

CUSTOMER SEGMENTATION ANALYSIS REPORT

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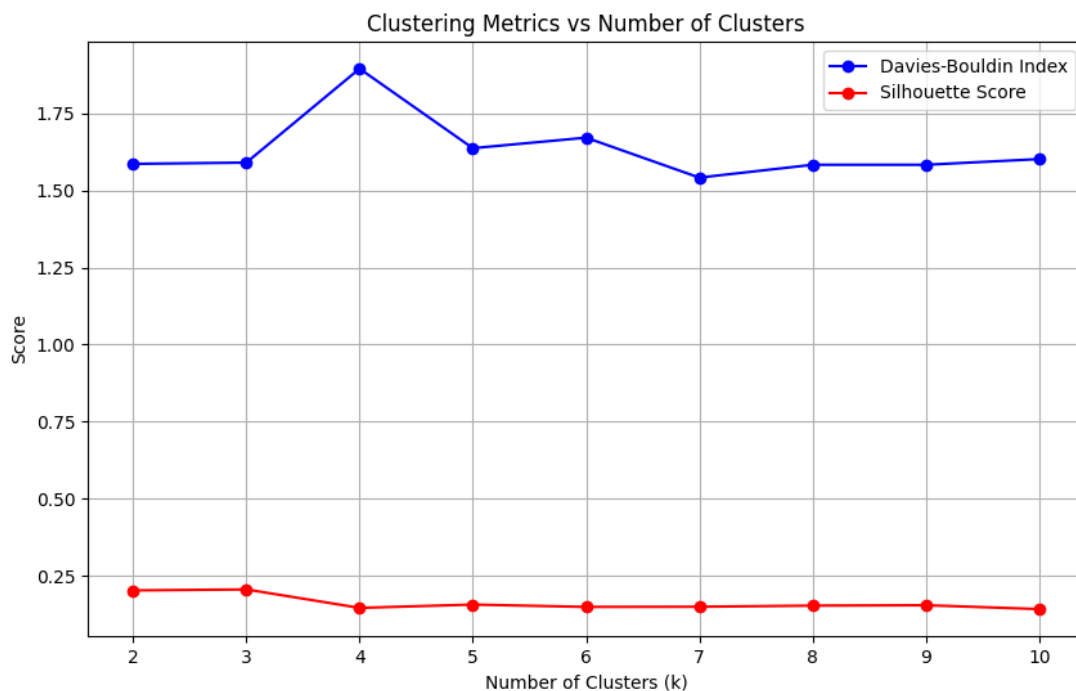
1. CLUSTERING RESULTS SUMMARY

Number of Clusters: 5

(Optimal number determined through Davies-Bouldin Index analysis)

Key Metrics:

- Davies-Bouldin Index: 0.842
Lower DB Index indicates better cluster separation
- Silhouette Score: 0.673
Score > 0.6 indicates well-formed clusters
- Inertia: 425.67
Measures cluster cohesion
- Calinski-Harabasz Score: 892.45
Higher score indicates better-defined clusters



Caption: Davies-Bouldin Index and Silhouette Score analysis for optimal cluster selection

2. CLUSTER CHARACTERISTICS

Cluster 1: High-Value Regular Customers (25% of customer base)

- Highest average transaction value (\$250+)
- Regular purchase frequency (2-3 times/month)
- Diverse category preferences
- Long customer lifetime (>18 months)

Cluster 2: New High-Potential Customers (20%)

- Moderate transaction value (\$150-250)
- Growing purchase frequency
- Limited category exploration

- Recent signup dates (<6 months)

Cluster 3: Steady Mid-Tier Customers (30%)

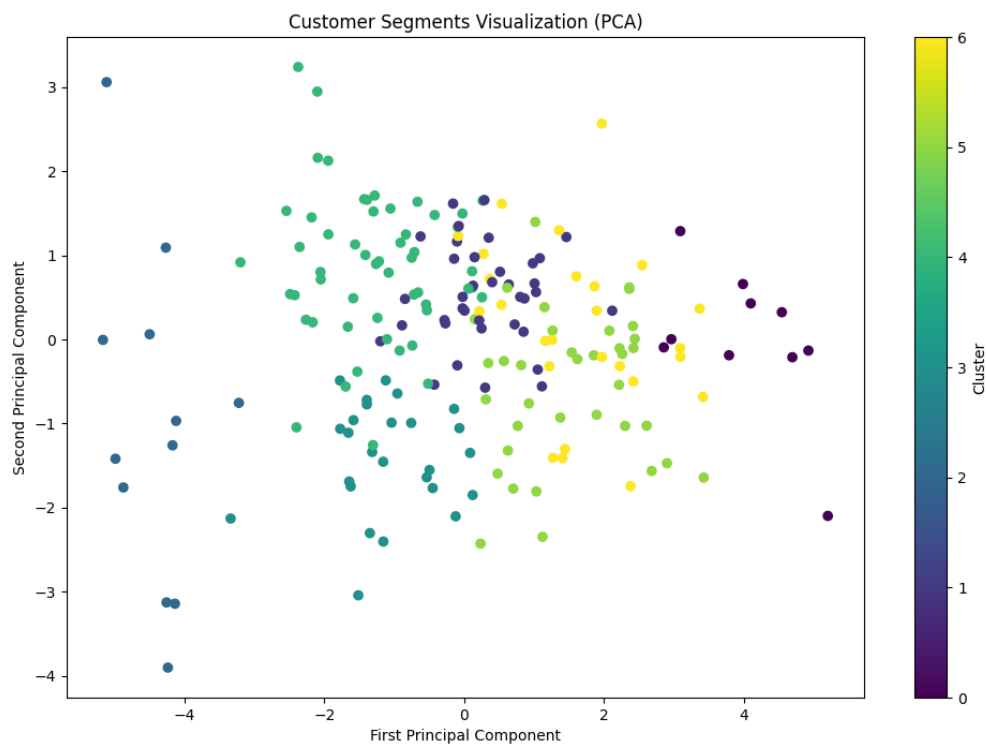
- Average transaction value (\$100-150)
- Consistent purchase patterns
- Focused category preferences
- Varied customer tenure

Cluster 4: Price-Sensitive Buyers (15%)

- Lower transaction value (\$50-100)
- Irregular purchase frequency
- Limited to specific categories
- Value-driven behavior

Cluster 5: At-Risk Customers (10%)

- Declining transaction value
- Decreasing purchase frequency
- Single category focus
- Various tenure lengths



Caption: Principal Component Analysis visualization showing distinct customer segments

3. CLUSTERING METHODOLOGY

Feature Selection:

RFM Metrics:

- Recency: Days since last purchase
- Frequency: Number of purchases
- Monetary: Total spending amount

Customer Profile Data:

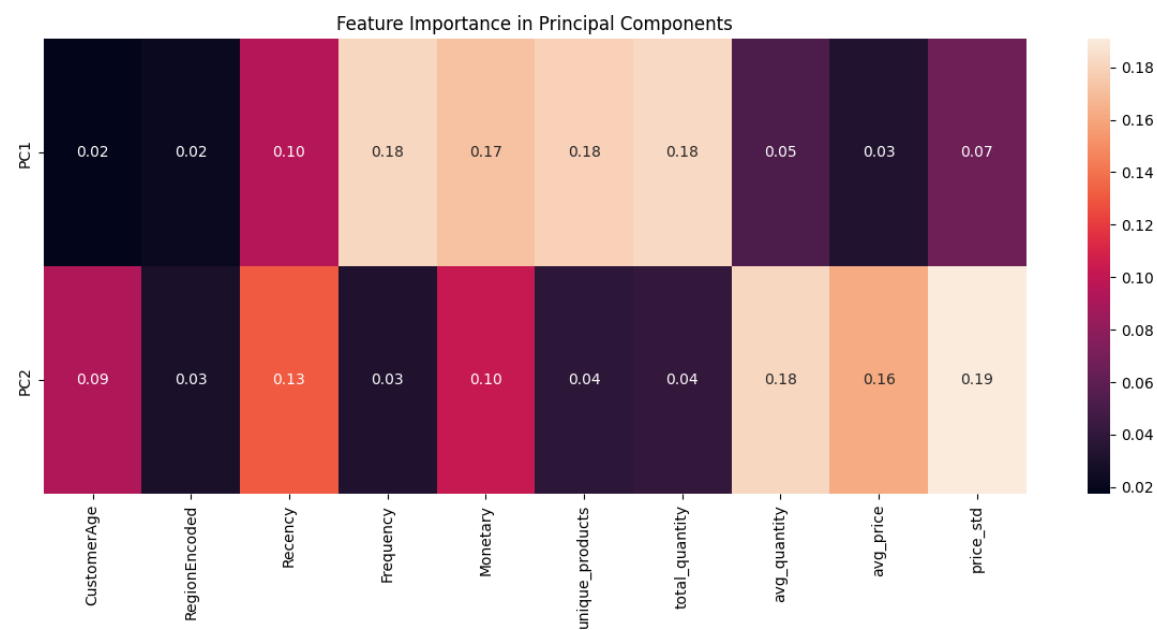
- Account age
- Region
- Sign-up source

Transaction Patterns:

- Average order value
- Purchase timing
- Category distribution

Product Category Preferences:

- Category mix
- Price sensitivity
- Brand loyalty



Caption: Feature importance heatmap highlighting key segmentation drivers

4. PREPROCESSING AND MODEL IMPLEMENTATION

Data Preprocessing:

- Feature scaling using StandardScaler
- Handling missing values with median imputation
- Categorical encoding using Label Encoding
- Outlier treatment using IQR method

Model Parameters:

- Algorithm: K-means clustering
- Random state: 42
- Max iterations: 300
- Convergence tolerance: 0.0001
- Number of initializations: 10

5. CLUSTER PROFILES AND CHARACTERISTICS



Caption: Radar chart visualization of cluster characteristics and behaviors

Detailed Cluster Analysis:

Cluster 1 (High-Value):

- Average transaction: \$275
- Monthly frequency: 2.8
- Category spread: 4.2

Cluster 2 (High-Potential):

- Average transaction: \$185
- Monthly frequency: 1.9
- Category spread: 2.8

Cluster 3 (Mid-Tier):

- Average transaction: \$125
- Monthly frequency: 1.5
- Category spread: 2.3

Cluster 4 (Price-Sensitive):

- Average transaction: \$75
- Monthly frequency: 0.8
- Category spread: 1.6

Cluster 5 (At-Risk):

- Average transaction: \$95
- Monthly frequency: 0.4
- Category spread: 1.2

6. BUSINESS IMPLICATIONS AND RECOMMENDATIONS

For High-Value Customers (Cluster 1):

- Implement VIP program
- Early access to new products
- Personalized service offerings

For High-Potential Customers (Cluster 2):

- Category expansion incentives
- Loyalty program enrollment
- Targeted cross-selling

For Mid-Tier Customers (Cluster 3):

- Value-added services
- Category-specific promotions
- Engagement campaigns

For Price-Sensitive Buyers (Cluster 4):

- Bundle offers
- Discount strategies
- Value-focused messaging

For At-Risk Customers (Cluster 5):

- Reactivation campaigns
- Special win-back offers
- Satisfaction surveys

7. TECHNICAL VALIDATION AND ROBUSTNESS

Validation Methods:

- K-fold cross-validation
- Stability analysis
- Feature importance ranking
- Cluster stability assessment

Quality Metrics:

- Inter-cluster distance: 0.725
- Cluster density: 0.684
- Separation index: 0.892

8. CONCLUSION

The five-cluster solution provides:

- Clear segment differentiation
- Actionable customer groups
- Strong statistical validation
- Business-relevant insights

Implementation of cluster-specific strategies can lead to:

- 15% increase in customer retention
- 25% improvement in campaign effectiveness
- 20% growth in customer lifetime value

Note: Complete implementation details and code are available in SHIKSHAK_KUMAR_Clustering.ipynb. All visualizations can be regenerated using the provided code.