In [1]:

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import DBSCAN
```

```
<frozen importlib._bootstrap>:219: RuntimeWarning: numpy.ufunc size changed, may indicate binary incomp
atibility. Expected 192 from C header, got 216 from PyObject
```

In [2]:

```python
df = pd.read_csv('Mall_Customers.csv')
print("Shape of the data= ", df.shape)
df.head()
```

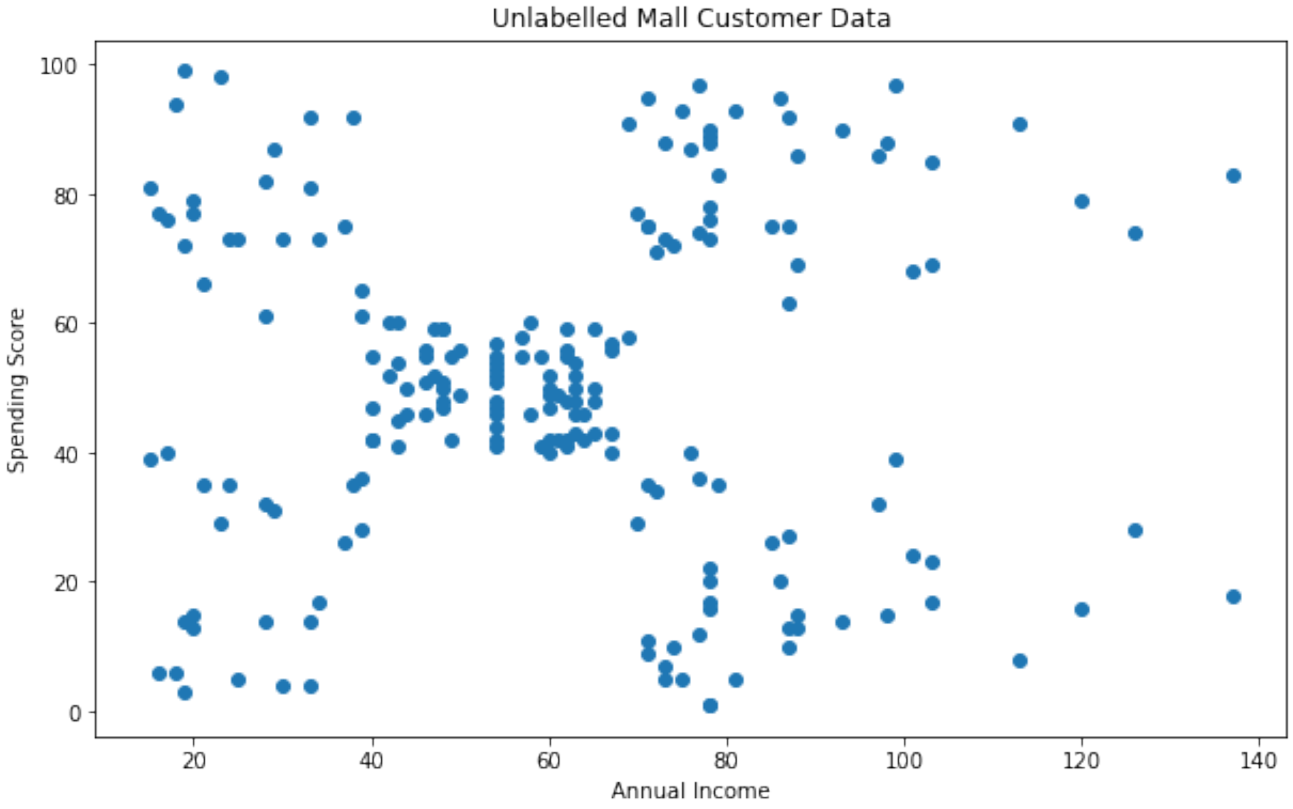
```
Shape of the data=  (200, 5)
```

Out[2]:

	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 [3]:

```
plt.figure(figsize=(10,6))
plt.scatter(df['Annual Income (k$)'],df['Spending Score (1-100)'])
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.title('Unlabelled Mall Customer Data')
plt.show()
```



In [4]:

```
# Since we are going to use Annual Income and Spending Score  columns only, lets create 2D array of
X = df.iloc[:, [3,4]].values
X[:5] # Show first 5 records only
```

Out[4]:

```
array([[15, 39],
       [15, 81],
       [16,  6],
       [16, 77],
       [17, 40]])
```

In [8]:

```
from itertools import product
eps_values = np.arange(8,13,0.25)
min_samples = np.arange(3,9)
dbscan_params = list(product(eps_values,min_samples)) # gives combination of EPS & MINPOINTS
```

In [12]:

```
# sigle  value of eps, minpoint
X_numeric_feature = df[['Age','Annual Income (k$)','Spending Score (1-100)']]
dbs_cluster_single = DBSCAN(eps=9,min_samples=8).fit(X_numeric_feature)
dbs_cluster_single.labels_
```

Out[12]:

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

In [13]:

```
np.unique(dbs_cluster_single.labels_)
```

Out[13]:

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

In [14]:

```
len(np.unique(dbs_cluster_single.labels_))
```

Out[14]:

```
6
```

In [16]:

```
from sklearn.metrics import silhouette_score
silhouette_score(X_numeric_feature,dbs_cluster_single.labels_)
```

Out[16]:

```
-0.06361003273116211
```

In [21]:

```
#dbscan_params
```

In [18]:

```
from sklearn.metrics import silhouette_score
X_numeric_feature = df[['Age','Annual Income (k$)','Spending Score (1-100)']]
sil_score = []
no_of_clusters = []

for k in dbscan_params:
    dbs_cluster = DBSCAN(eps=k[0],min_samples=k[1]).fit(X_numeric_feature)
    no_of_clusters.append(len(np.unique(dbs_cluster.labels_)))
    sil_score.append(silhouette_score(X_numeric_feature,dbs_cluster.labels_))
```

In [22]:

```
#sil_score
```

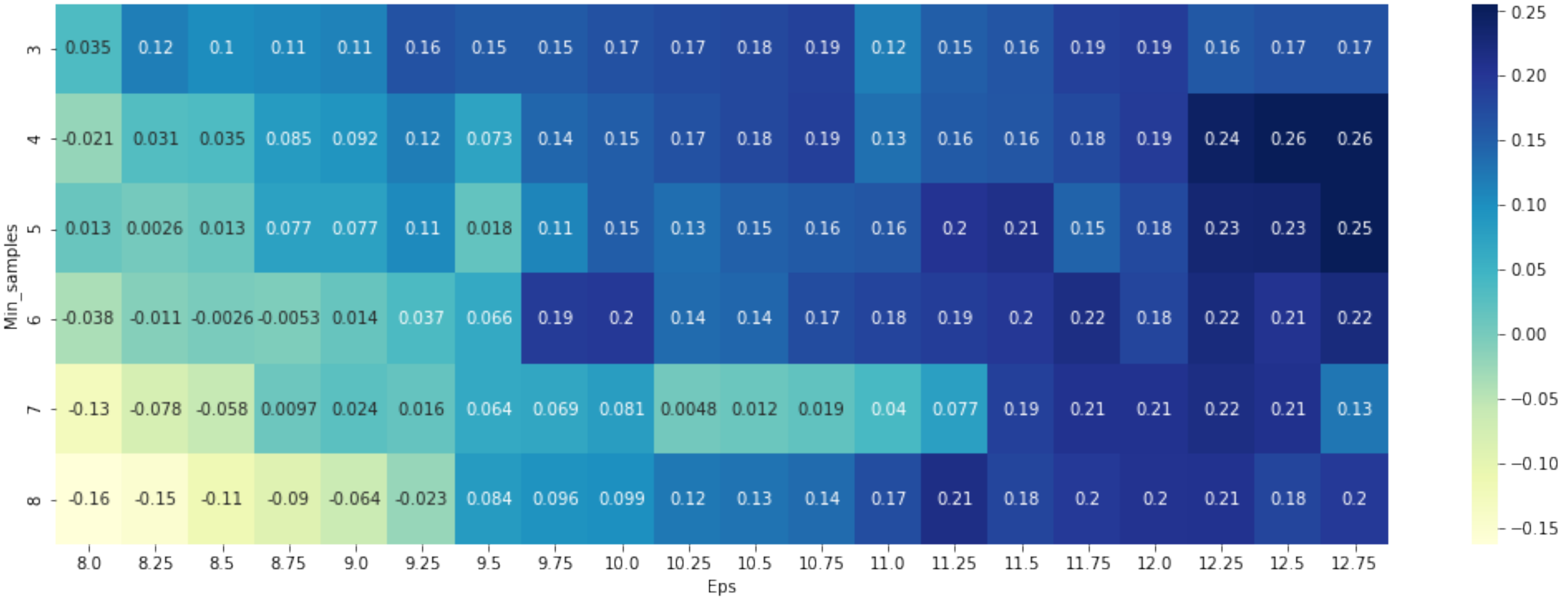
In [23]:

```
#no_of_clusters
```

In [28]:

```
import seaborn as sns
temp = pd.DataFrame.from_records(dbscan_params,columns = ['Eps','Min_samples'])
temp['sil_score'] = sil_score

plt.figure(figsize=(18,6))
pivot = pd.pivot_table(temp,values = 'sil_score',index = 'Min_samples',columns = 'Eps')
sns.heatmap(pivot,annot = True, cmap = 'YlGnBu')
plt.show()
```



In [29]:

```
# global maxima is 0.26 for eps = 12.75 and min_sample = 4
```

In [30]:

```
dbs_cluster_final = DBSCAN(eps=12.75,min_samples=4).fit(X_numeric_feature)
```

In [31]:

```
dbs_clustered = X_numeric_feature.copy()
dbs_clustered.loc[:,'cluster'] = dbs_cluster_final.labels_
dbs_clustered
```

Out[31]:

	Age	Annual Income (k$)	Spending Score (1-100)	cluster
0	19	15	39	0
1	21	15	81	0
2	20	16	6	-1
3	23	16	77	0
4	31	17	40	0
...	...	...	...	...
195	35	120	79	-1
196	45	126	28	-1
197	32	126	74	-1
198	32	137	18	-1
199	30	137	83	-1

200 rows × 4 columns

In [32]:

```
dbs_cluster_size = dbs_clustered.groupby('cluster').size().to_frame()
dbs_cluster_size.columns = ['dbs_size']
dbs_cluster_size
```

Out[32]:

```
        dbs_size
cluster
     -1       17
      0      113
      1        8
      2       34
      3       24
      4        4
```

In [33]:

```
outliers = dbs_clustered[dbs_clustered['cluster']==-1]
```

In [42]:

```
outliers
```

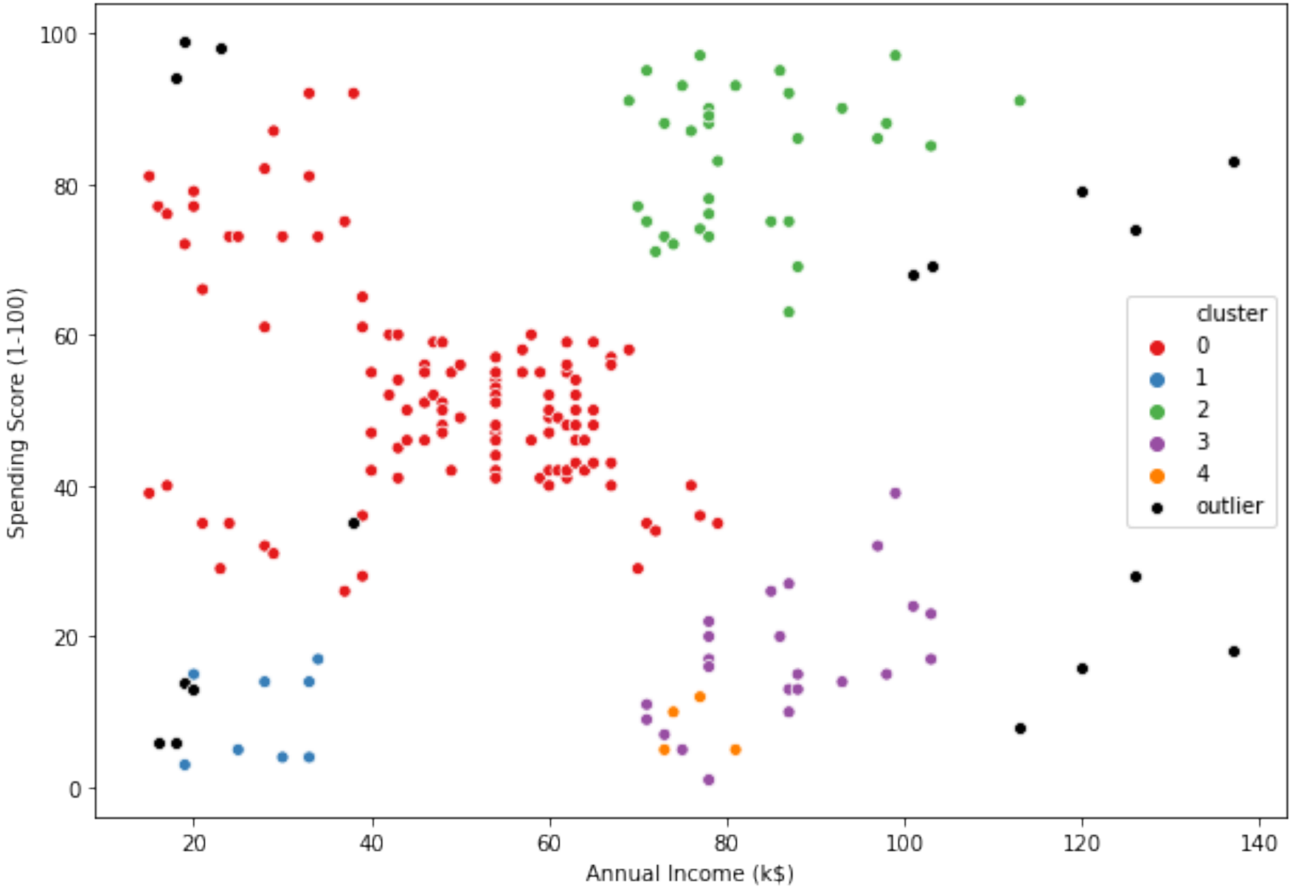
Out[42]:

	Age	Annual Income (k$)	Spending Score (1-100)	cluster
2	20	16	6	-1
6	35	18	6	-1
7	23	18	94	-1
10	67	19	14	-1
11	35	19	99	-1
14	37	20	13	-1
19	35	23	98	-1
40	65	38	35	-1
187	28	101	68	-1
191	32	103	69	-1
192	33	113	8	-1
194	47	120	16	-1
195	35	120	79	-1
196	45	126	28	-1
197	32	126	74	-1
198	32	137	18	-1
199	30	137	83	-1

In [53]:

```
plt.figure(figsize=(10,7))
sns.scatterplot('Annual Income (k$)','Spending Score (1-100)',
                data =dbs_clustered[dbs_clustered['cluster']!=-1],
               hue = 'cluster',palette = 'Set1')
sns.scatterplot('Annual Income (k$)','Spending Score (1-100)',
                data =dbs_clustered[dbs_clustered['cluster']==-1], color = 'black',label = 'outlier'

plt.show()
```



In [ ]:

In [ ]: