In [25]:

```python
# Import Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import DBSCAN
from sklearn.preprocessing import StandardScaler
```

In [35]:

```python
# Import Dataset
crime_data=pd.read_csv('crime_data.csv')
crime_data
```

Out[35]:

| | Unnamed: 0 | Murder | Assault | UrbanPop | Rape |
|---|---|---|---|---|---|
| 0 | Alabama | 13.2 | 236 | 58 | 21.2 |
| 1 | Alaska | 10.0 | 263 | 48 | 44.5 |
| 2 | Arizona | 8.1 | 294 | 80 | 31.0 |
| 3 | Arkansas | 8.8 | 190 | 50 | 19.5 |
| 4 | California | 9.0 | 276 | 91 | 40.6 |
| 5 | Colorado | 7.9 | 204 | 78 | 38.7 |
| 6 | Connecticut | 3.3 | 110 | 77 | 11.1 |
| 7 | Delaware | 5.9 | 238 | 72 | 15.8 |
| 8 | Florida | 15.4 | 335 | 80 | 31.9 |
| 9 | Georgia | 17.4 | 211 | 60 | 25.8 |
| 10 | Hawaii | 5.3 | 46 | 83 | 20.2 |
| 11 | Idaho | 2.6 | 120 | 54 | 14.2 |
| 12 | Illinois | 10.4 | 249 | 83 | 24.0 |
| 13 | Indiana | 7.2 | 113 | 65 | 21.0 |
| 14 | Iowa | 2.2 | 56 | 57 | 11.3 |
| 15 | Kansas | 6.0 | 115 | 66 | 18.0 |
| 16 | Kentucky | 9.7 | 109 | 52 | 16.3 |
| 17 | Louisiana | 15.4 | 249 | 66 | 22.2 |
| 18 | Maine | 2.1 | 83 | 51 | 7.8 |
| 19 | Maryland | 11.3 | 300 | 67 | 27.8 |
| 20 | Massachusetts | 4.4 | 149 | 85 | 16.3 |
| 21 | Michigan | 12.1 | 255 | 74 | 35.1 |
| 22 | Minnesota | 2.7 | 72 | 66 | 14.9 |
| 23 | Mississippi | 16.1 | 259 | 44 | 17.1 |
| 24 | Missouri | 9.0 | 178 | 70 | 28.2 |
| 25 | Montana | 6.0 | 109 | 53 | 16.4 |
| 26 | Nebraska | 4.3 | 102 | 62 | 16.5 |
| 27 | Nevada | 12.2 | 252 | 81 | 46.0 |
| 28 | New Hampshire | 2.1 | 57 | 56 | 9.5 |
| 29 | New Jersey | 7.4 | 159 | 89 | 18.8 |
| 30 | New Mexico | 11.4 | 285 | 70 | 32.1 |
| 31 | New York | 11.1 | 254 | 86 | 26.1 |
| 32 | North Carolina | 13.0 | 337 | 45 | 16.1 |
| 33 | North Dakota | 0.8 | 45 | 44 | 7.3 |
| 34 | Ohio | 7.3 | 120 | 75 | 21.4 |
| 35 | Oklahoma | 6.6 | 151 | 68 | 20.0 |
| 36 | Oregon | 4.9 | 159 | 67 | 29.3 |
| 37 | Pennsylvania | 6.3 | 106 | 72 | 14.9 |
| 38 | Rhode Island | 3.4 | 174 | 87 | 8.3 |
| 39 | South Carolina | 14.4 | 279 | 48 | 22.5 |
| 40 | South Dakota | 3.8 | 86 | 45 | 12.8 |
| 41 | Tennessee | 13.2 | 188 | 59 | 26.9 |
| 42 | Texas | 12.7 | 201 | 80 | 25.5 |
| 43 | Utah | 3.2 | 120 | 80 | 22.9 |
| 44 | Vermont | 2.2 | 48 | 32 | 11.2 |
| 45 | Virginia | 8.5 | 156 | 63 | 20.7 |
| 46 | Washington | 4.0 | 145 | 73 | 26.2 |
| 47 | West Virginia | 5.7 | 81 | 39 | 9.3 |
| 48 | Wisconsin | 2.6 | 53 | 66 | 10.8 |
| 49 | Wyoming | 6.8 | 161 | 60 | 15.6 |

In [36]:

```python
crime_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50 entries, 0 to 49
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   Unnamed: 0  50 non-null     object
 1   Murder      50 non-null     float64
 2   Assault     50 non-null     int64
 3   UrbanPop    50 non-null     int64
 4   Rape        50 non-null     float64
dtypes: float64(2), int64(2), object(1)
memory usage: 2.1+ KB
```

In [37]:

```python
crime_data.drop(['Unnamed: 0'],axis=1,inplace=True)
crime_data
```

Out[37]:

| | Murder | Assault | UrbanPop | Rape |
|---|---|---|---|---|
| 0 | 13.2 | 236 | 58 | 21.2 |
| 1 | 10.0 | 263 | 48 | 44.5 |
| 2 | 8.1 | 294 | 80 | 31.0 |
| 3 | 8.8 | 190 | 50 | 19.5 |
| 4 | 9.0 | 276 | 91 | 40.6 |
| 5 | 7.9 | 204 | 78 | 38.7 |
| 6 | 3.3 | 110 | 77 | 11.1 |
| 7 | 5.9 | 238 | 72 | 15.8 |
| 8 | 15.4 | 335 | 80 | 31.9 |
| 9 | 17.4 | 211 | 60 | 25.8 |
| 10 | 5.3 | 46 | 83 | 20.2 |
| 11 | 2.6 | 120 | 54 | 14.2 |
| 12 | 10.4 | 249 | 83 | 24.0 |
| 13 | 7.2 | 113 | 65 | 21.0 |
| 14 | 2.2 | 56 | 57 | 11.3 |
| 15 | 6.0 | 115 | 66 | 18.0 |
| 16 | 9.7 | 109 | 52 | 16.3 |
| 17 | 15.4 | 249 | 66 | 22.2 |
| 18 | 2.1 | 83 | 51 | 7.8 |
| 19 | 11.3 | 300 | 67 | 27.8 |
| 20 | 4.4 | 149 | 85 | 16.3 |
| 21 | 12.1 | 255 | 74 | 35.1 |
| 22 | 2.7 | 72 | 66 | 14.9 |
| 23 | 16.1 | 259 | 44 | 17.1 |
| 24 | 9.0 | 178 | 70 | 28.2 |
| 25 | 6.0 | 109 | 53 | 16.4 |
| 26 | 4.3 | 102 | 62 | 16.5 |
| 27 | 12.2 | 252 | 81 | 46.0 |
| 28 | 2.1 | 57 | 56 | 9.5 |
| 29 | 7.4 | 159 | 89 | 18.8 |
| 30 | 11.4 | 285 | 70 | 32.1 |
| 31 | 11.1 | 254 | 86 | 26.1 |
| 32 | 13.0 | 337 | 45 | 16.1 |
| 33 | 0.8 | 45 | 44 | 7.3 |
| 34 | 7.3 | 120 | 75 | 21.4 |
| 35 | 6.6 | 151 | 68 | 20.0 |
| 36 | 4.9 | 159 | 67 | 29.3 |
| 37 | 6.3 | 106 | 72 | 14.9 |
| 38 | 3.4 | 174 | 87 | 8.3 |
| 39 | 14.4 | 279 | 48 | 22.5 |
| 40 | 3.8 | 86 | 45 | 12.8 |
| 41 | 13.2 | 188 | 59 | 26.9 |
| 42 | 12.7 | 201 | 80 | 25.5 |
| 43 | 3.2 | 120 | 80 | 22.9 |
| 44 | 2.2 | 48 | 32 | 11.2 |
| 45 | 8.5 | 156 | 63 | 20.7 |
| 46 | 4.0 | 145 | 73 | 26.2 |
| 47 | 5.7 | 81 | 39 | 9.3 |
| 48 | 2.6 | 53 | 66 | 10.8 |
| 49 | 6.8 | 161 | 60 | 15.6 |

In [38]:

```python
# Normalize heterogenous numerical data using standard scalar fit transform to dataset
crime_norm=StandardScaler().fit_transform(crime)
crime_norm
```

Out[38]:

```
array([[ 1.25517927,  0.79078716, -0.52619514, -0.00345116, -0.21320072],
       [ 0.51301858,  1.11805959, -1.22406668,  2.50942392, -1.2792043 ],
       [ 0.07236067,  1.49381682,  1.00912225,  1.05346626, -1.2792043 ],
       [ 0.23470832,  0.23321191, -1.08449238, -0.18679398, -1.2792043 ],
       [ 0.28109336,  1.2756352 ,  1.77678094,  2.08881393, -1.2792043 ],
       [ 0.02597562,  0.40290872,  0.86954794,  1.88390137, -1.2792043 ],
       [-1.04088037, -0.73648418,  0.79976079, -1.09272319,  0.85280287],
       [-0.43787481,  0.81502956,  0.45082502, -0.58583422, -1.2792043 ],
       [ 1.76541475,  1.99078607,  1.00912225,  1.1505301 , -1.2792043 ],
       [ 2.22926518,  0.48775713, -0.38662083,  0.49265293, -1.2792043 ],
       [-0.57702994, -1.51224105,  1.21848371, -0.11129987, -1.2792043 ],
       [-1.20322802, -0.61527217, -0.80534376, -0.75839217,  0.85280287],
       [ 0.60578867,  0.94836277,  1.21848371,  0.29852525, -1.2792043 ],
       [-0.13637203, -0.70012057, -0.03768506, -0.0250209 ,  0.85280287],
       [-1.29599811, -1.39102904, -0.5959823 , -1.07115345,  0.85280287],
       [-0.41468229, -0.67587817,  0.03210209, -0.34856705,  0.85280287],
       [ 0.44344101, -0.74860538, -0.94491807, -0.53190987,  0.85280287],
       [ 1.76541475,  0.94836277,  0.03210209,  0.10439756, -0.21320072],
       [-1.31919063, -1.06375661, -1.01470522, -1.44862395,  0.85280287],
       [ 0.81452136,  1.56654403,  0.10188925,  0.70835037, -1.2792043 ],
       [-0.78576263, -0.26375734,  1.35805802, -0.53190987,  0.85280287],
       [ 1.00006153,  1.02108998,  0.59039932,  1.49564599, -1.2792043 ],
       [-1.1800355 , -1.19708982,  0.03210209, -0.68289807,  0.85280287],
       [ 1.9277624 ,  1.06957478, -1.5032153 , -0.44563089, -1.2792043 ],
       [ 0.28109336,  0.0877575 ,  0.31125071,  0.75148985,  0.85280287],
       [-0.41468229, -0.74860538, -0.87513091, -0.521125  ,  0.85280287],
       [-0.80895515, -0.83345379, -0.24704653, -0.51034012,  0.85280287],
       [ 1.02325405,  0.98472638,  1.0789094 ,  2.671197  , -1.2792043 ],
       [-1.31919063, -1.37890783, -0.66576945, -1.26528114,  0.85280287],
       [-0.08998698, -0.14254532,  1.63720664, -0.26228808,  0.85280287],
       [ 0.83771388,  1.38472601,  0.31125071,  1.17209984, -1.2792043 ],
       [ 0.76813632,  1.00896878,  1.42784517,  0.52500755, -1.2792043 ],
       [ 1.20879423,  2.01502847, -1.43342815, -0.55347961, -1.2792043 ],
       [-1.62069341, -1.52436225, -1.5032153 , -1.50254831,  0.85280287],
       [-0.11317951, -0.61527217,  0.66018648,  0.01811858,  0.85280287],
       [-0.27552716, -0.23951493,  0.1716764 , -0.13286962,  0.85280287],
       [-0.66980002, -0.14254532,  0.10188925,  0.87012344,  0.85280287],
       [-0.34510472, -0.78496898,  0.45082502, -0.68289807,  0.85280287],
       [-1.01768785,  0.03927269,  1.49763233, -1.39469959,  0.85280287],
       [ 1.53348953,  1.3119988 , -1.22406668,  0.13675217, -0.21320072],
       [-0.92491776, -1.027393  , -1.43342815, -0.90938037,  0.85280287],
       [ 1.25517927,  0.20896951, -0.45640799,  0.61128652, -0.21320072],
       [ 1.13921666,  0.36654512,  1.00912225,  0.46029832, -1.2792043 ],
       [-1.06407289, -0.61527217,  1.00912225,  0.17989166,  0.85280287],
       [-1.29599811, -1.48799864, -2.34066115, -1.08193832,  0.85280287],
       [ 0.16513075, -0.17890893, -0.17725937, -0.05737552,  0.85280287],
       [-0.87853272, -0.31224214,  0.52061217,  0.53579242,  0.85280287],
       [-0.48425985, -1.08799901, -1.85215107, -1.28685088,  0.85280287],
       [-1.20322802, -1.42739264,  0.03210209, -1.1250778 ,  0.85280287],
       [-0.22914211, -0.11830292, -0.38662083, -0.60740397,  0.85280287]])
```

## DBSCAN Clustering

In [39]:

```python
# DBSCAN Clustering
dbscan=DBSCAN(eps=1,min_samples=4)
dbscan.fit(crime_norm)
```

Out[39]:

```
DBSCAN(eps=1, min_samples=4)
```

In [40]:

```python
#Noisy samples are given the label -1.
dbscan.labels_
```

Out[40]:

```
array([ 0, -1, -1, -1, -1, -1,  1, -1, -1, -1, -1,  1, -1,  1,  1,  1,  1,
        0,  1, -1,  1, -1,  1, -1,  1,  1,  1, -1,  1,  1, -1, -1, -1,  1,
        1,  1,  1,  1,  1,  0,  1,  0, -1,  1,  1,  1,  1,  1,  1,  1],
      dtype=int64)
```

In [41]:

```python
# Adding clusters to dataset
crime_data['clusters']=dbscan.labels_
crime_data
```

Out[41]:

| | Murder | Assault | UrbanPop | Rape | clusters |
|---|---|---|---|---|---|
| 0 | 13.2 | 236 | 58 | 21.2 | 0 |
| 1 | 10.0 | 263 | 48 | 44.5 | -1 |
| 2 | 8.1 | 294 | 80 | 31.0 | -1 |
| 3 | 8.8 | 190 | 50 | 19.5 | -1 |
| 4 | 9.0 | 276 | 91 | 40.6 | -1 |
| 5 | 7.9 | 204 | 78 | 38.7 | -1 |
| 6 | 3.3 | 110 | 77 | 11.1 | 1 |
| 7 | 5.9 | 238 | 72 | 15.8 | -1 |
| 8 | 15.4 | 335 | 80 | 31.9 | -1 |
| 9 | 17.4 | 211 | 60 | 25.8 | -1 |
| 10 | 5.3 | 46 | 83 | 20.2 | -1 |
| 11 | 2.6 | 120 | 54 | 14.2 | 1 |
| 12 | 10.4 | 249 | 83 | 24.0 | -1 |
| 13 | 7.2 | 113 | 65 | 21.0 | 1 |
| 14 | 2.2 | 56 | 57 | 11.3 | 1 |
| 15 | 6.0 | 115 | 66 | 18.0 | 1 |
| 16 | 9.7 | 109 | 52 | 16.3 | 1 |
| 17 | 15.4 | 249 | 66 | 22.2 | 0 |
| 18 | 2.1 | 83 | 51 | 7.8 | 1 |
| 19 | 11.3 | 300 | 67 | 27.8 | -1 |
| 20 | 4.4 | 149 | 85 | 16.3 | 1 |
| 21 | 12.1 | 255 | 74 | 35.1 | -1 |
| 22 | 2.7 | 72 | 66 | 14.9 | 1 |
| 23 | 16.1 | 259 | 44 | 17.1 | -1 |
| 24 | 9.0 | 178 | 70 | 28.2 | 1 |
| 25 | 6.0 | 109 | 53 | 16.4 | 1 |
| 26 | 4.3 | 102 | 62 | 16.5 | 1 |
| 27 | 12.2 | 252 | 81 | 46.0 | -1 |
| 28 | 2.1 | 57 | 56 | 9.5 | 1 |
| 29 | 7.4 | 159 | 89 | 18.8 | 1 |
| 30 | 11.4 | 285 | 70 | 32.1 | -1 |
| 31 | 11.1 | 254 | 86 | 26.1 | -1 |
| 32 | 13.0 | 337 | 45 | 16.1 | -1 |
| 33 | 0.8 | 45 | 44 | 7.3 | 1 |
| 34 | 7.3 | 120 | 75 | 21.4 | 1 |
| 35 | 6.6 | 151 | 68 | 20.0 | 1 |
| 36 | 4.9 | 159 | 67 | 29.3 | 1 |
| 37 | 6.3 | 106 | 72 | 14.9 | 1 |
| 38 | 3.4 | 174 | 87 | 8.3 | 1 |
| 39 | 14.4 | 279 | 48 | 22.5 | 0 |
| 40 | 3.8 | 86 | 45 | 12.8 | 1 |
| 41 | 13.2 | 188 | 59 | 26.9 | 0 |
| 42 | 12.7 | 201 | 80 | 25.5 | -1 |
| 43 | 3.2 | 120 | 80 | 22.9 | 1 |
| 44 | 2.2 | 48 | 32 | 11.2 | 1 |
| 45 | 8.5 | 156 | 63 | 20.7 | 1 |
| 46 | 4.0 | 145 | 73 | 26.2 | 1 |
| 47 | 5.7 | 81 | 39 | 9.3 | 1 |
| 48 | 2.6 | 53 | 66 | 10.8 | 1 |
| 49 | 6.8 | 161 | 60 | 15.6 | 1 |

In [19]:

```python
crime_data.groupby('clusters').agg(['mean']).reset_index()
```

Out[19]:

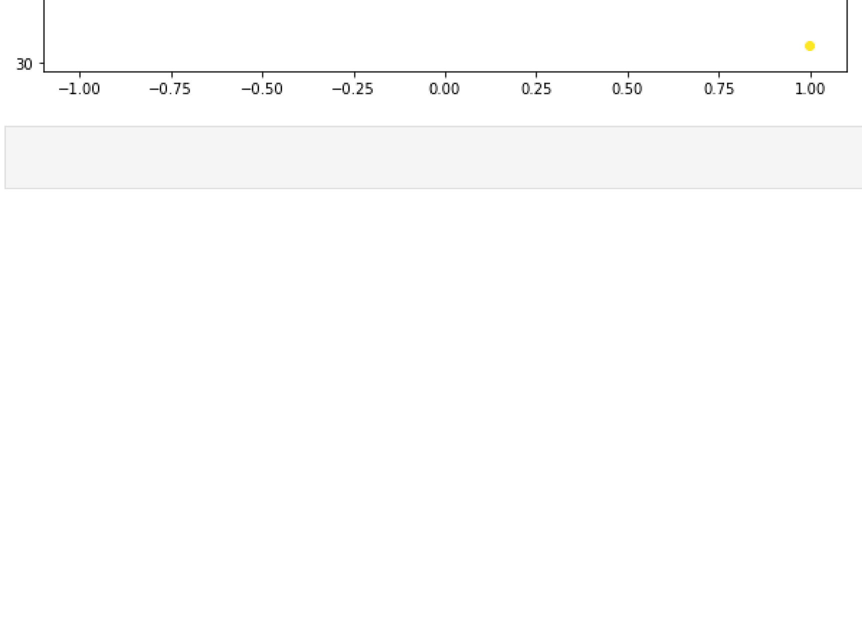
| | clusters | Murder | Assault | UrbanPop | Rape |
|---|---|---|---|---|---|
| | | mean | mean | mean | mean |
| 0 | -1 | 11.005556 | 247.166667 | 70.666667 | 28.766667 |
| 1 | 0 | 14.050000 | 238.000000 | 57.750000 | 23.200000 |
| 2 | 1 | 4.825000 | 112.035714 | 63.357143 | 16.107143 |

In [44]:

```python
# Plot Clusters
plt.figure(figsize=(10, 7))
plt.scatter(crime['clusters'],crime['UrbanPop'], c=dbscan.labels_)
```

Out[44]:

```
<matplotlib.collections.PathCollection at 0x2a3d733f1f0>
```




In [ ]: