In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
from matplotlib import pyplot as plt
import scipy.cluster.hierarchy as sch
from sklearn.cluster import AgglomerativeClustering
from sklearn.preprocessing import normalize

import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```
dt = pd.read_csv('crime_data.csv')
dt
```

Out[2]:

	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

	Unnamed: 0	Murder	Assault	UrbanPop	Rape
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 [3]:

```
dt.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 [4]:

```
# Normalization Function
```

In [5]:

```
def nor_fun(i):
    x =(i-i.min())/(i.max()-i.min())
    return(x)
```

In [6]:

```
## Considering the numerical part of data
```

In [8]:

```
dd_norm = nor_fun(dt.iloc[:,1:])
dd_norm
```

Out[8]:

	Murder	Assault	UrbanPop	Rape
0	0.746988	0.654110	0.440678	0.359173
1	0.554217	0.746575	0.271186	0.961240
2	0.439759	0.852740	0.813559	0.612403
3	0.481928	0.496575	0.305085	0.315245
4	0.493976	0.791096	1.000000	0.860465
5	0.427711	0.544521	0.779661	0.811370
6	0.150602	0.222603	0.762712	0.098191
7	0.307229	0.660959	0.677966	0.219638
8	0.879518	0.993151	0.813559	0.635659
9	1.000000	0.568493	0.474576	0.478036
10	0.271084	0.003425	0.864407	0.333333
11	0.108434	0.256849	0.372881	0.178295
12	0.578313	0.698630	0.864407	0.431525
13	0.385542	0.232877	0.559322	0.354005
14	0.084337	0.037671	0.423729	0.103359
15	0.313253	0.239726	0.576271	0.276486
16	0.536145	0.219178	0.338983	0.232558
17	0.879518	0.698630	0.576271	0.385013
18	0.078313	0.130137	0.322034	0.012920
19	0.632530	0.873288	0.593220	0.529716
20	0.216867	0.356164	0.898305	0.232558
21	0.680723	0.719178	0.711864	0.718346
22	0.114458	0.092466	0.576271	0.196382
23	0.921687	0.732877	0.203390	0.253230
24	0.493976	0.455479	0.644068	0.540052
25	0.313253	0.219178	0.355932	0.235142
26	0.210843	0.195205	0.508475	0.237726
27	0.686747	0.708904	0.830508	1.000000
28	0.078313	0.041096	0.406780	0.056848
29	0.397590	0.390411	0.966102	0.297158
30	0.638554	0.821918	0.644068	0.640827
31	0.620482	0.715753	0.915254	0.485788
32	0.734940	1.000000	0.220339	0.227390
33	0.000000	0.000000	0.203390	0.000000

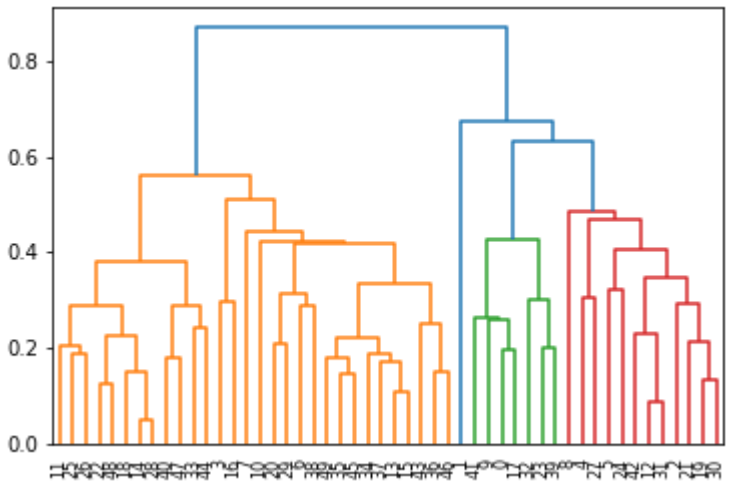
	Murder	Assault	UrbanPop	Rape
34	0.391566	0.256849	0.728814	0.364341
35	0.349398	0.363014	0.610169	0.328165
36	0.246988	0.390411	0.593220	0.568475
37	0.331325	0.208904	0.677966	0.196382
38	0.156627	0.441781	0.932203	0.025840
39	0.819277	0.801370	0.271186	0.392765
40	0.180723	0.140411	0.220339	0.142119
41	0.746988	0.489726	0.457627	0.506460
42	0.716867	0.534247	0.813559	0.470284
43	0.144578	0.256849	0.813559	0.403101
44	0.084337	0.010274	0.000000	0.100775
45	0.463855	0.380137	0.525424	0.346253
46	0.192771	0.342466	0.694915	0.488372
47	0.295181	0.123288	0.118644	0.051680
48	0.108434	0.027397	0.576271	0.090439
49	0.361446	0.397260	0.474576	0.214470

In [9]:

```
# Dendogram
```

In [11]:

```
dendogram = sch.dendrogram(sch.linkage(dd_norm,method='average'))
```



In [12]:

```
#Clusters
```

In [13]:

```
cl=AgglomerativeClustering(n_clusters=3,affinity='euclidean',linkage='complete')
cl
```

Out[13]:

```
AgglomerativeClustering(linkage='complete', n_clusters=3)
```

In [14]:

```
y_cl = cl.fit_predict(dd_norm)
y_cl
```

Out[14]:

```
array([0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 2, 0, 1, 2, 1, 1, 0, 2, 0, 1, 0,
       1, 0, 0, 2, 2, 0, 2, 1, 0, 0, 0, 2, 1, 1, 1, 1, 1, 0, 2, 0, 0, 1,
       2, 1, 1, 2, 1, 1], dtype=int64)
```

In [15]:

```
dt['h_clusterid'] = cl.labels_
dt
```

Out[15]:

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	h_clusterid
0	Alabama	13.2	236	58	21.2	0
1	Alaska	10.0	263	48	44.5	0
2	Arizona	8.1	294	80	31.0	0
3	Arkansas	8.8	190	50	19.5	1
4	California	9.0	276	91	40.6	0
5	Colorado	7.9	204	78	38.7	0
6	Connecticut	3.3	110	77	11.1	1
7	Delaware	5.9	238	72	15.8	1
8	Florida	15.4	335	80	31.9	0
9	Georgia	17.4	211	60	25.8	0
10	Hawaii	5.3	46	83	20.2	1
11	Idaho	2.6	120	54	14.2	2
12	Illinois	10.4	249	83	24.0	0
13	Indiana	7.2	113	65	21.0	1
14	Iowa	2.2	56	57	11.3	2
15	Kansas	6.0	115	66	18.0	1
16	Kentucky	9.7	109	52	16.3	1
17	Louisiana	15.4	249	66	22.2	0
18	Maine	2.1	83	51	7.8	2
19	Maryland	11.3	300	67	27.8	0
20	Massachusetts	4.4	149	85	16.3	1
21	Michigan	12.1	255	74	35.1	0
22	Minnesota	2.7	72	66	14.9	1
23	Mississippi	16.1	259	44	17.1	0
24	Missouri	9.0	178	70	28.2	0
25	Montana	6.0	109	53	16.4	2
26	Nebraska	4.3	102	62	16.5	2
27	Nevada	12.2	252	81	46.0	0
28	New Hampshire	2.1	57	56	9.5	2
29	New Jersey	7.4	159	89	18.8	1
30	New Mexico	11.4	285	70	32.1	0
31	New York	11.1	254	86	26.1	0
32	North Carolina	13.0	337	45	16.1	0
33	North Dakota	0.8	45	44	7.3	2

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	h_clusterid
34	Ohio	7.3	120	75	21.4	1
35	Oklahoma	6.6	151	68	20.0	1
36	Oregon	4.9	159	67	29.3	1
37	Pennsylvania	6.3	106	72	14.9	1
38	Rhode Island	3.4	174	87	8.3	1
39	South Carolina	14.4	279	48	22.5	0
40	South Dakota	3.8	86	45	12.8	2
41	Tennessee	13.2	188	59	26.9	0
42	Texas	12.7	201	80	25.5	0
43	Utah	3.2	120	80	22.9	1
44	Vermont	2.2	48	32	11.2	2
45	Virginia	8.5	156	63	20.7	1
46	Washington	4.0	145	73	26.2	1
47	West Virginia	5.7	81	39	9.3	2
48	Wisconsin	2.6	53	66	10.8	1
49	Wyoming	6.8	161	60	15.6	1

K-means

In [16]:

```
import pandas  as pd
import numpy  as np
from matplotlib import pyplot as  plt
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
```

In [17]:

```
dt2 = pd.read_csv('crime_data.csv')
dt2
```

Out[17]:

	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

	Unnamed: 0	Murder	Assault	UrbanPop	Rape
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 [18]:

```
## Normalization function
```

In [22]:

```
sl = StandardScaler()
sl_df = sl.fit_transform(dt2.iloc[:,1:])
sl_df
```

Out[22]:

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

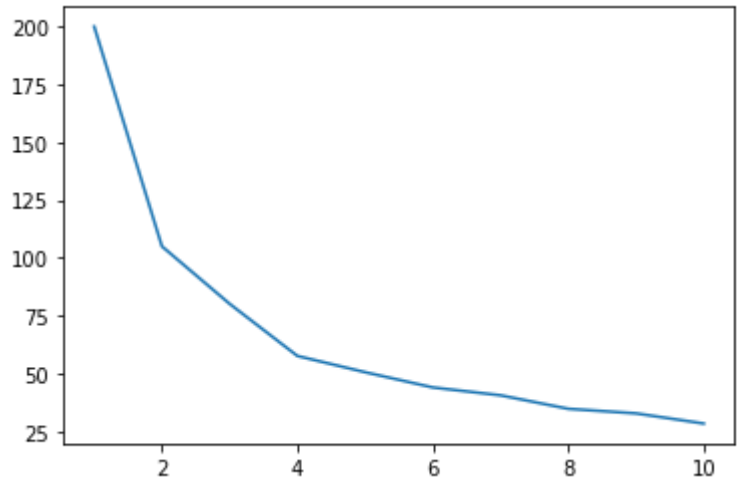
In [23]:

```
# to find  optimum number of cluster
```

In [24]:

```
wcss = []
for i  in range(1,11):
    kmeans=  KMeans(n_clusters=i,random_state=0)
    kmeans.fit(sl_df)
    wcss.append(kmeans.inertia_)

plt.plot(range(1,11),wcss)
plt.title = ('Elbow Method')
plt.xlabel= ('Numbers of cluster')
plt.ylabel= ('WCSS')
plt.show()
```



In [25]:

```
# Cluster Algo.
```

In [26]:

```
cluster_new = KMeans(4,random_state=42)
cluster_new.fit(sl_df)
```

Out[26]:

```
KMeans(n_clusters=4, random_state=42)
```

In [27]:

```
cluster_new.labels_
```

Out[27]:

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

In [28]:

```
### Assign cluster to the new data set
```

In [29]:

```
dt2['clusterid_new'] = cluster_new.labels_
```

In [30]:

```
dt2
```

Out[30]:

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	clusterid_new
0	Alabama	13.2	236	58	21.2	1
1	Alaska	10.0	263	48	44.5	2
2	Arizona	8.1	294	80	31.0	2
3	Arkansas	8.8	190	50	19.5	1
4	California	9.0	276	91	40.6	2
5	Colorado	7.9	204	78	38.7	2
6	Connecticut	3.3	110	77	11.1	0
7	Delaware	5.9	238	72	15.8	0
8	Florida	15.4	335	80	31.9	2
9	Georgia	17.4	211	60	25.8	1
10	Hawaii	5.3	46	83	20.2	0
11	Idaho	2.6	120	54	14.2	3
12	Illinois	10.4	249	83	24.0	2
13	Indiana	7.2	113	65	21.0	0
14	Iowa	2.2	56	57	11.3	3
15	Kansas	6.0	115	66	18.0	0
16	Kentucky	9.7	109	52	16.3	3
17	Louisiana	15.4	249	66	22.2	1
18	Maine	2.1	83	51	7.8	3
19	Maryland	11.3	300	67	27.8	2
20	Massachusetts	4.4	149	85	16.3	0
21	Michigan	12.1	255	74	35.1	2
22	Minnesota	2.7	72	66	14.9	3
23	Mississippi	16.1	259	44	17.1	1
24	Missouri	9.0	178	70	28.2	2
25	Montana	6.0	109	53	16.4	3
26	Nebraska	4.3	102	62	16.5	3
27	Nevada	12.2	252	81	46.0	2
28	New Hampshire	2.1	57	56	9.5	3
29	New Jersey	7.4	159	89	18.8	0
30	New Mexico	11.4	285	70	32.1	2
31	New York	11.1	254	86	26.1	2
32	North Carolina	13.0	337	45	16.1	1
33	North Dakota	0.8	45	44	7.3	3
34	Ohio	7.3	120	75	21.4	0

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	clusterid_new
35	Oklahoma	6.6	151	68	20.0	0
36	Oregon	4.9	159	67	29.3	0
37	Pennsylvania	6.3	106	72	14.9	0
38	Rhode Island	3.4	174	87	8.3	0
39	South Carolina	14.4	279	48	22.5	1
40	South Dakota	3.8	86	45	12.8	3
41	Tennessee	13.2	188	59	26.9	1
42	Texas	12.7	201	80	25.5	2
43	Utah	3.2	120	80	22.9	0
44	Vermont	2.2	48	32	11.2	3
45	Virginia	8.5	156	63	20.7	0
46	Washington	4.0	145	73	26.2	0
47	West Virginia	5.7	81	39	9.3	3
48	Wisconsin	2.6	53	66	10.8	3
49	Wyoming	6.8	161	60	15.6	0

In [31]:

```
cluster_new.cluster_centers_
```

Out[31]:

```
array([[-0.49440658, -0.3864845 ,  0.58167593, -0.26431024],
       [ 1.42622412,  0.88321132, -0.82279055,  0.01946669],
       [ 0.70212683,  1.04999438,  0.72997363,  1.28990383],
       [-0.97130281, -1.11783581, -0.93954982, -0.97657842]])
```

In [32]:

```
dt2.groupby('clusterid_new').agg(['mean'])
```

Out[32]:

	Murder	Assault	UrbanPop	Rape
	mean	mean	mean	mean
clusterid_new				
0	5.656250	138.875000	73.875000	18.781250
1	13.937500	243.625000	53.750000	21.412500
2	10.815385	257.384615	76.000000	33.192308
3	3.600000	78.538462	52.076923	12.176923

DB-SCAN

In [33]:

```
from sklearn.cluster import DBSCAN
from sklearn.preprocessing import StandardScaler
```

In [34]:

```
dt3 = pd.read_csv('crime_data.csv')
dt3
```

Out[34]:

	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

	Unnamed: 0	Murder	Assault	UrbanPop	Rape
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 [35]:

```
dt3.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 [36]:

```
dt3.isna().sum()
```

Out[36]:

```
Unnamed: 0    0
Murder        0
Assault       0
UrbanPop      0
Rape          0
dtype: int64
```

In [37]:

```
dt3.describe()
```

Out[37]:

	Murder	Assault	UrbanPop	Rape
count	50.00000	50.000000	50.000000	50.000000
mean	7.78800	170.760000	65.540000	21.232000
std	4.35551	83.337661	14.474763	9.366385
min	0.80000	45.000000	32.000000	7.300000
25%	4.07500	109.000000	54.500000	15.075000
50%	7.25000	159.000000	66.000000	20.100000
75%	11.25000	249.000000	77.750000	26.175000
max	17.40000	337.000000	91.000000	46.000000

In [38]:

```
dd = dt3.iloc[:,1:]
dd
```

Out[38]:

	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

	Murder	Assault	UrbanPop	Rape
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 [39]:

```
array = dd.values
array
```

Out[39]:

```
array([[ 13.2, 236. ,  58. ,  21.2],
       [ 10. , 263. ,  48. ,  44.5],
       [  8.1, 294. ,  80. ,  31. ],
       [  8.8, 190. ,  50. ,  19.5],
       [  9. , 276. ,  91. ,  40.6],
       [  7.9, 204. ,  78. ,  38.7],
       [  3.3, 110. ,  77. ,  11.1],
       [  5.9, 238. ,  72. ,  15.8],
       [ 15.4, 335. ,  80. ,  31.9],
       [ 17.4, 211. ,  60. ,  25.8],
       [  5.3,  46. ,  83. ,  20.2],
       [  2.6, 120. ,  54. ,  14.2],
       [ 10.4, 249. ,  83. ,  24. ],
       [  7.2, 113. ,  65. ,  21. ],
       [  2.2,  56. ,  57. ,  11.3],
       [  6. , 115. ,  66. ,  18. ],
       [  9.7, 109. ,  52. ,  16.3],
       [ 15.4, 249. ,  66. ,  22.2],
       [  2.1,  83. ,  51. ,   7.8],
       [ 11.3, 300. ,  67. ,  27.8],
       [  4.4, 149. ,  85. ,  16.3],
       [ 12.1, 255. ,  74. ,  35.1],
       [  2.7,  72. ,  66. ,  14.9],
       [ 16.1, 259. ,  44. ,  17.1],
       [  9. , 178. ,  70. ,  28.2],
       [  6. , 109. ,  53. ,  16.4],
       [  4.3, 102. ,  62. ,  16.5],
       [ 12.2, 252. ,  81. ,  46. ],
       [  2.1,  57. ,  56. ,   9.5],
       [  7.4, 159. ,  89. ,  18.8],
       [ 11.4, 285. ,  70. ,  32.1],
       [ 11.1, 254. ,  86. ,  26.1],
       [ 13. , 337. ,  45. ,  16.1],
       [  0.8,  45. ,  44. ,   7.3],
       [  7.3, 120. ,  75. ,  21.4],
       [  6.6, 151. ,  68. ,  20. ],
       [  4.9, 159. ,  67. ,  29.3],
       [  6.3, 106. ,  72. ,  14.9],
       [  3.4, 174. ,  87. ,   8.3],
       [ 14.4, 279. ,  48. ,  22.5],
       [  3.8,  86. ,  45. ,  12.8],
       [ 13.2, 188. ,  59. ,  26.9],
       [ 12.7, 201. ,  80. ,  25.5],
       [  3.2, 120. ,  80. ,  22.9],
       [  2.2,  48. ,  32. ,  11.2],
       [  8.5, 156. ,  63. ,  20.7],
       [  4. , 145. ,  73. ,  26.2],
       [  5.7,  81. ,  39. ,   9.3],
       [  2.6,  53. ,  66. ,  10.8],
       [  6.8, 161. ,  60. ,  15.6]])
```

In [40]:

```
stscaler = StandardScaler().fit(array)
X = stscaler.transform(array)
X
```

Out[40]:

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

In [41]:

```
dbscan = DBSCAN(eps=2, min_samples=5)
dbscan.fit(X)
```

Out[41]:

```
DBSCAN(eps=2)
```

In [42]:

```
# Noicy samples are given the label -1
```

In [43]:

```
dbscan.labels_
```

Out[43]:

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

In [44]:

```
cc = pd.DataFrame(dbscan.labels_,columns=['cluster'])
cc
```

Out[44]:

	cluster
0	0
1	-1
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0
29	0
30	0
31	0
32	0
33	0

	cluster
34	0
35	0
36	0
37	0
38	0
39	0
40	0
41	0
42	0
43	0
44	0
45	0
46	0
47	0
48	0
49	0

In [45]:

```
pd.concat([dt3,cc],axis=1)
```

Out[45]:

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	cluster
0	Alabama	13.2	236	58	21.2	0
1	Alaska	10.0	263	48	44.5	-1
2	Arizona	8.1	294	80	31.0	0
3	Arkansas	8.8	190	50	19.5	0
4	California	9.0	276	91	40.6	0
5	Colorado	7.9	204	78	38.7	0
6	Connecticut	3.3	110	77	11.1	0
7	Delaware	5.9	238	72	15.8	0
8	Florida	15.4	335	80	31.9	0
9	Georgia	17.4	211	60	25.8	0
10	Hawaii	5.3	46	83	20.2	0
11	Idaho	2.6	120	54	14.2	0
12	Illinois	10.4	249	83	24.0	0
13	Indiana	7.2	113	65	21.0	0
14	Iowa	2.2	56	57	11.3	0
15	Kansas	6.0	115	66	18.0	0
16	Kentucky	9.7	109	52	16.3	0
17	Louisiana	15.4	249	66	22.2	0
18	Maine	2.1	83	51	7.8	0
19	Maryland	11.3	300	67	27.8	0
20	Massachusetts	4.4	149	85	16.3	0
21	Michigan	12.1	255	74	35.1	0
22	Minnesota	2.7	72	66	14.9	0
23	Mississippi	16.1	259	44	17.1	0
24	Missouri	9.0	178	70	28.2	0
25	Montana	6.0	109	53	16.4	0
26	Nebraska	4.3	102	62	16.5	0
27	Nevada	12.2	252	81	46.0	0
28	New Hampshire	2.1	57	56	9.5	0
29	New Jersey	7.4	159	89	18.8	0
30	New Mexico	11.4	285	70	32.1	0
31	New York	11.1	254	86	26.1	0
32	North Carolina	13.0	337	45	16.1	0
33	North Dakota	0.8	45	44	7.3	0
34	Ohio	7.3	120	75	21.4	0

	Unnamed: 0	Murder	Assault	UrbanPop	Rape	cluster
35	Oklahoma	6.6	151	68	20.0	0
36	Oregon	4.9	159	67	29.3	0
37	Pennsylvania	6.3	106	72	14.9	0
38	Rhode Island	3.4	174	87	8.3	0
39	South Carolina	14.4	279	48	22.5	0
40	South Dakota	3.8	86	45	12.8	0
41	Tennessee	13.2	188	59	26.9	0
42	Texas	12.7	201	80	25.5	0
43	Utah	3.2	120	80	22.9	0
44	Vermont	2.2	48	32	11.2	0
45	Virginia	8.5	156	63	20.7	0
46	Washington	4.0	145	73	26.2	0
47	West Virginia	5.7	81	39	9.3	0
48	Wisconsin	2.6	53	66	10.8	0
49	Wyoming	6.8	161	60	15.6	0

In [ ]: