A

Assesment Report

on

"Customer Behavior"

submitted as partial fulfillment for the award of

BACHELOR OF TECHNOLOGY DEGREE

SESSION 2024-25

in

Computer Science & Engineering (Artificial Intelligence)

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Introduction

In the present competitive business environment, customer behavior is vital in creating effective marketing campaigns and for improving customer experience. The data set employed in this report consists of customer behavioral data, which includes:

Total Spending (total_spent) – The total amount incurred by the customer.

Average Purchase Value (avg_purch) – The average purchase price.

Monthly Visit Frequency (visits_per_) – Visits undertaken by the customer on average per month.

Buyer Type (buyer_type) – A categorical tag representing whether the customer is a bargain_hunter or a premium_buyer.

The project seeks to examine the dataset from both supervised and unsupervised learning angles. In the supervised method, a classification model is trained to forecast the buyer type from spending behavior. In the unsupervised method, clustering is used to segment customers into separate groups without using pre-defined labels.

The findings derived from this analysis can assist organizations: In tailoring marketing strategy to various customer segments, In determining high-value customers, In optimizing promotional campaigns for bargain-seeking and premium-spending customers.

The subsequent sections outline the preprocessing, modeling, evaluation, and visualization methods applied in order to derive meaningful insights out of the data.

Methodology:

1. Data Upload & Cleaning
The customer data was uploaded from a CSV file. Null values were removed, and only numerical features (total_spent, avg_purchase_value, visits_per_month) were retained for clustering.

2. Feature Scaling
StandardScaler was applied to normalize the features, ensuring that no feature dominated the clustering process due to scale differences.

3. Finding Optimal Clusters
The Elbow Method was used to identify the optimal number of clusters by plotting the Within-Cluster Sum of Squares (WCSS) for cluster counts from 1 to 10. The "elbow point" revealed the ideal number of clusters.

4. K-Means Clustering
The KMeans algorithm was run with the chosen number of clusters (e.g., 4). Customers were assigned to clusters based on their purchasing behavior.

5. PCA for Visualization
PCA was applied to reduce the data to two dimensions, and a scatter plot was created to visualize the customer segments.

Code

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# ======================

# 1. Import Libraries

# ======================

import pandas as pd

import numpy as np

import seaborn as sns

import matplotlib.pyplot as plt


from sklearn.model_selection import train_test_split

from sklearn.preprocessing import LabelEncoder, StandardScaler

from sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import confusion_matrix, classification_report, accuracy_score, precision_score, recall_score

from sklearn.cluster import KMeans

from sklearn.decomposition import PCA


# ======================

# 2. Upload CSV File in Colab

# ======================

from google.colab import files

uploaded = files.upload()


# Load CSV

df = pd.read_csv(next(iter(uploaded)))


# ======================

# 3. Show Data Summary

# ======================

print("📄 Columns in dataset:", df.columns.tolist())

print("\n🔍 First 5 rows:\n", df.head())


# ======================

# 4. Label Encode the Target
```

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# ========================

target_column = 'buyer_type'  # Target: bargain_hunter / premium_buyer

label_encoders = {}


# Encode all object (string) columns except the target

for col in df.select_dtypes(include='object').columns:

   if col != target_column:

      le = LabelEncoder()

      df[col] = le.fit_transform(df[col])

      label_encoders[col] = le


# Encode target separately

target_le = LabelEncoder()

df[target_column] = target_le.fit_transform(df[target_column])


# ========================

# 5. Prepare Features & Labels

# ========================

X = df.drop(columns=[target_column])

y = df[target_column]


scaler = StandardScaler()

X_scaled = scaler.fit_transform(X)


# ========================

# 6. Train-Test Split

# ========================

X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)


# ========================

# 7. Train Classifier

# ========================

clf = RandomForestClassifier(random_state=42)

clf.fit(X_train, y_train)

y_pred = clf.predict(X_test)
```
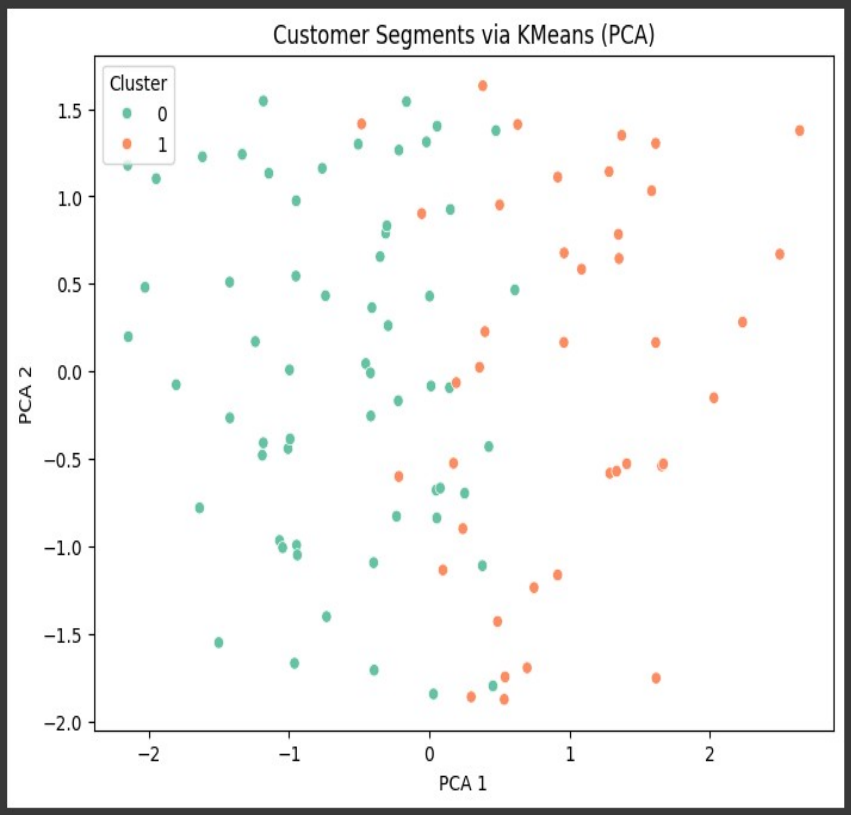

```
# ========================
# 8. Evaluation
# ========================
cm = confusion_matrix(y_test, y_pred)
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=target_le.classes_, yticklabels=target_le.classes_)
plt.title('Confusion Matrix')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.show()

print("✅ Accuracy:", accuracy_score(y_test, y_pred))
print("✅ Precision:", precision_score(y_test, y_pred, average='binary'))
print("✅ Recall:", recall_score(y_test, y_pred, average='binary'))
print("\n📋 Classification Report:\n", classification_report(y_test, y_pred, target_names=target_le.classes_))

# ========================
# 9. KMeans Clustering
# ========================
kmeans = KMeans(n_clusters=2, random_state=42)
cluster_labels = kmeans.fit_predict(X_scaled)
df['Cluster'] = cluster_labels

# Dimensionality reduction for plotting
pca = PCA(n_components=2)
reduced = pca.fit_transform(X_scaled)

plt.figure(figsize=(8,6))
sns.scatterplot(x=reduced[:,0], y=reduced[:,1], hue=cluster_labels, palette='Set2')
plt.title('Customer Segments via KMeans (PCA)')
plt.xlabel('PCA 1')
plt.ylabel('PCA 2')
plt.legend(title='Cluster')
plt.show()
```

Classification Report:

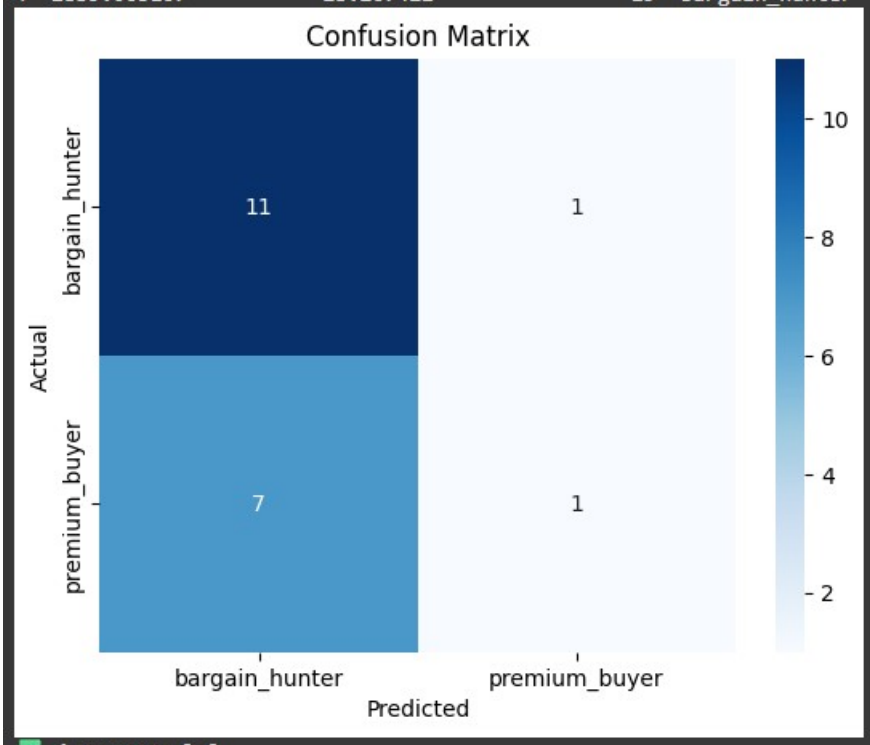
	precision	recall	f1-score	support
bargain_hunter	0.61	0.92	0.73	12
premium_buyer	0.50	0.12	0.20	8
accuracy			0.60	20
macro avg	0.56	0.52	0.47	20
weighted avg	0.57	0.60	0.52	20



Choose Files customer_behavior.csv

- **customer_behavior.csv**(text/csv) - 5476 bytes, last modified: 5/13/2025 - 100% done

```
Saving customer_behavior.csv to customer_behavior (2).csv
📄 Columns in dataset: ['total_spent', 'avg_purchase_value', 'visits_per_month', 'buyer_type']

🔍 First 5 rows:
   total_spent  avg_purchase_value  visits_per_month      buyer_type
0  4007.982067          235.560678                 3  bargain_hunter
1  3117.968387          313.883912                13  bargain_hunter
2  4232.062646          122.280804                15  bargain_hunter
3   577.820196          470.747406                20   premium_buyer
4  2839.005107           23.207422                19  bargain_hunter
```




```
✅ Accuracy: 0.6
✅ Precision: 0.5
✅ Recall: 0.125

📋 Classification Report:
              precision    recall  f1-score   support
```

References/Credits

References / Credits

- **Dataset**: Provided CSV file – "Customer Behavior Data.csv"
- **Libraries Used**: pandas, scikit-learn, matplotlib, seaborn
- **Algorithms**: K-Means Clustering, PCA, Elbow Method
- **Customer Behavior Insights**: Analysis based on typical customer segmentation methods and behavior trends.
- **Elbow Method Reference**: Wikipedia - Elbow Method
- **PCA Reference**: Jolliffe, I. T. (2002). Principal Component Analysis. Springer Series in Statistics.