Customer Segmentation and Behavior Analysis

by Dewansh Vishwakarma

Importing library

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import mpl_toolkits
import seaborn as sns
```

Loading Data

In [2]:
```
data=pd.read_csv("Mall_Customers.csv")
```

Understanding Data

In [3]:
```
data.head()
```

Out[3]:

	CustomerID	Genre	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

In [4]:
```
data.tail()
```

Out[4]:

	CustomerID	Genre	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

In [5]:
```
data.shape
```

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

In [6]:
```
data.index
```

Out[6]:
```
RangeIndex(start=0, stop=200, step=1)
```

In [7]:
```
data.columns
```

Out[7]:
```
Index(['CustomerID', 'Genre', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

In [8]:
```
data.dtypes
```

Out[8]:
```
CustomerID                int64
Genre                    object
Age                       int64
Annual Income (k$)        int64
Spending Score (1-100)    int64
dtype: object
```

In [9]:
```
data.describe()
```

Out[9]:

	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

Data CLeaning

In [10]:
```
data.rename(columns={"Genre":"Gender"},inplace=True)
```

In [11]:
```
data.head()
```

Out[11]:

	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

In [12]:
```
data.isnull().sum()
```

Out[12]:
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [13]:
```
data.drop(["CustomerID"],axis=1,inplace=True)
```

In [14]:
```
data.head()
```

Out[14]:

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

Data Visualization

In [15]:
```
plt.figure(1,figsize=(15,6))
n=0
for x in ['Age','Annual Income (k$)','Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    plt.subplots_adjust(hspace=0.5, wspace=0.5)
    sns.distplot(data[x],bins=20)
    plt.title('Displot of {}'.format(x))
plt.show()
```

```
C:\Users\user\AppData\Local\Temp\ipykernel_480\1653952910.py:7: 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(data[x],bins=20)
C:\Users\user\AppData\Local\Temp\ipykernel_480\1653952910.py:7: 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
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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(data[x],bins=20)
```
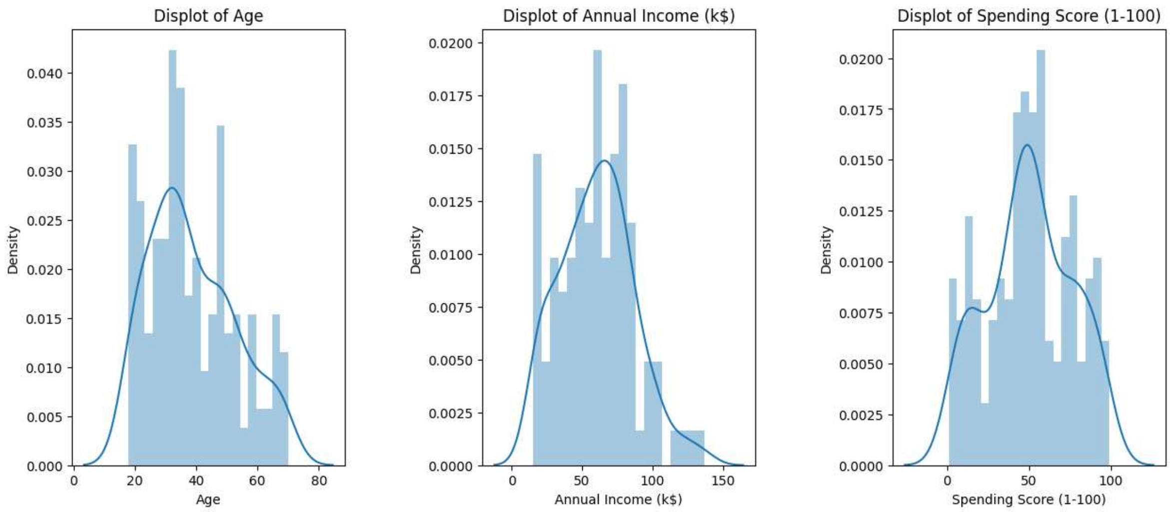
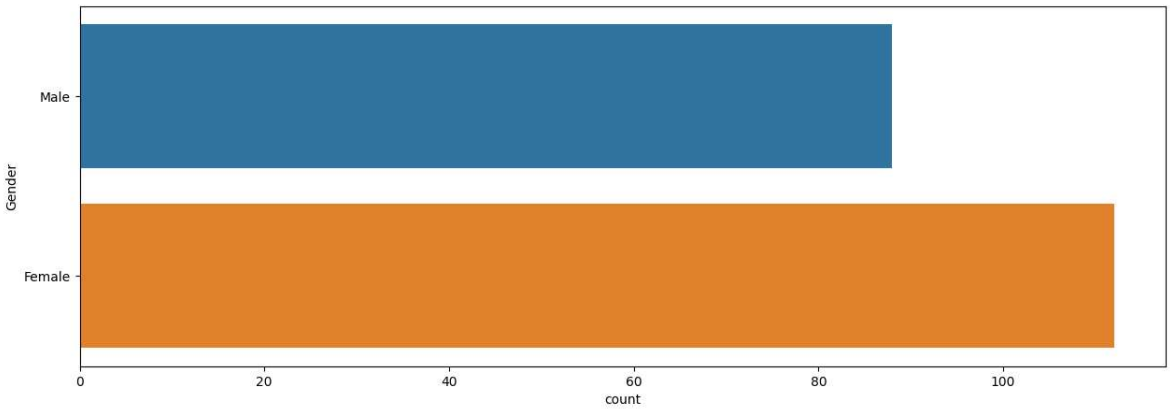
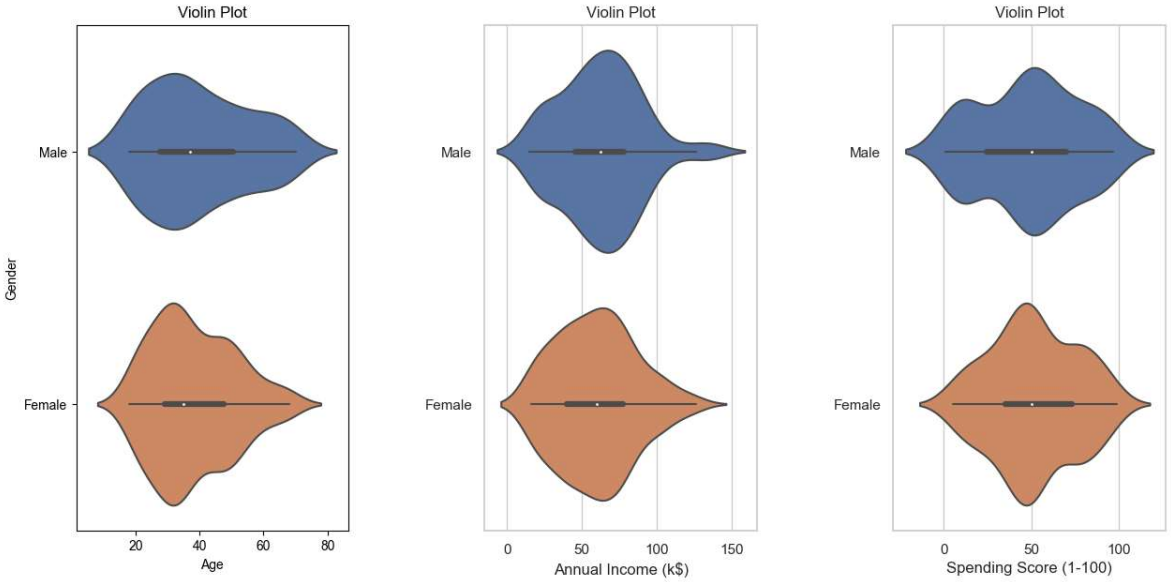



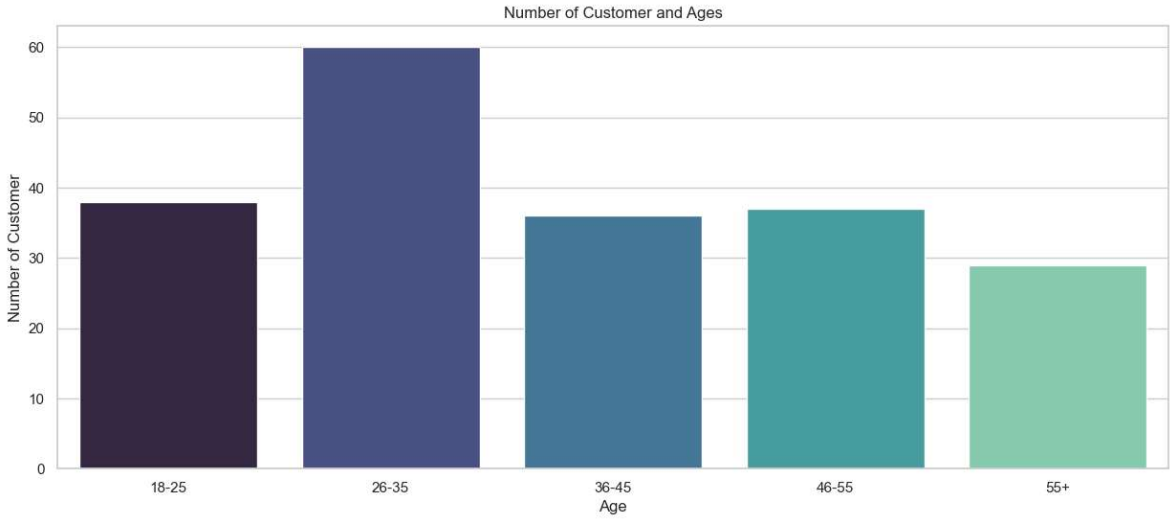
In [16]:
```
plt.figure(figsize=(15,5))
sns.countplot(y='Gender',data=data)
plt.show()
```



In [17]:
```
plt.figure(1,figsize=(15,7))
n=0
for cols in ['Age','Annual Income (k$)','Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    sns.set(style="whitegrid")
    plt.subplots_adjust(hspace=0.5, wspace=0.5)
    sns.violinplot(x = cols ,y='Gender' ,data=data)
    plt.ylabel('Gender' if n == 1 else '')
    plt.title('Violin Plot')
plt.show()
```



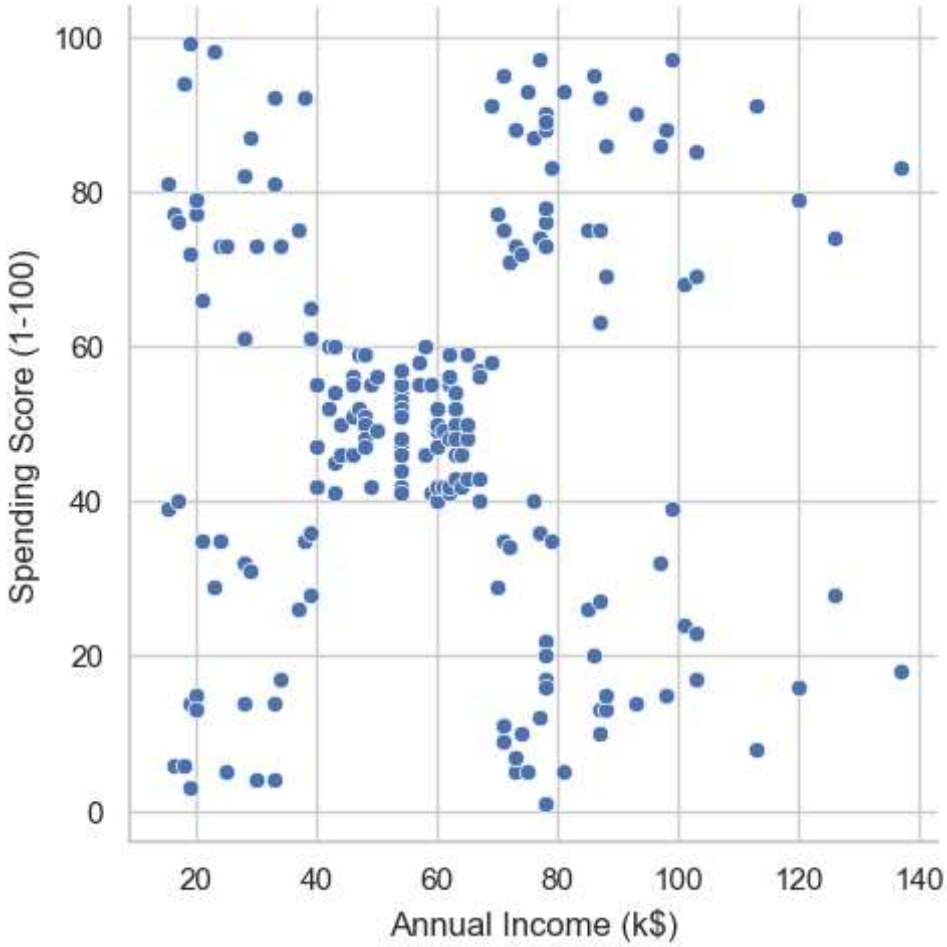
In [18]:
```
age_18_25 = data.Age[(data.Age >= 18)&(data.Age <= 25)]
age_26_35 = data.Age[(data.Age >= 26)&(data.Age <= 35)]
age_36_45 = data.Age[(data.Age >= 36)&(data.Age <= 45)]
age_46_55 = data.Age[(data.Age >= 46)&(data.Age <= 55)]
age_55above = data.Age[data.Age >= 56]

agex = ["18-25","26-35","36-45","46-55","55+"]
agey = [len(age_18_25.values),len(age_26_35.values),len(age_36_45.values),len(ag

plt.figure(figsize=(15,6))
sns.barplot(x=agex, y=agey , palette="mako")
plt.title("Number of Customer and Ages")
plt.xlabel("Age")
plt.ylabel("Number of Customer")
plt.show()
```



In [19]:
```
sns.relplot(x="Annual Income (k$)",y="Spending Score (1-100)",data=data)
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\axisgrid.py:118: UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```

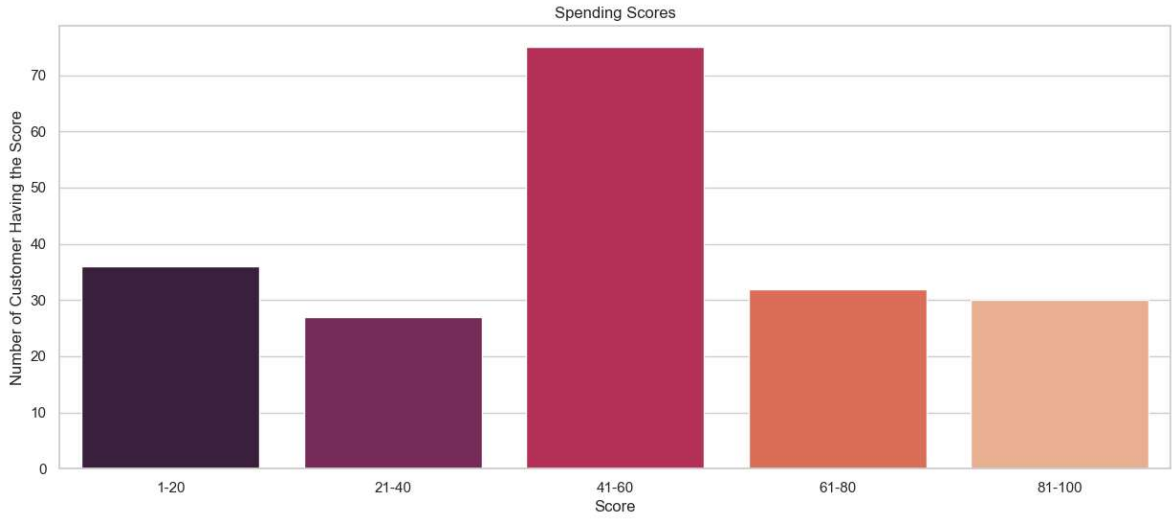
Out[19]: <seaborn.axisgrid.FacetGrid at 0x29dfc9b1a10>



In [20]:
```
ss_1_20 = data["Spending Score (1-100)"][(data["Spending Score (1-100)"]>=1)&(da
ss_21_40 = data["Spending Score (1-100)"][(data["Spending Score (1-100)"]>=21)&(
ss_41_60 = data["Spending Score (1-100)"][(data["Spending Score (1-100)"]>=41)&(
ss_61_80 = data["Spending Score (1-100)"][(data["Spending Score (1-100)"]>=61)&(
ss_81_100 = data["Spending Score (1-100)"][(data["Spending Score (1-100)"]>=81)&
```

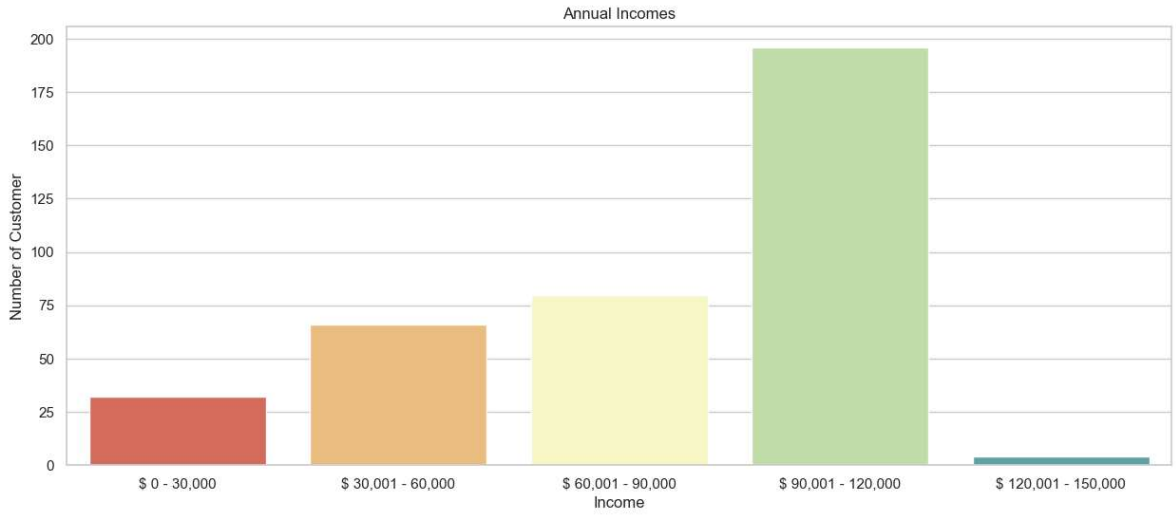
```
ssx=["1-20","21-40","41-60","61-80","81-100"]
ssy=[len(ss_1_20.values),len(ss_21_40.values),len(ss_41_60.values),len(ss_61_80.
```

In [21]:
```
plt.figure(figsize=(15,6))
sns.barplot(x=ssx,y=ssy,palette="rocket")
plt.title("Spending Scores")
plt.xlabel("Score")
plt.ylabel("Number of Customer Having the Score")
plt.show()
```



In [22]:
```
ai0_30 = data["Annual Income (k$)"][(data["Annual Income (k$)"]>=0)&(data["Annua
ai31_60 = data["Annual Income (k$)"][(data["Annual Income (k$)"]>=31)&(data["Anr
ai61_90 = data["Annual Income (k$)"][(data["Annual Income (k$)"]>=61)&(data["Anr
ai91_120 = data["Annual Income (k$)"][(data["Annual Income (k$)"]>=9)&(data["Anr
ai121_150 = data["Annual Income (k$)"][(data["Annual Income (k$)"]>=121)&(data["

aix=["$ 0 - 30,000","$ 30,001 - 60,000","$ 60,001 - 90,000","$ 90,001 - 120,000"
aiy=[len(ai0_30.values),len(ai31_60.values),len(ai61_90.values),len(ai91_120.val
```

In [23]:
```
plt.figure(figsize=(15,6))
sns.barplot(x=aix,y=aiy,palette="Spectral")
plt.title("Annual Incomes")
plt.xlabel("Income")
plt.ylabel("Number of Customer")
plt.show()
```



In [24]:
```
X1=data.loc[:,["Age","Spending Score (1-100)"]].values

from sklearn.cluster import KMeans
wcss = []
for k in range(1,11):
    kmeans = KMeans(n_clusters=k,init="k-means++")
    kmeans.fit(X1)
    wcss.append(kmeans.inertia_)
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
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from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
```
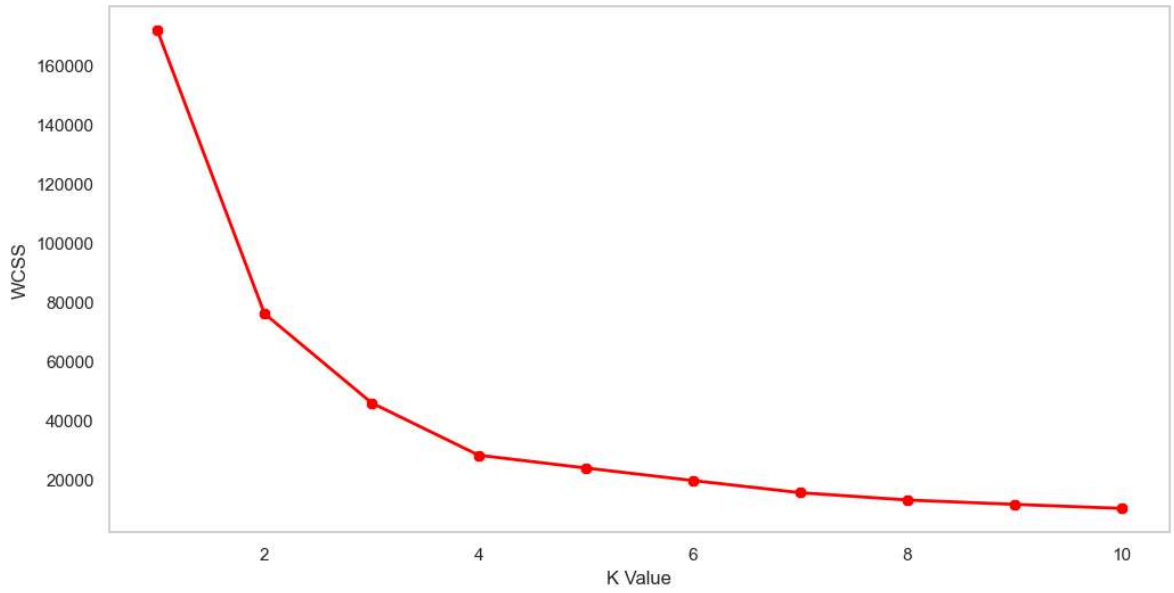

In [25]:
```
plt.figure(figsize=(12,6))
plt.grid()
plt.plot(range(1,11),wcss,linewidth=2,color='red',marker='8')
plt.xlabel("K Value")
plt.ylabel("WCSS")
plt.show()
```



In [26]:
```
kmeans = KMeans(n_clusters=4)

label = kmeans.fit_predict(X1)
print(label)
```

```
[2 1 3 1 2 1 3 1 3 1 3 1 3 1 3 1 2 2 3 1 2 1 3 1 3 1 3 2 3 1 3 1 3 1 3 1 3
 1 3 1 0 1 0 2 3 2 0 2 2 2 0 2 2 0 0 0 0 0 2 0 0 2 0 0 0 2 0 0 2 2 0 0 0 0
 0 2 0 2 2 0 0 2 0 0 2 0 0 2 2 0 0 2 0 2 2 2 0 2 0 2 2 0 0 2 0 2 0 0 0 0 0
 2 2 2 2 2 0 0 0 0 2 2 2 1 2 1 0 1 3 1 3 1 2 1 3 1 3 1 3 1 3 1 2 1 3 1 0 1
 3 1 3 1 3 1 3 1 3 1 3 1 0 1 3 1 3 1 3 1 3 2 3 1 3 1 3 1 3 1 3 1 3 1 3 1 2
 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1]
```

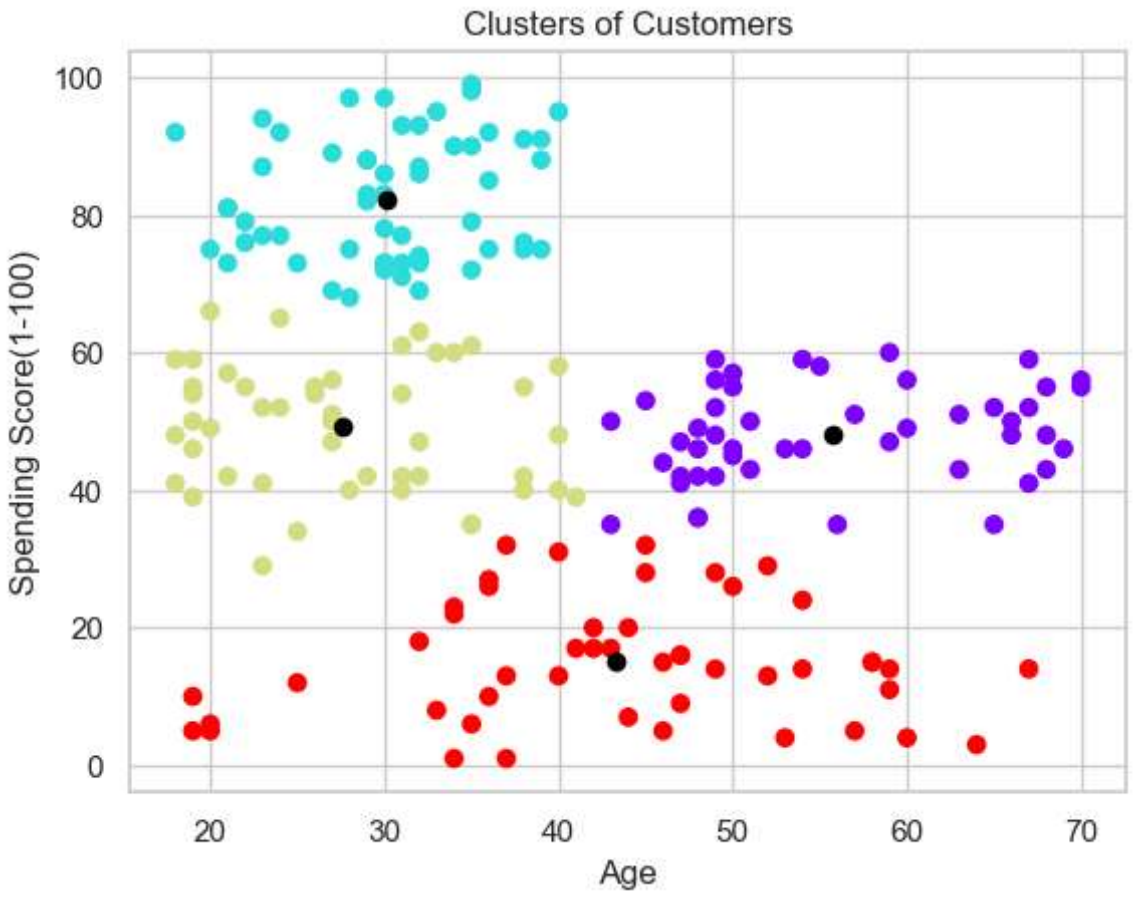
```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
```

In [27]:
```
print(kmeans.cluster_centers_)
```

```
[[55.70833333 48.22916667]
 [30.1754386  82.35087719]
 [27.61702128 49.14893617]
 [43.29166667 15.02083333]]
```

In [28]:
```
plt.scatter(X1[:,0],X1[:,1],c=kmeans.labels_,cmap='rainbow')
plt.scatter(kmeans.cluster_centers_[:,0],kmeans.cluster_centers_[:,1],color='bla
plt.title("Clusters of Customers")
plt.xlabel('Age')
plt.ylabel('Spending Score(1-100)')
plt.show
```

Out[28]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



In [29]:
```
X2=data.loc[:,["Annual Income (k$)","Spending Score (1-100)"]].values

from sklearn.cluster import KMeans
wcss = []
for k in range(1,11):
    kmeans = KMeans(n_clusters=k,init="k-means++")
    kmeans.fit(X2)
    wcss.append(kmeans.inertia_)
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: 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
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  super()._check_params_vs_input(X, default_n_init=10)
```
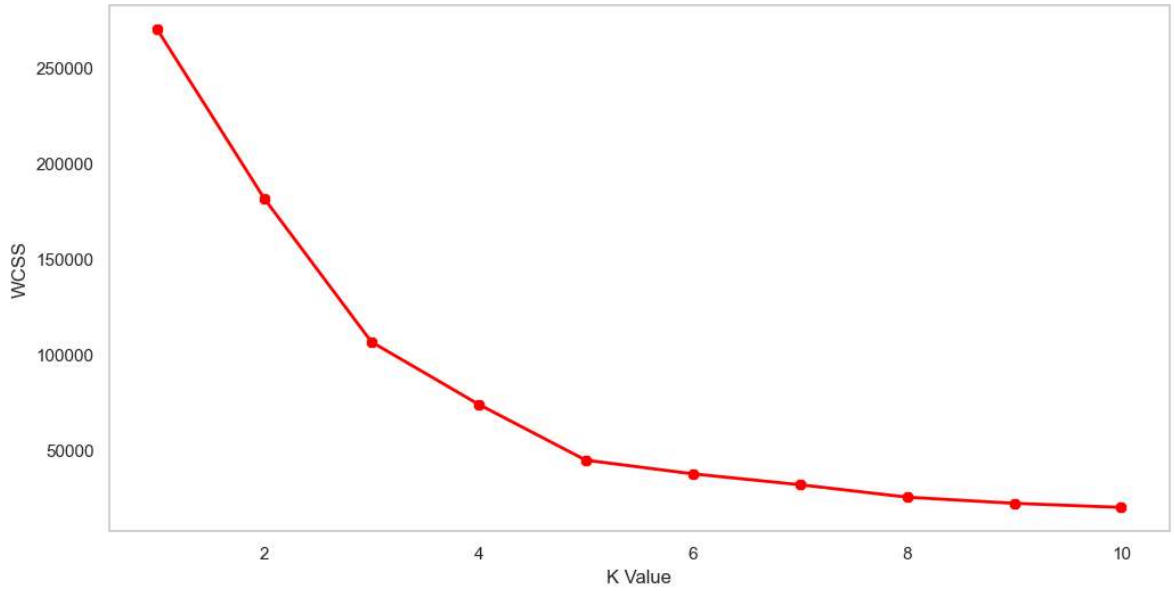

In [30]:

```python
plt.figure(figsize=(12,6))
plt.grid()
plt.plot(range(1,11),wcss,linewidth=2,color='red',marker='8')
plt.xlabel("K Value")
plt.ylabel("WCSS")
plt.show()
```



In [31]:
```
kmeans = KMeans(n_clusters=4)

label = kmeans.fit_predict(X2)
print(label)
```

```
[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 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 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 3
 3 3 3 3 3 3 3 3 3 3 3 3 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 0 2 0 2 0 2
 0 2 0 2 0 2 0 2 0 2 0 2 0 2 0]
```

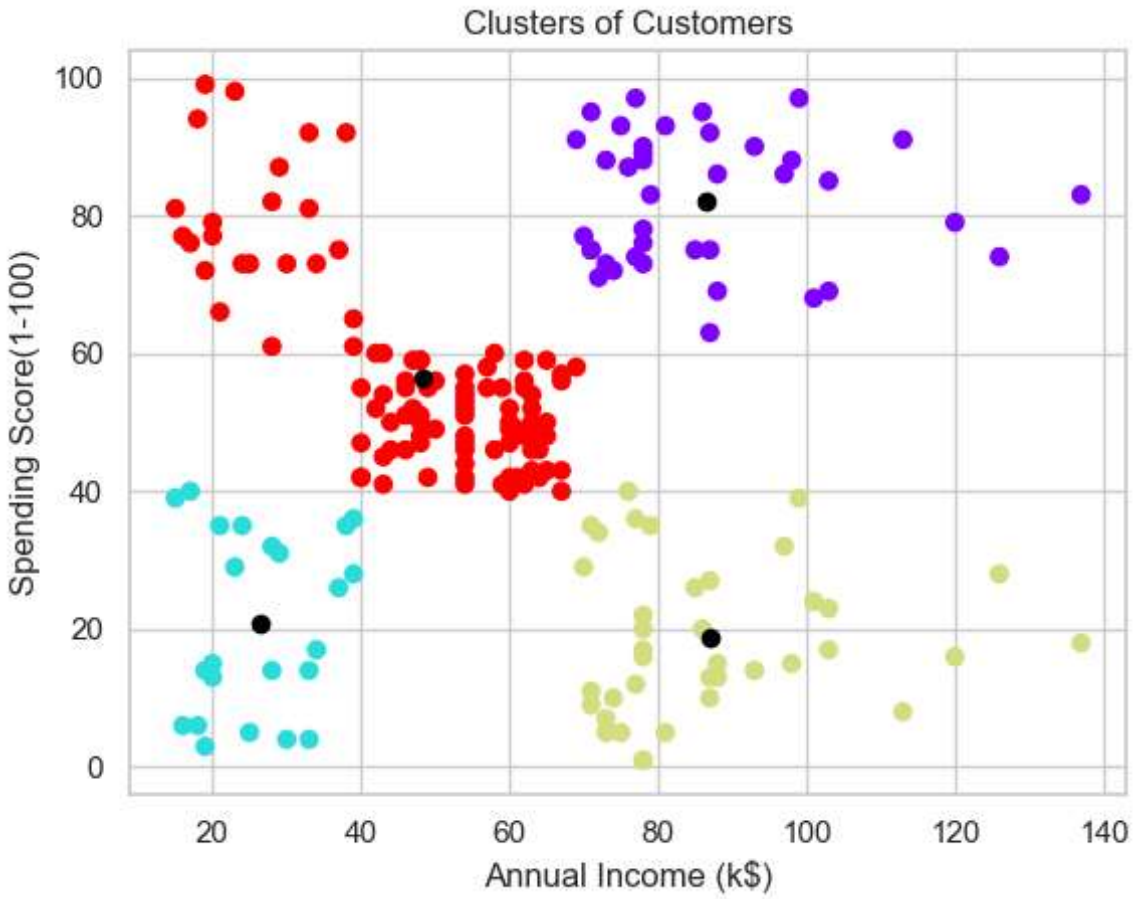
```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
```

In [32]:
```
print(kmeans.cluster_centers_)
```

```
[[86.53846154 82.12820513]
 [26.30434783 20.91304348]
 [87.         18.63157895]
 [48.26       56.48      ]]
```

In [33]:
```
plt.scatter(X2[:,0],X1[:,1],c=kmeans.labels_,cmap='rainbow')
plt.scatter(kmeans.cluster_centers_[:,0],kmeans.cluster_centers_[:,1],color='bla
plt.title("Clusters of Customers")
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score(1-100)')
plt.show
```

Out[33]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```



In [34]:
```
X3=data.iloc[:,1:]

wcss = []
for k in range(1,11):
    kmeans = KMeans(n_clusters=k,init="k-means++")
    kmeans.fit(X3)
    wcss.append(kmeans.inertia_)
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
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  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
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from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the wa
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C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
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from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the wa
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  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\c
luster\_kmeans.py:1412: 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 wa
rning
  super()._check_params_vs_input(X, default_n_init=10)
```
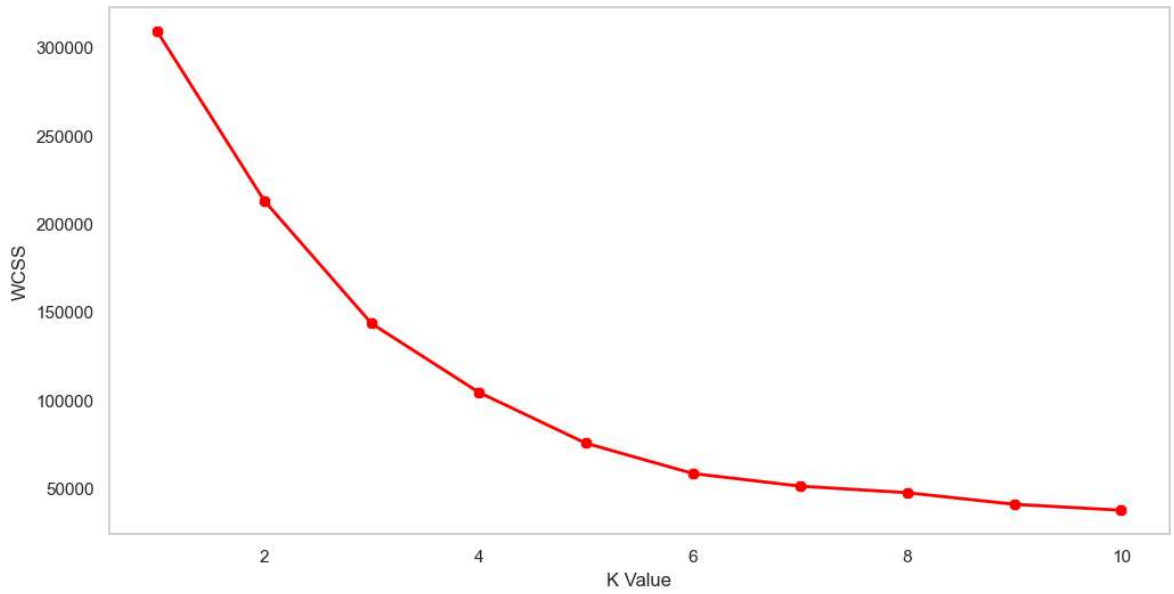

In [35]:

```
plt.figure(figsize=(12,6))
plt.grid()
plt.plot(range(1,11),wcss,linewidth=2,color='red',marker='8')
plt.xlabel("K Value")
plt.ylabel("WCSS")
plt.show()
```



In [36]:
```
kmeans = KMeans(n_clusters=5)

label = kmeans.fit_predict(X3)
print(label)
```

```
[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 4 0 4 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 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 3 2 3 1 3 2 3 2 3 2 3 2 3 2 3 2 3 1 3 2 3 2 3
 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2
 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3]
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: 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)
```

In [37]:
```
print(kmeans.cluster_centers_)
```

```
[[45.2173913  26.30434783 20.91304348]
 [43.08860759 55.29113924 49.56962025]
 [40.66666667 87.75       17.58333333]
 [32.69230769 86.53846154 82.12820513]
 [25.52173913 26.30434783 78.56521739]]
```

In [38]:
```
clusters = kmeans.fit_predict(X3)
data["label"]=clusters

from mpl_toolkits.mplot3d import Axes3D

fig =plt.figure(figsize=(20,10))
ax=fig.add_subplot(111,projection='3d')
ax.scatter(data.Age[data.label == 0], data['Annual Income (k$)'][data.label == 0
ax.scatter(data.Age[data.label == 1], data['Annual Income (k$)'][data.label == 1
ax.scatter(data.Age[data.label == 2], data['Annual Income (k$)'][data.label == 2
ax.scatter(data.Age[data.label == 3], data['Annual Income (k$)'][data.label == 3
ax.scatter(data.Age[data.label == 4], data['Annual Income (k$)'][data.label == 4
plt.xlabel("Age")
plt.ylabel("Annual Income (k$)")
ax.set_zlabel("Spending Score (1-100)")
```

```
plt.show()
```

```
C:\Users\user\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\cluster\_kmeans.py:1412: 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)
```