21162101012_CBA_Yash_Lakhtariya

ML Practical 7

Aim - Clustering of mall customers

- For a given dataset make clusters of customers using different attributes.
- Change values of hyper parameters in each model i.e value of k in k-means and select the best value
- Plot graph of clusters with centroid for each model

Use following models :

- k-means
- Fuzzy c-mean : Plot graph of clusters generated by fuzzy c mean
- DBSCAN

Calculate silhouette score, db index and dunn index for all three models and write your conclusion based on it

```
[ ] !pip install -q scikit-fuzzy
    !pip install tabulate
```

```
[15] import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import seaborn as sns
     from sklearn.cluster import KMeans, DBSCAN
     from sklearn.preprocessing import StandardScaler
     from sklearn.metrics import silhouette_score, davies_bouldin_score
     from scipy.spatial.distance import pdist, squareform
     import skfuzzy as fuzz
     from tabulate import tabulate
```

```
df = pd.read_csv('/content/drive/MyDrive/Colab Notebooks/ML_7/p7_mallcstmrs.csv')
df.head()
```

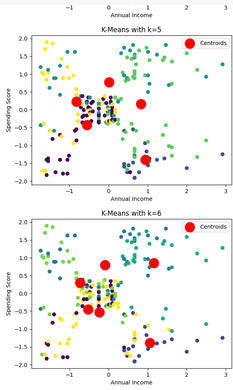
	CustomerID	Genre	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

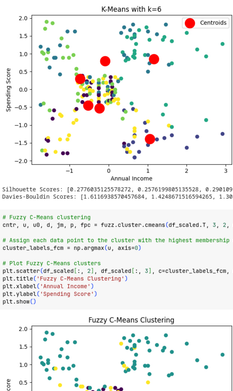
Next steps: Generate code with df | View recommended plots | New interactive sheet

```
[9] # Check for missing values
    print("Missing values in each column:\n", df.isnull().sum())

    # Drop CustomerID as it's irrelevant for clustering
    df = df.drop(['CustomerID'], axis=1)

    # Encode the categorical column 'Genre' (Male=1, Female=0)
    df['Genre'] = df['Genre'].map({'Male': 1, 'Female': 0})

    # Feature Scaling (standardizing the data)
    scaler = StandardScaler()
    df_scaled = scaler.fit_transform(df)

    print()
    print(df_scaled[:5])
```

```
Missing values in each column:
 CustomerID              0
Genre                   0
Age                     0
Annual Income (k$)      0
Spending Score (1-100)  0
dtype: int64

[[ 1.12815215 -1.42456879 -1.73899919 -0.43480148]
 [ 1.12815215 -1.28035363 -1.73899919  1.19570407]
 [-0.88640526 -1.3528021  -1.70082976 -1.71591298]
 [-0.88640526 -1.13750203 -1.70082976  1.04041783]
 [-0.88640526 -0.56336851 -1.66266033 -0.39599922]]
```

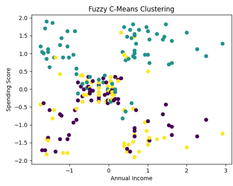
```
[10] # List to store evaluation metrics
     silhouette_scores = []
     davies_bouldin_scores = []

     # Try different values of k (number of clusters)
     for k in range(2, 7):
         kmeans = KMeans(n_clusters=k, random_state=42)
         cluster_labels = kmeans.fit_predict(df_scaled)

         # Calculate silhouette score and Davies-Bouldin index
         silhouette = silhouette_score(df_scaled, cluster_labels)
         db_index = davies_bouldin_score(df_scaled, cluster_labels)

         silhouette_scores.append(silhouette)
         davies_bouldin_scores.append(db_index)

         # Plot the clusters
         plt.figure()
         plt.scatter(df_scaled[:, 2], df_scaled[:, 3], c=cluster_labels, cmap='viridis')
         plt.scatter(kmeans.cluster_centers_[:, 2], kmeans.cluster_centers_[:, 3], s=300, c='red', label='Centroids')
         plt.title(f'K-Means with k={k}')
         plt.xlabel('Annual Income')
         plt.ylabel('Spending Score')
         plt.legend()
         plt.show()

     # Print the silhouette and Davies-Bouldin scores
     print("Silhouette Scores:", silhouette_scores)
     print("Davies-Bouldin Scores:", davies_bouldin_scores)
```



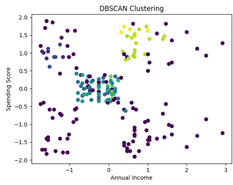



```
Silhouette Scores: [0.2776035125578222, 0.25761990805135528, 0.29018917402318876, 0.27191023466188324, 0.3347543475669217]
Davies-Bouldin Scores: [1.6116938570457684, 1.4248671516594265, 1.3055634980816425, 1.1818914524061711, 1.0139617115087866]
```

```
[11] # Fuzzy C-Means clustering
     cntr, u, u0, d, jm, p, fpc = fuzz.cluster.cmeans(df_scaled.T, 3, 2, error=0.005, maxiter=1000, init=None)

     # Assign each data point to the cluster with the highest membership degree
     cluster_labels_fcm = np.argmax(u, axis=0)

     # Plot fuzzy C-Means clusters
     plt.scatter(df_scaled[:, 2], df_scaled[:, 3], c=cluster_labels_fcm, cmap='viridis')
     plt.title('Fuzzy C-Means Clustering')
     plt.xlabel('Annual Income')
     plt.ylabel('Spending Score')
     plt.show()
```




```
# DBSCAN Clustering
dbscan = DBSCAN(eps=0.5, min_samples=5)
cluster_labels_dbscan = dbscan.fit_predict(df_scaled)

# Plot DBSCAN clusters
plt.scatter(df_scaled[:, 2], df_scaled[:, 3], c=cluster_labels_dbscan, cmap='viridis')
plt.title('DBSCAN Clustering')
plt.xlabel('Annual Income')
plt.ylabel('Spending Score')
plt.show()
```




```
# Function to calculate Dunn Index
def dunn_index(X, labels):
    distances = squareform(pdist(X))
    unique_clusters = np.unique(labels)
    intra_dists = []
    min_inter_dists = np.inf

    for cluster in unique_clusters:
        intra_dists.append(np.mean(distances[labels == cluster][:, labels == cluster]))

    for i in range(len(unique_clusters)):
        for j in range(i + 1, len(unique_clusters)):
            inter_dist = np.min(distances[labels == unique_clusters[i]][:, labels == unique_clusters[j]])
            if inter_dist < min_inter_dists:
                min_inter_dists = inter_dist

    return min_inter_dists / np.max(intra_dists)

# Calculate metrics for K-Means
silhouette_kmeans = silhouette_score(df_scaled, cluster_labels)
db_index_kmeans = davies_bouldin_score(df_scaled, cluster_labels)
dunn_kmeans = dunn_index(df_scaled, cluster_labels)

# Calculate metrics for Fuzzy C-Means
silhouette_fcm = silhouette_score(df_scaled, cluster_labels_fcm)
db_index_fcm = davies_bouldin_score(df_scaled, cluster_labels_fcm)
dunn_fcm = dunn_index(df_scaled, cluster_labels_fcm)

# Calculate metrics for DBSCAN
silhouette_dbscan = silhouette_score(df_scaled, cluster_labels_dbscan)
db_index_dbscan = davies_bouldin_score(df_scaled, cluster_labels_dbscan)
dunn_dbscan = dunn_index(df_scaled, cluster_labels_dbscan)

evaluation_data = [
    ['K-Means', round(silhouette_kmeans, 2), round(db_index_kmeans, 2)], round(dunn_kmeans, 2)],
    ['Fuzzy C-Means', round(silhouette_fcm, 2), round(db_index_fcm, 2), round(dunn_fcm, 2)],
    ['DBSCAN', round(silhouette_dbscan, 2), round(db_index_dbscan, 2), round(dunn_dbscan, 2)]
]

headers = ['Model', 'Silhouette Score', 'DB Index', 'Dunn Index']

print(tabulate(evaluation_data, headers=headers, tablefmt='fancy_grid'))
```

Model	Silhouette Score	DB Index	Dunn Index
K-Means	0.33	1.01	0.22
Fuzzy C-Means	0.23	1.38	0.09
DBSCAN	0.01	1.39	0.08

```
print("K-Means is the best model with the highest Silhouette Score (0.33), best DB Index (1.01), and higher Dunn Index (0.22).")
print("DBSCAN performed the worst, with the lowest Silhouette Score (0.01) and Dunn Index (0.08), and the highest DB Index (1.39).")
```

```
K-Means is the best model with the highest Silhouette Score (0.33), best DB Index (1.01), and higher Dunn Index (0.22).
DBSCAN performed the worst, with the lowest Silhouette Score (0.01) and Dunn Index (0.08), and the highest DB Index (1.39).
```