Customer Segmentation (CLUSTERING)

Objective

This project is dedicated for customer segmentation using clustering methods in unsupervised machine learning for the purpose of identifying groups of customers based on their behaviors and attributes.

Benefits from Analysis

1. ***Better marketing plan***: Understand customer behaviors to make offers, promotions and gifts aways according to income and spending score.
2. ***Customer retention***: Facilitate better services and improve satisfaction for high-spending customers.
3. ***Resource allocation***: Plan marketing budgets more effectively by focusing on valuable segments based on behaviors of customers.
4. ***Inventory management***: Predict which customer group is likely to purchase what category of products and manage stock accordingly.
5. ***Customer lifecycle management***: Identify high-value customers, potential churners, and new leads based on demographic clusters.

Methods

Three main clustering methods were used in this project and selected the best one:

1. K-Means
2. Density-Based Spatial Clustering of Applications with Noise (DBSCAN) and
3. Gaussian Mixture Model (GMM)

Data Information

The small shopping mall customer data set [from Kaggle] is used as a sample data, which contains **200 records**, each row representing individual customers.

Attributes:

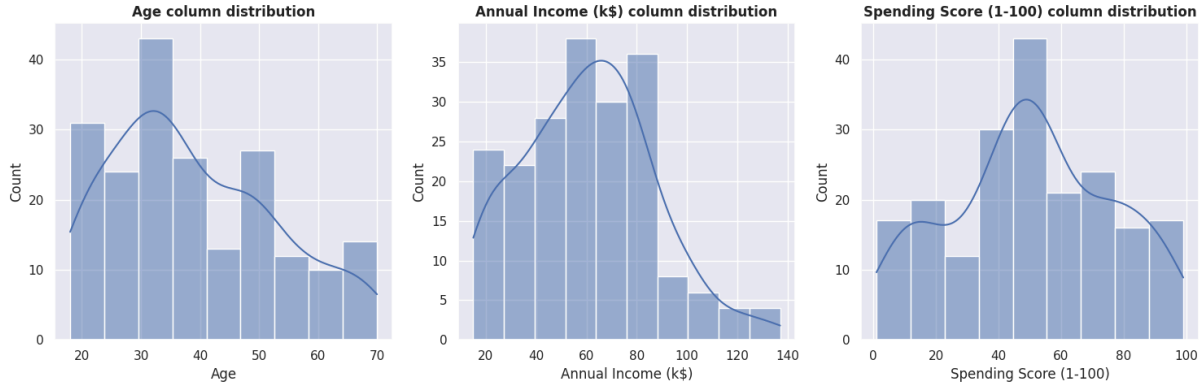
Column Names	**Description**
CustomerID	Unique ID assigned to each customer
Gender	Gender of each customer (Male/ Female)
Age	Age of each customer
Annual Income (k$)	Approximate annual income in thousands of dollars
Spending Score (1-100)	Score assigned based on customer spending behavior and shopping patterns (higher score = higher spending tendency)

Data Exploration

The data has no missing and duplicated information.

- ***Annual Income (k$)*** and ***Spending Score (1-100)*** are used as major columns to identify types of customers.
- ***Gender*** and ***Age*** columns are used to find some hidden insights.
- ***CustomerID*** column is not useful here.

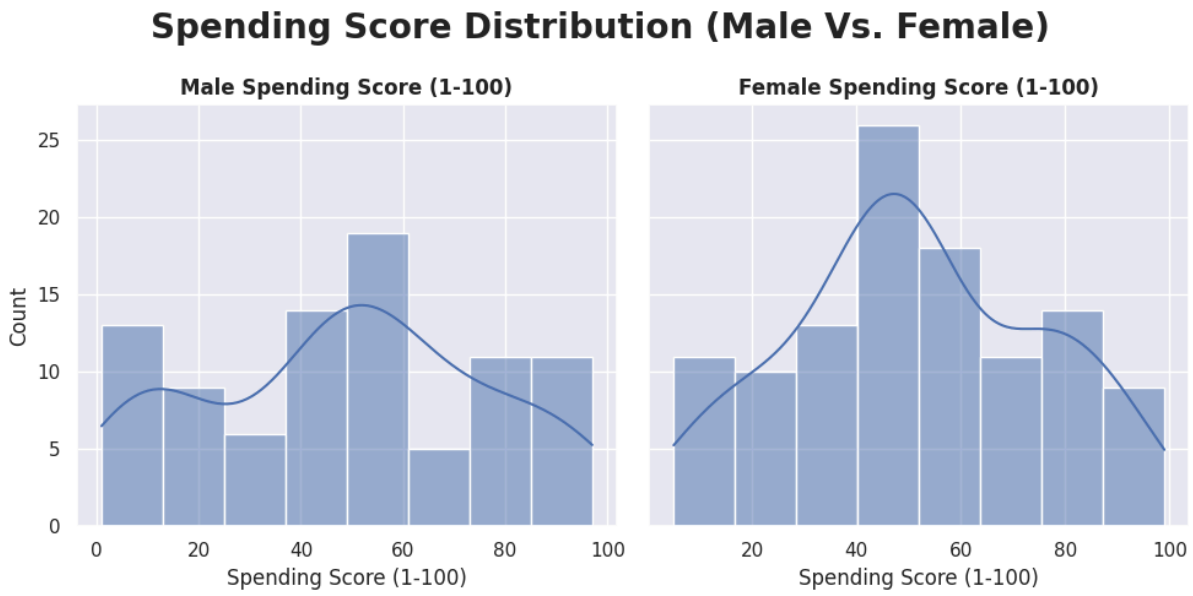
Analysis



Age: Ranging from 18 to 70 years, with a mean of approximately 38.85. The distribution shows a higher concentration of younger customers (around 20-35 years old).

Annual Income (k$): Ranges from $15k to $137k, with a mean of about $60.56k. The distribution is right-skewed, meaning few customers' annual incomes are with higher incomes.

Spending Score (1-100): Ranges from 1 to 99, with a mean of approximately 50.20. The distribution appears relatively uniform across the range.



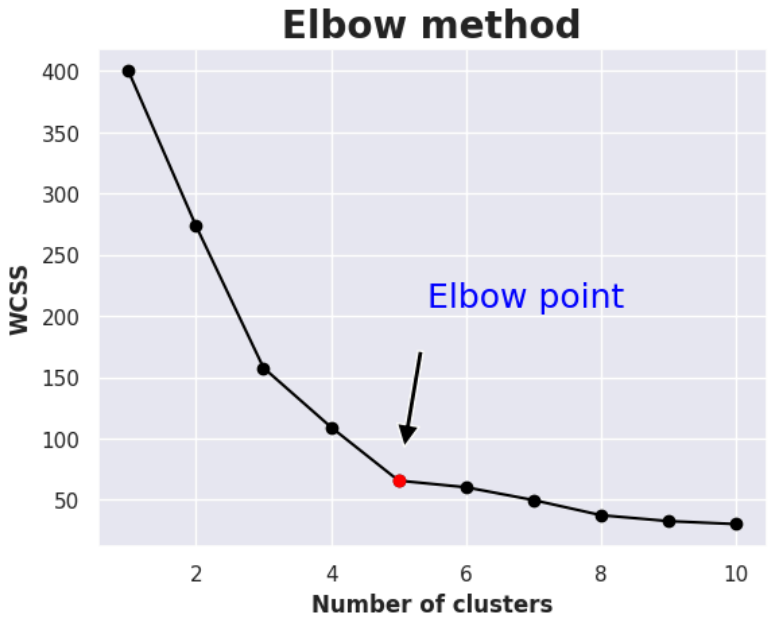
Gender Vs. Spending Score: Female spending score (ranging from 5 to 99, mean value: 51.53) is higher than male spending score(ranging from 1 to 97, mean value: 48.51).

Original Data Visualization

The original data before scaling based on majors columns (with 200 records).

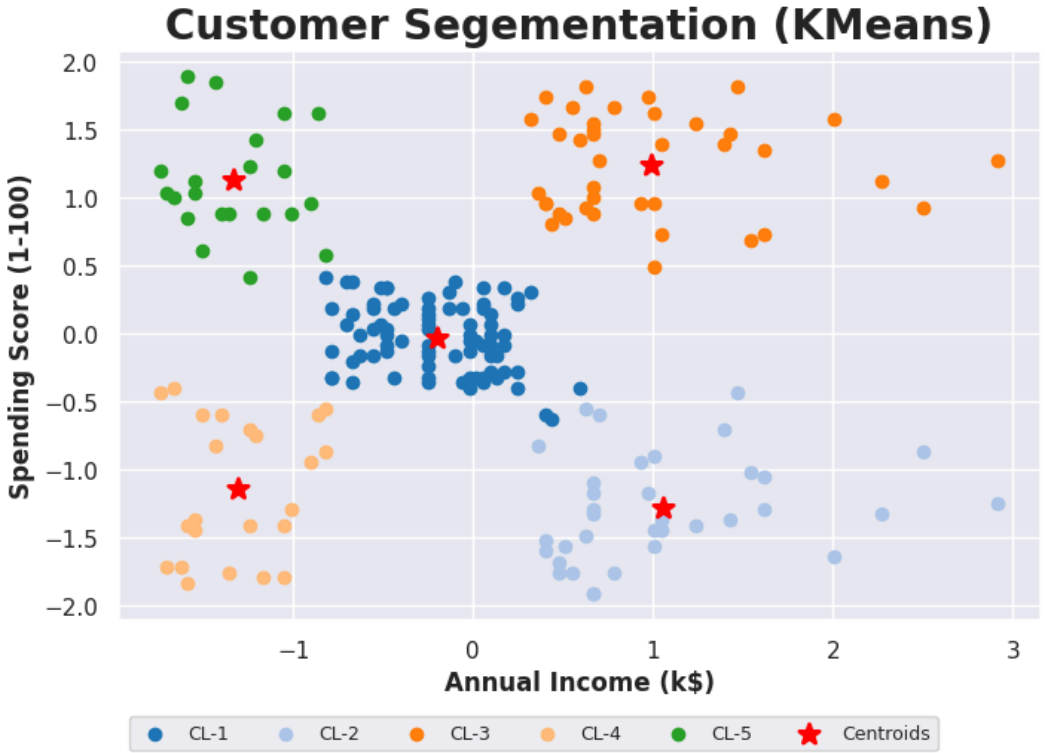
Building Models

K-Means (K = 5)



- **Elbow method** is used to find the best number of clusters K, ranging from 1 to 10.
- **K = 5** is chosen based on the result.

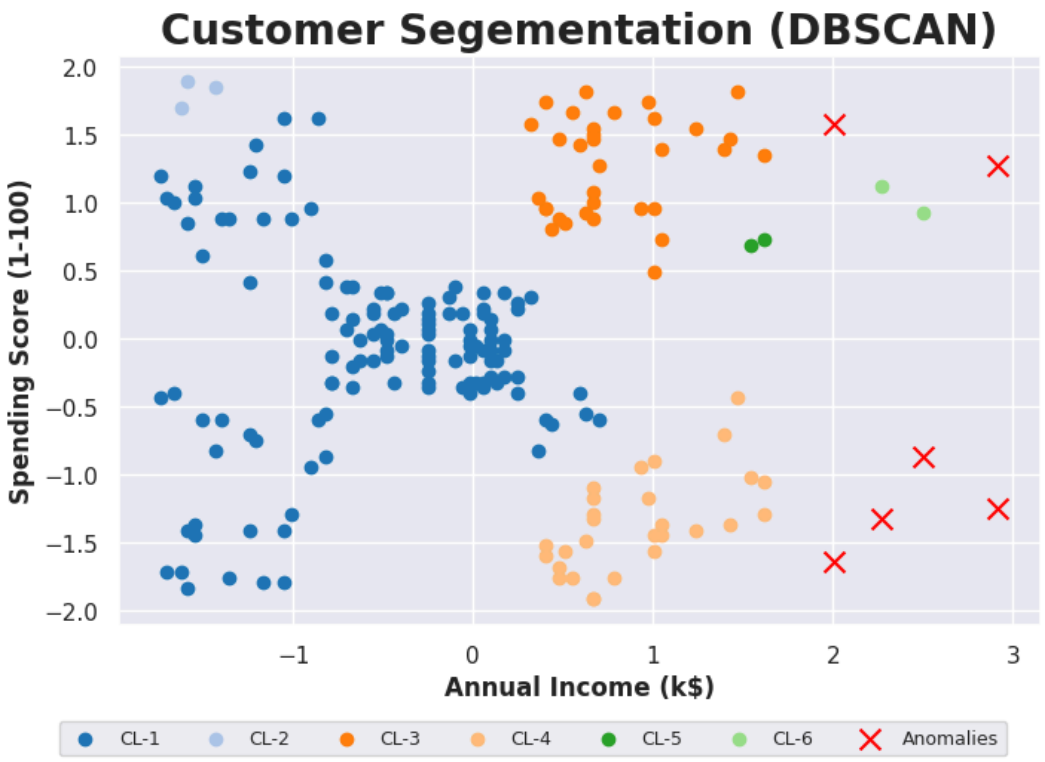
```
KMeans(n_clusters=5, init='k-means++')
```



Silhouette Score = 0.554657

DBSCAN

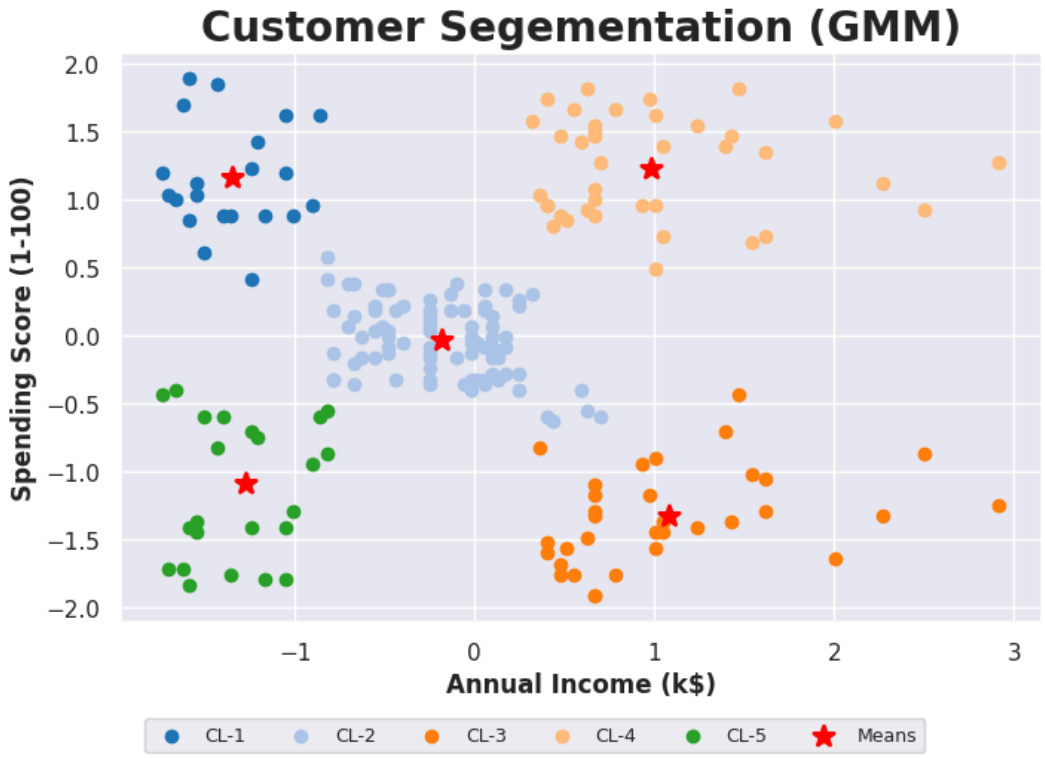
```
DBSCAN(min_samples=2, eps=10)
```



Silhouette Score = 0.322194

Gaussian Mixture Model

```
GaussianMixture(n_components=5)
```



Silhouette Score = 0.553689

Model Evaluations and Recommendation

KMeans is the best (~ near GMM) to choose for customer segmentation in clustering in this case according to model evaluations using **Silhouette Score**.

Model Names	Silhouette Score
KMeans	0.554657
GMM	0.553689
DBSCAN	0.322194

The final representation for seven type of customers are as per following:

1. High Income, High Spending
2. Moderate Income and Spending
3. Low Income and Spending
4. Low Income, High Spending
5. High Income, Low Spending

Customer_Type	Annual Income (k$)	Spending Score (1-100)
High Income, High Spending	55.296296	49.518519
High Income, Low Spending	25.727273	79.363636
Low Income and Spending	86.538462	82.128205
Low Income, High Spending	26.304348	20.913043
Moderate Income and Spending	88.200000	17.114286

Key findings

The KMeans clustering algorithm was found to be the best model for the given features of annual income and spending scores of the mall customer dataset. And it was effective in segmenting five different groups of customers as discussed earlier.

Completed code file: [LINK]