assignment-5

October 3, 2023

1 Kaggle Connection & DataFrame setup

```
[451]: !pip install -q kaggle
```

```
[452]: !mkdir ~/.kaggle
```

```
mkdir: cannot create directory ‘/root/.kaggle’: File exists
```

```
[453]: !cp kaggle.json ~/.kaggle
```

```
[454]: ! kaggle datasets download -d vjchoudhary7/
         ↪customer-segmentation-tutorial-in-python
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix
this, you can run 'chmod 600 /root/.kaggle/kaggle.json'
Downloading customer-segmentation-tutorial-in-python.zip to /content
  0% 0.00/1.55k [00:00<?, ?B/s]
100% 1.55k/1.55k [00:00<00:00, 4.28MB/s]
```

```
[455]: !unzip /content/customer-segmentation-tutorial-in-python.zip
```

```
Archive:  /content/customer-segmentation-tutorial-in-python.zip
  inflating: Mall_Customers.csv
```

2 Pre-Processing

```
[456]: import pandas as pd
       import numpy as np
       import seaborn as sns
       import matplotlib.pyplot as plt
```

```
[457]: df = pd.read_csv('./Mall_Customers.csv')
       df.head()
```

```
[457]:    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
```

[458]:
```
df.describe()
```

[458]:
```
       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
```

[459]:
```
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 (k$)      200 non-null    int64 
 4   Spending Score (1-100)  200 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

[460]:
```
df.isnull().values.any()
```

[460]:
```
False
```

[461]:
```
df.shape
```

[461]:
```
(200, 5)
```

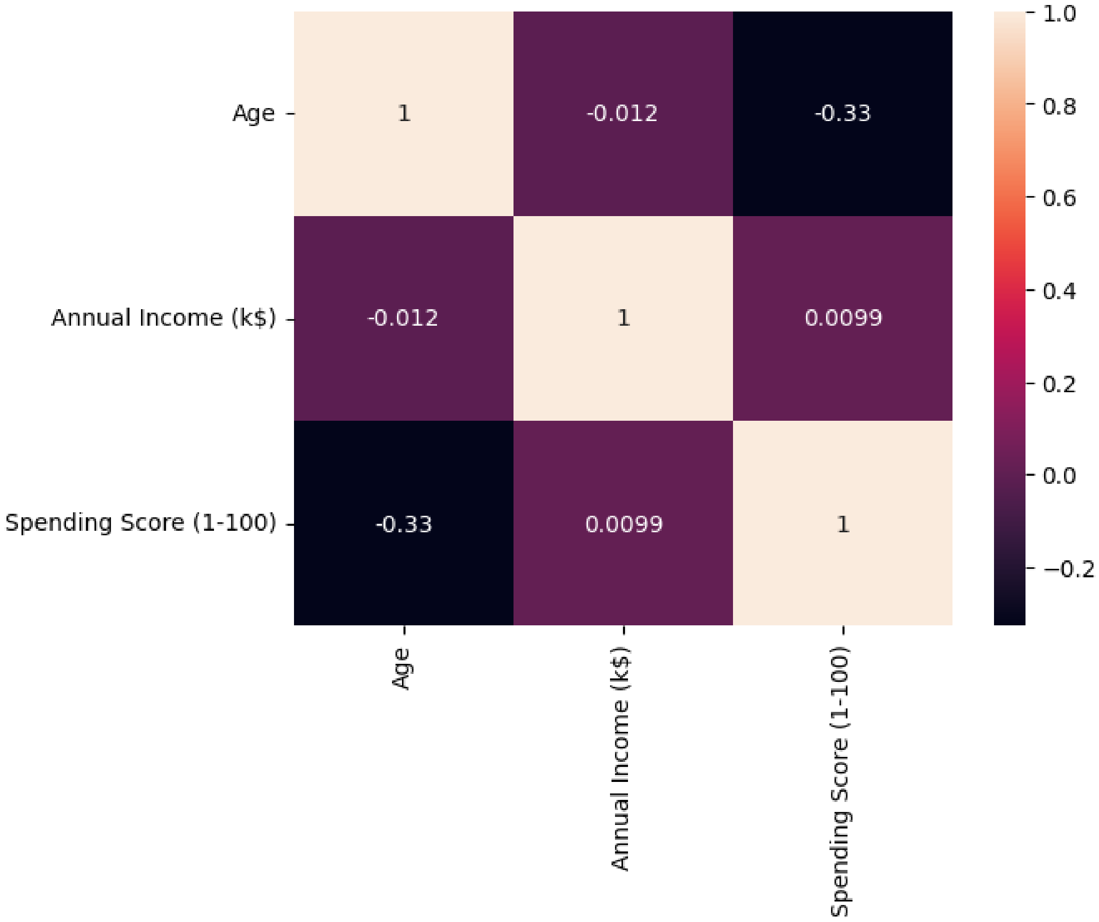
[462]:
```
# Dropping 'CustomerID' as it has no impact or connection to dataset or data values
df.drop(['CustomerID'], axis=1, inplace=True)
```

[463]:
```
sns.heatmap(df.corr(), annot=True)
```

```
<ipython-input-463-6dc1c4c1753e>:1: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
```

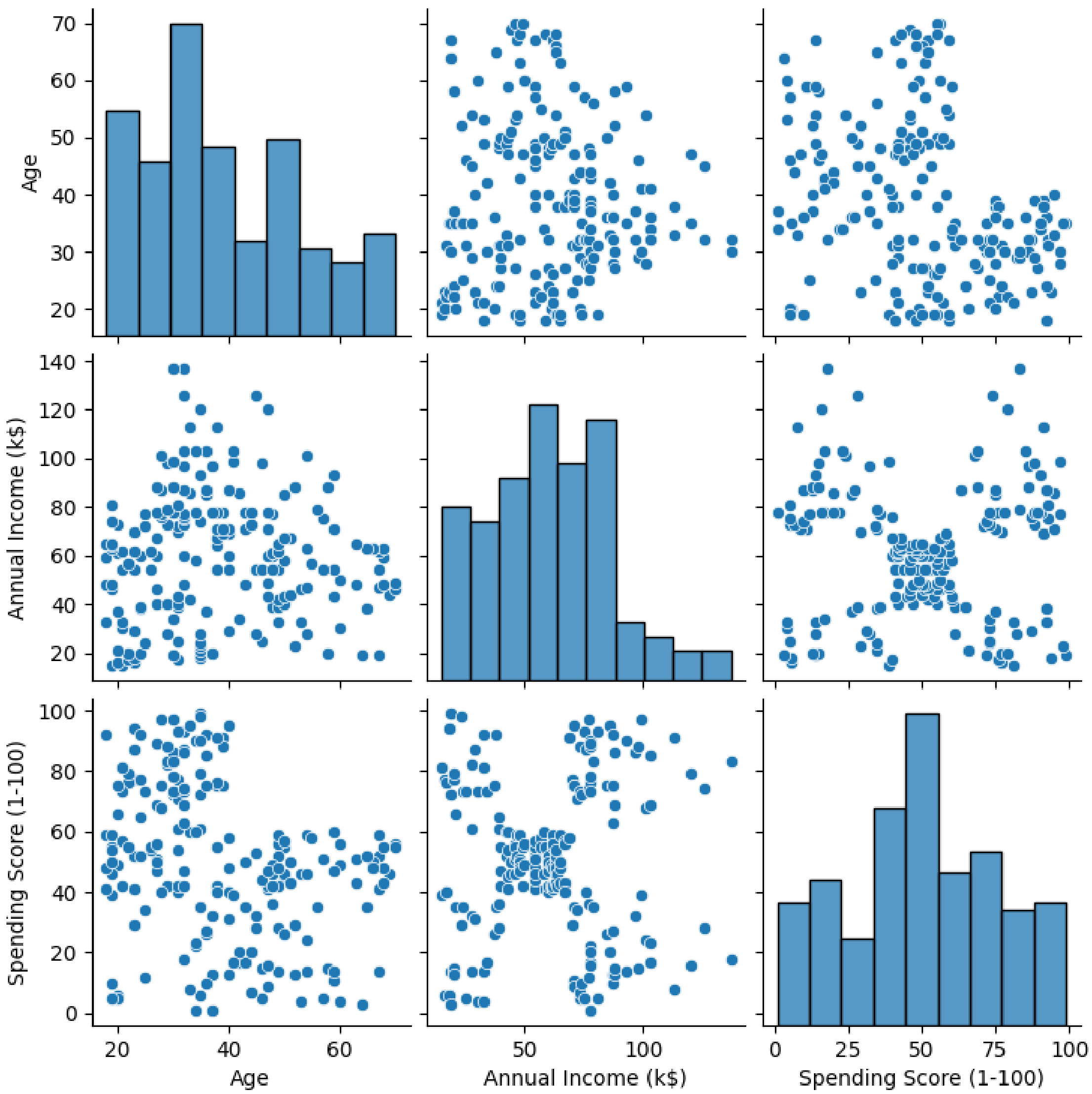
```
to silence this warning.
  sns.heatmap(df.corr(), annot=True)
```

```
[463]: <Axes: >
```



```
[464]: sns.pairplot(df)
```

```
[464]: <seaborn.axisgrid.PairGrid at 0x7b17495fb400>
```



3 Converting Categorical Data (Columns) to Numerical

[465]:

```
df['Gender'].value_counts()
```

[465]:

```
Female    112
Male       88
Name: Gender, dtype: int64
```

[466]:

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

[467]:

```
# Label Encoding 'Gender' column
# '1' == 'Male' && 0 == 'Female'
df['Gender'] = le.fit_transform(df.Gender)
```

[468]:

```
df.head()
```

[468]:

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

[469]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   Gender                  200 non-null    int64
 1   Age                     200 non-null    int64
 2   Annual Income (k$)      200 non-null    int64
 3   Spending Score (1-100)  200 non-null    int64
dtypes: int64(4)
memory usage: 6.4 KB
```

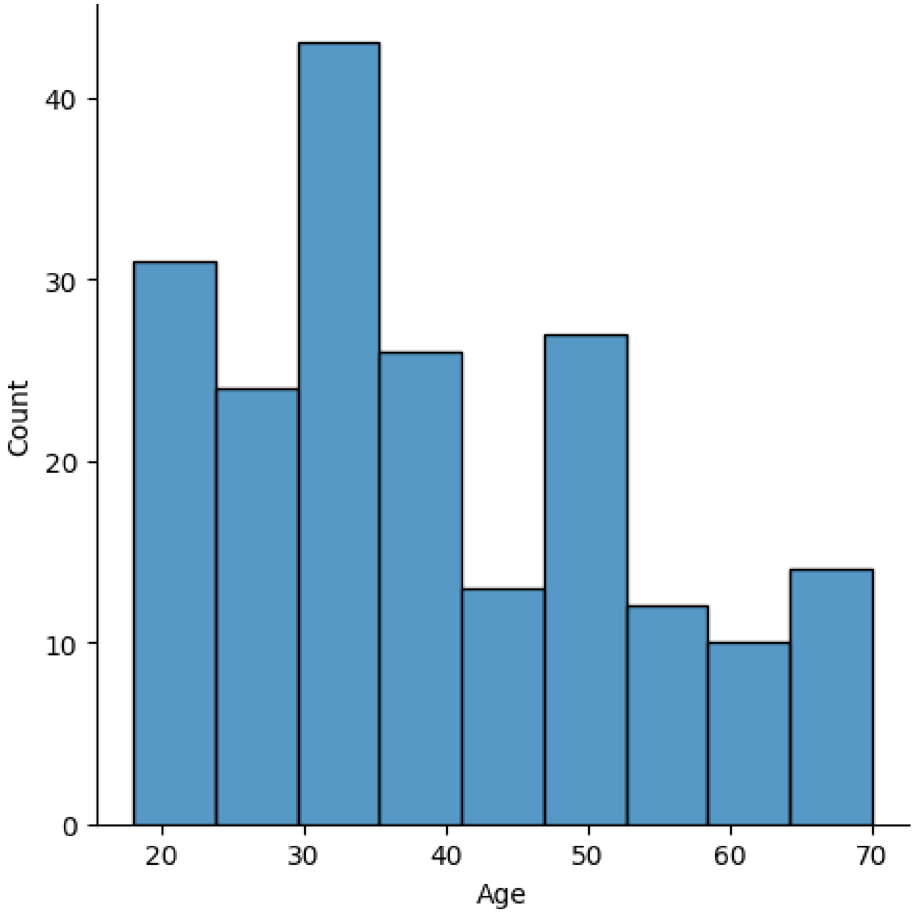
4 Data Analysis, Outlier Detection & Outlier Elimination

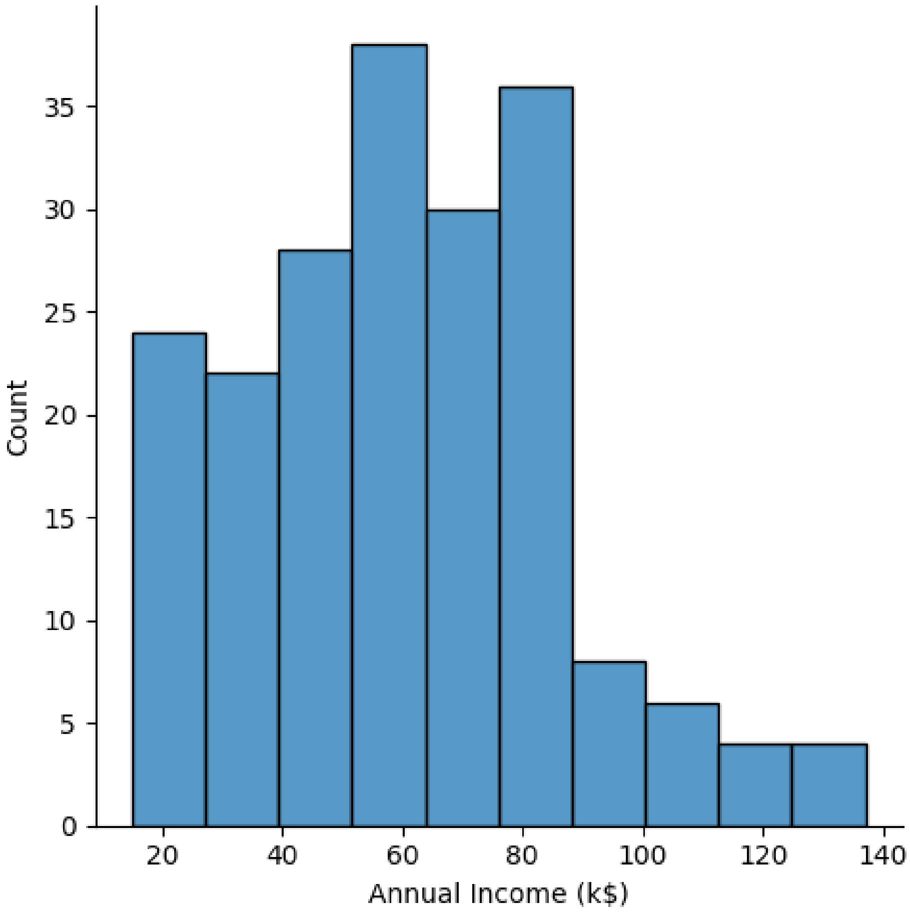
[470]:

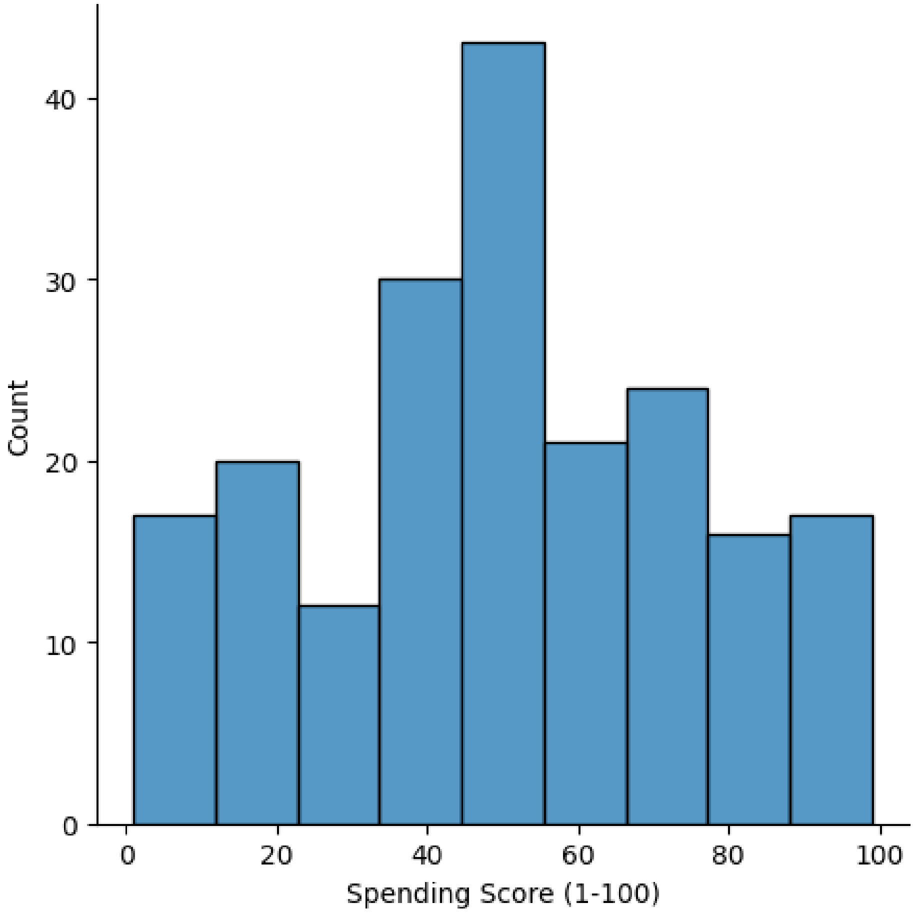
```
sns.displot(df['Age'])
sns.displot(df['Annual Income (k$)'])
sns.displot(df['Spending Score (1-100)'])
```

[470]:

```
<seaborn.axisgrid.FacetGrid at 0x7b1748477ca0>
```


Count
0
10
20
30
40
20
30
40
50
60
70
Age

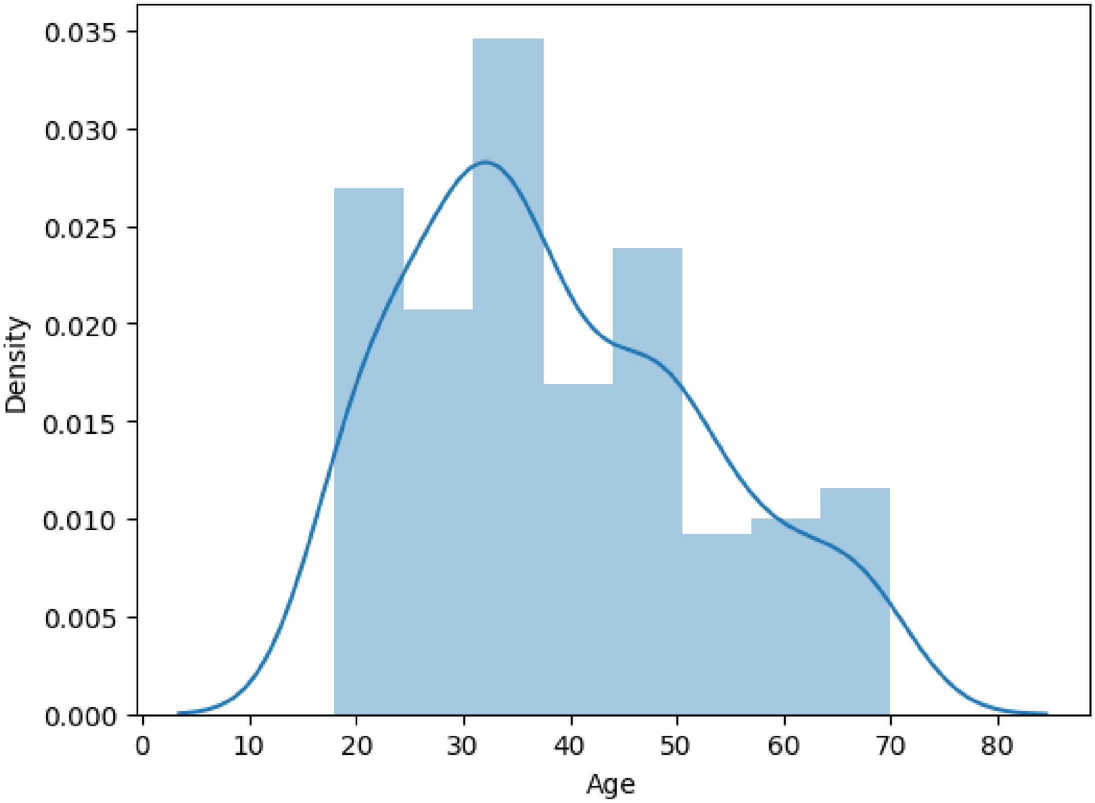

Count
0
5
10
15
20
25
30
35
20
40
60
80
100
120
140
Annual Income (k$)



```
[471]: sns.distplot(df['Age'])
```

```
<ipython-input-471-0fafe04ea3f6>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Age'])
```

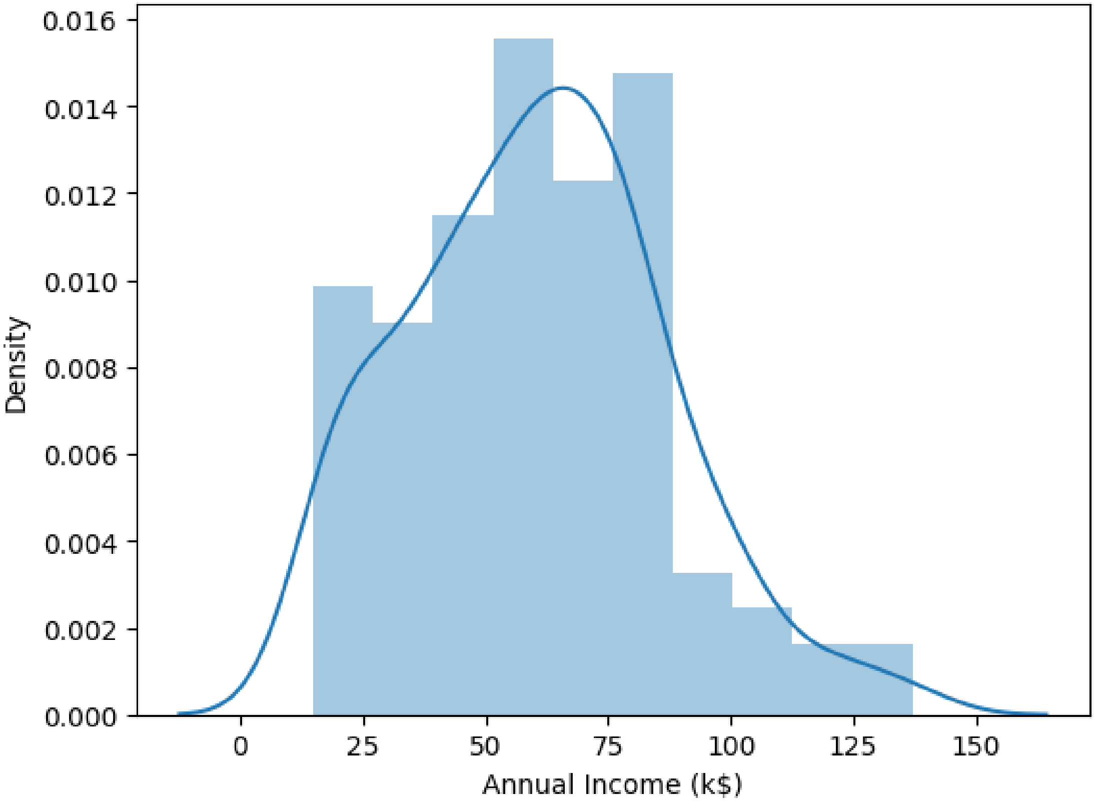
```
[471]: <Axes: xlabel='Age', ylabel='Density'>
```



[472]:
```
sns.distplot(df['Annual Income (k$)'])
```

```
<ipython-input-472-5c9bfeb4bab1>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

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

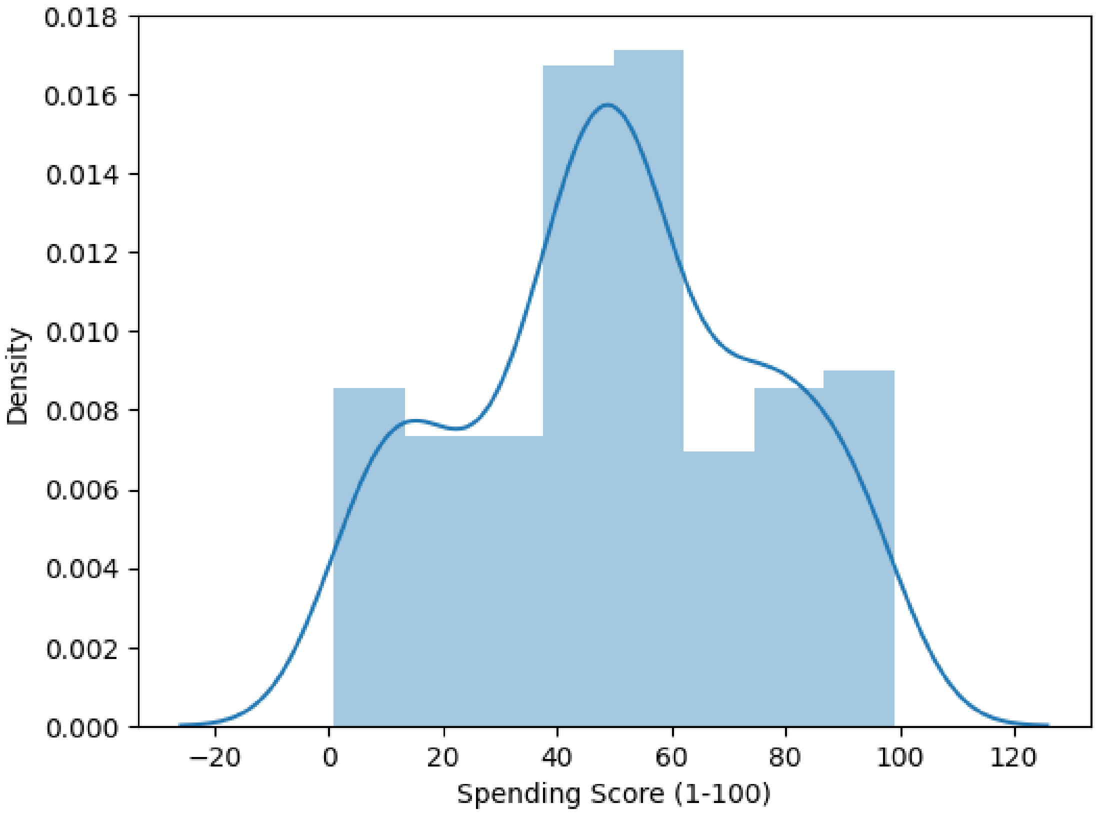
[472]:
```
<Axes: xlabel='Annual Income (k$)', ylabel='Density'>
```



```
[473]: sns.distplot(df['Spending Score (1-100)'])
```

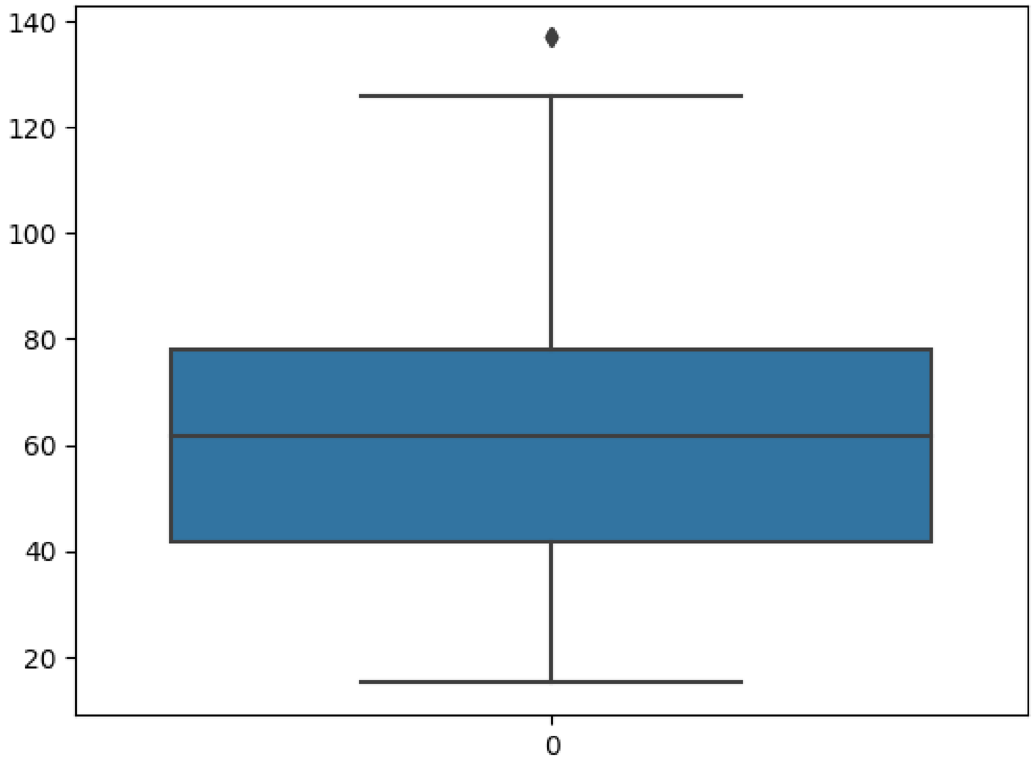
```
<ipython-input-473-beed7b40d5ab>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Spending Score (1-100)'])
```

```
[473]: <Axes: xlabel='Spending Score (1-100)', ylabel='Density'>
```



```
[474]: sns.boxplot(df['Annual Income (k$)'])
```

```
[474]: <Axes: >
```



```
[475]: Q1 = df['Annual Income (k$)'].quantile(0.25)
       Q3 = df['Annual Income (k$)'].quantile(0.75)
```

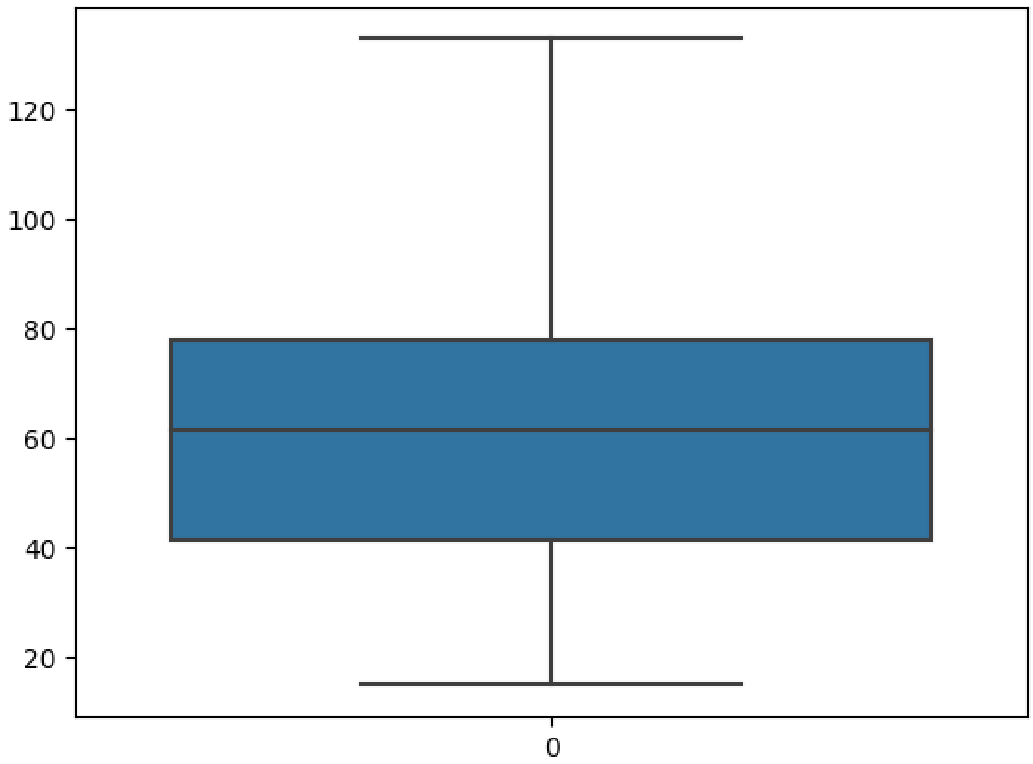
```
[476]: IQR = Q3 - Q1
       whisker_width = 1.5
```

```
[477]: lower_whisker = Q1 - (whisker_width*IQR)
       upper_whisker = Q3 + (whisker_width*IQR)
```

```
[478]: df['Annual Income (k$)'] = np.where(df['Annual Income (k$)'] > upper_whisker,␣
        ↪upper_whisker, np.where(df['Annual Income (k$)'] < lower_whisker,␣
        ↪lower_whisker, df['Annual Income (k$)']))
```

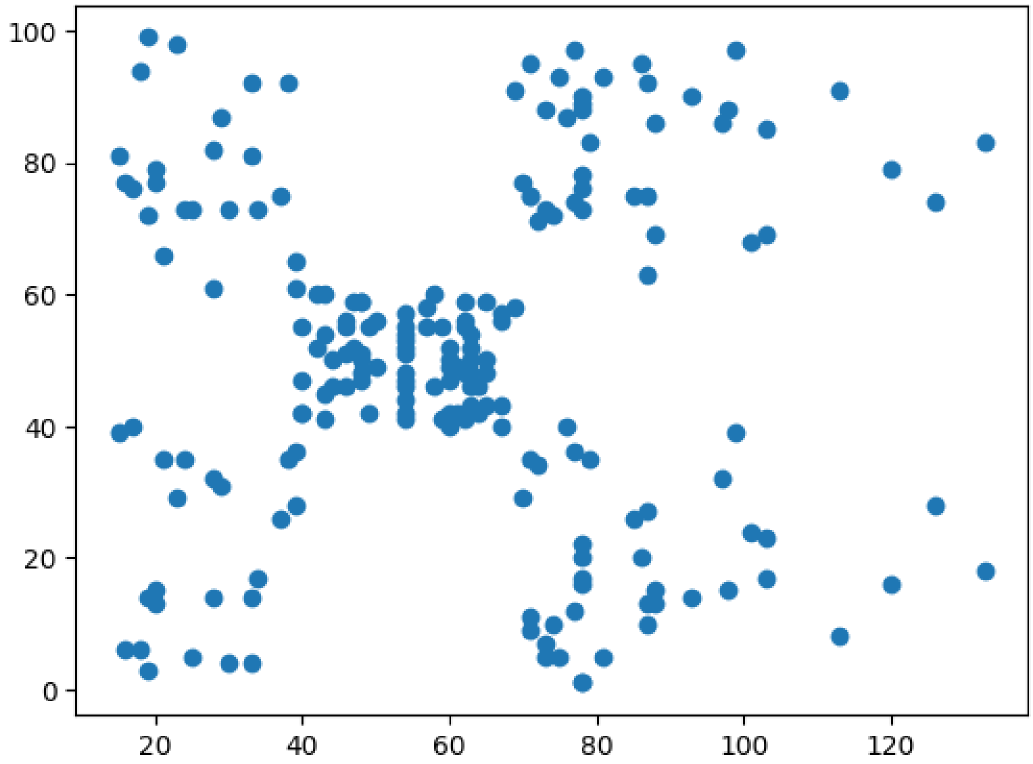
```
[479]: sns.boxplot(df['Annual Income (k$)'])
```

```
[479]: <Axes: >
```



```
[480]: plt.scatter(df['Annual Income (k$)'], df['Spending Score (1-100)'])
```

```
[480]: <matplotlib.collections.PathCollection at 0x7b174809ea40>
```



[481]:
```
X_train = df.drop(['Spending Score (1-100)'], axis=1)
Y_train = df['Spending Score (1-100)']
```

[482]:
```
X_train.head(), Y_train.head()
```

[482]:
```
(   Gender  Age  Annual Income (k$)
 0       1   19                15.0
 1       1   21                15.0
 2       0   20                16.0
 3       0   23                16.0
 4       0   31                17.0,
 0    39
 1    81
 2     6
 3    77
 4    40
 Name: Spending Score (1-100), dtype: int64)
```

5 Finding Elbow Point (Possible 'K' value)

[483]:

```
from sklearn.cluster import KMeans
```

[ ]:

```
k_rng = range(1,40)
sse = []

for k in k_rng:
  km = KMeans(n_clusters=k)
  km.fit(df[['Annual Income (k$)', 'Spending Score (1-100)']])
  sse.append(km.inertia_)
```

[ ]:

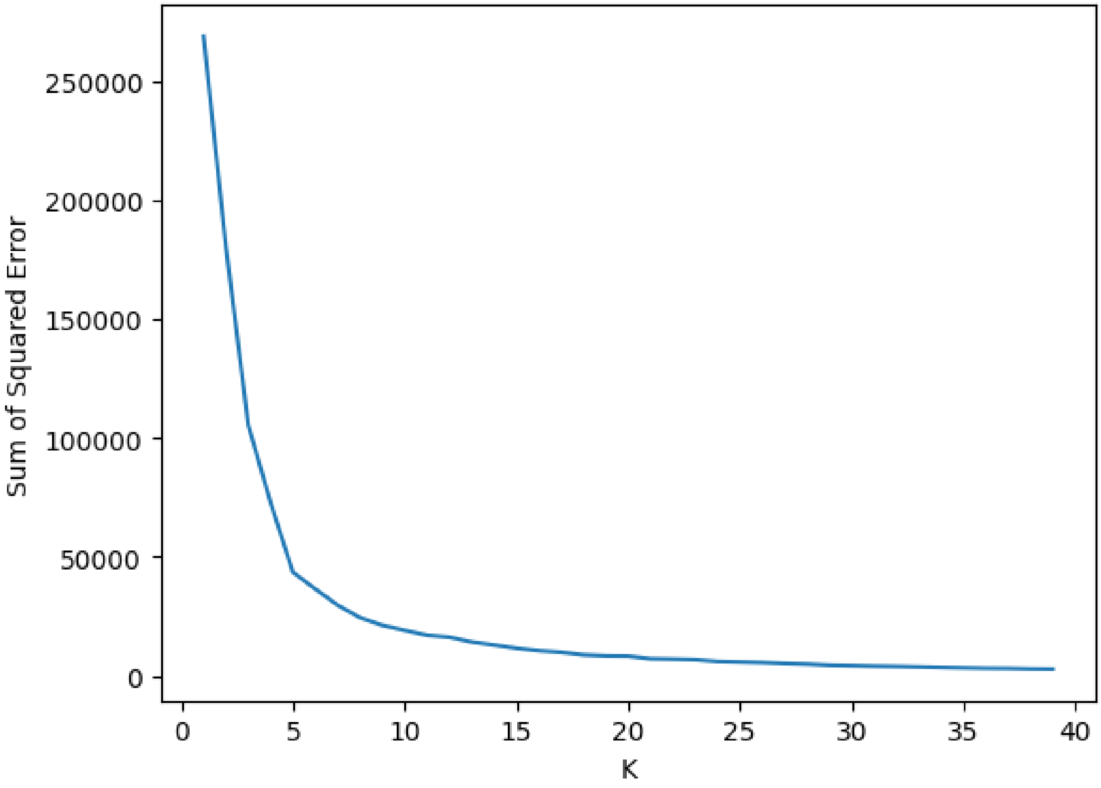
```
sse
```

[486]:

```
plt.xlabel('K')
plt.ylabel('Sum of Squared Error')
plt.plot(k_rng, sse)
```

[486]:

```
[<matplotlib.lines.Line2D at 0x7b17481235b0>]
```



[487]:
```
kmeans = KMeans(n_clusters=5)
kmeans
```

[487]:
```
KMeans(n_clusters=5)
```

[488]:
```
z = kmeans.fit_predict(df[['Annual Income (k$)','Spending Score (1-100)']])
z
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

[488]:
```
array([0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4,
       0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 4, 0, 2,
       0, 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, 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, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 1, 3, 2, 3, 1, 3, 1, 3,
       2, 3, 1, 3, 1, 3, 1, 3, 1, 3, 2, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3, 1, 3,
       1, 3], dtype=int32)
```

[489]:
```
df_2 = df
```

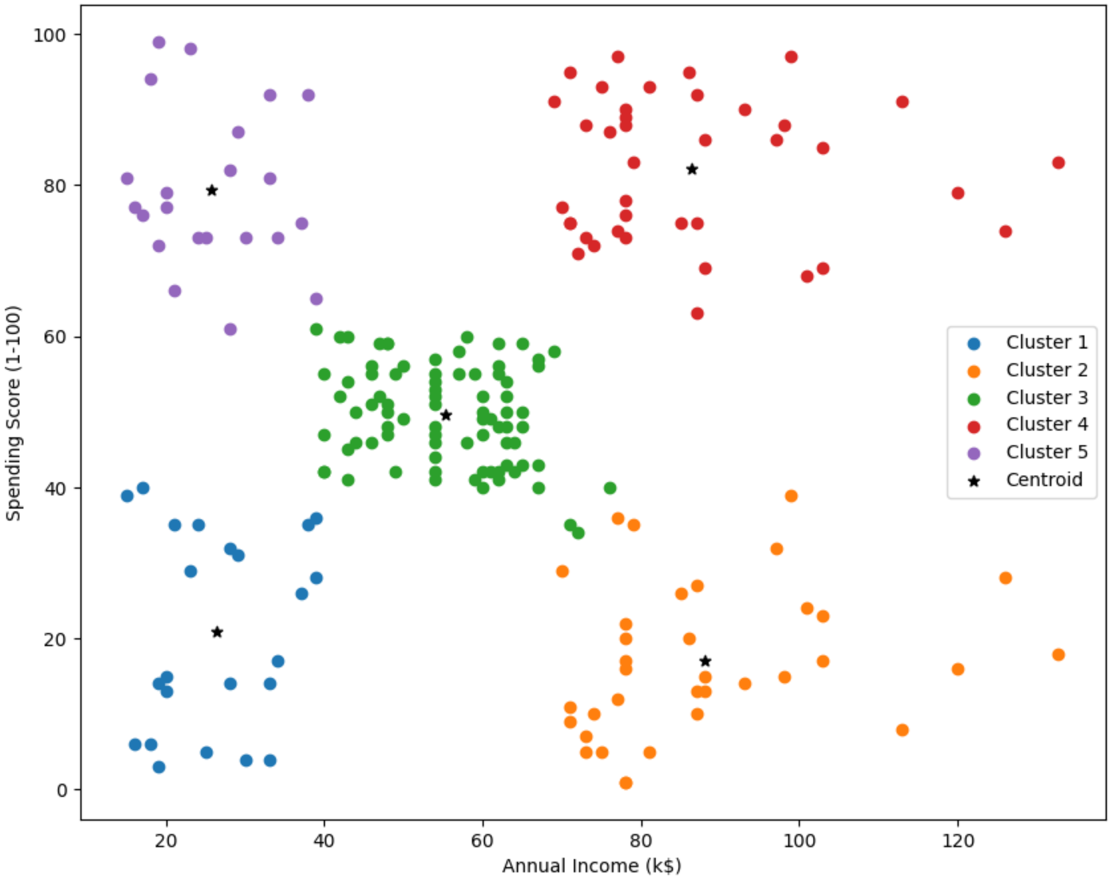
[490]:
```
df_2['Cluster'] = z
df_2.head()
```

[490]:
```
   Gender  Age  Annual Income (k$)  Spending Score (1-100)  Cluster
0       1   19                15.0                      39        0
1       1   21                15.0                      81        4
2       0   20                16.0                       6        0
3       0   23                16.0                      77        4
4       0   31                17.0                      40        0
```

[491]:
```
plt.figure(figsize=(10,8))

df1 = df_2[df_2.Cluster==0]
df2 = df_2[df_2.Cluster==1]
df3 = df_2[df_2.Cluster==2]
df4 = df_2[df_2.Cluster==3]
df5 = df_2[df_2.Cluster==4]


plt.scatter(df1['Annual Income (k$)'], df1['Spending Score (1-100)'],␣
 ↪label='Cluster 1')
```

```
plt.scatter(df2['Annual Income (k$)'], df2['Spending Score (1-100)'],␣
 ↪label='Cluster 2')
plt.scatter(df3['Annual Income (k$)'], df3['Spending Score (1-100)'],␣
 ↪label='Cluster 3')
plt.scatter(df4['Annual Income (k$)'], df4['Spending Score (1-100)'],␣
 ↪label='Cluster 4')
plt.scatter(df5['Annual Income (k$)'], df5['Spending Score (1-100)'],␣
 ↪label='Cluster 5')

plt.scatter(kmeans.cluster_centers_[:,0], kmeans.cluster_centers_[:,1],␣
 ↪color='black', marker='*', label='Centroid')

plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
```

```
[491]: <matplotlib.legend.Legend at 0x7b1747fbfd90>
```



6 Train - Test Split

[492]:
```
df.drop(['Cluster'], axis=1, inplace=True)
```

[493]:
```
df.head()
```

[493]:
```
   Gender  Age  Annual Income (k$)  Spending Score (1-100)
0       1   19                15.0                      39
1       1   21                15.0                      81
2       0   20                16.0                       6
3       0   23                16.0                      77
4       0   31                17.0                      40
```

[494]:
```
from sklearn.model_selection import train_test_split
```

[495]:
```
X = df.drop(['Spending Score (1-100)'], axis=1)
y = df['Spending Score (1-100)']
```

7 KNN and Logistic Regression Modeling

[496]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
```

7.1 KNN Model

[554]:
```
lr = LogisticRegression(max_iter=10000)
knn = KNeighborsClassifier(n_neighbors=3)
```

[555]:
```
xtrain, xtest, ytrain, ytest = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=12)
```

[556]:
```
xtest.shape, xtrain.shape
```

[556]:
```
((60, 3), (140, 3))
```

[557]:
```
ytest.shape, ytrain.shape
```

[557]:
```
((60,), (140,))
```

[558]:
```
knn.fit(xtrain, ytrain)
```

[558]:
```
KNeighborsClassifier(n_neighbors=3)
```

[559]:
```
acc = knn.score(xtest, ytest)
print(f"Accuracy for the KNN model is {acc*100:.2f}%")
```

```
Accuracy for the KNN model is 3.33%
```

7.2 Logistic Regression Model

[560]:
```
Xtrain, Xtest, Ytrain, Ytest = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=10)
```

[561]:
```
Xtest.shape, Xtrain.shape
```

[561]:
```
((60, 3), (140, 3))
```

[562]:
```
Ytest.shape, Ytrain.shape
```

[562]:
```
((60,), (140,))
```

[563]:
```
lr.fit(Xtrain, Ytrain)
```

[563]:
```
LogisticRegression(max_iter=10000)
```

[564]:
```
acc = lr.score(xtest, ytest)
print(f"Accuracy for the Logistic Regression model is {acc*100:.2f}%")
```

```
Accuracy for the Logistic Regression model is 18.33%
```

8 Prediction

[565]:
```
prediction1 = knn.predict([[1.0, 36.0 , 24.0]])[0]
prediction2 = lr.predict([[1.0, 36.0 , 24.0]])[0]
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does
not have valid feature names, but KNeighborsClassifier was fitted with feature
names
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does
not have valid feature names, but LogisticRegression was fitted with feature
names
  warnings.warn(
```

[566]:
```
print("KNN Model")
print("Gender: Male, Age: 36, Salary(k$): 24.0, Spending Score(1-100): {}".
 ↪format(prediction1))

print("Logistic Regression Model")
print("Gender: Male, Age: 36, Salary(k$): 24.0, Spending Score(1-100): {}".
 ↪format(prediction2))
```

```
KNN Model
Gender: Male, Age: 36, Salary(k$): 24.0, Spending Score(1-100): 35
Logistic Regression Model
Gender: Male, Age: 36, Salary(k$): 24.0, Spending Score(1-100): 73
```

```
[ ]:
```