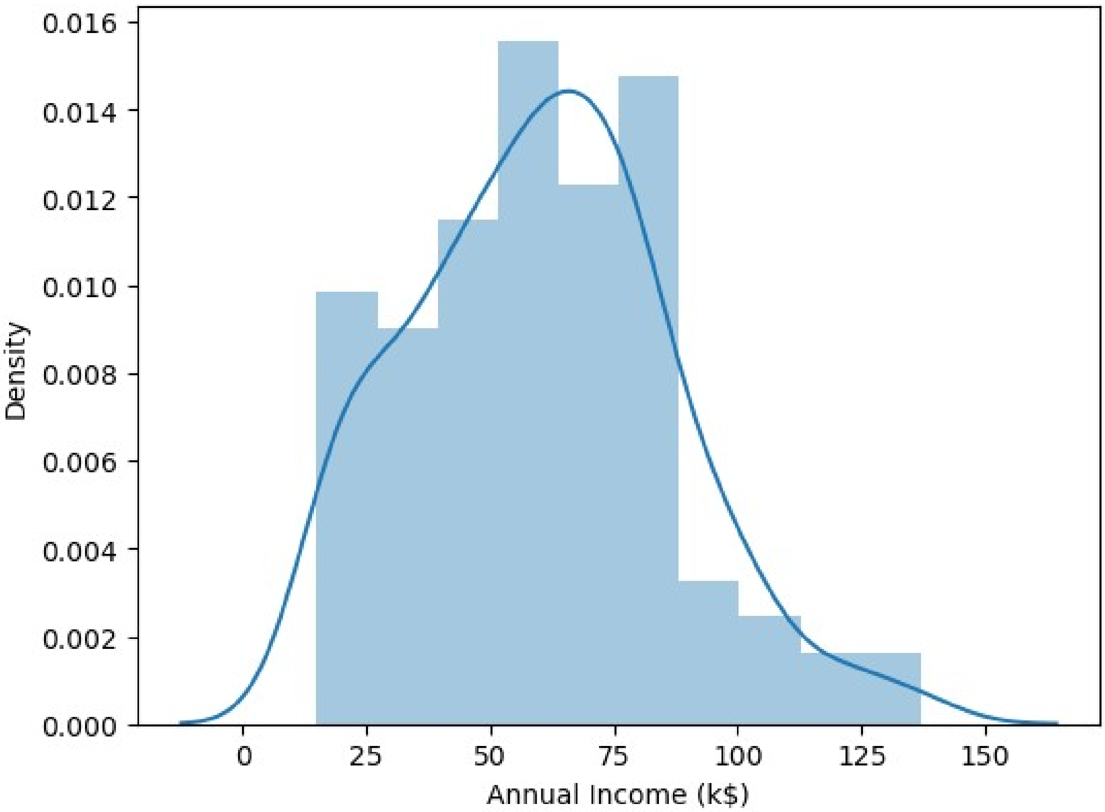
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
import warnings
warnings.filterwarnings('ignore')

df= pd.read_csv("Mall_Customers.csv")

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
```

Univariate Analysis

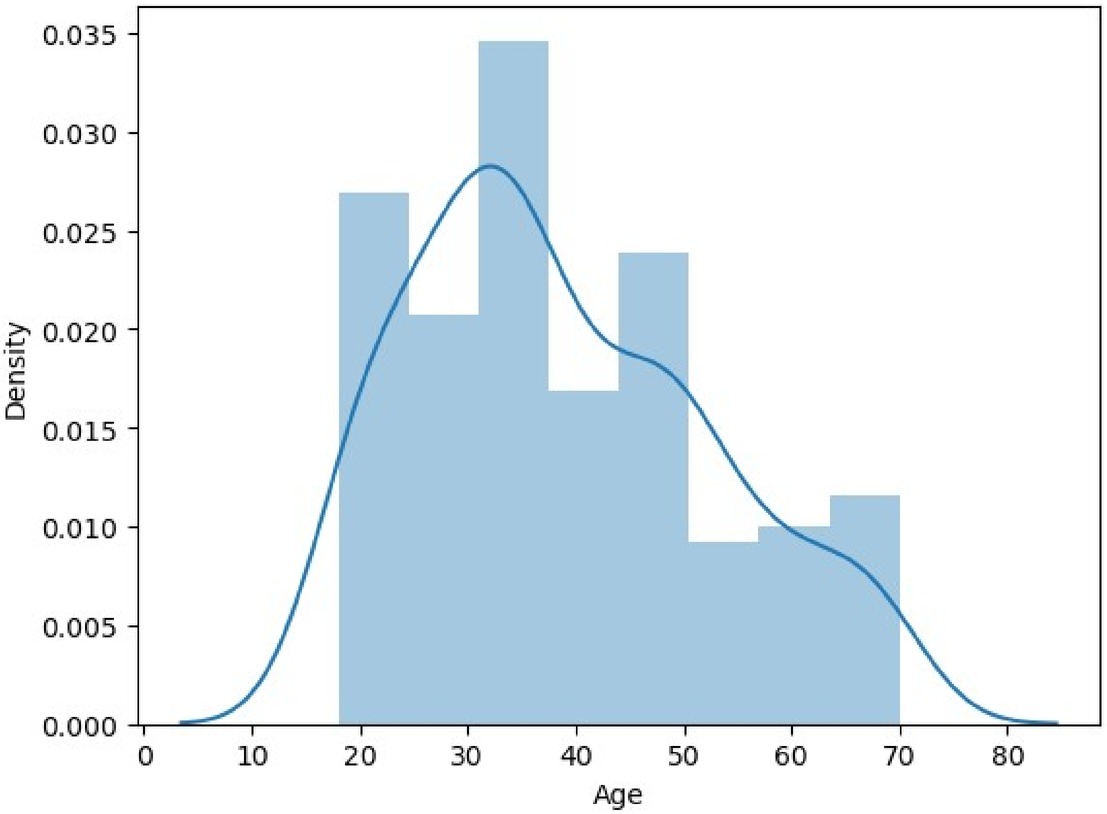
```
df.describe()

       CustomerID         Age  Annual Income (k$)  Spending Score (1-
100)
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

sns.distplot(df['Annual Income (k$)'])

<Axes: xlabel='Annual Income (k$)', ylabel='Density'>
```

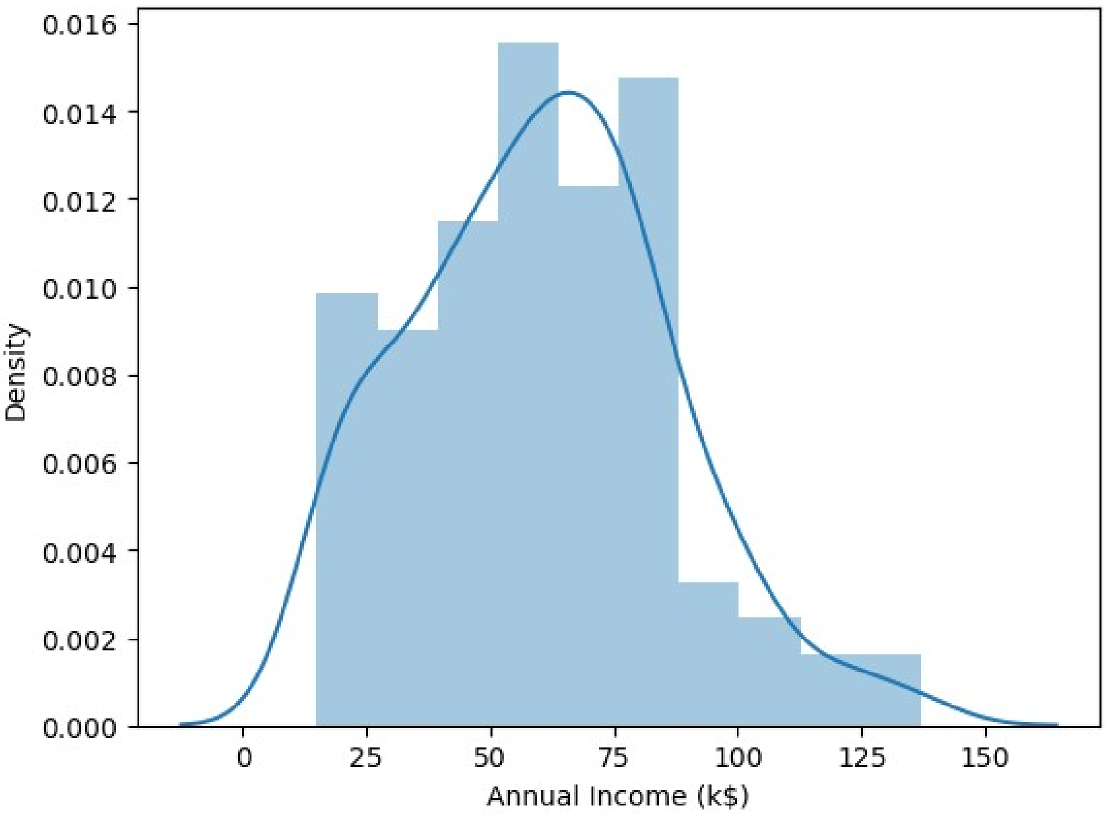


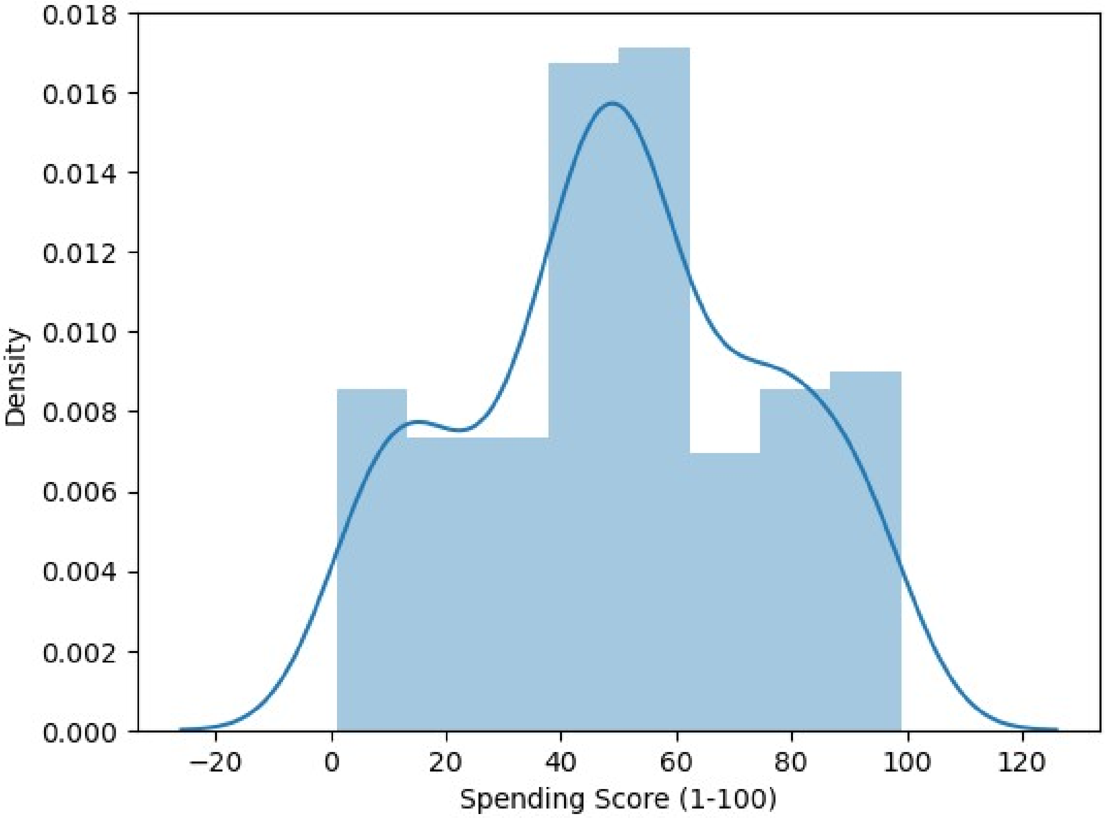
```
df.columns
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

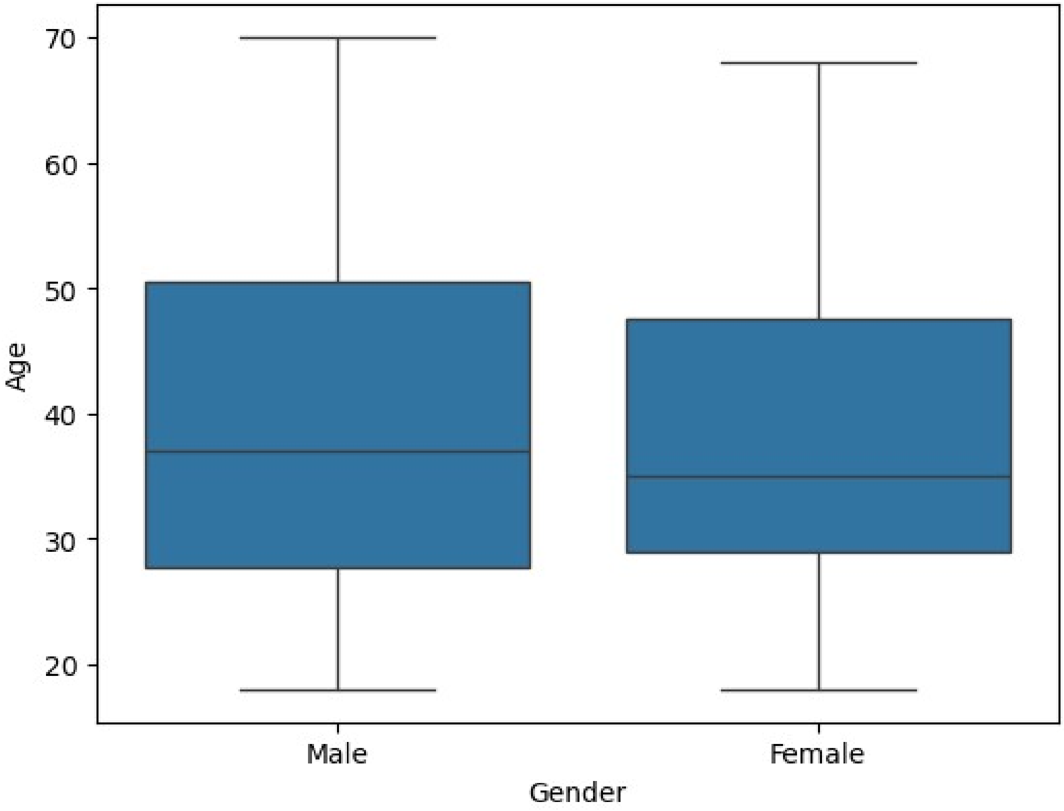
```
columns = ['Age', 'Annual Income (k$)','Spending Score (1-100)']
for i in columns:
    plt.figure()
    sns.distplot(df[i])
```

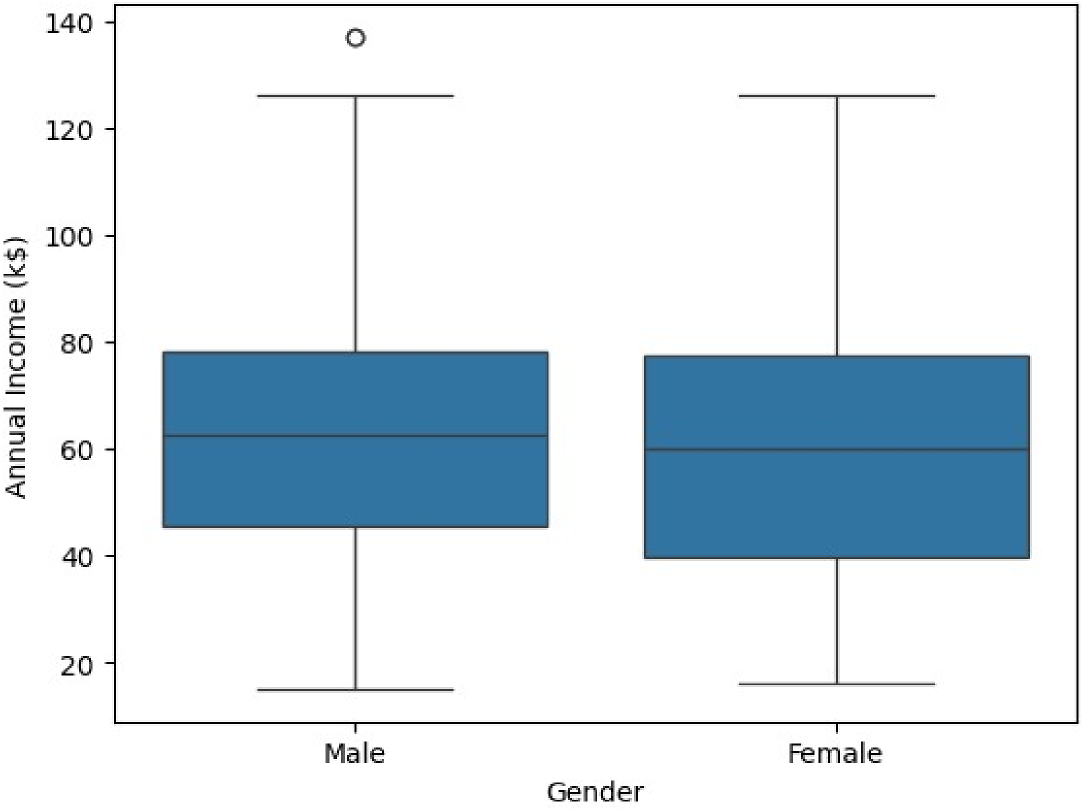

0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Density
0
10
20
30
40
50
60
70
80
Age

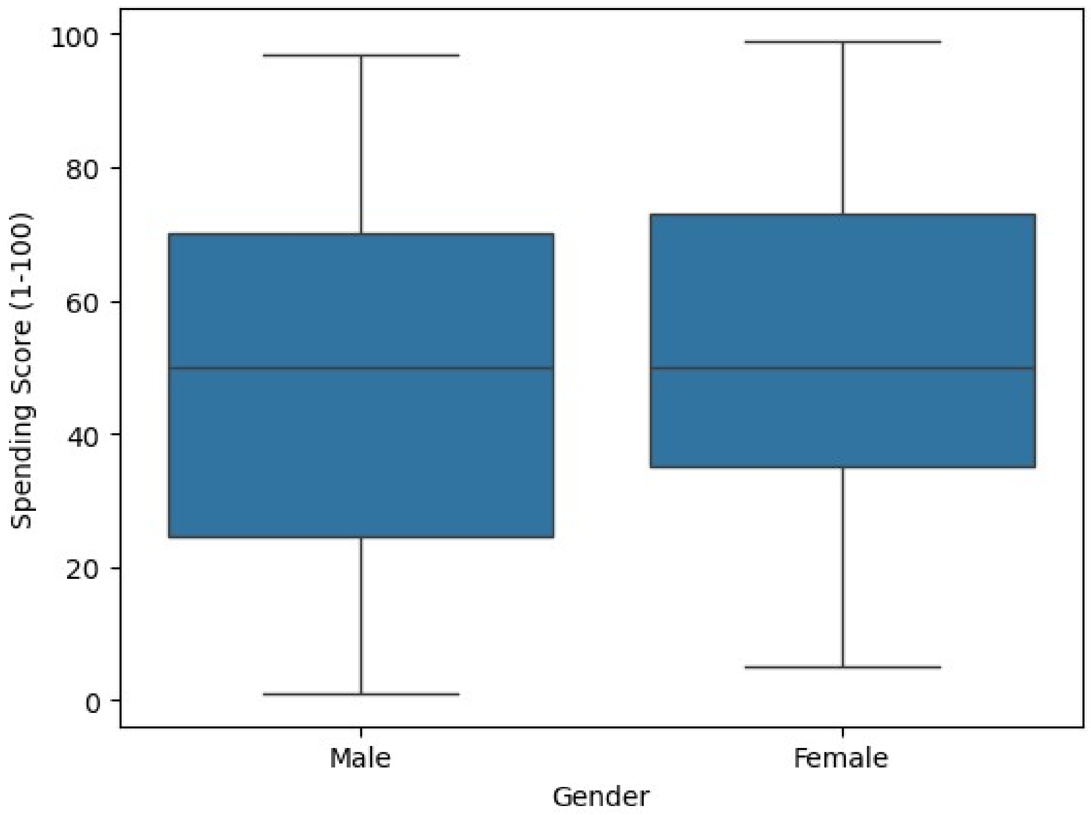

0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
Density
0
25
50
75
100
125
150
Annual Income (k$)



```
columns = ['Age', 'Annual Income (k$)','Spending Score (1-100)']
for i in columns:
    plt.figure()
    sns.boxplot(data=df, x='Gender',y=df[i]);
```


70
60
50
40
30
20
Age
Male
Female
Gender

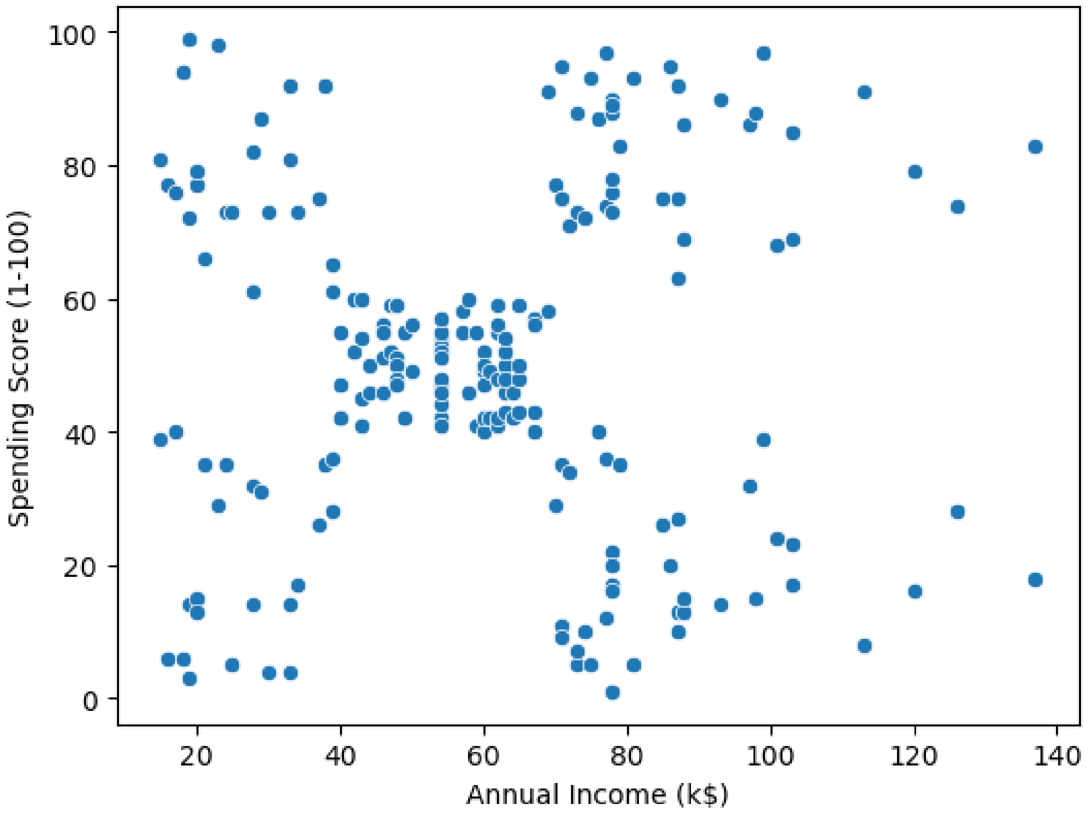

140
120
100
80
60
40
20
Annual Income (k$)
Male
Female
Gender



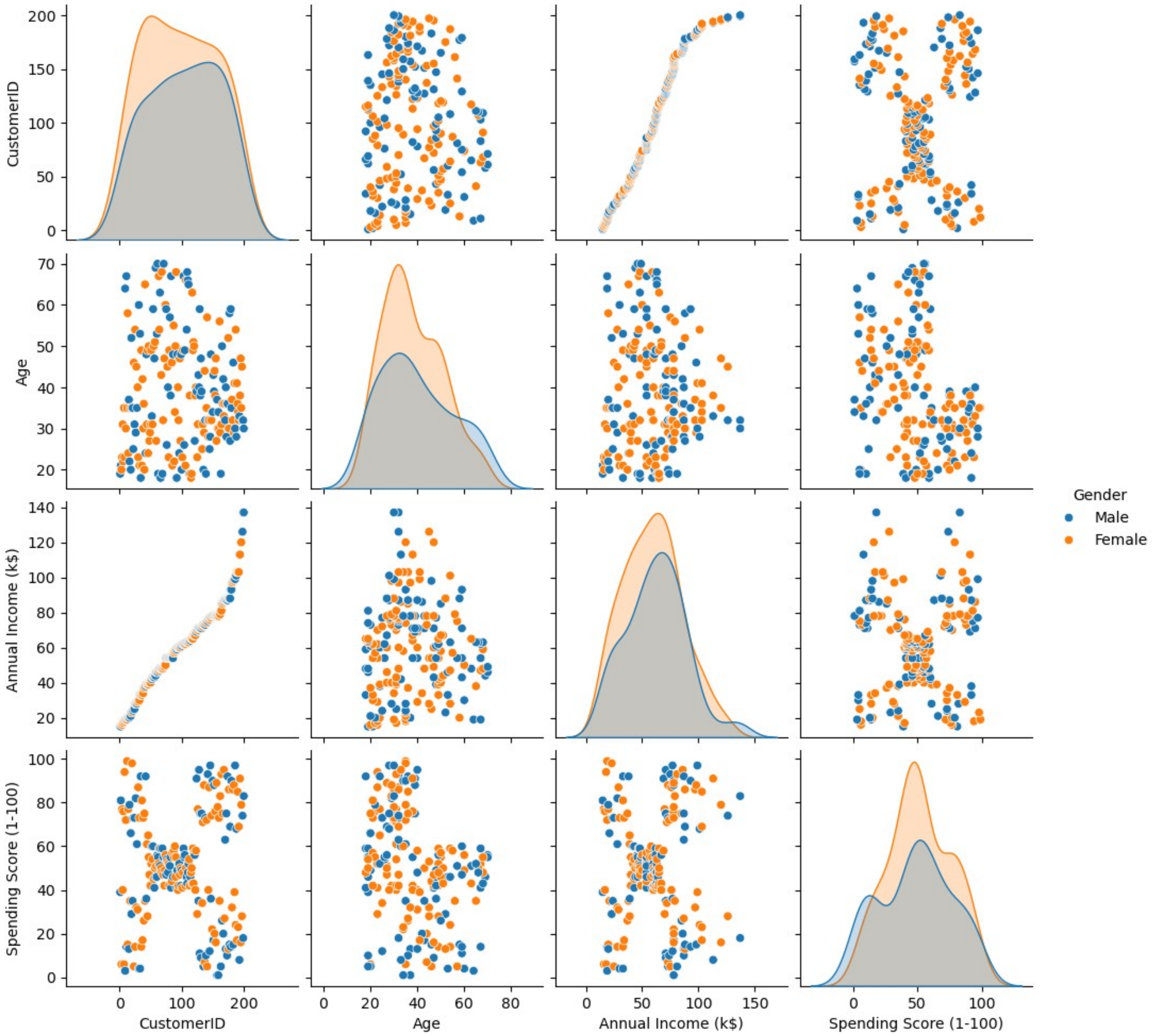
```
df['Gender'].value_counts(normalize=True)

Gender
Female    0.56
Male      0.44
Name: proportion, dtype: float64
```

bivariate analysis

```
sns.scatterplot(data=df,x='Annual Income (k$)', y='Spending Score (1-
100)')

<Axes: xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```



```
#df=df.drop('CustomerID',axis=1)
sns.pairplot(df,hue='Gender')

<seaborn.axisgrid.PairGrid at 0x187b0cf23f0>
```

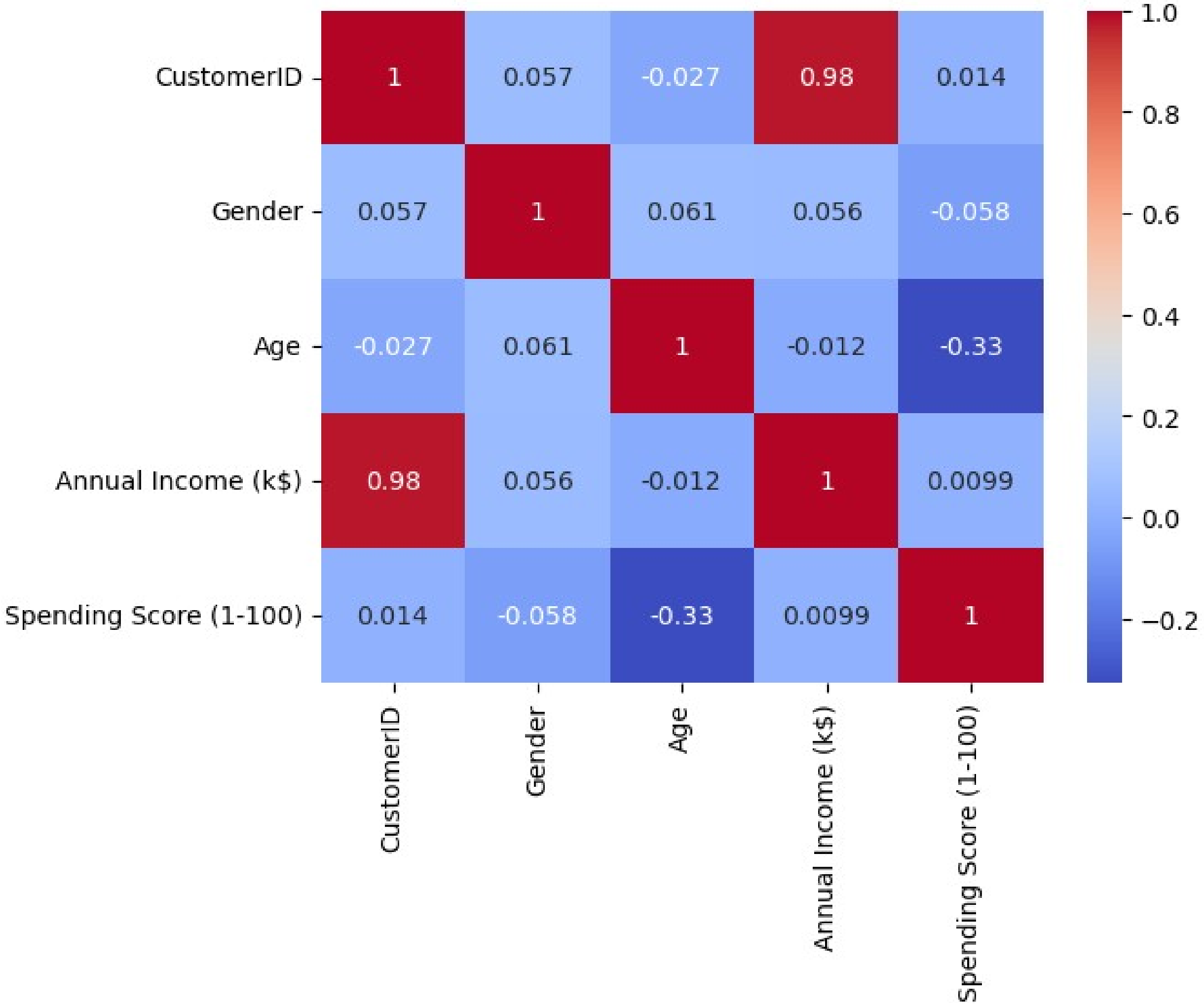


```
df.groupby('Gender')[['Age', 'Annual Income (k$)', 'Spending Score (1-
100)']].mean()

              Age  Annual Income (k$)  Spending Score (1-100)
Gender
Female  38.098214           59.250000               51.526786
Male    39.806818           62.227273               48.511364

df.select_dtypes(include='number').corr()
df['Gender'] = df['Gender'].map({'Male': 1, 'Female': 0})  # Assuming
'Male' = 1 and 'Female' = 0
df.corr()
df = pd.get_dummies(df, drop_first=True)  # Converts categorical
columns to dummy variables
df.corr()
```

```
                        CustomerID    Gender       Age  Annual Income
(k$)  \
CustomerID                1.000000  0.057400 -0.026763
0.977548
Gender                    0.057400  1.000000  0.060867
0.056410
Age                      -0.026763  0.060867  1.000000            -
0.012398
Annual Income (k$)        0.977548  0.056410 -0.012398
1.000000
Spending Score (1-100)    0.013835 -0.058109 -0.327227
0.009903

                        Spending Score (1-100)
CustomerID                            0.013835
Gender                               -0.058109
Age                                  -0.327227
Annual Income (k$)                    0.009903
Spending Score (1-100)                1.000000
```

```
sns.heatmap(df.corr(),annot=True,cmap='coolwarm')
```

```
<Axes: >
```



clutering- univariate, bivariate,multivarirate

```
clustering1= KMeans(n_clusters=6)

clustering1.fit(df[['Annual Income (k$)']])

KMeans(n_clusters=6)

clustering1.labels_

array([3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
5,
       5, 5, 5, 5, 5, 5, 5, 5, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1,
       1, 1, 1, 1, 1, 1, 1, 1, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
4,
       4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 0, 0, 0, 0, 0,
0,
       0, 0])
```

```
df['Income Cluster']= clustering1.labels_
df.head()
```

```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)
\
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


   Income Cluster
0               3
1               3
2               3
3               3
4               3
```

```
df['Income Cluster'].value_counts()
```

```
Income Cluster
4    46
1    44
5    42
3    32
2    28
0     8
Name: count, dtype: int64
```

```
from sklearn.cluster import KMeans

# Example data
X = [[1, 2], [1, 3], [2, 3], [8, 8], [8, 9], [9, 9]]

# Fit KMeans
```

```
kmeans = KMeans(n_clusters=2)
kmeans.fit(X)

# Get inertia
print(kmeans.inertia_)
```

```
2.666666666666667
```

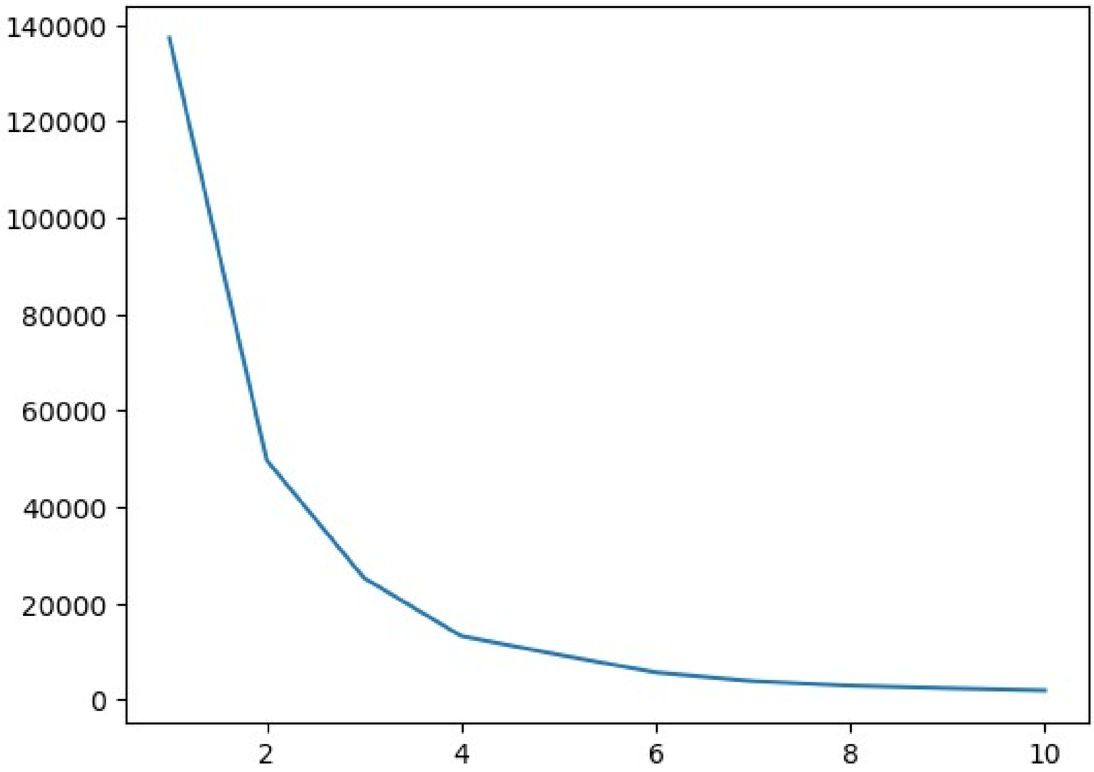
```
intertia_scores=[]
for i in range(1,11):
    kmeans=KMeans(n_clusters=i)
    kmeans.fit(df[['Annual Income (k$)']])
    intertia_scores.append(kmeans.inertia_)
```

```
intertia_scores
```

```
[137277.28000000006,
 49761.73701298703,
 25341.285871863212,
 13278.112713472483,
 9407.908188585603,
 5742.224880382777,
 3941.4163614163635,
 2985.5603641456573,
 2459.3303030303055,
 2013.4640637140633]
```

```
plt.plot(range(1,11),intertia_scores)
```

```
[<matplotlib.lines.Line2D at 0x187b7fc4c80>]
```



```
df.columns
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)', 'Income Cluster'],
      dtype='object')
```

```
from sklearn.cluster import KMeans

# Assuming you are clustering based on 'Annual Income (k$)' and
'Spending Score (1-100)'
kmeans = KMeans(n_clusters=3)  # Example: 3 clusters
df['income cluster'] = kmeans.fit_predict(df[['Annual Income (k$)',
'Spending Score (1-100)']])

df.groupby('income cluster')[['Age', 'Annual Income (k$)', 'Spending
Score (1-100)']].mean()
```

```
                      Age  Annual Income (k$)  Spending Score (1-100)
income cluster
0               40.325203           44.154472               49.829268
1               40.394737           87.000000               18.631579
2               32.692308           86.538462               82.128205
```

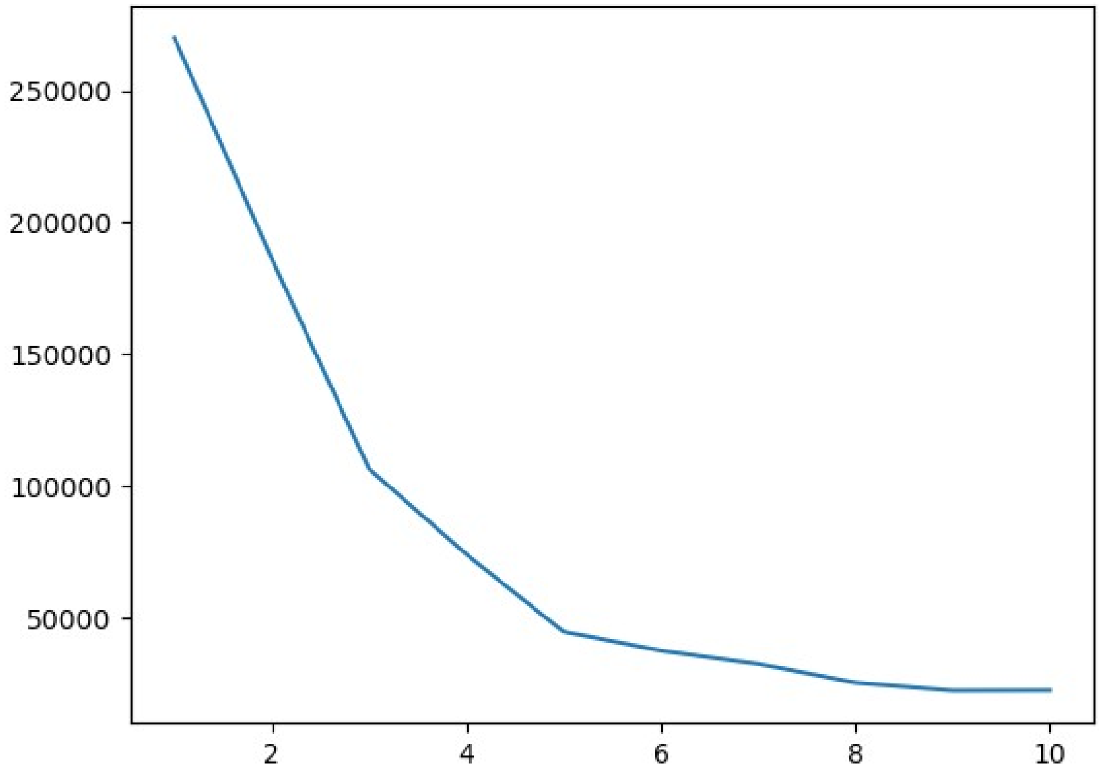
bivariate clustering

```
clustering2= KMeans()
clustering2.fit(df[['Annual Income (k$)', 'Spending Score (1-100)']])

df['Spending and income cluster']=clustering2.labels_
df.head()
```

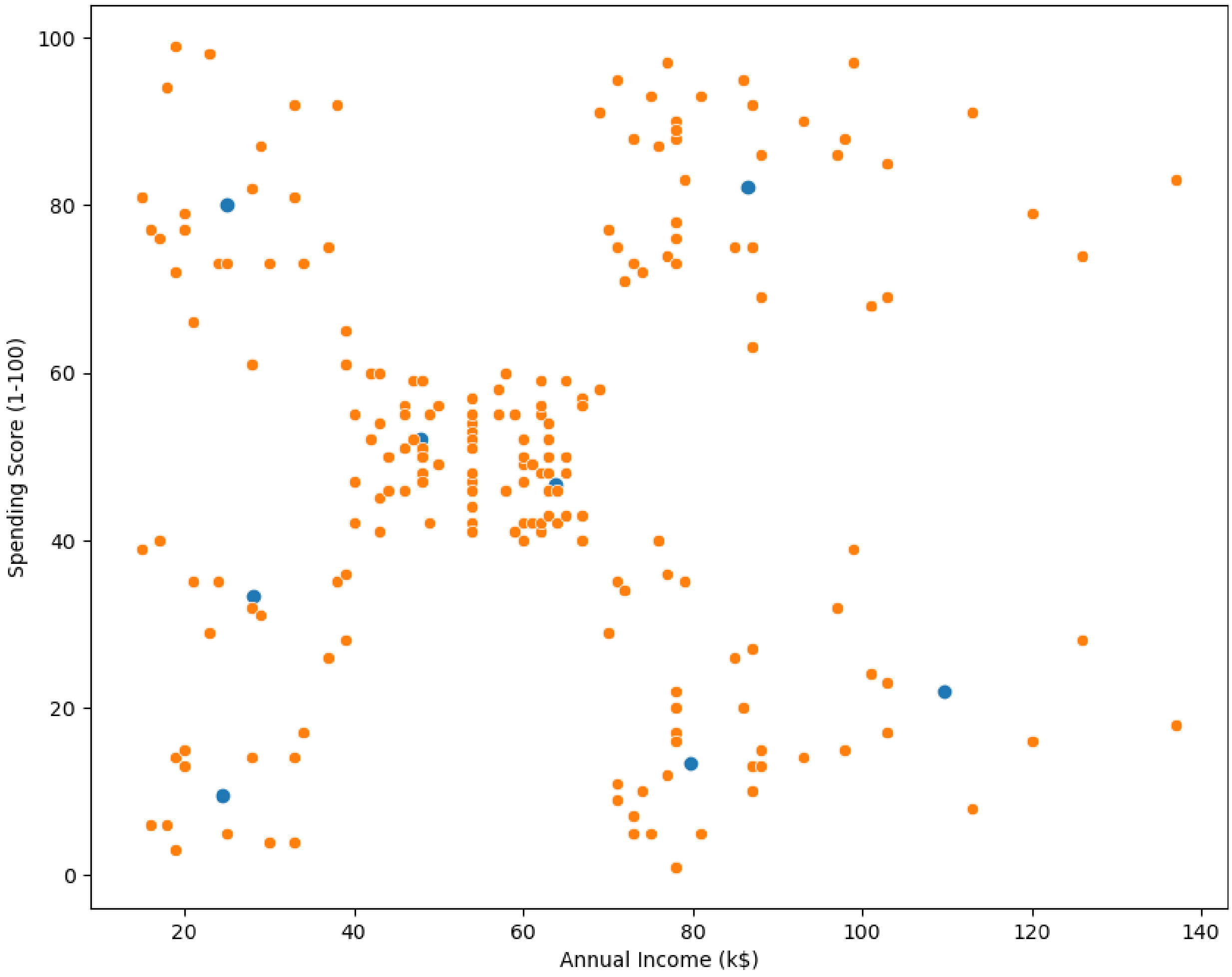
```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)  
\
0           1       1   19                  15                      39

1           2       1   21                  15                      81

2           3       0   20                  16                       6

3           4       0   23                  16                      77

4           5       0   31                  17                      40


   Income Cluster  income cluster  Spending and income cluster
0               3               0                            3
1               3               0                            4
2               3               0                            6
3               3               0                            4
4               3               0                            3
```

```
intertia_scores2=[]
for i in range(1,11):
    kmeans2=KMeans(n_clusters=i)
    kmeans2.fit(df[['Annual Income (k$)','Spending Score (1-100)']])
    intertia_scores2.append(kmeans2.inertia_)
plt.plot(range(1,11), intertia_scores2)
```

```
[<matplotlib.lines.Line2D at 0x187b923cec0>]
```



```
centers= pd.DataFrame(clustering2.cluster_centers_)
centers.columns= ['x','y']

plt.figure(figsize=(10,8))
plt.scatter(x=centers['x'],y=centers['y'])
sns.scatterplot(data = df, x='Annual Income (k$)', y='Spending Score
(1-100)',palette='table')
plt.savefig("clustering_bivariate.png")
```



```
pd.crosstab(df['Spending and income
cluster'],df['Gender'],normalize='index')
```

```
Gender                             0         1
Spending and income cluster
0                           0.585366  0.414634
1                           0.538462  0.461538
2                           0.700000  0.300000
3                           0.636364  0.363636
4                           0.571429  0.428571
5                           0.347826  0.652174
6                           0.583333  0.416667
7                           0.604651  0.395349
```

```
df.groupby('Spending and income cluster')[['Age', 'Annual Income
(k$)', 'Spending Score (1-100)']].mean()
```

```
                                  Age  Annual Income (k$)  \
Spending and income cluster
0                           42.024390           63.804878
```

```
1                            32.692308           86.538462
2                            41.000000          109.700000
3                            41.363636           28.181818
4                            25.333333           25.095238
5                            40.217391           79.739130
6                            48.750000           24.583333
7                            43.372093           47.860465

                             Spending Score (1-100)
Spending and income cluster                        
0                                         46.634146
1                                         82.128205
2                                         22.000000
3                                         33.272727
4                                         80.047619
5                                         13.391304
6                                          9.583333
7                                         51.976744
```

#multivariate clustering

```
from sklearn.preprocessing import StandardScaler

scale= StandardScaler()

df.head()

   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)  
\
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   


   Income Cluster  income cluster  Spending and income cluster  
0               3               0                            3  
1               3               0                            4  
2               3               0                            6  
3               3               0                            4  
4               3               0                            3  

dff= pd.get_dummies(df,drop_first=True)
dff.head()
```

```
   CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-100)
\
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


   Income Cluster  income cluster  Spending and income cluster
0               3               0                            3
1               3               0                            4
2               3               0                            6
3               3               0                            4
4               3               0                            3
```

```
dff.columns
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)', 'Income Cluster', 'income cluster',
       'Spending and income cluster'],
      dtype='object')
```

```
print(dff.columns)
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)', 'Income Cluster', 'income cluster',
       'Spending and income cluster'],
      dtype='object')
```

```
dff['Gender_Male'] = (dff['Gender'] == 'Male').astype(int)
```

```
dff = dff[['Age', 'Annual Income (k$)', 'Spending Score (1-100)',
'Gender_Male']]
dff.head()
```

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

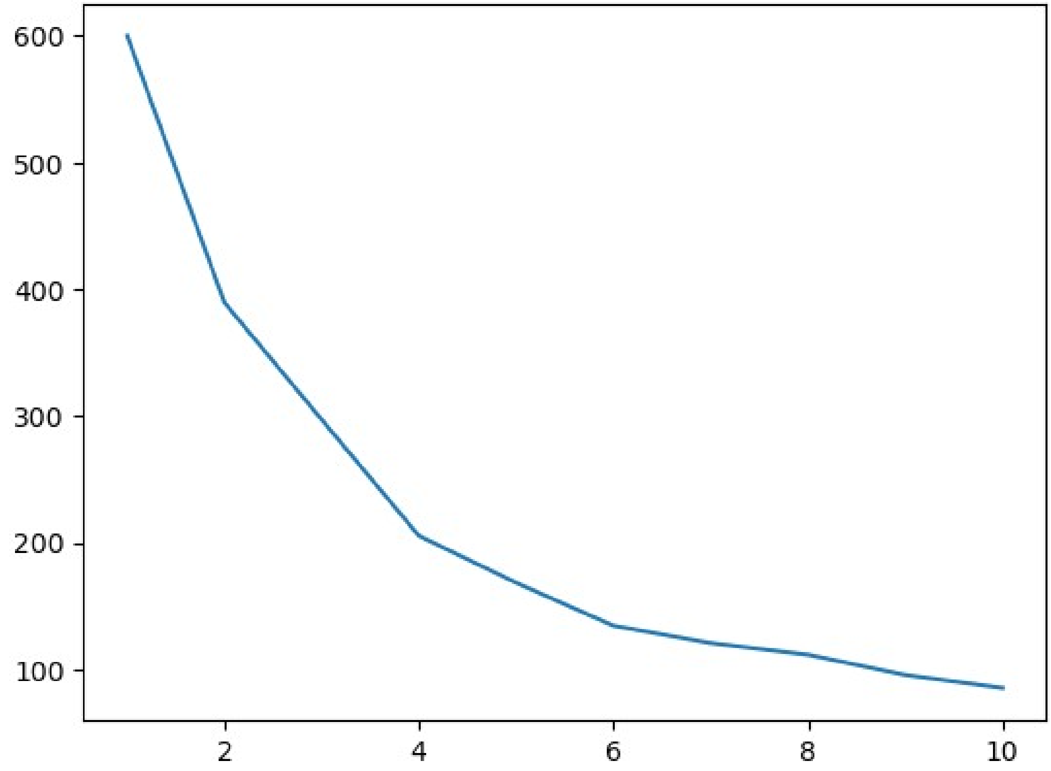
```
dff=scale.fit_transform(dff)
```

```
dff=pd.DataFrame(scale.fit_transform(dff))
dff.head()
```

```
          0         1         2    3
0 -1.424569 -1.738999 -0.434801  0.0
1 -1.281035 -1.738999  1.195704  0.0
2 -1.352802 -1.700830 -1.715913  0.0
3 -1.137502 -1.700830  1.040418  0.0
4 -0.563369 -1.662660 -0.395980  0.0
```

```
intertia_scores3=[]
for i in range(1,11):
    kmeans3=KMeans(n_clusters=i)
    kmeans3.fit(dff)
    intertia_scores3.append(kmeans3.inertia_)
plt.plot(range(1,11), intertia_scores3)
```

```
[<matplotlib.lines.Line2D at 0x187baddcda0>]
```



```
df
```

```
     CustomerID  Gender  Age  Annual Income (k$)  Spending Score (1-
100)  \
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
..          ...     ...  ...                 ...                     .
..
195         196       0   35                 120
79
196         197       0   45                 126
28
197         198       1   32                 126
74
198         199       1   32                 137
18
199         200       1   30                 137
83

     Income Cluster  income cluster  Spending and income cluster
0                 3               0                            3
1                 3               0                            4
2                 3               0                            6
3                 3               0                            4
4                 3               0                            3
..              ...             ...                          ...
195               0               2                            1
196               0               1                            2
197               0               2                            1
198               0               1                            2
199               0               2                            1

[200 rows x 8 columns]
```

```
df.to_csv("Clustering.csv")
```