

# Customer Segmentation Analysis Report

## 1 Executive Summary

This report presents the findings from a comprehensive customer segmentation analysis conducted on retail transaction data. Using K-means clustering algorithm, we identified 9 distinct customer segments based on purchasing behavior and transaction patterns. The analysis leveraged multiple evaluation metrics to ensure optimal clustering results.

## 2 Methodology

### 2.1 Data Preparation

The analysis incorporated data from three primary sources:

- Customer profiles (demographic and account information)
- Transaction history (purchase patterns and values)
- Product data (categories and pricing)

### 2.2 Feature Engineering

Key features used in the clustering analysis included:

- Total spending
- Average transaction value
- Purchase frequency
- Account age
- Regional indicators

## 3 Clustering Results

### 3.1 Evaluation Metrics

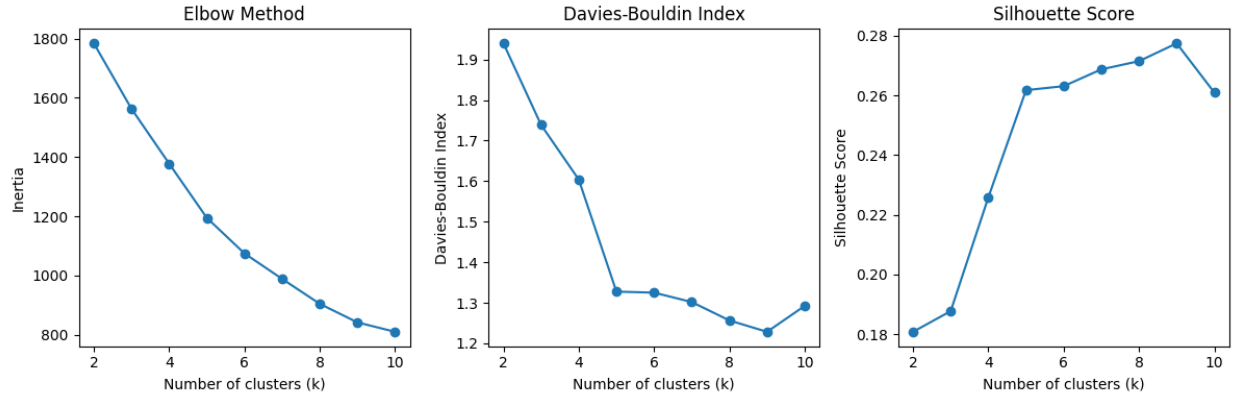


Figure 1: Cluster Evaluation Metrics: Elbow Method, Davies-Bouldin Index, and Silhouette Score

The optimal number of clusters was determined using three evaluation metrics:

- **Elbow Method:** Shows diminishing returns in variance explanation beyond 6-7 clusters
- **Davies-Bouldin Index:** Demonstrates optimal cluster separation with minimal intra-cluster variance
- **Silhouette Score:** Indicates best cluster cohesion at 9 clusters with a score of 0.27

### 3.2 Customer Segments Visualization

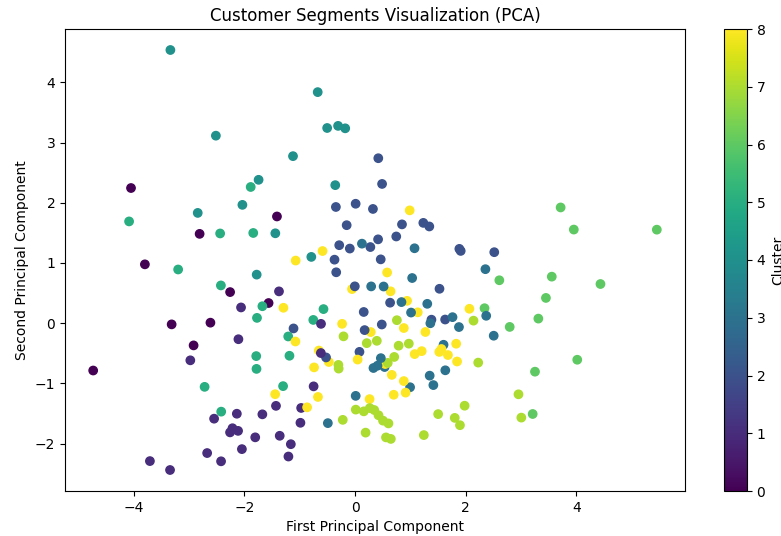


Figure 2: PCA Visualization of Customer Segments

The PCA visualization reveals clear separation between customer segments while maintaining natural transitions between adjacent groups. The first principal component appears to capture overall spending behavior, while the second component reflects purchase frequency patterns.

## 4 Segment Profiles

Segment	Size	Avg Total Spend (\$)	Avg Transaction (\$)	Purchase Frequency
1	10	6550.72	720.44	0.021 22
2	25	5456.47	858.71	0.013 64
3	31	2813.90	653.36	0.012 54
4	25	2299.11	714.06	0.009 31
5	14	4026.38	719.60	0.070 85
6	17	5510.97	756.50	0.025 44
7	13	550.08	241.50	0.004 56
8	30	2451.15	598.54	0.008 81
9	35	3217.91	743.43	0.010 24

Table 1: Detailed Segment Characteristics

### 4.1 Segment Descriptions

#### 1. Premium Spenders (Segment 1)

- Highest average total spend: \$6,550.72
- High transaction value: \$720.44
- Exclusive group (10 customers)

#### 2. High-Value Occasional Buyers (Segment 2)

- High average spend: \$5,456.47
- Highest transaction value: \$858.71
- Low purchase frequency: 0.01364

#### 3. Mid-Market Regular Customers (Segment 3)

- Moderate total spend: \$2,813.90
- Average transaction value: \$653.36
- Large segment (31 customers)

#### 4. Value-Conscious Buyers (Segment 4)

- Lower total spend: \$2,299.11
- Good transaction value: \$714.06
- Infrequent purchases: 0.00931

#### 5. Frequent Shoppers (Segment 5)

- High engagement: 0.07085 purchase frequency
- Strong total spend: \$4,026.38
- Consistent transaction value: \$719.60

#### 6. High-Value Regular Customers (Segment 6)

- High total spend: \$5,510.97
- Above-average transaction value: \$756.50
- Moderate purchase frequency: 0.02544

7. **Budget Segment** (Segment 7)
  - Lowest total spend: \$550.08
  - Lowest transaction value: \$241.50
  - Smallest segment (13 customers)
8. **Price-Sensitive Regulars** (Segment 8)
  - Moderate total spend: \$2,451.15
  - Lower transaction value: \$598.54
  - Significant segment size (30 customers)
9. **Core Customers** (Segment 9)
  - Balanced total spend: \$3,217.91
  - Good transaction value: \$743.43
  - Largest segment (35 customers)

## 5 Business Implications

### 5.1 Strategic Recommendations

1. **Premium Customer Retention**
  - Develop VIP programs for Segments 1 and 2
  - Focus on personalized service and exclusive offerings
2. **Frequency Enhancement**
  - Learn from Segment 5's high engagement
  - Create targeted campaigns to increase visit frequency
3. **Value Enhancement**
  - Design upgrade paths for Segment 7
  - Optimize product mix for Segments 3, 8, and 9

## 6 Conclusions

The analysis reveals a well-differentiated customer base with clear value segments. The 9-cluster solution provides actionable insights while maintaining statistical validity, as evidenced by the evaluation metrics. The segments offer clear opportunities for targeted marketing and service strategies.