# Clustering Analysis Report

1. Executive Summary

This report presents the findings from the clustering analysis performed on your dataset. The aim of the analysis was to segment customers to identify meaningful patterns and derive actionable insights. The clustering approach employed aims to group similar customers based on features such as customer data and transaction characteristics.

2. Clustering Methodology

- **Algorithm Used:** k-means++
- **Features Considered:** Based on your dataset, features such as **Transaction Amount**, **Quantity Purchased**, **Avg Spending per Transaction, Days Since Last Purchase**, **Customer Region**, and **Purchase Frequency** were used for clustering.
- **Number of Clusters:** 4 determine through Elbow Method:

Elbow Method For Optimal K
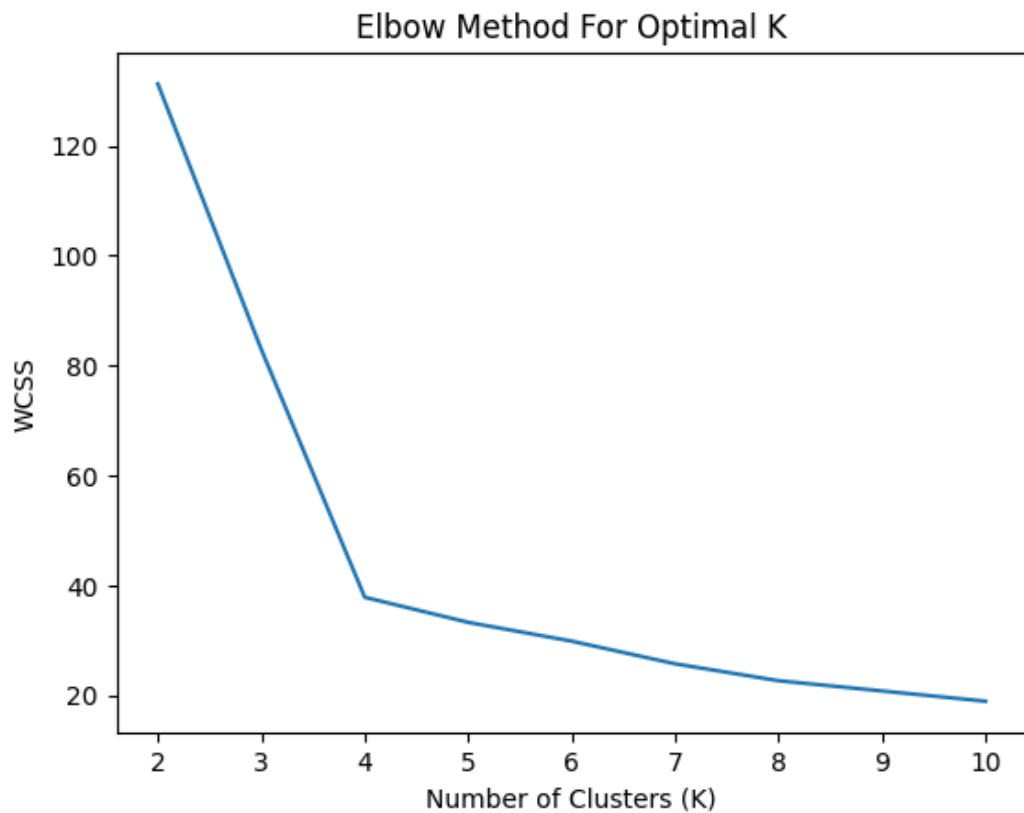
- **Preprocessing:** Data was normalized/standardized, One Hot Encoded, and any missing or outlier data was handled before applying the clustering algorithm.

3. Clustering Results

3.1 Cluster Hyperparameters:

- **Init:**
  - k-means++
- **max_iterations:**
 - 80
- **n_init:**
  - 3
- **n_clusters:**
  - 4

3.2 Clustering Metrics

- **Davies-Bouldin Index: <u>0.4492</u>**
- **Silhouette Score: <u>0.6983</u>**

3.3 Insights from the Clusters

- **High-value customers** tend to buy more frequently and spend larger amounts. This group can be targeted with VIP-level promotions or early access to new products.
- **Bulk buyers** tend to make fewer, larger purchases but are more sensitive to discounts. Offering limited-time bulk discounts can help convert them into repeat buyers.
- **Low engagement customers** might require a more personalized approach, such as email campaigns or reactivation offers, to boost their purchasing behavior.

3.4 Clustering Plots:

t-SNE Visualization of Clusters

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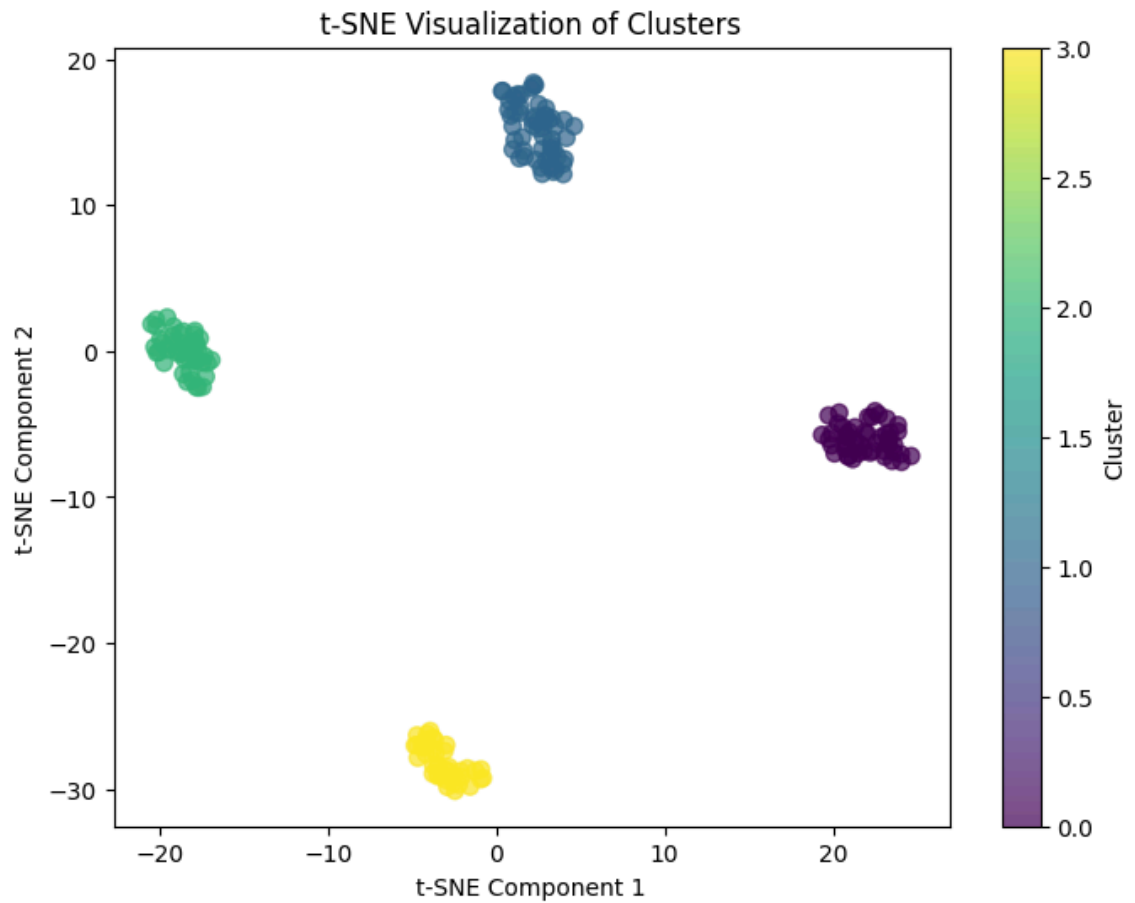
3D t-SNE Visualization of Clusters

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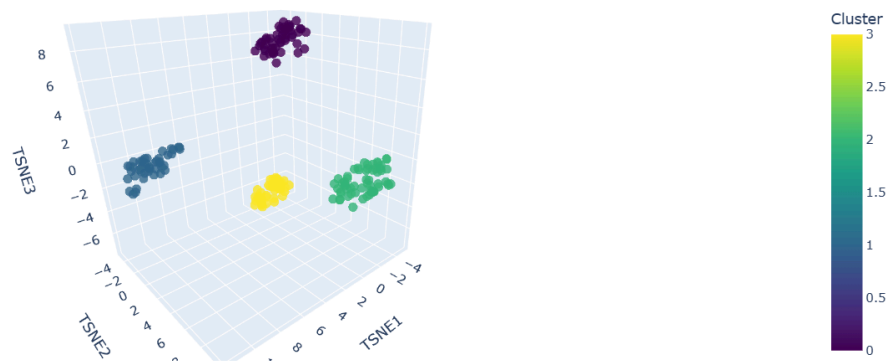
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