A

Assesment Report

on

“Customer Segmentation in E-Commerce”

submitted as partial fulfillment for the award of

BACHELOR OF TECHNOLOGY DEGREE

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in

CSE AI & ML

By

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- **Problem Statement:** Perform customer segmentation using transactional e-commerce data. Generate classification and clustering-based insights using machine learning.

- **Introduction**

The goal of this project is to use an e-commerce transactional dataset to segment customers based on their purchasing behaviour. Using machine learning techniques, we identify high-value customers and group all customers into clusters to inform marketing and business strategies.

We approach this task in two ways:

1. **Clustering (Unsupervised Learning)** using RFM (Recency, Frequency, Monetary) features.
2. **Classification (Supervised Learning)** to predict high-value customers.

- **Methodology**

1. **Data Preprocessing:**
    - Remove entries with missing CustomerID, negative Quantity, or UnitPrice.
    - Compute TotalPrice = Quantity * UnitPrice
    - Parse InvoiceDate into datetime format.
2. **Feature Engineering (RFM Analysis):**
    - **Recency:** Days since last purchase.
    - **Frequency:** Number of invoices.
    - **Monetary:** Total amount spent.
3. **Classification:**
    - Define high-value customers as those in the top 20% based on Monetary value.
    - Apply Random Forest Classifier.
    - Evaluate using Accuracy, Precision, Recall.
4. **Clustering:**
    - Use StandardScaler and KMeans for grouping customers into 4 clusters.
    - Visualize clusters using PCA.

- Plot heatmaps for cluster RFM values.

5. **Visualization:**
    - Confusion matrix as heatmap.
    - PCA scatter plot of clusters.
    - Cluster-wise RFM heatmap.

➢ **Code**

The complete commented code is provided in the Google Colab notebook.

- Upload and preprocess the dataset
- Generate RFM features
- Classification and evaluation
- KMeans clustering and visualization

The code is given below:

```
# 📌 Install packages

!pip install seaborn --quiet


# 📄 Import libraries

import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

import seaborn as sns

from sklearn.preprocessing import StandardScaler

from sklearn.cluster import KMeans

from sklearn.decomposition import PCA

from sklearn.model_selection import train_test_split
```

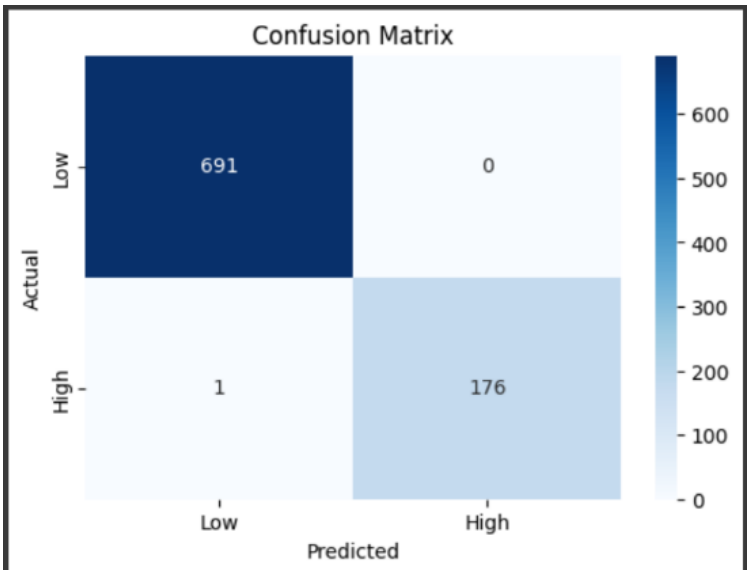
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import confusion_matrix, classification_report

# 🗁 Upload dataset
from google.colab import files
uploaded = files.upload()

# □ Load and clean data
df = pd.read_csv("Customer Segmentation in E-commerce.csv")
df['InvoiceDate'] = pd.to_datetime(df['InvoiceDate'])
df = df.dropna(subset=['CustomerID'])
df = df[(df['Quantity'] > 0) & (df['UnitPrice'] > 0)]
df['TotalPrice'] = df['Quantity'] * df['UnitPrice']

# 📊 RFM features
ref_date = df['InvoiceDate'].max()
rfm = df.groupby('CustomerID').agg({
    'InvoiceDate': lambda x: (ref_date - x.max()).days,
    'InvoiceNo': 'nunique',
    'TotalPrice': 'sum'
}).reset_index()
rfm.columns = ['CustomerID', 'Recency', 'Frequency', 'Monetary']

# 🎯 Create classification label (Top 20% as High-Value Customers)
threshold = rfm['Monetary'].quantile(0.80)
```

```
rfm['HighValue'] = (rfm['Monetary'] >= threshold).astype(int)


# ⚙️ Scaling features
features = ['Recency', 'Frequency', 'Monetary']
X = rfm[features]
y = rfm['HighValue']
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)


# 🤘 Train classification model
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)
clf = RandomForestClassifier(random_state=42)
clf.fit(X_train, y_train)
y_pred = clf.predict(X_test)


# 📈 Evaluation
print(classification_report(y_test, y_pred))


# 🔥 Confusion matrix heatmap
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(6,4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['Low', 'High'], yticklabels=['Low', 'High'])
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion Matrix')
```

```
plt.show()


# 🎯 KMeans Clustering (unsupervised)
kmeans = KMeans(n_clusters=4, random_state=42)
rfm['Cluster'] = kmeans.fit_predict(scaler.fit_transform(rfm[features]))


# 🎨 PCA for visualization
pca = PCA(n_components=2)
pca_vals = pca.fit_transform(scaler.fit_transform(rfm[features]))
rfm['PCA1'] = pca_vals[:, 0]
rfm['PCA2'] = pca_vals[:, 1]
plt.figure(figsize=(8,6))
sns.scatterplot(data=rfm, x='PCA1', y='PCA2', hue='Cluster', palette='Set2')
plt.title('Customer Segmentation via KMeans + PCA')
plt.grid(True)
plt.show()


# 🔥 RFM heatmap by cluster
cluster_summary = rfm.groupby('Cluster')[features].mean()
plt.figure(figsize=(8,5))
sns.heatmap(cluster_summary, annot=True, cmap='YlGnBu')
plt.title("RFM Feature Averages by Cluster")
plt.show()
```

➢ **Output/Result**

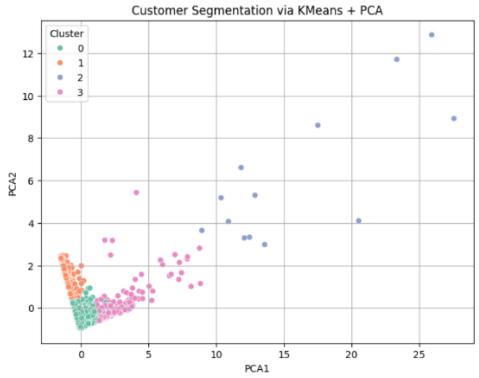
- Confusion matrix heatmap showing model performance.



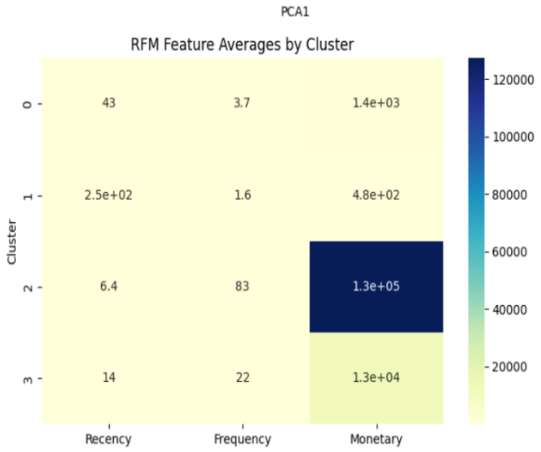
- Accuracy, Precision, and Recall printed via classification report.

	precision	recall	f1-score	support
0	1.00	1.00	1.00	691
1	1.00	0.99	1.00	177
accuracy			1.00	868
macro avg	1.00	1.00	1.00	868
weighted avg	1.00	1.00	1.00	868

- PCA-based customer clusters.



- Heatmap of RFM averages by cluster.



➢ **References/Credits**

- Dataset: Provided e-commerce transaction dataset
- Libraries: Pandas, NumPy, Matplotlib, Seaborn, Scikit-learn
- Google Colab environment for code execution and visualization

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End of Report