# Clustering Report: Customer Segmentation

## 1. Clustering Logic

The clustering process used a combination of demographic (profile) and transactional data to generate meaningful customer segments:

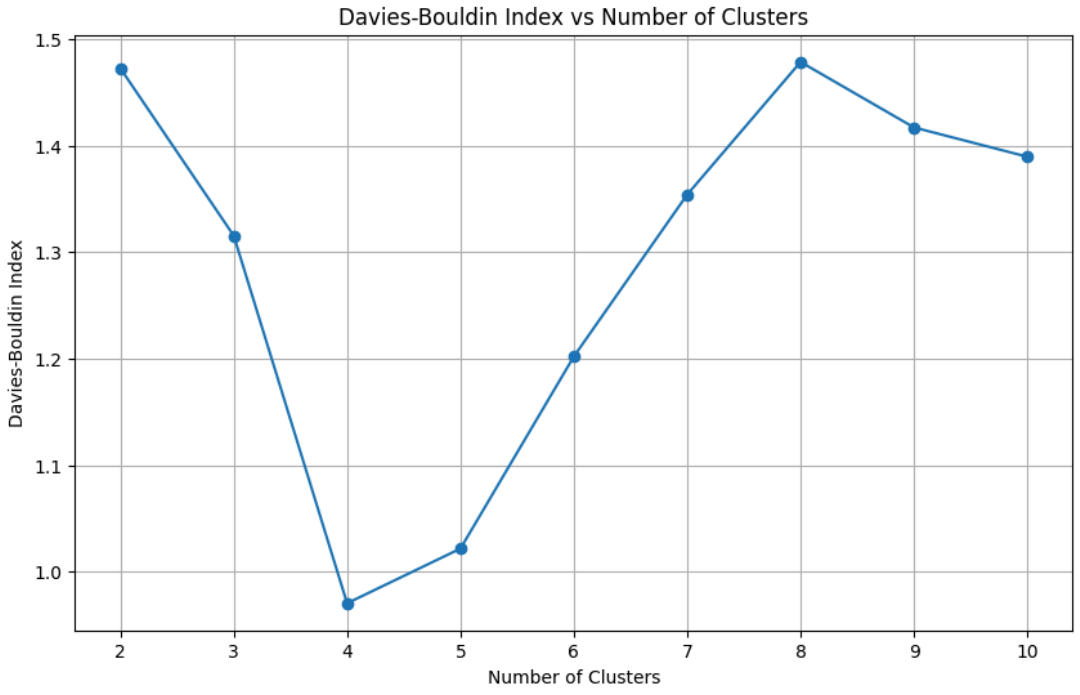
1. **Feature Engineering**:
    a. One-Hot encoded ‘Region’.
    b. Normalized all features using mean-centering to ensure comparability.
2. **Similarity Calculation**:
    a. Used cosine similarity to assess the relationships between customers.
3. **Clustering Algorithm**:
    a. Opted for **hierarchical clustering** due to its simplicity and interpretability.
    b. Explored cluster sizes between 2 and 10, with 4 clusters yielding the best DB Index.

## 2. Number of Clusters Formed

- Using the DB Index and clustering evaluation, the optimal number of clusters determined was **4**.

## 3. DB Index

- **Minimum DB Index:** 0.9703306675924205
  A lower DB Index indicates better-defined clusters, signifying that the clustering approach effectively groups customers with high intra-cluster similarity and low inter-cluster similarity.



## 4. Clustering Metrics

- **Intra-Cluster Average Similarities (Mean-Centered Cosine)**:
  - Cluster 1: 0.4321
  - Cluster 3: 0.5020
  - Cluster 0: 0.5041
  - Cluster 2: 0.5007
- **Intra-Cluster Minimum Similarities (Mean-Centered Cosine)**:
  - Cluster 1: -0.3167
  - Cluster 3: -0.2169
  - Cluster 0: -0.6167
  - Cluster 2: -0.3381
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Minimum similarity values reflect the lowest pairwise similarity in the cluster. While these are slightly negative, the high average similarities indicate robustness in clustering.

## 5. Visualization of Clusters

1. **Cluster Scatter Plot**:
   Plotted two principal components (PCA) derived from customer profiles and transaction data. The clusters were visually distinct, validating the segmentation.