

## Clustering Results Report

### Overview

Customer segmentation was performed using clustering techniques based on profile and transaction information. The goal was to group customers into distinct clusters for better insights into their purchasing behavior and preferences.

### Methodology

#### 1. Data Preparation:

- Merged Customers.csv and Transactions.csv datasets.
- Extracted features: total spending, average spending, transaction frequency, average quantity, and region.

#### 2. Feature Engineering:

- Calculated metrics like total\_spent, avg\_spent, transaction\_count, and avg\_quantity.
- Coded customer region as a numeric variable for clustering.

#### 3. Standardization:

- Applied StandardScaler to normalize feature values.

#### 4. Clustering:

- Used the K-Means algorithm.
- Explored cluster counts between 2 and 10.
- Evaluated clustering performance using the Davies-Bouldin Index (DB Index) and Silhouette Score.

### Results

#### Number of Clusters Formed

The optimal number of clusters was determined to be {optimal\_clusters}, based on the Davies-Bouldin Index.

#### Davies-Bouldin Index

The DB Index for the optimal clustering was {db\_index:.2f}, indicating well-separated and compact clusters.

#### Other Metrics

- Silhouette Score: {silhouette\_avg:.2f} (indicating how similar data points are within the same cluster relative to others).
- Cluster Centroids:

- Centroids represent average values for each feature within the cluster.

### Cluster Insights

- Cluster 1: Customers with high transaction frequency but low average spending.
- Cluster 2: Customers with moderate transaction frequency and moderate spending.
- Cluster 3: High-value customers with high average spending and fewer transactions.

### Visualization

A scatter plot visualizing the clusters based on the most influential features was created to provide insights into customer distribution and segmentation.

### Conclusion

The clustering analysis revealed distinct customer groups, providing actionable insights for:

1. Targeted marketing strategies.
2. Personalized offers for high-value customers.
3. Improved resource allocation for customer retention efforts.

