🧠 Customer Segmentation using K-Means Clustering

🔍 Machine Learning Project Report

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Tools: Python · Pandas · Scikit-learn · Matplotlib · Seaborn
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This project demonstrates the use of unsupervised machine learning to segment customers based on their spending behavior. The results provide actionable insights for targeted marketing and customer relationship strategies.

📌 1. Import Libraries

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

📂 2. Load Dataset

```
df=pd.read_csv('/content/drive/MyDrive/Freelancer/Mall_Customers.csv')
```

```
df.describe()
```

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

```
df.head()
```

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

```
df.columns
```

```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

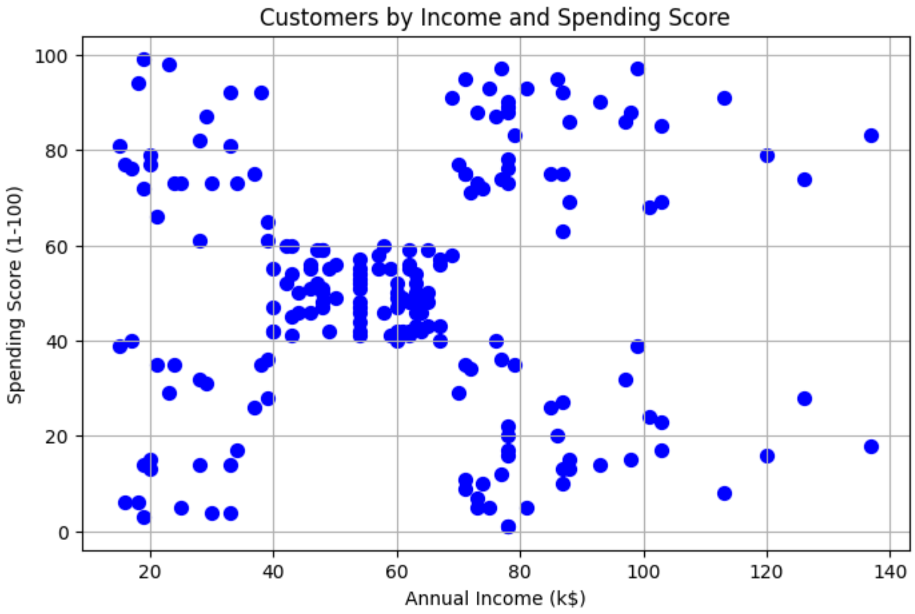
🔍 3. Exploratory Data Analysis (EDA)

```
# Select features for clustering
X = df[["Annual Income (k$)", "Spending Score (1-100)"]]

# Show first 5 rows of the selected features
X.head()

```

	Annual Income (k$)	Spending Score (1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40

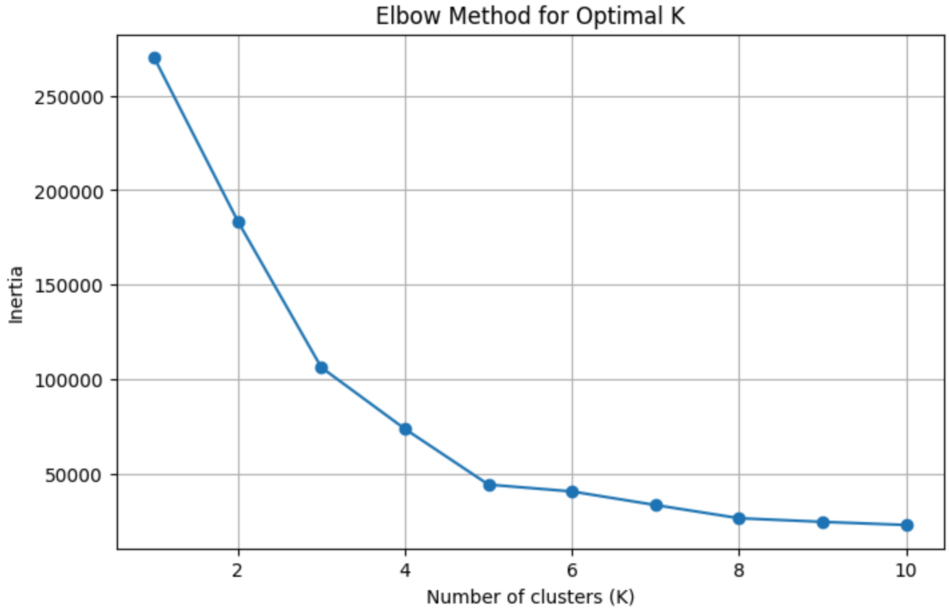
📊 4. Visualize Customer Distribution

```python
# Scatter plot to visualize customer distribution
plt.figure(figsize=(8,5))
plt.scatter(X["Annual Income (k$)"], X["Spending Score (1-100)"], c='blue', s=50)
plt.title("Customers by Income and Spending Score")
plt.xlabel("Annual Income (k$)")
plt.ylabel("Spending Score (1-100)")
plt.grid(True)
plt.show()

```



📉 5. Elbow Method to Find Optimal K

```python
from sklearn.cluster import KMeans

inertia = []
K_range = range(1, 11)

for k in K_range:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(X)
    inertia.append(kmeans.inertia_)

# Plot the elbow curve
plt.figure(figsize=(8,5))
plt.plot(K_range, inertia, marker='o')
plt.title("Elbow Method for Optimal K")
plt.xlabel("Number of clusters (K)")
plt.ylabel("Inertia")
plt.grid(True)
plt.show()

```



6. Apply K-Means Clustering

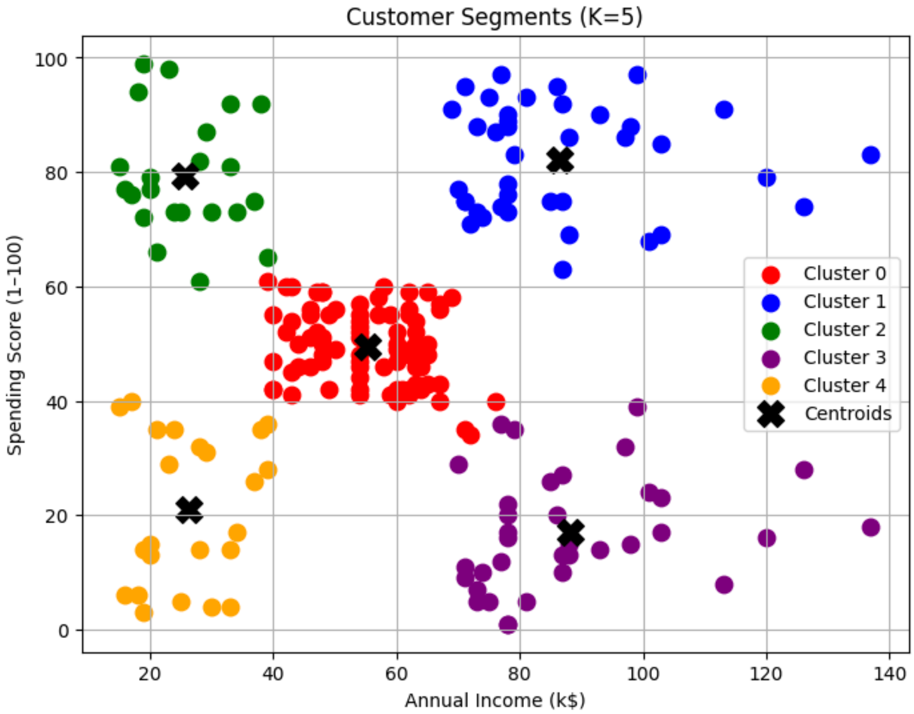
Add Cluster Labels to Dataset

```
# Apply KMeans with K=5
kmeans = KMeans(n_clusters=5, random_state=42)
clusters = kmeans.fit_predict(X)

# Add the cluster labels to the original data
df['Cluster'] = clusters

# Show the first few rows with the new cluster
df.head()

```

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)	Cluster
0	1	Male	19	15	39	4
1	2	Male	21	15	81	2
2	3	Female	20	16	6	4
3	4	Female	23	16	77	2
4	5	Female	31	17	40	4

7. Add Cluster Labels to Dataset

```
# Visualize the clusters
plt.figure(figsize=(8,6))

# Use a color for each cluster
colors = ['red', 'blue', 'green', 'purple', 'orange']

for i in range(5):
    plt.scatter(
        X[clusters == i]["Annual Income (k$)"],
        X[clusters == i]["Spending Score (1-100)"],
        s=80, c=colors[i], label=f'Cluster {i}'
    )

# Plot cluster centers
plt.scatter(
    kmeans.cluster_centers_[:, 0],
    kmeans.cluster_centers_[:, 1],
    s=200, c='black', marker='X', label='Centroids'
)

plt.title("Customer Segments (K=5)")
plt.xlabel("Annual Income (k$)")
plt.ylabel("Spending Score (1–100)")
plt.legend()
plt.grid(True)
plt.show()

```



💾 8. Export Clustered Data (optional)

```
 # Save the data with cluster labels to a CSV file
 df.to_csv('mall_customer_final.csv', index=False)
```

```
from google.colab import files
files.download('mall_customer_final.csv')

```

```
df.to_csv('/content/drive/MyDrive/Freelancer/mall_customer_final.csv', index=False)

```