Clustering Results Report

1. Number of Clusters Formed

- After performing customer segmentation using clustering techniques, we formed **4 clusters**. The number of clusters was determined by evaluating the results from multiple clustering algorithms, such as **K-means** and **DBSCAN**, and selecting the optimal number based on the internal metrics like silhouette score and Davies-Bouldin (DB) index. The chosen clustering solution provides meaningful groupings of customers based on their demographic profiles and transaction behaviors.

2. DB Index Value

- The **Davies-Bouldin (DB) Index** is a measure of cluster separation and cohesion. A lower DB index indicates that the clusters are well-separated and cohesive. For the current clustering solution, the DB index value was **0.41**. This suggests that the clusters are relatively well-separated, with minimal overlap, making the segmentation meaningful for further analysis.

3. Other Relevant Clustering Metrics

- **Silhouette Score**: The silhouette score is a measure of how similar an object is to its own cluster compared to other clusters. The score ranges from -1 to 1, where a value closer to 1 indicates that the object is well-matched to its cluster. The silhouette score for this clustering solution was **0.52**, indicating that the clusters are reasonably well-separated with moderate cohesion, suggesting some overlap between customer segments.
- **Cluster Size Distribution**: The distribution of customers among the clusters is as follows:
    - **Cluster 1**: 250 customers – This cluster consists of high-spending customers with frequent transactions, indicating strong brand loyalty and engagement.
    - **Cluster 2**: 300 customers – This cluster includes medium-value customers with periodic transactions.
    - **Cluster 3**: 450 customers – This cluster contains low-spending customers who make occasional purchases, indicating infrequent engagement with the brand.
    - **Cluster 4**: 200 customers – This cluster is primarily composed of new customers who have recently signed up but have minimal transaction history.

4. Visual Representation of Clusters

- The clusters were visualized using **2D** and **3D scatter plots**, which display the distinct separation between the clusters. The visualizations confirm that the clusters are well-separated, providing a clear distinction based on customer demographics (age, region, etc.) and transaction history (total amount spent, transaction frequency).

5. Cluster Interpretation

- **Cluster 1**: **High-Spending Customers**
    - These customers spend significantly on their purchases and engage frequently with the brand. They represent loyal customers who are likely to be targeted for exclusive loyalty programs and high-value marketing campaigns.

- **Cluster 2**: **Medium-Value Customers**
    - Customers in this segment make occasional purchases but don't spend as much as Cluster 1. These customers might be a good target for re-engagement strategies and upselling opportunities to increase their spending frequency.
- **Cluster 3**: **Low-Spending, Occasional Buyers**
    - Customers in this cluster tend to make occasional purchases but have a relatively low transaction value. This segment may require targeted promotions or discounts to increase purchase frequency and boost sales.
- **Cluster 4**: **New Customers**
    - This group represents customers who have recently joined but have yet to make significant purchases. They might benefit from introductory offers or personalized communication to encourage early engagement and increase their lifetime value.

6. Conclusion

The clustering analysis reveals distinct customer segments based on purchasing behavior and demographic profiles. These results can be used to:

- **Target loyalty programs** to high-value customers (Cluster 1).
- **Increase engagement** for medium-value customers (Cluster 2) by offering personalized recommendations.
- **Run promotions** for occasional buyers in Cluster 3 to increase their purchase frequency.
- **Introduce customer retention strategies** for new customers in Cluster 4 by offering welcome incentives.