lab5.1

January 20, 2025

[11]:
```python
import numpy as np
import pandas as pd
from sklearn.cluster import KMeans, DBSCAN
from sklearn.decomposition import PCA
from sklearn import datasets
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import LabelEncoder
sns.set()
```

[12]:
```python
df = pd.read_csv("./Country-data.csv")
```

[13]:
```python
label = LabelEncoder()
df['country'] = label.fit_transform(df['country'])
```

[14]:
```python
X = df[['country', 'child_mort', 'exports', 'health', 'imports', 'income',
       'inflation', 'life_expec', 'total_fer', 'gdpp']]
```

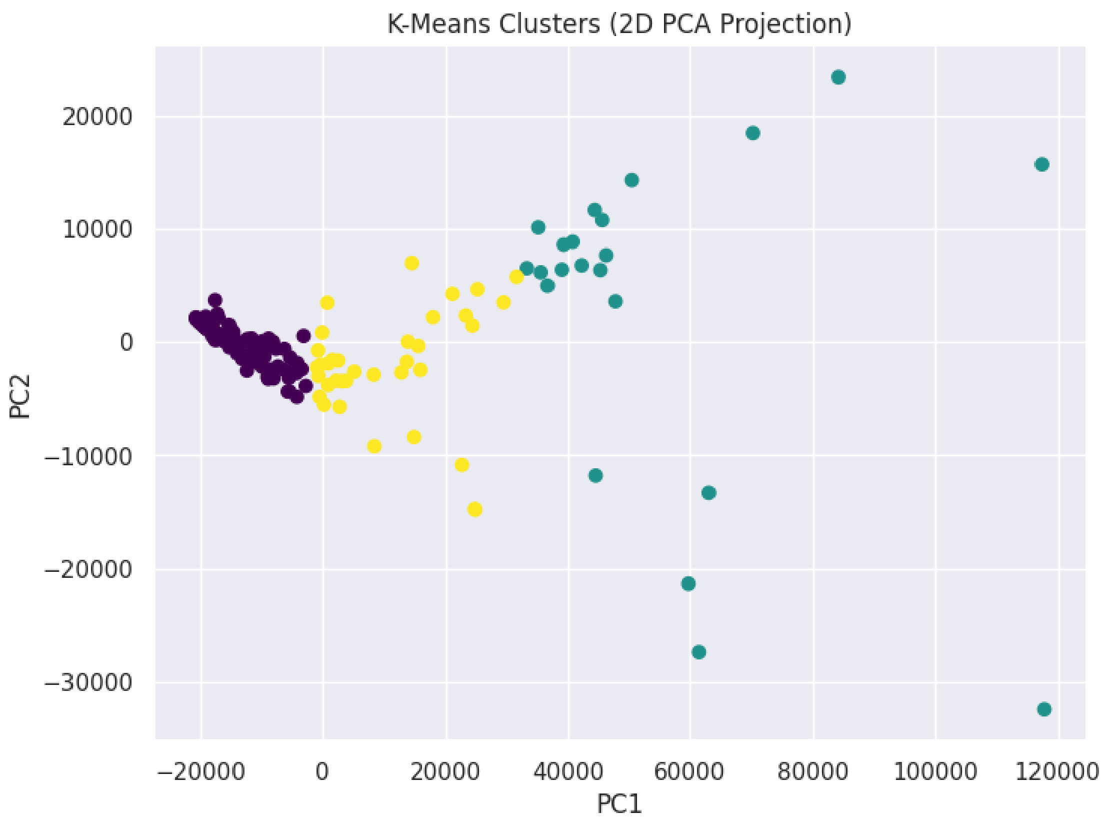
[15]:
```python
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
scaler = StandardScaler()

for colm in X:
    df[colm] = scaler.fit_transform(df[colm].values.reshape(-1,1))
```

[16]:
```python
inertia = []
k_range = range(1, 11)
```

[ ]:
```python
for k in k_range:
    kmeans = KMeans(n_clusters=3, random_state=42)
    kmeans.fit(X)
    inertia.append(kmeans.inertia_)
    labels_kmeans = kmeans.labels_
```

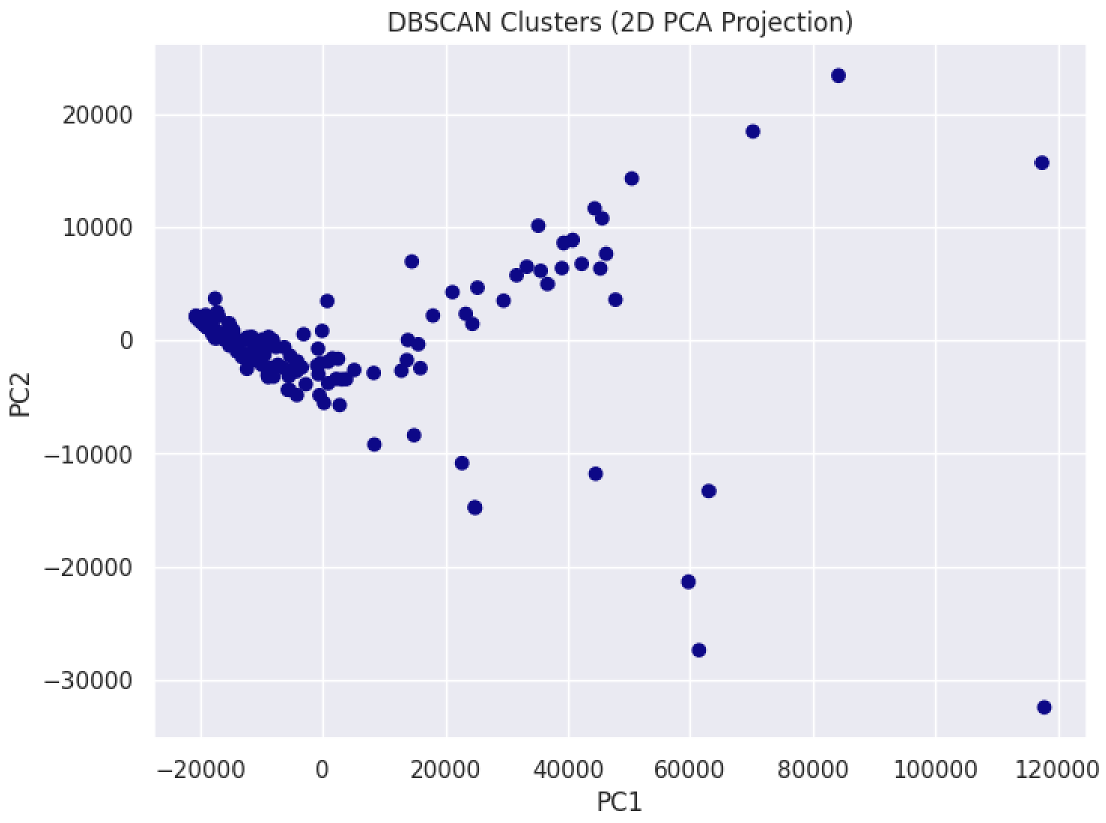
[43]:
```python
pca_kmeans = PCA(n_components=2)
X_2d_kmeans = pca_kmeans.fit_transform(X)
```

```
plt.figure(figsize=(8, 6))
plt.scatter(X_2d_kmeans[:, 0], X_2d_kmeans[:, 1], c=labels_kmeans,␣
 ↪cmap='viridis')
plt.title("K-Means Clusters (2D PCA Projection)")
plt.xlabel("PC1")
plt.ylabel("PC2")
plt.show()
```



[18]:
```
dbscan = DBSCAN(eps=0.5, min_samples=5)
dbscan.fit(X)

labels_dbscan = dbscan.labels_
```

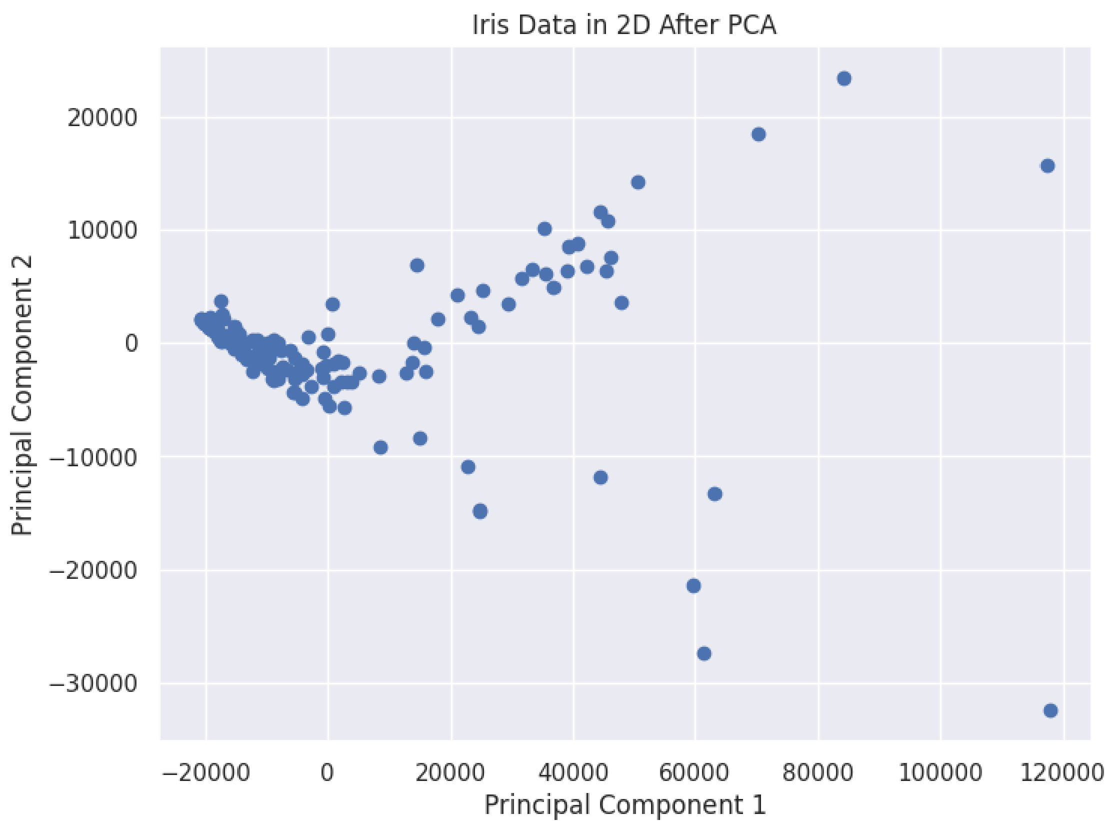
[45]:
```
pca_dbscan = PCA(n_components=2)
X_2d_dbscan = pca_dbscan.fit_transform(X)

plt.figure(figsize=(8, 6))
plt.scatter(X_2d_dbscan[:, 0], X_2d_dbscan[:, 1], c=labels_dbscan,␣
 ↪cmap='plasma')
plt.title("DBSCAN Clusters (2D PCA Projection)")
plt.xlabel("PC1")
plt.ylabel("PC2")
plt.show()
```



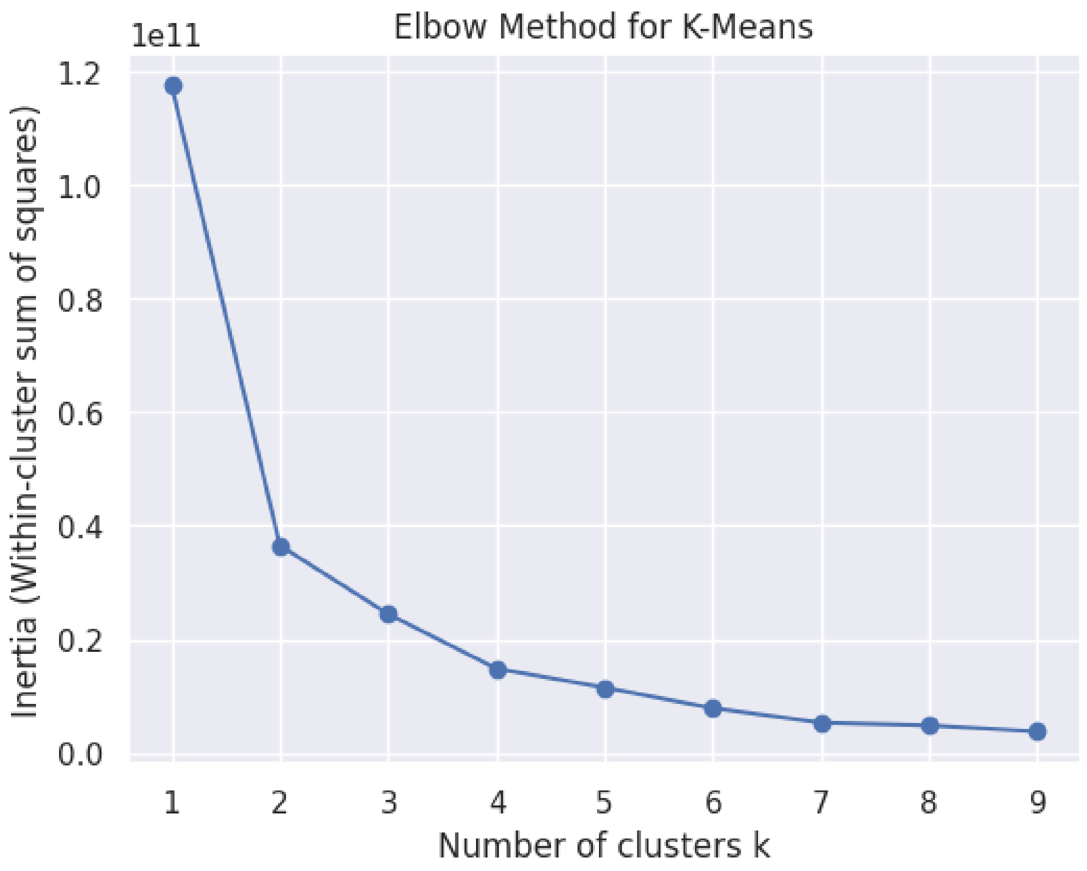
[46]:
```
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X)

print("Explained variance ratio:", pca.explained_variance_ratio_)
```

```
Explained variance ratio: [0.94791994 0.05207329]
```

[47]:
```
plt.figure(figsize=(8, 6))
plt.scatter(X_pca[:, 0], X_pca[:, 1])
plt.title("Iris Data in 2D After PCA")
plt.xlabel("Principal Component 1")
plt.ylabel("Principal Component 2")
plt.show()
```



[48]:
```
inertias = []
K_range = range(1, 10)  # Example: testing k = 1 to 9

for k in K_range:
    kmeans_temp = KMeans(n_clusters=k, random_state=42)
    kmeans_temp.fit(X)
    inertias.append(kmeans_temp.inertia_)

plt.plot(K_range, inertias, marker='o')
plt.xlabel("Number of clusters k")
plt.ylabel("Inertia (Within-cluster sum of squares)")
plt.title("Elbow Method for K-Means")
plt.show()
```



```
[53]: from sklearn.metrics import silhouette_score

      kmeans = KMeans(n_clusters=3, random_state=42)
      kmeans.fit(X)
      labels_kmeans = kmeans.labels_

      silhouette_kmeans = silhouette_score(X, labels_kmeans)
      print("Silhouette Score (K-Means):", silhouette_kmeans)

      dbscan = DBSCAN(eps=0.5, min_samples=5)
      dbscan.fit(X)
      labels_dbscan = dbscan.labels_
      if len(set(labels_dbscan) - {-1}) > 1:  # Exclude noise (-1)
          silhouette_dbscan = silhouette_score(X, labels_dbscan)
          print("Silhouette Score (DBSCAN):", silhouette_dbscan)
      else:
          print("DBSCAN did not produce enough clusters to compute a silhouette score.
        ↪")
```

```
Silhouette Score (K-Means): 0.6004224256794997
```

```
DBSCAN did not produce enough clusters to compute a silhouette score.
```

[50]:
```python
from sklearn.decomposition import PCA

pca = PCA(n_components=2)
X_pca = pca.fit_transform(X)

print("Explained variance ratio:", pca.explained_variance_ratio_)
```

```
Explained variance ratio: [0.94791994 0.05207329]
```

[51]:
```python
from sklearn.decomposition import PCA
from sklearn.metrics import mean_squared_error
```

[52]:
```python
pca = PCA(n_components=2)
X_pca = pca.fit_transform(X)
print("Explained variance ratio:", pca.explained_variance_ratio_)
```

```
Explained variance ratio: [0.94791994 0.05207329]
```