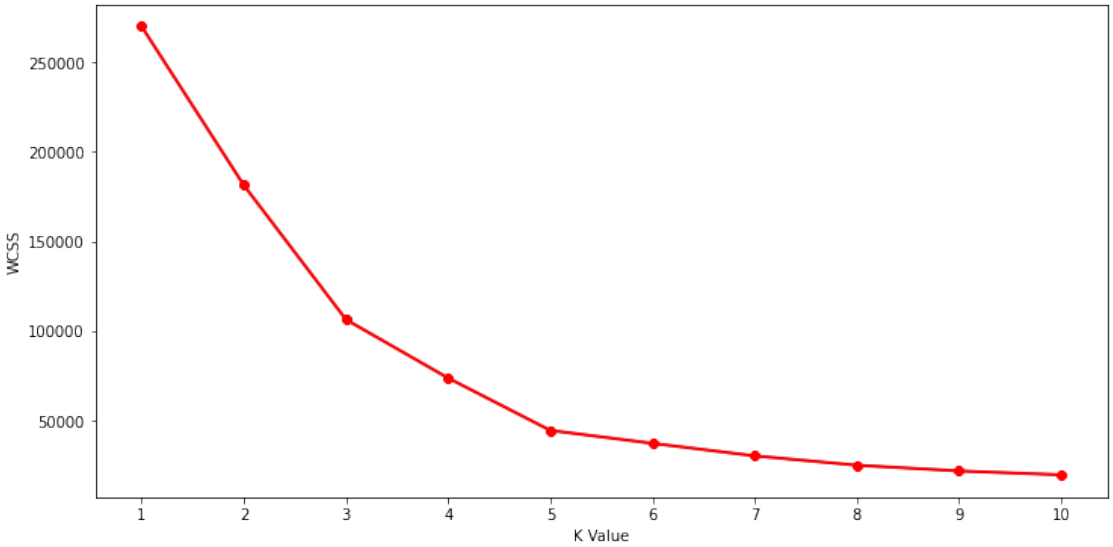
```
X.head()
```

	annual_income	spending_score
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40

1. Train the Model

```
wcss=[]
for i in range(1,11):
    km=KMeans(n_clusters=i)
    km.fit(X)
    wcss.append(km.inertia_)

import numpy as np
plt.figure(figsize=(12,6))
plt.plot(range(1,11),wcss)
plt.plot(range(1,11),wcss, linewidth=2, color="red", marker ="8")
```

```
plt.xlabel("K Value")
plt.xticks(np.arange(1,11,1))
plt.ylabel("WCSS")
plt.show()
```

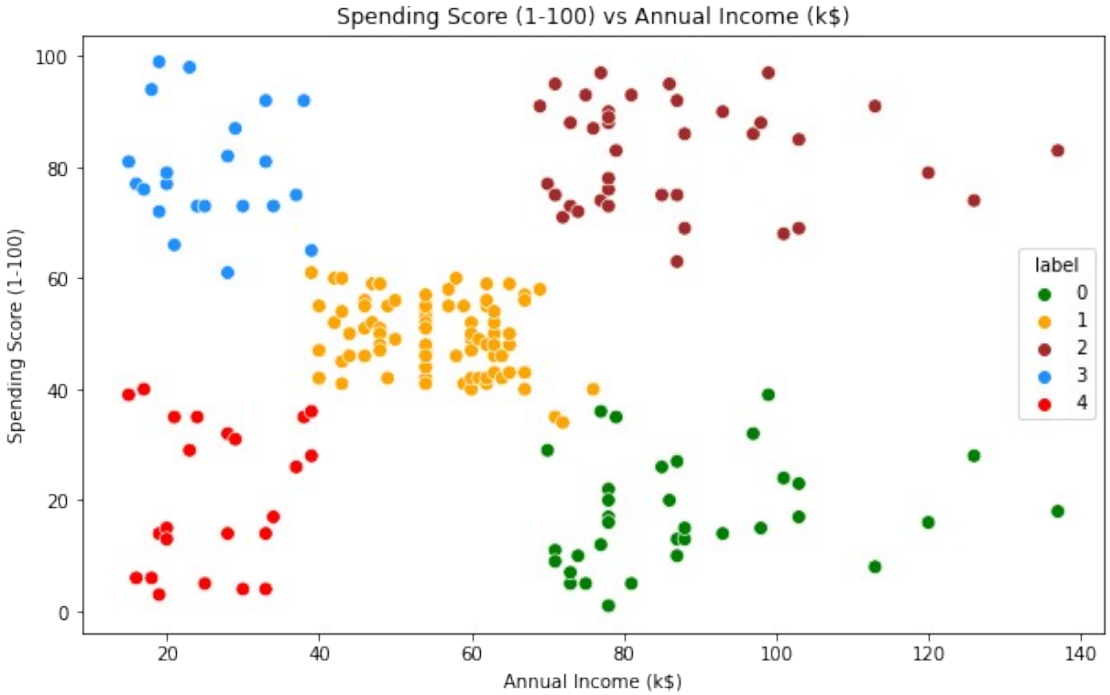


1. Test the Model

```
km1=KMeans(n_clusters=5)
km1.fit(X)
y=km1.predict(X)
df1["label"] = y
df1.head()
```

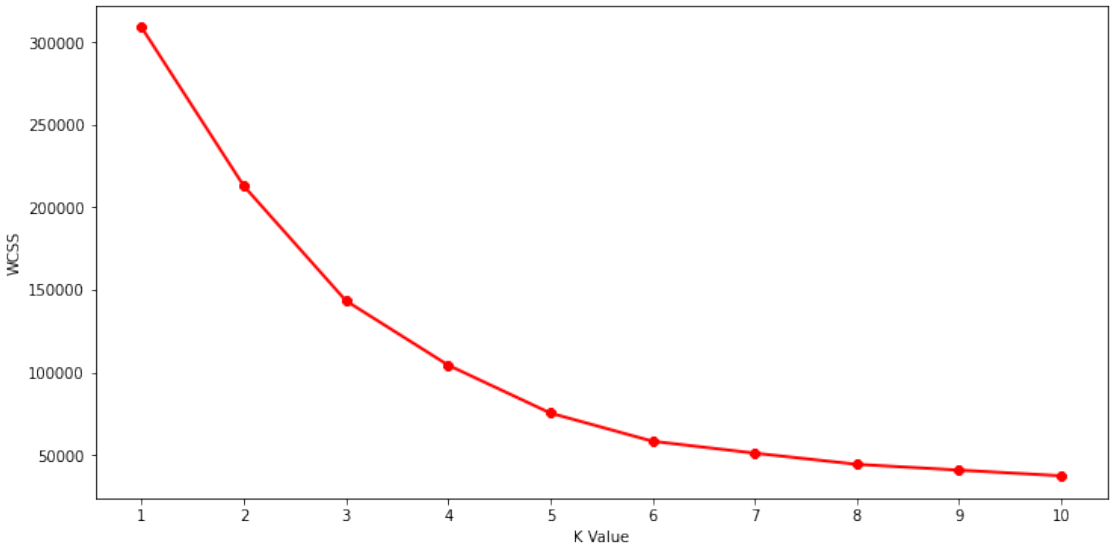
	CustomerID	Gender	Age	annual_income	spending_score	label
0	1	1	19	15	39	4
1	2	1	21	15	81	3
2	3	0	20	16	6	4
3	4	0	23	16	77	3
4	5	0	31	17	40	4

```
plt.figure(figsize=(10,6))
sns.scatterplot(x = 'annual_income',y = 'spending_score',hue="label",


palette=['green','orange','brown','dodgerblue','red'],
legend='full',data = df1  ,s = 60 )
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.title('Spending Score (1-100) vs Annual Income (k$)')
plt.show()
```



1. Measure the performance using Evaluation Metrics

```
X2=df1[["Age","annual_income","spending_score"]]
wcss = []
for k in range(1,11):
    kmeans = KMeans(n_clusters=k, init="k-means++")
    kmeans.fit(X2)
    wcss.append(kmeans.inertia_)
plt.figure(figsize=(12,6))
plt.plot(range(1,11),wcss, linewidth=2, color="red", marker ="8")
plt.xlabel("K Value")
plt.xticks(np.arange(1,11,1))
plt.ylabel("WCSS")
plt.show()
```




```
cust1=df1[df1["label"]==1]
print('Number of customer in 1st group=', len(cust1))
print('They are -', cust1["CustomerID"].values)
print("-----------------------------------------")
cust2=df1[df1["label"]==2]
print('Number of customer in 2nd group=', len(cust2))
print('They are -', cust2["CustomerID"].values)
print("-----------------------------------------")
cust3=df1[df1["label"]==0]
print('Number of customer in 3rd group=', len(cust3))
print('They are -', cust3["CustomerID"].values)
print("-----------------------------------------")
cust4=df1[df1["label"]==3]
print('Number of customer in 4th group=', len(cust4))
print('They are -', cust4["CustomerID"].values)
print("-----------------------------------------")
cust5=df1[df1["label"]==4]
print('Number of customer in 5th group=', len(cust5))
print('They are -', cust5["CustomerID"].values)
print("-----------------------------------------")
```

```
Number of customer in 1st group= 81
They are - [ 44  47  48  49  50  51  52  53  54  55  56  57  58  59
60  61  62  63
  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80
81
  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98
99
 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116
117
 118 119 120 121 122 123 127 133 143]
-----------------------------------------
Number of customer in 2nd group= 39
```

```
They are - [124 126 128 130 132 134 136 138 140 142 144 146 148 150
152 154 156 158
 160 162 164 166 168 170 172 174 176 178 180 182 184 186 188 190 192
194
 196 198 200]
-----------------------------------------
Number of customer in 3rd group= 35
They are - [125 129 131 135 137 139 141 145 147 149 151 153 155 157
159 161 163 165
 167 169 171 173 175 177 179 181 183 185 187 189 191 193 195 197 199]
-----------------------------------------
Number of customer in 4th group= 22
They are - [ 2  4  6  8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
40 42 46]
-----------------------------------------
Number of customer in 5th group= 23
They are - [ 1  3  5  7  9 11 13 15 17 19 21 23 25 27 29 31 33 35 37
39 41 43 45]
-----------------------------------------
```