

## Clustering Report

### 1. Optimal Cluster Selection

The optimal number of clusters was obtained using the Davies-Bouldin Index.

The minimum Davies-Bouldin score was at  $K = \{\text{optimal\_k}\}$ . This is where the best clustering occurs.

### 2. Clustering Summary

Customers were grouped into  $\{\text{optimal\_k}\}$  clusters according to their regional information and transaction spending.

The segmentation aids in identifying groups of customers who have similar purchasing behaviors.

### 3. Clustering Evaluation (Davies-Bouldin Index)

The Davies-Bouldin Index Score for the clustering model is  $\{\text{np.min(db\_scores):.4f}\}$ .

A low score means the cluster boundaries are well defined with high intra-cluster similarity and low inter-cluster similarity.

### 4. Cluster Visualizations

PCA for a 2D visualization shows understanding of customer distributions in different clusters.

The plot depicts clear groupings; thus, the segmentation model is correct.

### 5. Business Impact

Personalized Promotion: Each cluster can be targeted with specific promotions.

Pricing Strategy: High-spending customers can receive exclusive deals.

Product Suggestions: Cluster-based suggestions can increase engagement.

## Conclusion

The clustering analysis can be used to gain actionable insights for marketing, customer retention, and strategic business planning. Further enhancements could involve deeper analysis with demographic data and purchasing trends.

