assignment-5

October 5, 2023

1 Kaggle Connection & DataFrame setup

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

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

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

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

```
[604]: ! 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, 2.51MB/s]
```

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

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

2 Pre-Processing

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

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

```
[607]:    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
```

[608]:

```
df.describe()
```

[608]:

```
       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
```

[609]:

```
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
```

[610]:

```
df.isnull().values.any()
```

[610]:

```
False
```

[611]:

```
df.shape
```

[611]:

```
(200, 5)
```

[612]:

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

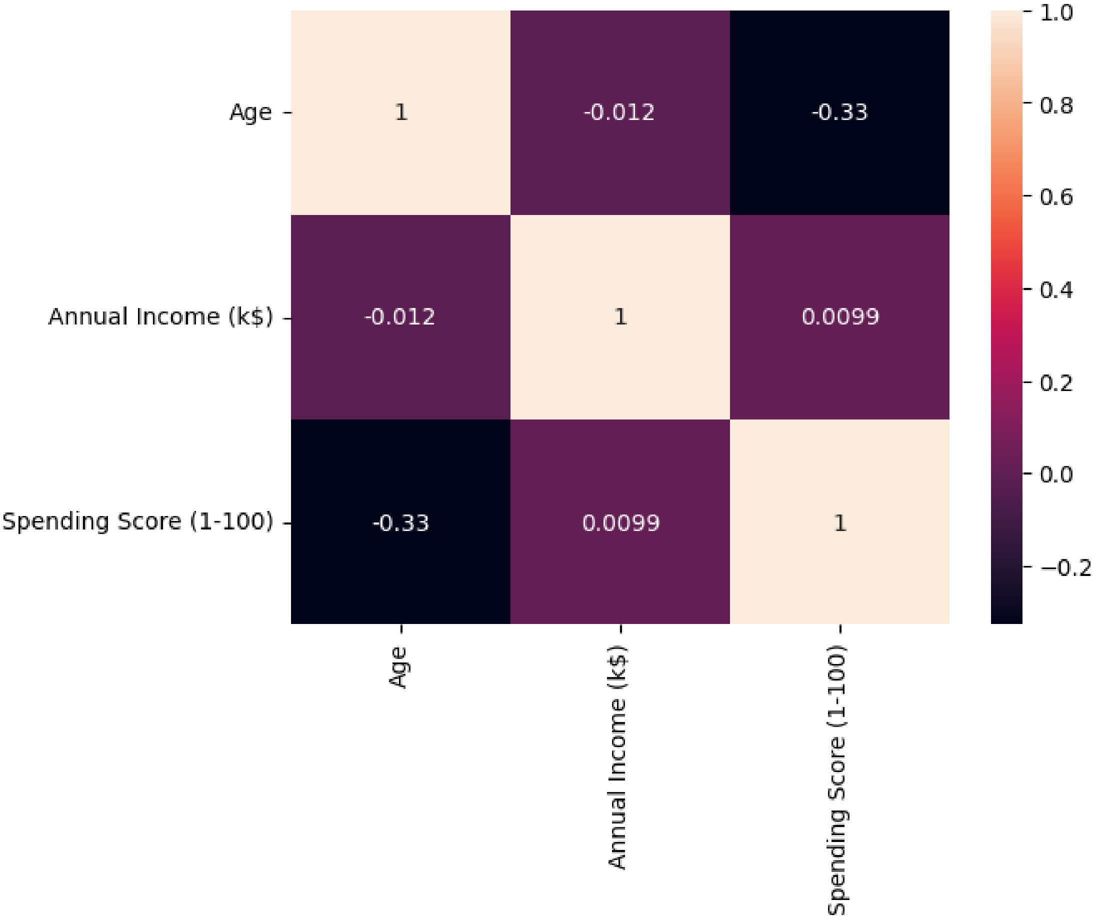
[613]:

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

```
<ipython-input-613-6dc1c4c1753e>: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
```

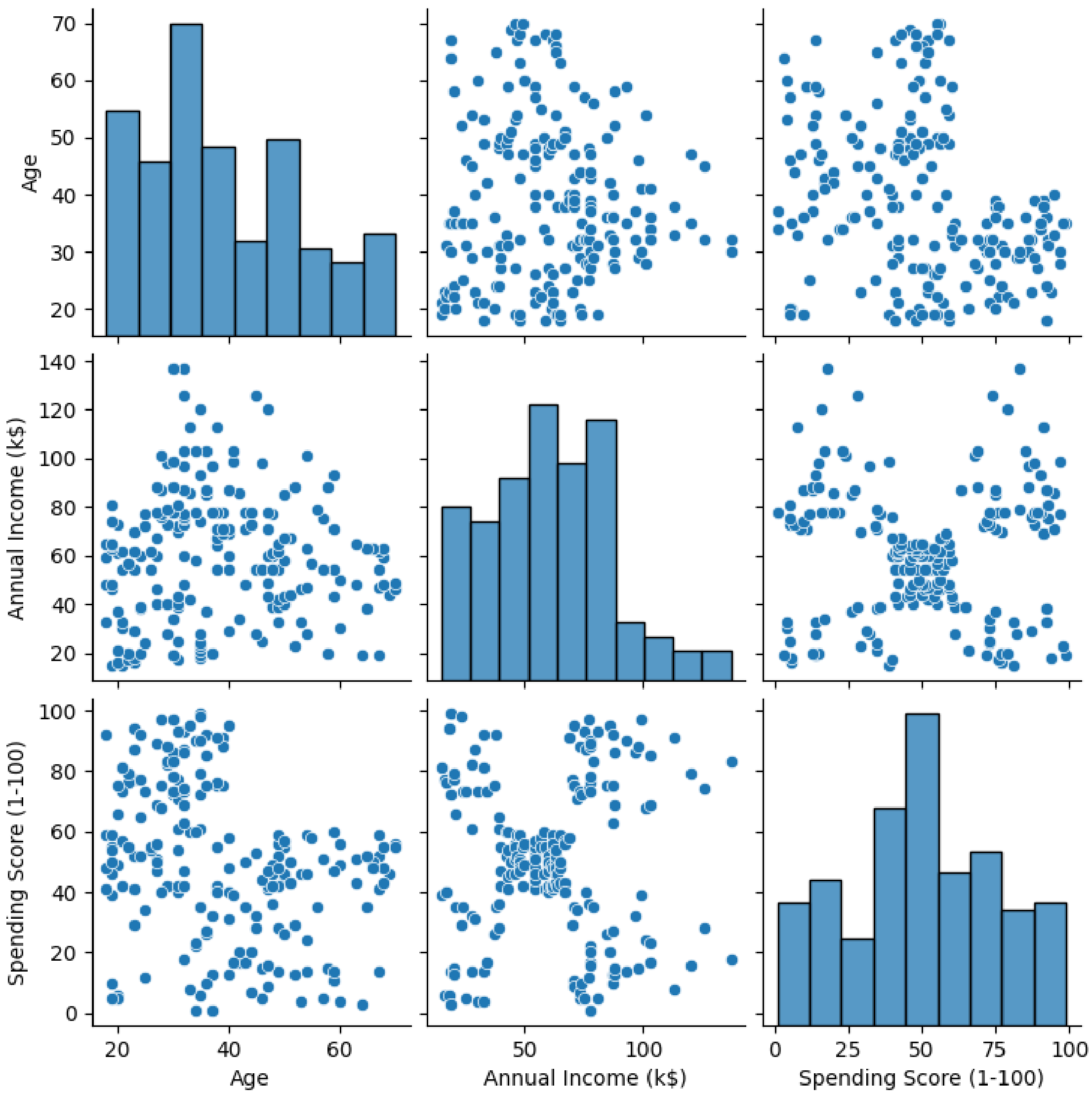
```
to silence this warning.
  sns.heatmap(df.corr(), annot=True)
```

```
[613]: <Axes: >
```



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

```
[614]: <seaborn.axisgrid.PairGrid at 0x7daddca476a0>
```



3 Converting Categorical Data (Columns) to Numerical

[615]:

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

[615]:

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

[616]:

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

[617]:

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

[618]:

```
df.head()
```

[618]:

```
   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
```

[619]:

```
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
```

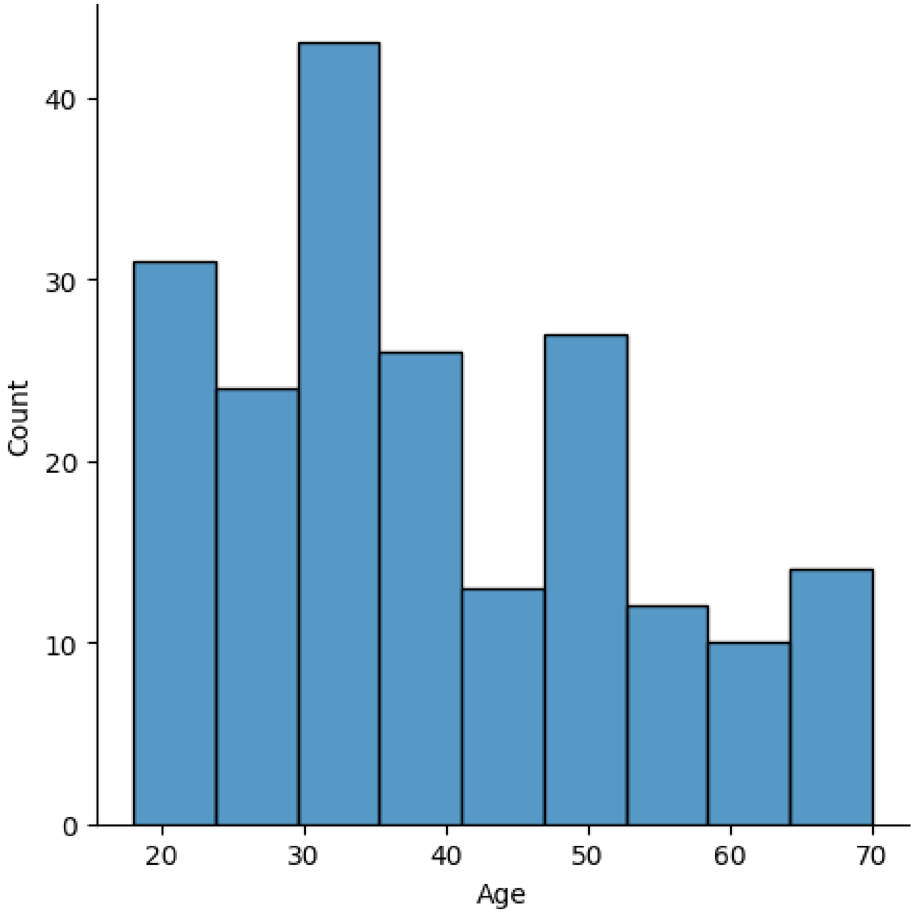
4 Data Analysis, Outlier Detection & Outlier Elimination

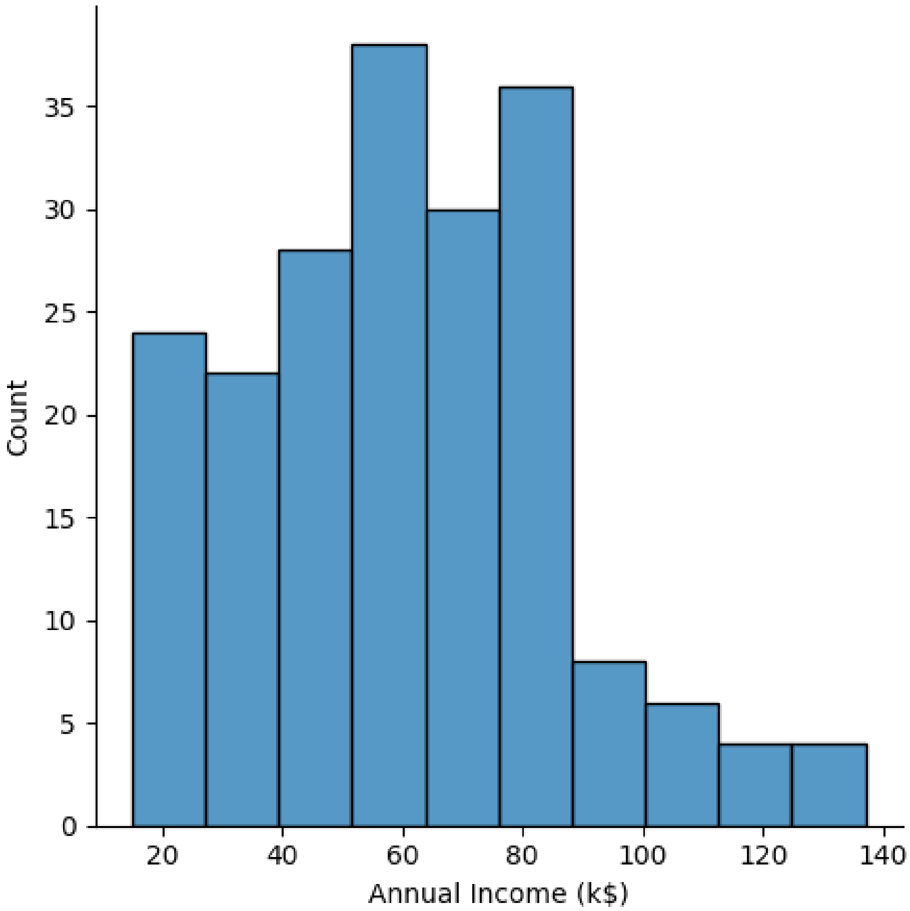
[620]:

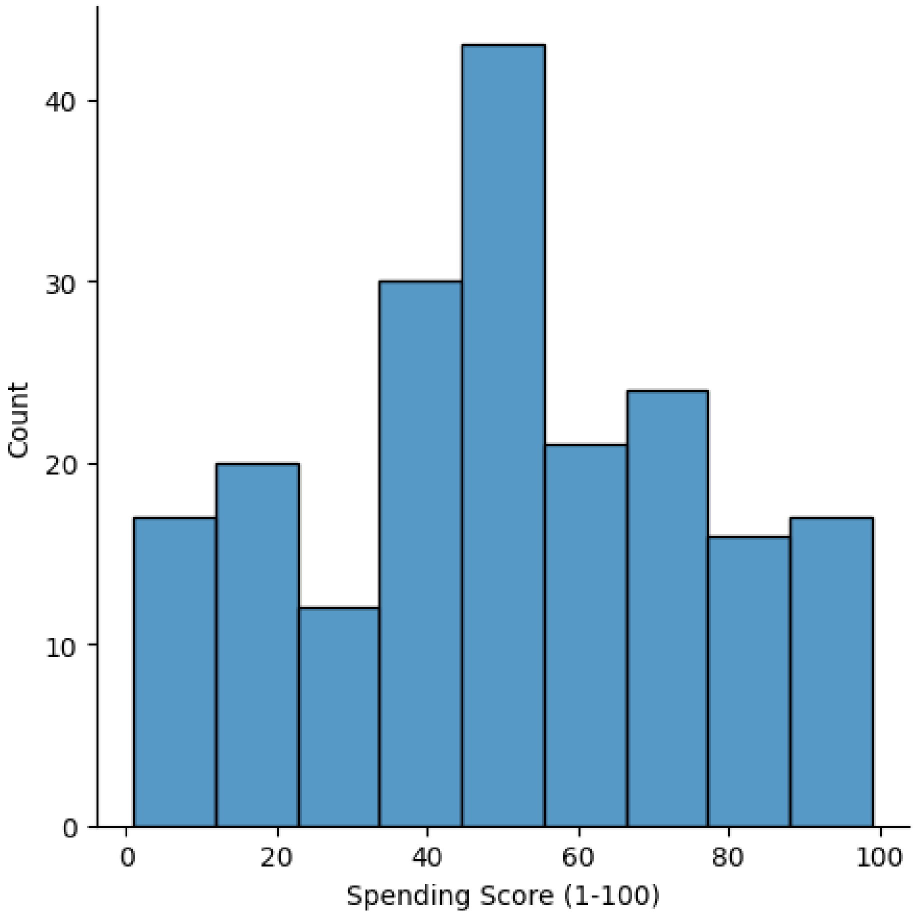
```
sns.displot(df['Age'])
sns.displot(df['Annual Income (k$)'])
sns.displot(df['Spending Score (1-100)'])
```

[620]:

```
<seaborn.axisgrid.FacetGrid at 0x7daddba3dae0>
```


0
10
20
30
40
Count
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$)



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

```
<ipython-input-621-0fafe04ea3f6>:1: UserWarning:

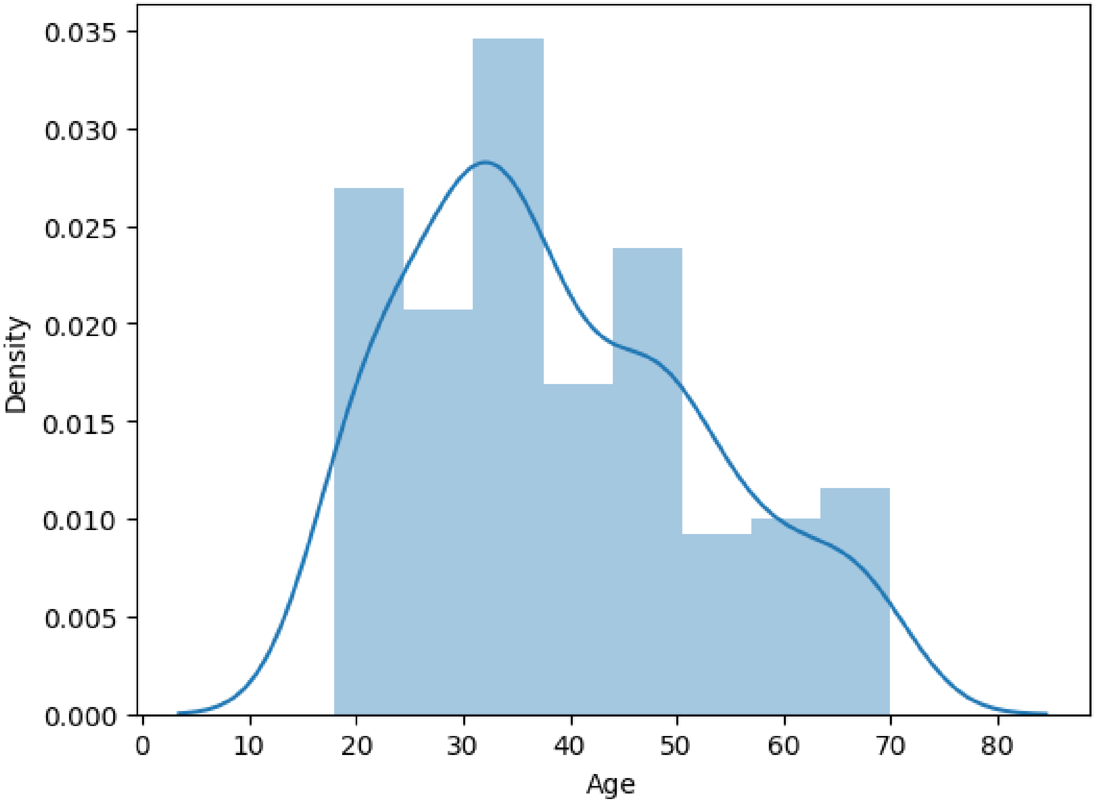
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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'])
```

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



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

```
<ipython-input-622-5c9bfeb4bab1>:1: UserWarning:

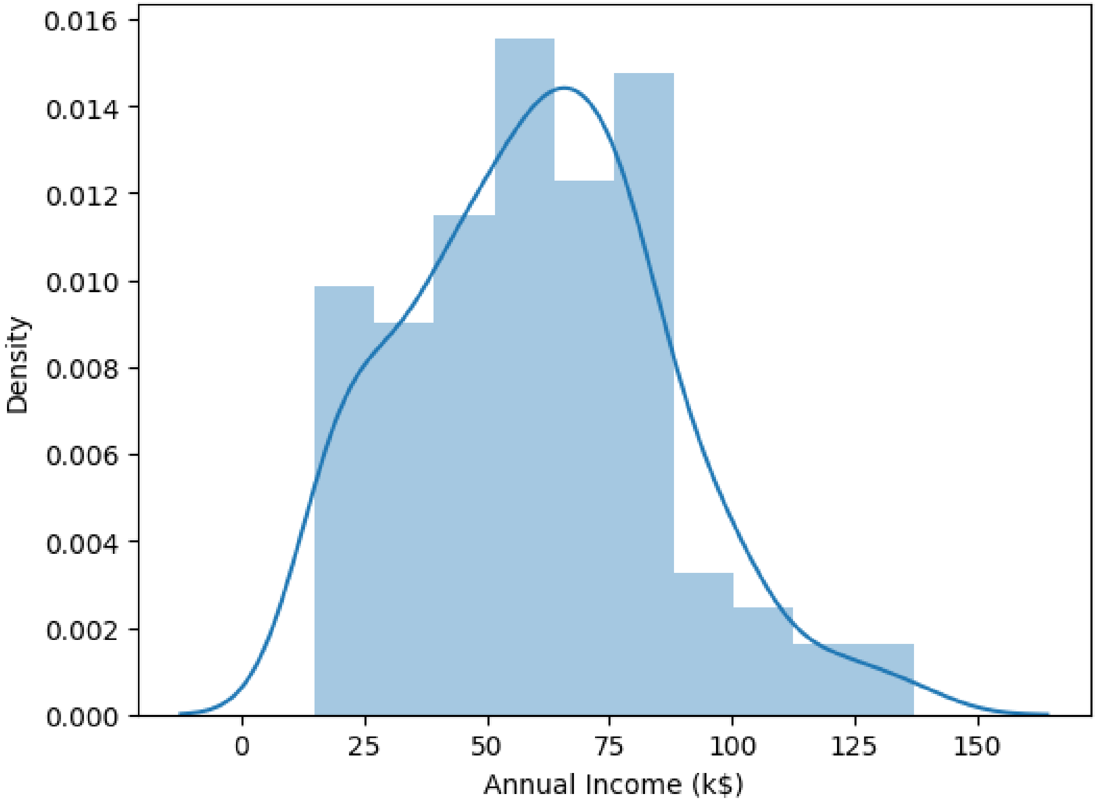
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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$)'])
```

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



[623]:
```
sns.distplot(df['Spending Score (1-100)'])
```

```
<ipython-input-623-beed7b40d5ab>:1: UserWarning:

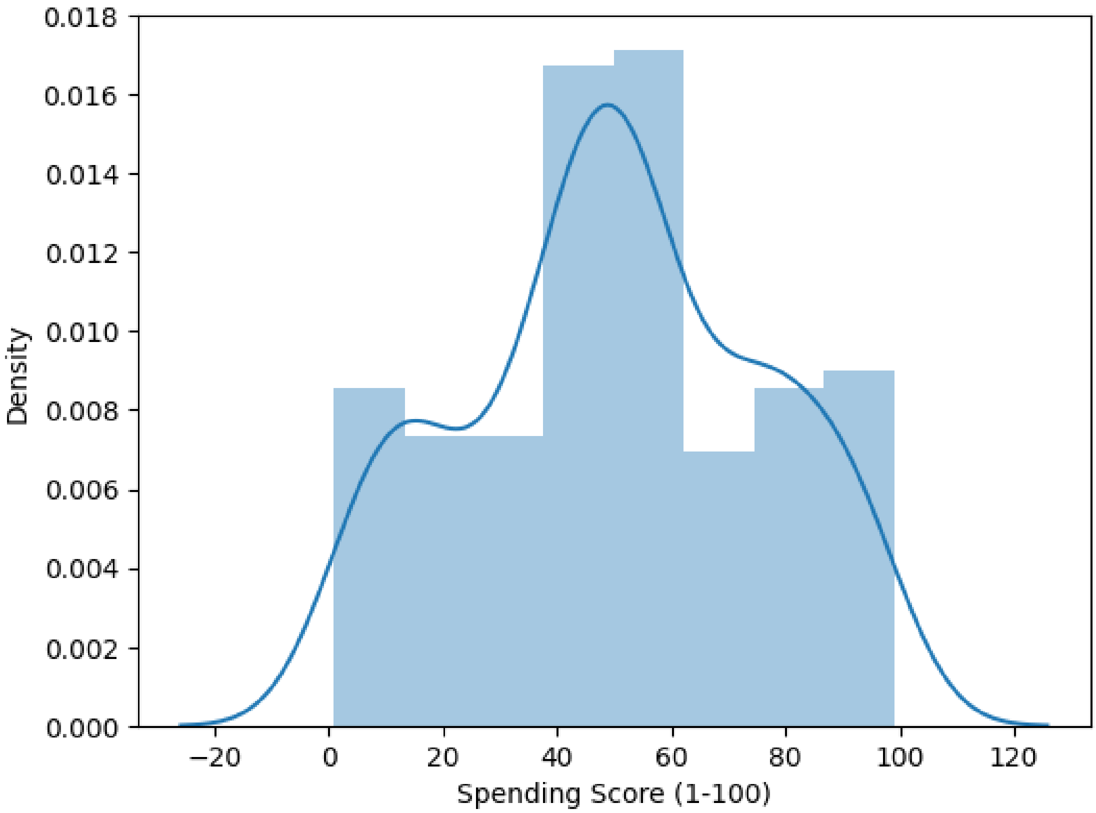
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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

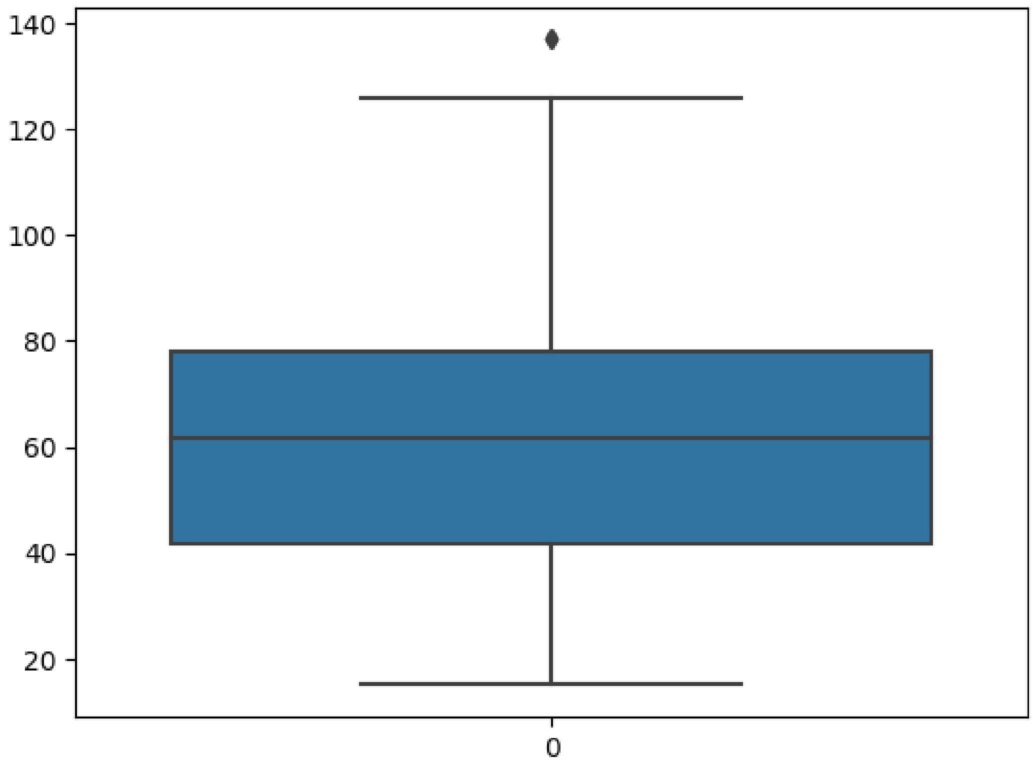
  sns.distplot(df['Spending Score (1-100)'])
```

[623]:
```
<Axes: xlabel='Spending Score (1-100)', ylabel='Density'>
```



[624]:
```
sns.boxplot(df['Annual Income (k$)'])
```

[624]:
```
<Axes: >
```



[625]:
```
Q1 = df['Annual Income (k$)'].quantile(0.25)
Q3 = df['Annual Income (k$)'].quantile(0.75)
```

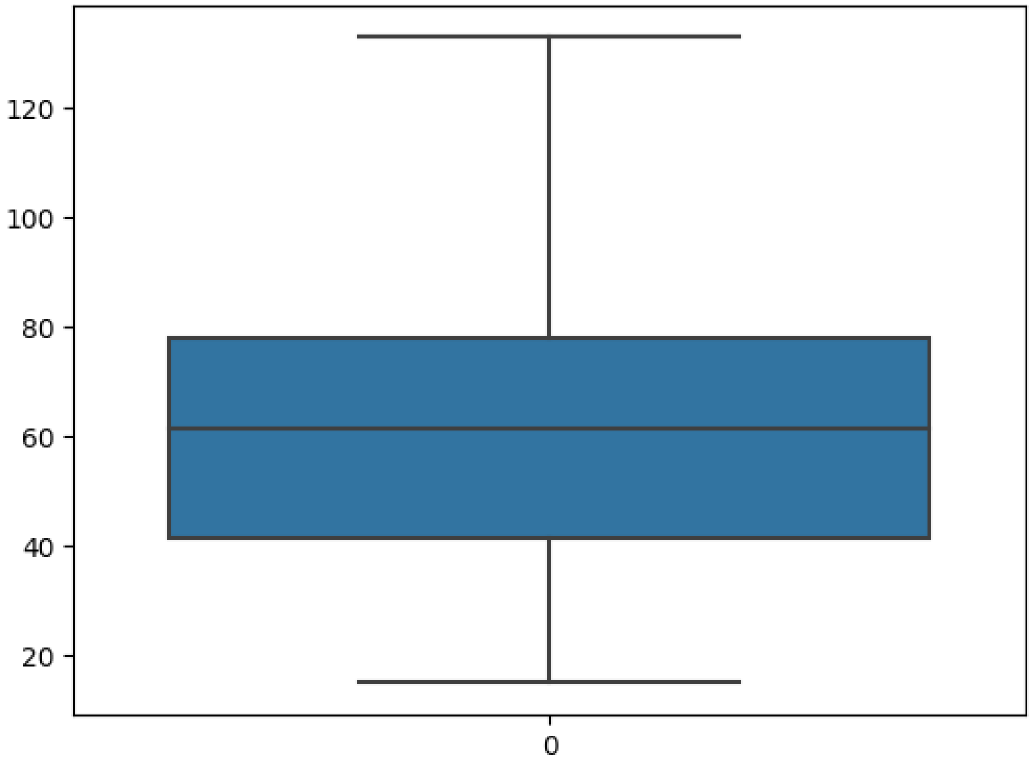
[626]:
```
IQR = Q3 - Q1
whisker_width = 1.5
```

[627]:
```
lower_whisker = Q1 - (whisker_width*IQR)
upper_whisker = Q3 + (whisker_width*IQR)
```

[628]:
```
df['Annual Income (k$)'] = np.where(df['Annual Income (k$)'] > upper_whisker,␣
 ↪upper_whisker, np.where(df['Annual Income (k$)'] < lower_whisker,␣
 ↪lower_whisker, df['Annual Income (k$)']))
```

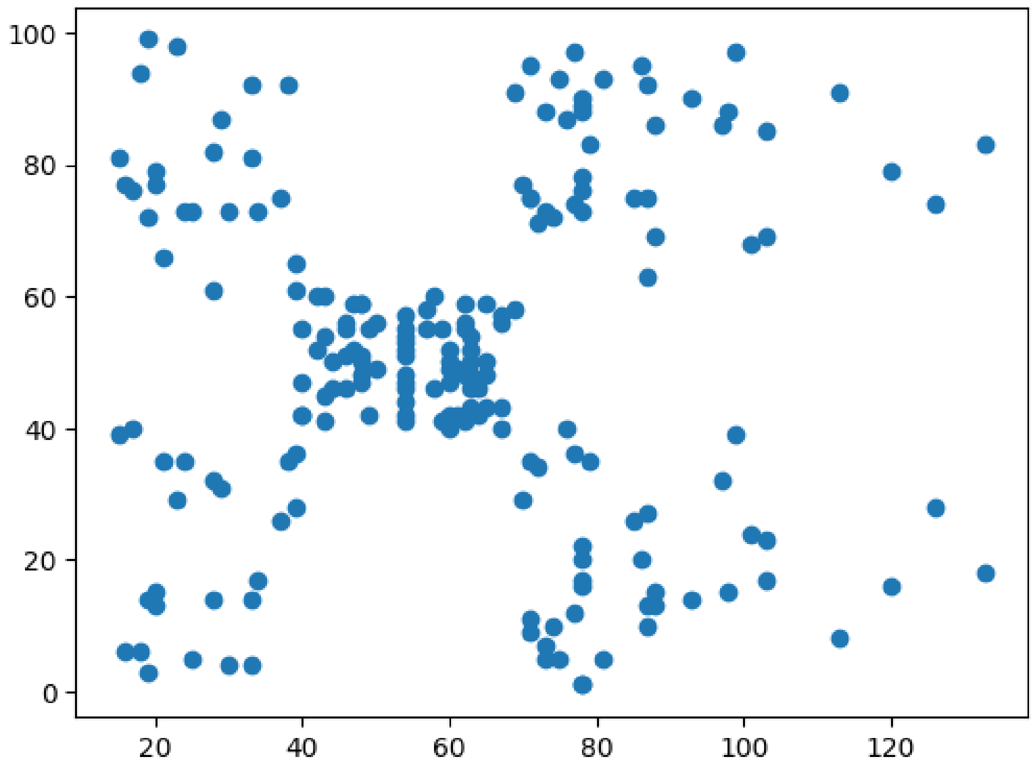
[629]:
```
sns.boxplot(df['Annual Income (k$)'])
```

[629]:
```
<Axes: >
```



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

```
[630]: <matplotlib.collections.PathCollection at 0x7daddb65d7b0>
```



```
[631]: from sklearn.preprocessing import MinMaxScaler
```

```
[632]: X_train = df.drop(['Spending Score (1-100)'], axis=1)
       X_train = pd.DataFrame(MinMaxScaler().fit_transform(X_train), columns=X_train.
        ↪columns)

       Y_train = df['Spending Score (1-100)']
```

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

```
[633]: (   Gender       Age  Annual Income (k$)
        0     1.0  0.019231            0.000000
        1     1.0  0.057692            0.000000
        2     0.0  0.038462            0.008493
        3     0.0  0.096154            0.008493
        4     0.0  0.250000            0.016985,
        0    39
        1    81
        2     6
        3    77
        4    40
        Name: Spending Score (1-100), dtype: int64)
```

5 Finding Elbow Point (Possible 'K' value)

[634]:
```
from sklearn.cluster import KMeans
```

[635]:
```
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_)
```

```
/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(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
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```
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1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

```
[636]: sse
```

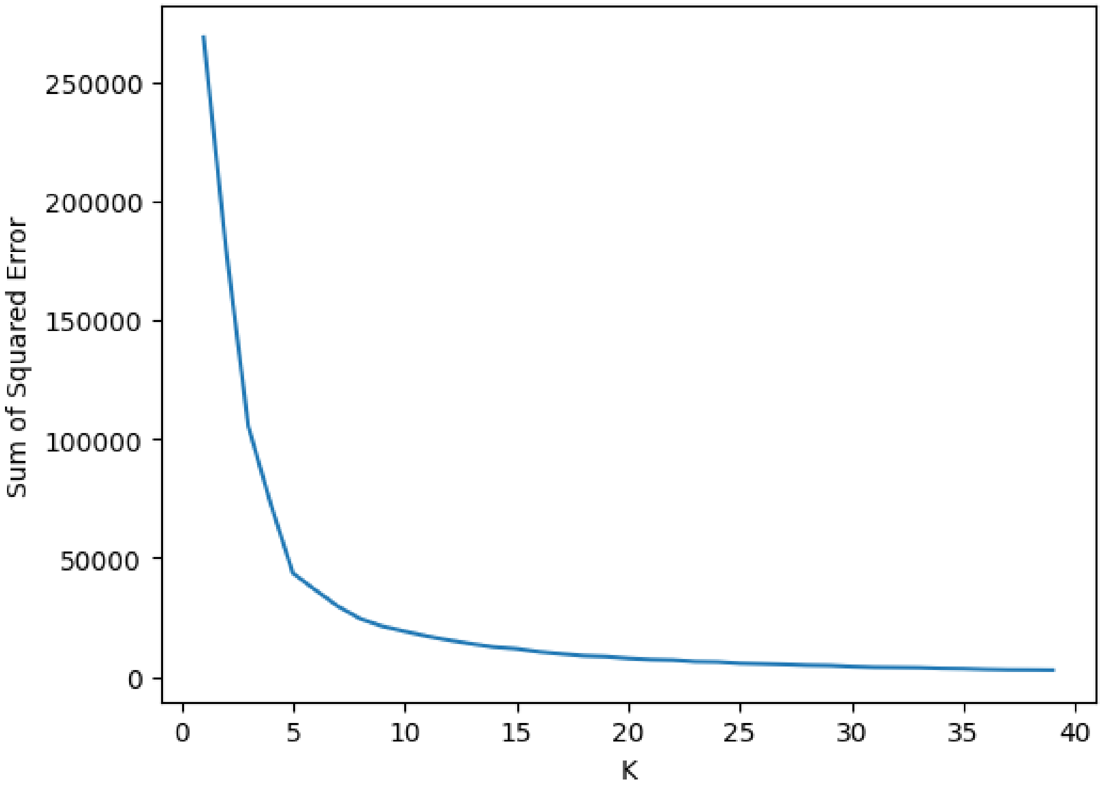
```
[636]: [268717.5637499999,
        180456.95393668828,
        105529.63651521516,
        72861.0524925923,
        43639.878158556414,
        36620.76718928144,
        29829.066471160957,
        24564.382281135964,
        21382.608462322565,
        19244.814450778555,
        17205.548702513755,
        15502.186514191457,
        13958.923407658516,
        12628.419801889288,
        11912.3291765694,
        10619.603376831503,
        9803.323762719561,
        8965.422420223756,
        8637.61374868696,
        7904.32068998865,
        7385.5635939800795,
        7173.877767501928,
        6543.25370736201,
        6410.3651709766855,
        5833.792235750361,
        5613.621778221779,
        5360.4049035807175,
        5023.465877329192,
        4887.764547258296,
        4447.030006105006,
        4149.634623015872,
        4064.836663336663,
        3972.645093795093,
        3663.232523726274,
        3537.3413149350654,
        3272.340124458874,
        3107.4417117604617,
        3070.0163149350656,
        2991.7733901515153]
```

[637]:

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

[637]:

```
[<matplotlib.lines.Line2D at 0x7daddb6e1540>]
```



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

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

```
[639]: 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(
```

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

[640]:
```
df_2 = df
```

[641]:
```
df_2['Cluster'] = z
df_2.head()
```

[641]:
```
   Gender  Age  Annual Income (k$)  Spending Score (1-100)  Cluster
0       1   19                15.0                      39        3
1       1   21                15.0                      81        1
2       0   20                16.0                       6        3
3       0   23                16.0                      77        1
4       0   31                17.0                      40        3
```

[642]:
```
plt.figure(figsize=(10,8))

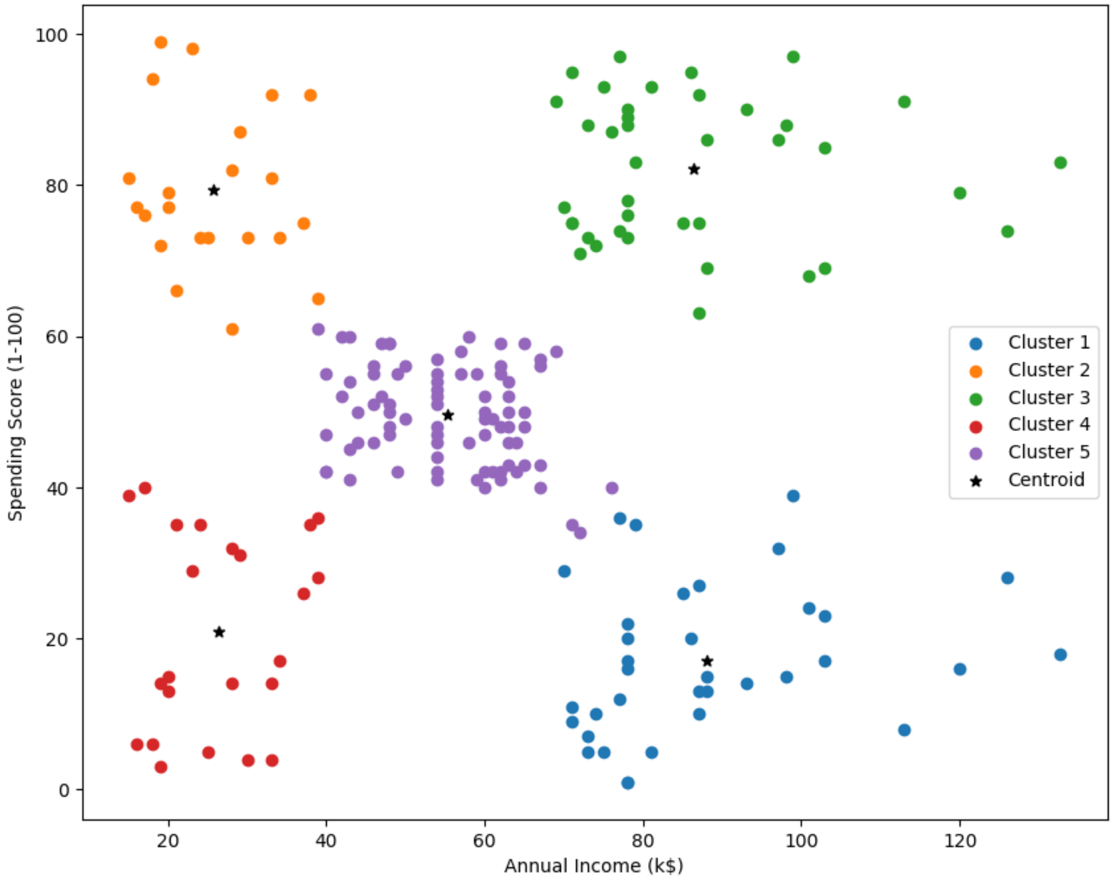
df1 = df_2[df_2.Cluster==0]
df2 = df_2[df_2.Cluster==1]
df3 = df_2[df_2.Cluster==2]
df4 = df_2[df_2.Cluster==3]
df5 = df_2[df_2.Cluster==4]


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()
```

[642]:
```
<matplotlib.legend.Legend at 0x7dadd b701b10>
```



6 Scaling & Train - Test Split

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

```
[664]: X = df.drop(['Spending Score (1-100)'], axis=1)
       X = pd.DataFrame(MinMaxScaler().fit_transform(X), columns=X.columns)
       X.drop(['Cluster', 'Gender'], axis=1, inplace=True)
```

```
[665]: y = df['Spending Score (1-100)']
```

```
[666]: X.head(), y.head()
```

```
[666]: (         Age  Annual Income (k$)
        0  0.019231            0.000000
        1  0.057692            0.000000
        2  0.038462            0.008493
        3  0.096154            0.008493
        4  0.250000            0.016985,
        0    39
        1    81
        2     6
        3    77
        4    40
        Name: Spending Score (1-100), dtype: int64
```

7 KNN and Logistic Regression Modeling

[667]:

```
from sklearn.linear_model import LinearRegression, LogisticRegression
from sklearn.neighbors import KNeighborsRegressor
```

[668]:

```
lr = LogisticRegression(max_iter=10000)
knn = KNeighborsRegressor(n_neighbors=3)
```

7.1 KNN Model

[669]:

```
xtrain, xtest, ytrain, ytest = train_test_split(X, y, test_size=0.25,␣
 ↪random_state=100)
```

[670]:

```
xtest.shape, xtrain.shape
```

[670]:

```
((50, 2), (150, 2))
```

[671]:

```
ytest.shape, ytrain.shape
```

[671]:

```
((50,), (150,))
```

[672]:

```
knn.fit(xtrain, ytrain)
```

[672]:

```
KNeighborsRegressor(n_neighbors=3)
```

[673]:

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

```
Accuracy for the KNN model is 56.86%
```

7.2 Logistic Regression Model

[674]:

```
Xtrain, Xtest, Ytrain, Ytest = train_test_split(X, y, test_size=0.30,␣
 ↪random_state=42)
```

[675]:

```
Xtest.shape, Xtrain.shape
```

[675]:

```
((60, 2), (140, 2))
```

[676]:
```
Ytest.shape, Ytrain.shape
```

[676]:
```
((60,), (140,))
```

[677]:
```
lr.fit(Xtrain, Ytrain)
```

[677]:
```
LogisticRegression(max_iter=10000)
```

[678]:
```
acc = lr.score(Xtest, Ytest)
print(f"Accuracy for the Logistic Regression model is {acc*100:.2f}%")
```

```
Accuracy for the Logistic Regression model is 0.00%
```

8 Prediction

[691]:
```
prediction1 = knn.predict([[36 , 24]])[0]
prediction2 = lr.predict([[36 , 24]])[0]
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does
not have valid feature names, but KNeighborsRegressor 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(
```

[696]:
```
print("KNN Model")
print(f"Age: 36, Salary(k$): 24.0, Spending Score(1-100): {prediction1:.2f}")

print('\n', "*"*10, '\n')

print("Logistic Regression Model")
print(f"Age: 36, Salary(k$): 24.0, Spending Score(1-100): {prediction2:.2f}")
```

```
KNN Model
Age: 36, Salary(k$): 24.0, Spending Score(1-100): 37.33

 **********

Logistic Regression Model
Age: 36, Salary(k$): 24.0, Spending Score(1-100): 43.00
```