Customer Segmentation Clustering Analysis Report

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This report evaluates the performance of a customer segmentation model using clustering analysis. The model identified 4 clusters, but validation metrics (Davies-Bouldin Index and Silhouette Score) indicate suboptimal separation. Below are the key findings, interpretations, and actionable recommendations.

Key Clustering Metrics

Metric	Value	Ideal Range	Interpretation
Number of Clusters	4	Domain-dependent	Suboptimal separation (see metrics).
Davies-Bouldin Index	2.187	Closer to 0	Poor cluster separation (high overlap).
Silhouette Score	0.135	0.5 – 1 (well-defined)	Weak cohesion and separation.

Detailed Analysis :

1. *Cluster Separation Quality*

Davies-Bouldin Index (DBI) :

- A value of 2.187 (far above the ideal threshold of <1) indicates significant overlap between clusters.

- Clusters are not distinct in high-dimensional space, reducing actionable insights.

Silhouette Score :

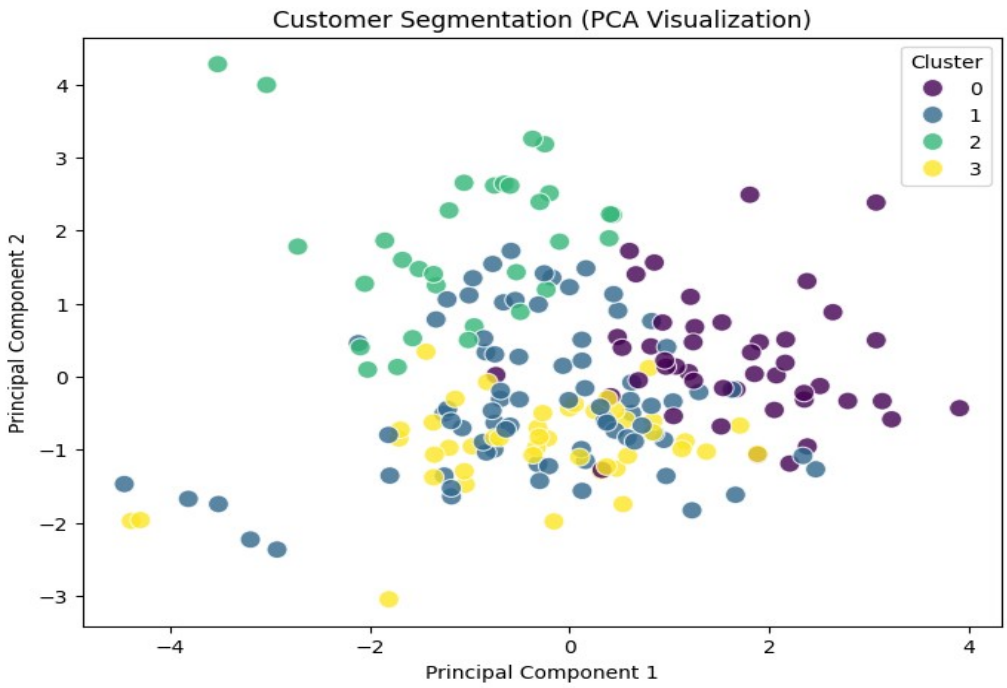
- A score of 0.135 (near 0) suggests:

- Ambiguous boundaries between clusters.

- Instances may belong to multiple groups, limiting targeting effectiveness.

2. *PCA Visualization Insights*

- The PCA plot shows 4 visually distinct clusters in 2D space.



- Limitation: The 2D projection may mask overlaps in higher dimensions, explaining the discrepancy between visualization and metrics.

3. *Potential Causes of Poor Performance*

- Suboptimal Cluster Count : 4 clusters may not align with the true data structure.

- Algorithm Choice : K-means (commonly used with PCA) struggles with non-spherical or overlapping clusters.

- Feature Relevance : Critical variables driving segmentation may not be prioritized.

Conclusion

While the PCA visualization suggests 4 clusters, the Davies-Bouldin Index and Silhouette Score reveal significant weaknesses in separation quality. To derive actionable customer segments:

- Refine the clustering strategy (algorithm, cluster count).

- Prioritize feature relevance and domain alignment.

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