

# Clustering Analysis Report

## Number of Clusters Formed:

- **KMeans Clustering:** 4 clusters
- **Agglomerative Clustering:** 4 clusters
- **Gaussian Mixture Model (GMM):** 4 clusters

## Evaluation Metrics:

- **Silhouette Score:**
  - KMeans: **0.3309**
  - Agglomerative: **0.2434**
  - GMM: **0.1963**
- *Higher Silhouette Scores indicate well-separated clusters. KMeans achieved the best score among the three methods.*
- **Davies-Bouldin Index (DBI):**
  - KMeans: **0.9488**
  - Agglomerative: **1.2784**
  - GMM: **1.1334**
- *Lower DBI values indicate better clustering. KMeans outperformed Agglomerative and GMM in this metric.*

## Observations:

- **KMeans** consistently outperformed the other two clustering methods in both metrics, indicating it provided the most cohesive and well-separated clusters.
- **Agglomerative Clustering** exhibited moderate performance but struggled with separation, as reflected in its higher DBI and lower Silhouette Score.
- **GMM** showed the weakest performance, likely due to overlap among clusters, as suggested by its lowest Silhouette Score.

## Visual Analysis:

- The clustering results were visualized using PCA for dimensionality reduction.
  - KMeans clusters appeared distinct and well-separated.
  - Agglomerative clusters showed some overlap between neighboring clusters.
  - GMM clusters had significant overlap, making differentiation challenging.

## Recommendation:

Based on the evaluation metrics and visual inspection, **KMeans Clustering** is recommended for this dataset.