K-Mean Clustering (Customer Segmentation)

March 2, 2024

1 Customer Segmentation using K-Mean Clustering

2 Import Libraries

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import re
from sklearn.cluster import KMeans
```

3 Importing the dataset

[3]:
```
df = pd.read_csv("C:/Users/Dharini/Downloads/Mall_Customers.csv")
```

4 Data Anlaysis

[4]:
```
df.head()
```

[4]:

	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

[5]:
```
df.tail()
```

[5]:

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

[8]:
```
df.shape
```

[8]:
```
(200, 5)
```

[9]:
```
df.isnull().sum()
```

[9]:
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

[10]:
```
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
```

- Conclusions

1. No Null Value
2. Gender has the dtype of object, which needs to be converted

[11]:
```
df.describe()
```

[11]:

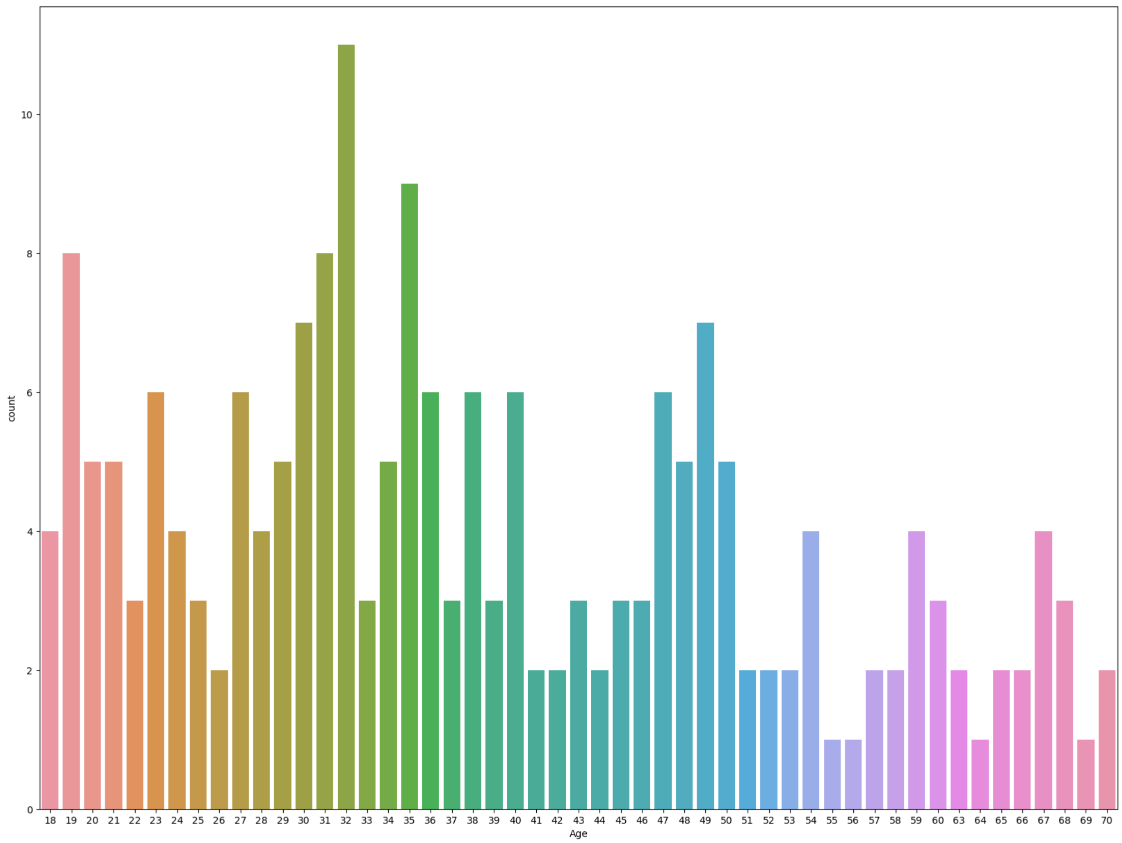
	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

- Conclusions

1. Avg. age of Customer is 38
2. Customer that visits the mall is having the age b/w 18 to 70
3. Having the Avg. annual income as $60k

[12]:
```
plt.figure(figsize=(20,15))
sns.countplot(data=df, x='Age')
```

[12]: <AxesSubplot: xlabel='Age', ylabel='count'>



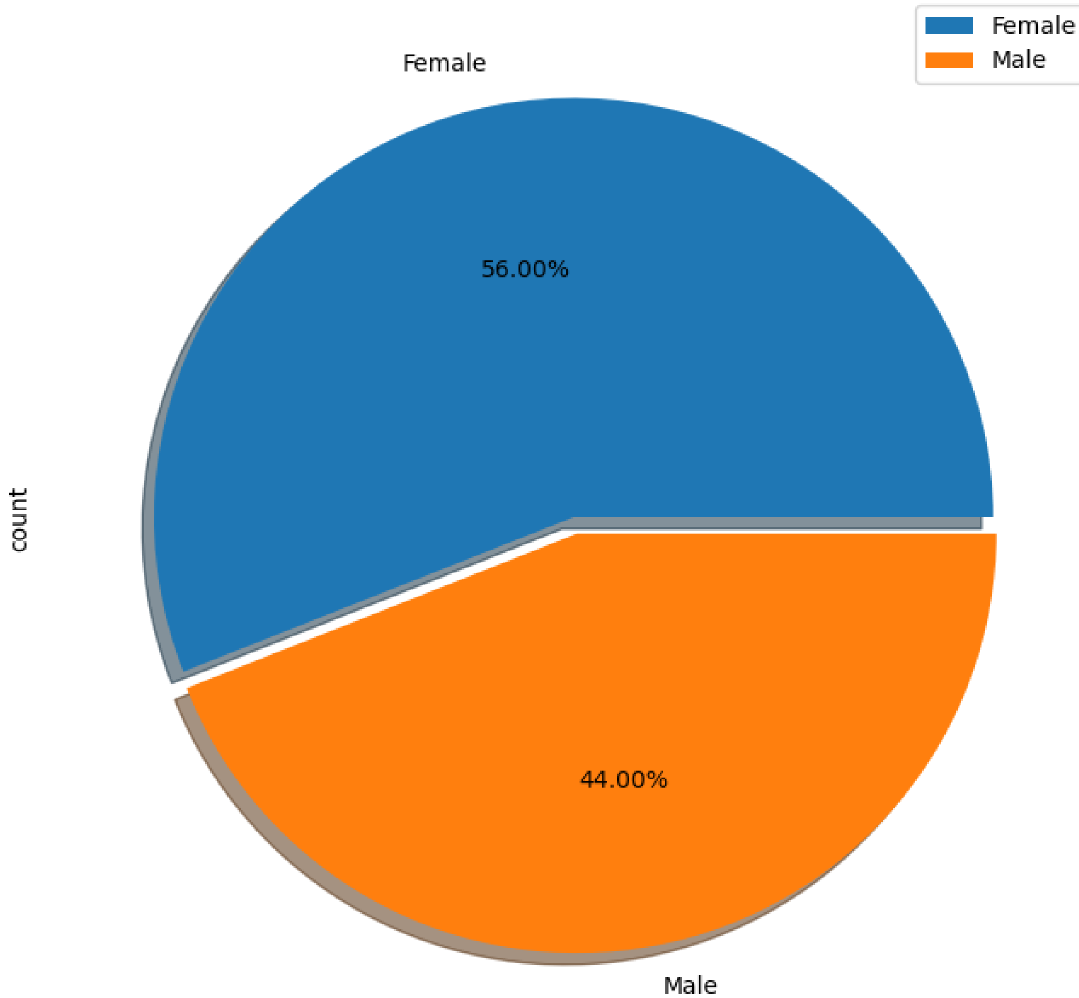
[13]:
```
df.head()
```

[13]:

	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

[14]:
```
#showing how many % of male and female visits the mall with the help of a plot
plt.figure(figsize=(8,8))
df.Gender.value_counts().plot(kind='pie', autopct='%.2f%%', shadow=True,
                              explode=(0,0.04))
plt.legend()
```

[14]: <matplotlib.legend.Legend at 0x281426ff370>



- Conclusion

1. No. of females > No. of males
2. Females are 12% more than Male
3. Female visits the mall most of the time.

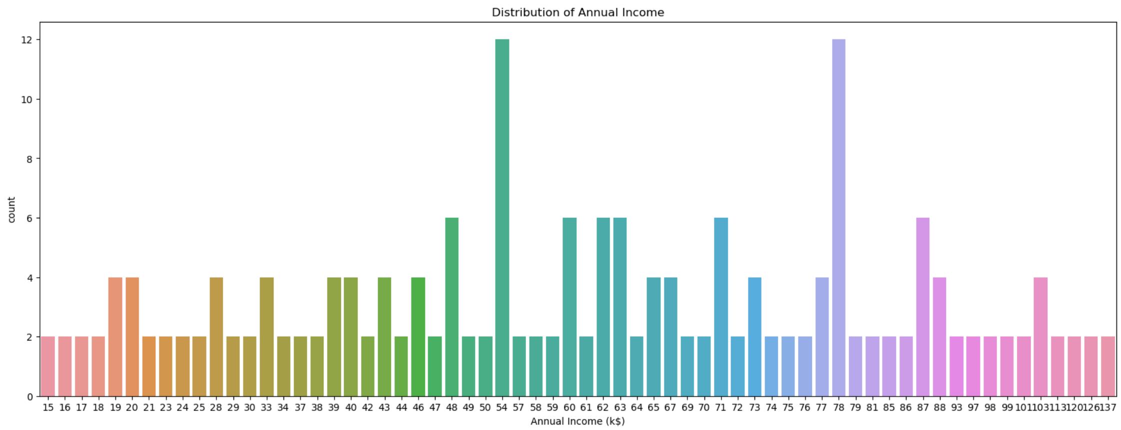
[15]:
```
df.head(2)
```

[15]:
```
   CustomerID Gender  Age  Annual Income (k$)  Spending Score (1-100)
0           1   Male   19                  15                      39
1           2   Male   21                  15                      81
```

[23]:
```
# Distribution of Income
plt.figure(figsize=(20, 7))
sns.countplot(x='Annual Income (k$)', data=df)
```

```
plt.title('Distribution of Annual Income')
```

[23]: Text(0.5, 1.0, 'Distribution of Annual Income')

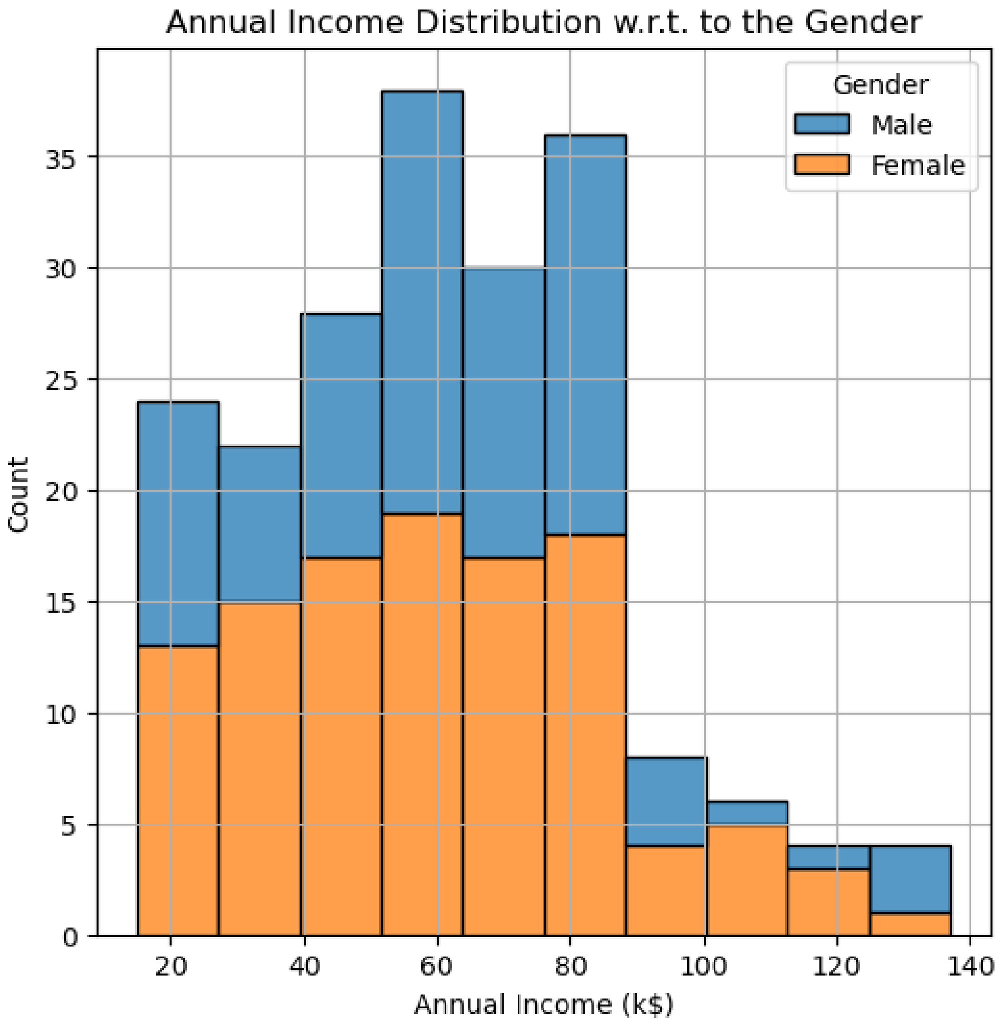


- Conclusions

1. The customers that are having the salary of $54(k) and $78(K), visits the mall most of time

[24]:
```
# Show the Annual Income Distribution with respect to the Gender

plt.figure(figsize=(6,6))
sns.histplot(df,x='Annual Income (k$)',hue='Gender', multiple='stack')
plt.title('Annual Income Distribution w.r.t. to the Gender')
plt.grid()
```



- Conclusion

The histogram provides a visual representation of the annual income distribution with respect to gender, allowing for insights into potential income disparities and informing various decision-making processes.

5 Seaborn lmplot

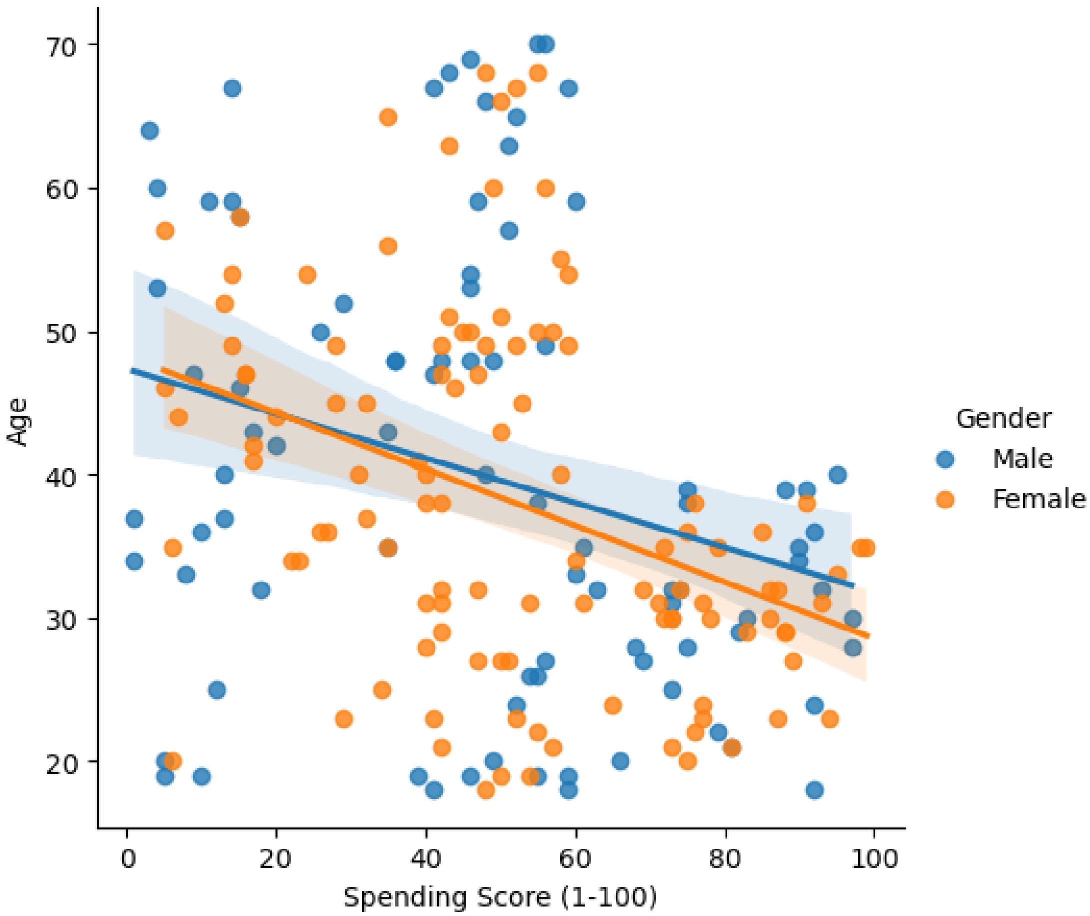
[25]:
```
df.head()
```

[25]:
```
   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
```

[26]:
```python
sns.lmplot(data=df,x='Spending Score (1-100)', y='Age', hue='Gender')
```

[26]: <seaborn.axisgrid.FacetGrid at 0x28141fce3a0>



6 Machine Learning

[27]:
```python
df.head()
```

[27]:

	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

[28]:
```python
# Label Encoding
from sklearn.preprocessing import LabelEncoder
```

[29]:
```python
enc = LabelEncoder()
```

[30]:
```python
df.Gender = enc.fit_transform(df.Gender)
```

[31]:
```python
df.head()
```

[31]:

	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

[32]:
```python
df.drop('CustomerID', axis=1, inplace=True)
```

- K-Mean Clustering

[33]:
```python
ssd = []
# clusters will be 1-10
for i in range(1,11):
  Kmodel = KMeans(n_clusters=i, n_init=15,max_iter=500)
  Kmodel.fit(df)
  ssd.append(Kmodel.inertia_)
```

```
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
```

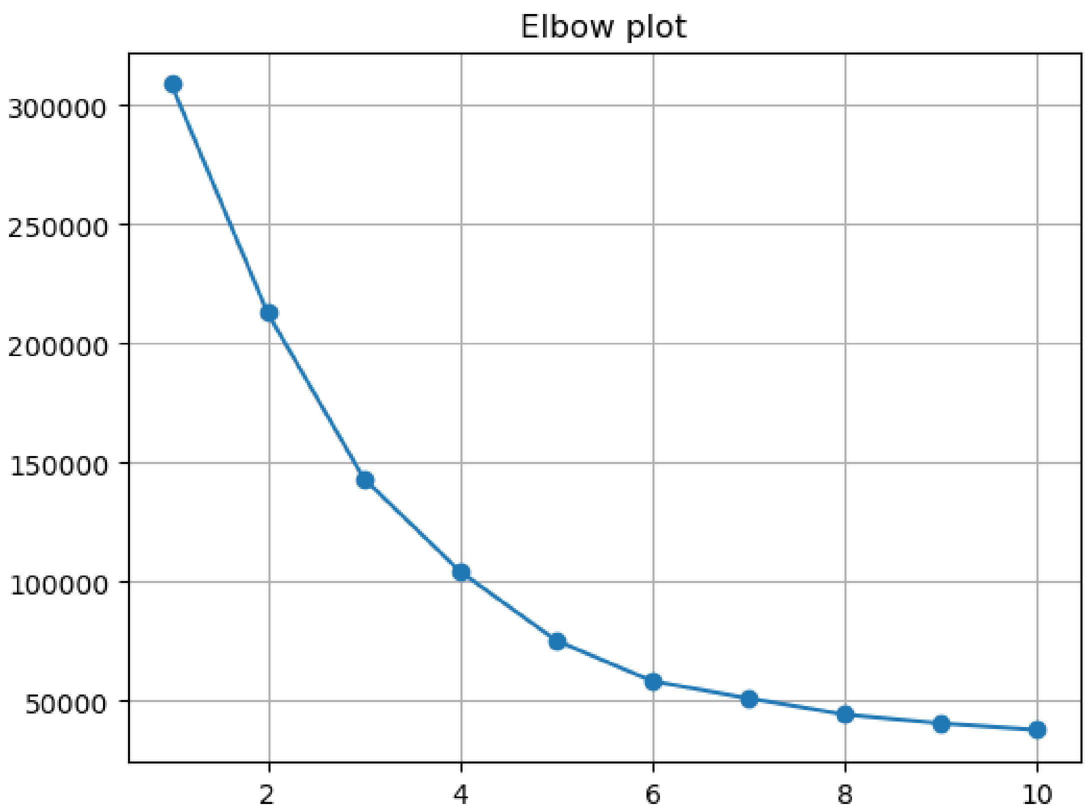
```
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
```

[34]:
```
ssd
```

[34]:
```
[308862.06,
 212889.442455243,
 143391.59236035674,
 104414.67534220166,
 75399.61541401484,
 58348.64136331505,
 51167.19736842105,
 44355.31351771352,
 40639.660394660765,
 37895.206575973054]
```

[35]:
```
plt.plot(range(1,11), ssd, marker='o')
plt.grid()
plt.title('Elbow plot')
```

[35]:
```
Text(0.5, 1.0, 'Elbow plot')
```



- k=6 because after 6 the curve is becoming linear
- i.e we can make 6 categories of customers

[37]:
```
Kmodel = KMeans(n_clusters=6)
```

[38]:
```
Kmodel.fit(df)
# Kmodel.fit_predict(df)
# Kmodel.predict(df)
```

```
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1416: 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
  super()._check_params_vs_input(X, default_n_init=10)
D:\anaconda\lib\site-packages\sklearn\cluster\_kmeans.py:1440: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
```

[38]:
```
KMeans(n_clusters=6)
```

[39]:
```
prediction = Kmodel.predict(df)
```

```
[40]: prediction
```

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

```
[41]: len(prediction)
```

```
[41]: 200
```

```
[42]: Kmodel.cluster_centers_
```

```
[42]: array([[ 0.40909091, 25.27272727, 25.72727273, 79.36363636],
       [ 0.57142857, 41.68571429, 88.22857143, 17.28571429],
       [ 0.34210526, 27.        , 56.65789474, 49.13157895],
       [ 0.46153846, 32.69230769, 86.53846154, 82.12820513],
       [ 0.43181818, 56.34090909, 53.70454545, 49.38636364],
       [ 0.40909091, 44.31818182, 25.77272727, 20.27272727]])
```

```
[43]: len(Kmodel.cluster_centers_)
```

```
[43]: 6
```

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

[44]:

	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

```
[45]: # to see which customer belongs to which cluster
df['Cluster'] = prediction
```

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

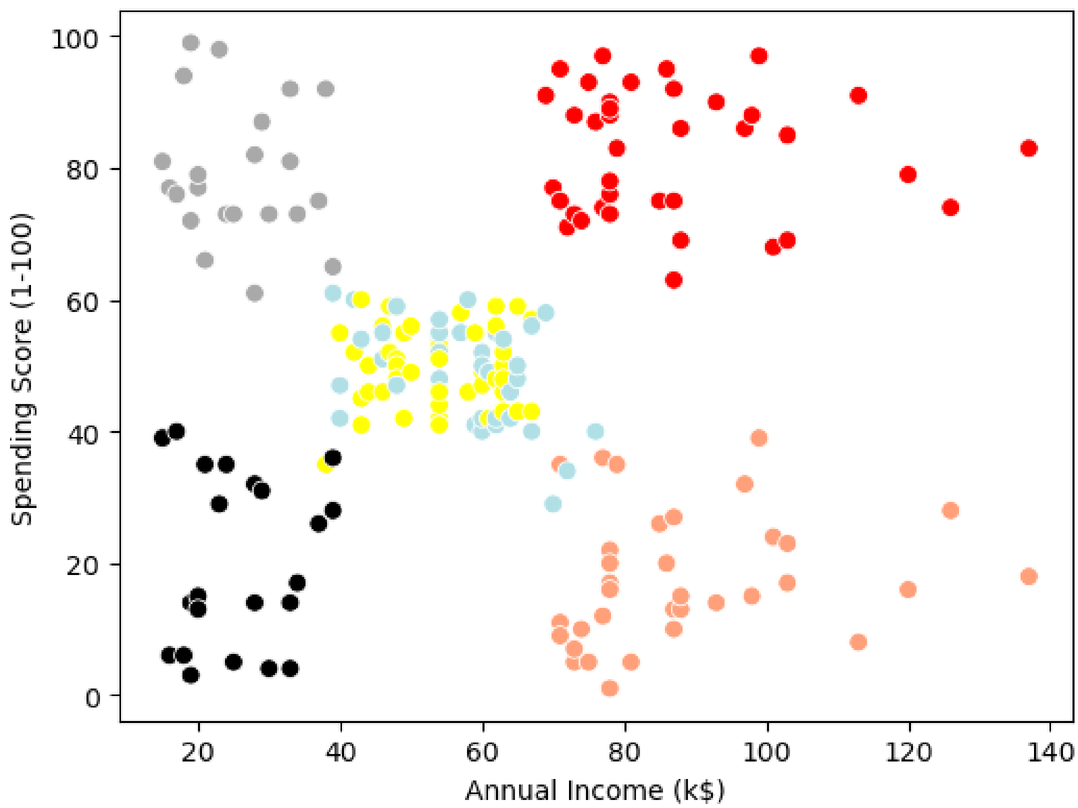
[46]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)	Cluster
0	1	19	15	39	5
1	1	21	15	81	0
2	0	20	16	6	5

```
3         0    23                    16                        77         0
4         0    31                    17                        40         5
```

[47]:
```
# visualization
color = np.array(['darkgray', 'lightsalmon', 'powderblue', 'red', 'yellow',␣
 ↪'black'])
sns.scatterplot(x = df['Annual Income (k$)'],
                y = df['Spending Score (1-100)'],
                c=color[Kmodel.labels_],
                s=50)
```

[47]:
```
<AxesSubplot: xlabel='Annual Income (k$)', ylabel='Spending Score (1-100)'>
```



[48]:
```
from scipy.cluster.hierarchy import linkage, dendrogram
```

[49]:
```
var = linkage(df, method='ward')
```

[50]:
```
plt.figure(figsize=(20,15))
dendrogram(var, leaf_rotation=90)
```

```
[50]: {'icoord': [[15.0, 15.0, 25.0, 25.0],
        [5.0, 5.0, 20.0, 20.0],
        [45.0, 45.0, 55.0, 55.0],
        [65.0, 65.0, 75.0, 75.0],
        [50.0, 50.0, 70.0, 70.0],
        [35.0, 35.0, 60.0, 60.0],
        [105.0, 105.0, 115.0, 115.0],
        [95.0, 95.0, 110.0, 110.0],
        [85.0, 85.0, 102.5, 102.5],
        [47.5, 47.5, 93.75, 93.75],
        [145.0, 145.0, 155.0, 155.0],
        [135.0, 135.0, 150.0, 150.0],
        [125.0, 125.0, 142.5, 142.5],
        [165.0, 165.0, 175.0, 175.0],
        [185.0, 185.0, 195.0, 195.0],
        [170.0, 170.0, 190.0, 190.0],
        [133.75, 133.75, 180.0, 180.0],
        [70.625, 70.625, 156.875, 156.875],
        [12.5, 12.5, 113.75, 113.75],
        [215.0, 215.0, 225.0, 225.0],
        [205.0, 205.0, 220.0, 220.0],
        [235.0, 235.0, 245.0, 245.0],
        [265.0, 265.0, 275.0, 275.0],
        [255.0, 255.0, 270.0, 270.0],
        [240.0, 240.0, 262.5, 262.5],
        [212.5, 212.5, 251.25, 251.25],
        [295.0, 295.0, 305.0, 305.0],
        [285.0, 285.0, 300.0, 300.0],
        [335.0, 335.0, 345.0, 345.0],
        [325.0, 325.0, 340.0, 340.0],
        [315.0, 315.0, 332.5, 332.5],
        [355.0, 355.0, 365.0, 365.0],
        [385.0, 385.0, 395.0, 395.0],
        [375.0, 375.0, 390.0, 390.0],
        [360.0, 360.0, 382.5, 382.5],
        [323.75, 323.75, 371.25, 371.25],
        [292.5, 292.5, 347.5, 347.5],
        [231.875, 231.875, 320.0, 320.0],
        [425.0, 425.0, 435.0, 435.0],
        [415.0, 415.0, 430.0, 430.0],
        [405.0, 405.0, 422.5, 422.5],
        [445.0, 445.0, 455.0, 455.0],
        [413.75, 413.75, 450.0, 450.0],
        [465.0, 465.0, 475.0, 475.0],
        [485.0, 485.0, 495.0, 495.0],
        [470.0, 470.0, 490.0, 490.0],
        [515.0, 515.0, 525.0, 525.0],
```

```
[505.0, 505.0, 520.0, 520.0],
[535.0, 535.0, 545.0, 545.0],
[585.0, 585.0, 595.0, 595.0],
[575.0, 575.0, 590.0, 590.0],
[565.0, 565.0, 582.5, 582.5],
[555.0, 555.0, 573.75, 573.75],
[540.0, 540.0, 564.375, 564.375],
[512.5, 512.5, 552.1875, 552.1875],
[480.0, 480.0, 532.34375, 532.34375],
[431.875, 431.875, 506.171875, 506.171875],
[605.0, 605.0, 615.0, 615.0],
[625.0, 625.0, 635.0, 635.0],
[610.0, 610.0, 630.0, 630.0],
[655.0, 655.0, 665.0, 665.0],
[645.0, 645.0, 660.0, 660.0],
[620.0, 620.0, 652.5, 652.5],
[675.0, 675.0, 685.0, 685.0],
[715.0, 715.0, 725.0, 725.0],
[705.0, 705.0, 720.0, 720.0],
[735.0, 735.0, 745.0, 745.0],
[712.5, 712.5, 740.0, 740.0],
[695.0, 695.0, 726.25, 726.25],
[680.0, 680.0, 710.625, 710.625],
[765.0, 765.0, 775.0, 775.0],
[755.0, 755.0, 770.0, 770.0],
[785.0, 785.0, 795.0, 795.0],
[762.5, 762.5, 790.0, 790.0],
[805.0, 805.0, 815.0, 815.0],
[835.0, 835.0, 845.0, 845.0],
[825.0, 825.0, 840.0, 840.0],
[810.0, 810.0, 832.5, 832.5],
[855.0, 855.0, 865.0, 865.0],
[885.0, 885.0, 895.0, 895.0],
[875.0, 875.0, 890.0, 890.0],
[860.0, 860.0, 882.5, 882.5],
[821.25, 821.25, 871.25, 871.25],
[776.25, 776.25, 846.25, 846.25],
[695.3125, 695.3125, 811.25, 811.25],
[636.25, 636.25, 753.28125, 753.28125],
[469.0234375, 469.0234375, 694.765625, 694.765625],
[915.0, 915.0, 925.0, 925.0],
[905.0, 905.0, 920.0, 920.0],
[945.0, 945.0, 955.0, 955.0],
[935.0, 935.0, 950.0, 950.0],
[912.5, 912.5, 942.5, 942.5],
[985.0, 985.0, 995.0, 995.0],
[975.0, 975.0, 990.0, 990.0],
```

```
[965.0, 965.0, 982.5, 982.5],
[927.5, 927.5, 973.75, 973.75],
[1025.0, 1025.0, 1035.0, 1035.0],
[1015.0, 1015.0, 1030.0, 1030.0],
[1005.0, 1005.0, 1022.5, 1022.5],
[1055.0, 1055.0, 1065.0, 1065.0],
[1045.0, 1045.0, 1060.0, 1060.0],
[1013.75, 1013.75, 1052.5, 1052.5],
[1085.0, 1085.0, 1095.0, 1095.0],
[1075.0, 1075.0, 1090.0, 1090.0],
[1135.0, 1135.0, 1145.0, 1145.0],
[1125.0, 1125.0, 1140.0, 1140.0],
[1115.0, 1115.0, 1132.5, 1132.5],
[1105.0, 1105.0, 1123.75, 1123.75],
[1082.5, 1082.5, 1114.375, 1114.375],
[1165.0, 1165.0, 1175.0, 1175.0],
[1155.0, 1155.0, 1170.0, 1170.0],
[1185.0, 1185.0, 1195.0, 1195.0],
[1205.0, 1205.0, 1215.0, 1215.0],
[1190.0, 1190.0, 1210.0, 1210.0],
[1225.0, 1225.0, 1235.0, 1235.0],
[1245.0, 1245.0, 1255.0, 1255.0],
[1230.0, 1230.0, 1250.0, 1250.0],
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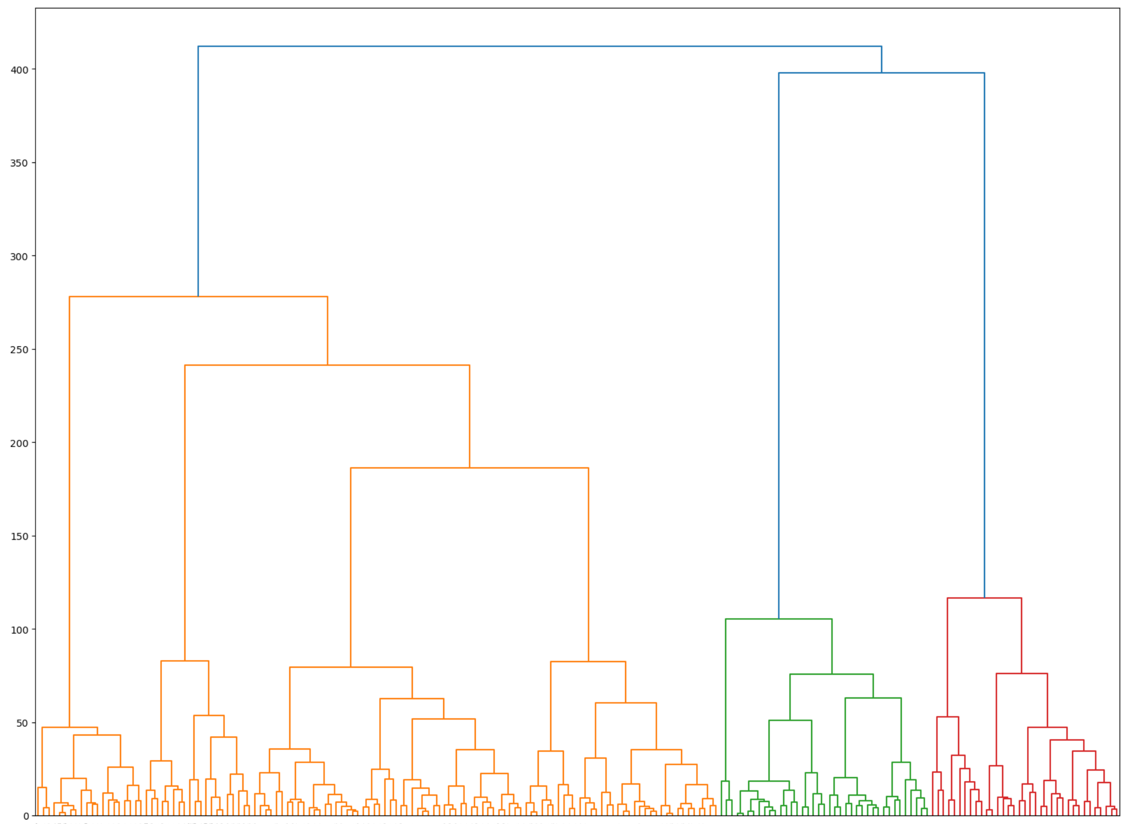

[54]:
```python
# DBSCAN
from sklearn.cluster import DBSCAN
```

[66]:
```python
# DBSCAN clustering
dbscan_model = DBSCAN(eps=0.3, min_samples=5)
dbscan_model.fit(df)
df['DBSCAN_Cluster'] = dbscan_model.labels_
```

[67]:
```
dbscan_labels = df['DBSCAN_Cluster']
dbscan_labels
```

[67]:
```
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3      -1
4      -1
       ..
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Name: DBSCAN_Cluster, Length: 200, dtype: int64
```
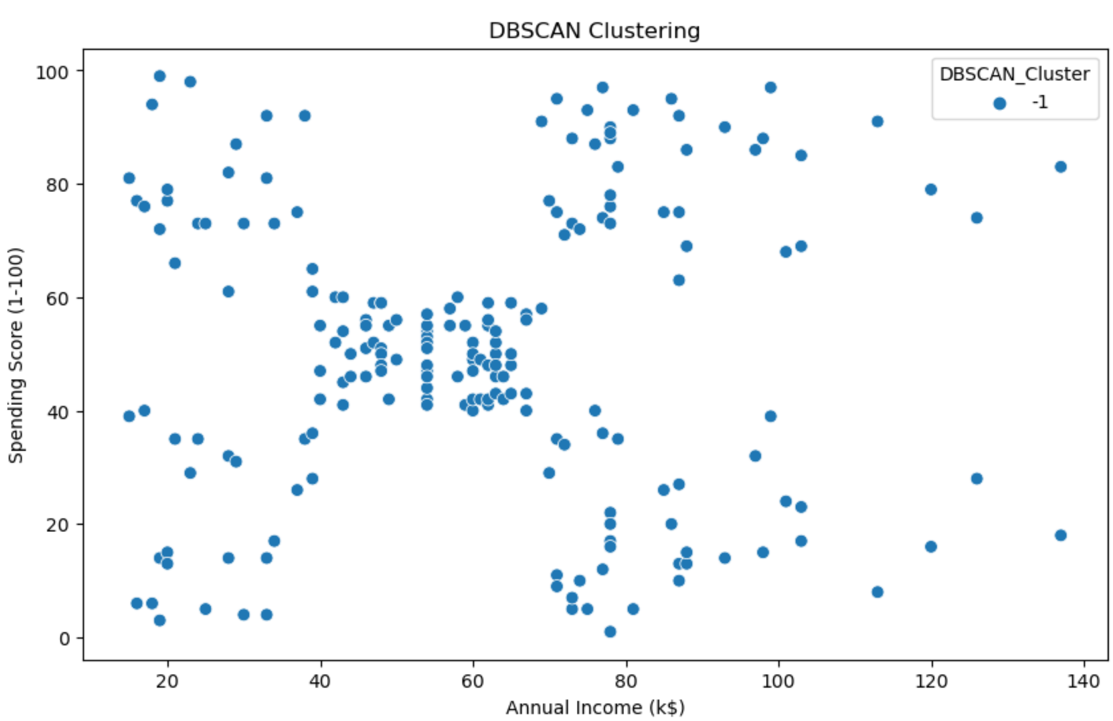

[68]:
```
# Visualize DBSCAN clustering
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Annual Income (k$)',
                y='Spending Score (1-100)',
                hue='DBSCAN_Cluster',
                data=df,
                palette='tab10',
                legend='full',
                s=50)
plt.title('DBSCAN Clustering')
plt.show()
```



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[ ]:
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