Title: Customer Segmentation Using Clustering Algorithms

1. **Introduction** The purpose of this report is to explore customer segmentation using clustering techniques. By segmenting customers into different groups based on their purchasing behaviors and demographics, businesses can target specific customer groups with tailored marketing strategies and personalized experiences. In this analysis, K-means clustering was used to segment customer data into meaningful clusters based on transaction patterns and behaviors.

2. **Data Overview**
   a. **Data Sources:** The customer data used in this analysis includes transactional information such as customer ID, product ID, transaction amount, quantity, and transaction date.
   b. **Features:** The features used for clustering include:
      i. **Total Transaction Value:** Total amount spent by the customer across all transactions.
      ii. **Transaction Frequency:** Number of transactions made by the customer in a given period.
      iii. **Average Spend per Transaction:** The average amount spent per individual transaction.

3. **Methodology**
   a. **Data Preprocessing:**
      i. Missing values were handled by either imputation or removal.
      ii. Data was standardized to ensure equal importance of all features in the clustering process.
   b. **Clustering Algorithm:**
      i. K-means clustering was applied to group customers into k clusters.
      ii. The optimal number of clusters was determined using the Elbow Method, which evaluates the point where adding more clusters no longer improves the model significantly.
      iii. Principal Component Analysis (PCA) was used to reduce the dimensionality of the data and visualize the clusters.
   c. **Evaluation:**
      i. The Davies-Bouldin Index (DB Index) was used to evaluate the clustering results. A lower DB index indicates better clustering quality.

4. **Results**
   a. **Cluster Distribution and Cluster Visualization:**
      i. The clustering process resulted in three primary customer segments based on purchasing behavior.

Cluster ID	Avg Total Spend	Avg Transaction Count	Avg Spend per Transaction

      ii. A PCA scatter plot of the clusters:

Customer Segmentation Clusters

       iii.

b. Cluster Insights:

    i.   **Cluster 1:** High-value, frequent buyers who make multiple transactions.

    ii.   **Cluster 2:** Moderate-value, moderate-frequency buyers.

    iii. **Cluster 3:** High-value, infrequent buyers who spend larger amounts on fewer transactions.

5. **Conclusion** Customer segmentation via clustering provides valuable insights into customer behaviours, enabling businesses to tailor marketing strategies. The findings from the clustering analysis can be used for targeted promotions, loyalty programs, and improving customer service. The segmentation will also help in understanding customer needs and preferences, leading to better resource allocation.