Assesment Report

on

"Market Analysis"

submitted as partial fulfillment for the award of

BACHELOR OF TECHNOLOGY DEGREE

SESSION 2024-25

By

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Introduction

Market Basket Analysis (MBA) is a data mining technique used to uncover relationships between items frequently purchased together. It plays a vital role in understanding customer purchasing behavior and supporting business strategies such as product placement, bundling, and targeted marketing.

In this project, we simulate customer transactions based on real-world retail data and apply the Apriori algorithm to discover frequent itemsets and generate association rules. Additionally, we classify customers into high and low spenders using a logistic regression model and perform clustering to segment customers based on their shopping patterns. These insights help in making data-driven decisions to improve customer engagement and sales.

Methodology

The project follows a structured approach to perform Market Basket Analysis using simulated transaction data and machine learning techniques:

1. Data Preparation

We begin by uploading a real-world dataset and randomly selecting a subset of aisle names. Using these, we simulate 500 customer transactions with varying item counts. Customers purchasing more than 4 items are labeled as high spenders, while others are labeled as low spenders.

2. Association Rule Mining

The transaction data is one-hot encoded using `TransactionEncoder`. The **Apriori algorithm** is applied to identify frequent itemsets with a minimum support of 0.05. From these, **association rules** are generated using a confidence threshold of 0.3, helping us uncover meaningful item relationships.

3. Customer Classification

We use the number of items in a transaction as a feature to train a **logistic regression** model that predicts whether a customer is a high or low spender. The model's performance is evaluated using accuracy, precision, recall, and a confusion matrix.

4. Customer Segmentation

To understand different customer profiles, we apply **K-Means clustering** on the one-hot encoded transaction data. **PCA (Principal Component Analysis)** is used to reduce dimensions and visualize customer clusters based on their purchase behavior.

CODE

```
#  STEP 1: Load and Simulate Transaction Data
import pandas as pd
import numpy as np
import random
import seaborn as sns
import matplotlib.pyplot as plt

from google.colab import files
uploaded = files.upload()  # Upload your "10. Market Basket Analysis.csv"

df_aisles = pd.read_csv("10. Market Basket Analysis.csv")
aisles = df_aisles['aisle'].sample(20, random_state=42).tolist()

transactions = []
customer_labels = []

np.random.seed(42)
for _ in range(500):
    num_items = np.random.randint(1, 8)
    items = random.sample(aisles, num_items)
    transactions.append(items)
    customer_labels.append(1 if num_items > 4 else 0)  # High spender if more than 4 items
```

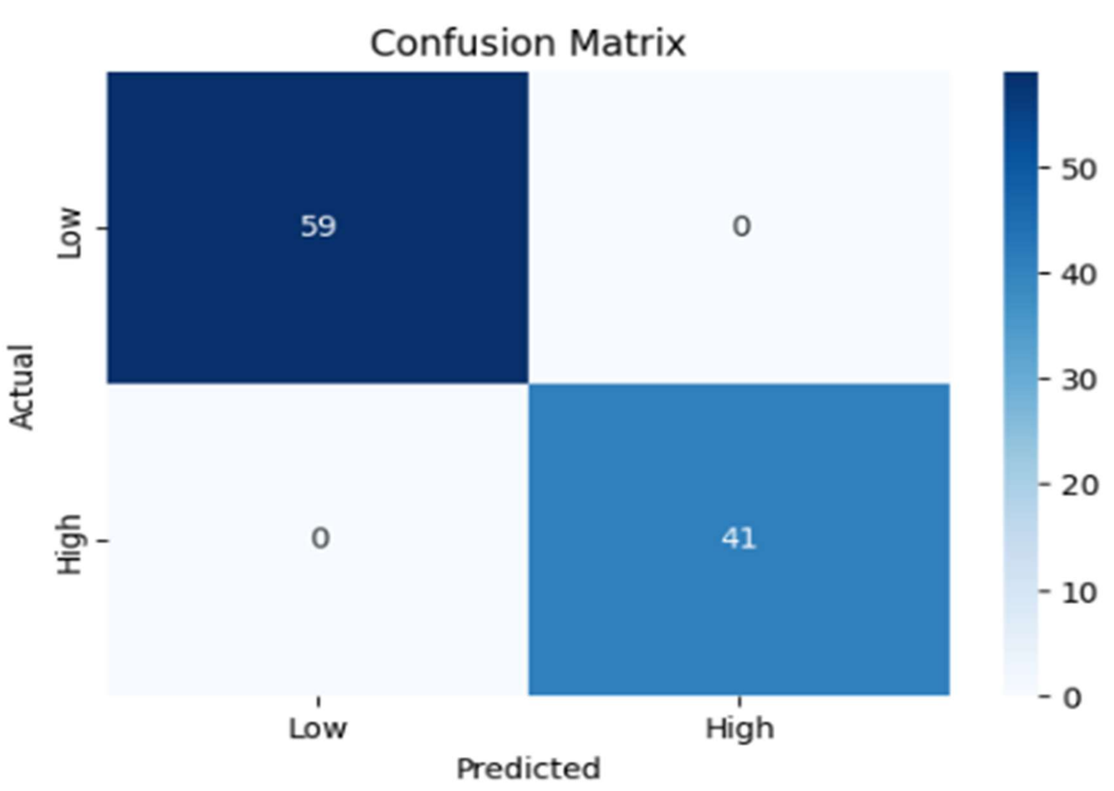
```
#  STEP 2: Association Rule Mining (Apriori)

!pip install mlxtend

from mlxtend.preprocessing import TransactionEncoder

from mlxtend.frequent_patterns import apriori, association_rules


te = TransactionEncoder()

te_array = te.fit(transactions).transform(transactions)

df_trans = pd.DataFrame(te_array, columns=te.columns_)


frequent_itemsets = apriori(df_trans, min_support=0.05, use_colnames=True)

rules = association_rules(frequent_itemsets, metric="confidence", min_threshold=0.3)


print("Top 5 Association Rules:")

display(rules.sort_values(by='confidence', ascending=False).head())


#  STEP 3: Classification (High vs. Low Spender)

from sklearn.model_selection import train_test_split

from sklearn.linear_model import LogisticRegression

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


X = np.array([len(t) for t in transactions]).reshape(-1, 1)

y = np.array(customer_labels)
```

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


model = LogisticRegression()

model.fit(X_train, y_train)

y_pred = model.predict(X_test)


cm = confusion_matrix(y_test, y_pred)

acc = accuracy_score(y_test, y_pred)

prec = precision_score(y_test, y_pred)

rec = recall_score(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()


print(f"Accuracy: {acc:.2f}")

print(f"Precision: {prec:.2f}")

print(f"Recall: {rec:.2f}")
```

```
#  STEP 4: Clustering and Customer Segmentation
from sklearn.cluster import KMeans
from sklearn.decomposition import PCA


item_df = pd.DataFrame(te_array.astype(int), columns=te.columns_)
kmeans = KMeans(n_clusters=3, random_state=42)
clusters = kmeans.fit_predict(item_df)


reduced = PCA(n_components=2).fit_transform(item_df)


plt.figure(figsize=(8, 6))
sns.scatterplot(x=reduced[:, 0], y=reduced[:, 1], hue=clusters, palette="Set2")
plt.title("Customer Segmentation Based on Aisle Preferences")
plt.xlabel("PCA 1")
plt.ylabel("PCA 2")
plt.show()
```

OUTPUT

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	representativity	leverage	conviction	zhangs_metric	jaccard	certainty	kulczynski
8	(pickled goods olives)	(dish detergents)	0.170	0.266	0.062	0.364706	1.371075	1.0	0.016780	1.155370	0.326079	0.165775	0.134477	0.298894
6	(juice nectars)	(dish detergents)	0.222	0.266	0.080	0.360360	1.354738	1.0	0.020948	1.147521	0.336568	0.196078	0.128556	0.330556
3	(cookies cakes)	(dish detergents)	0.172	0.266	0.060	0.348837	1.311418	1.0	0.014248	1.127214	0.286795	0.158730	0.112857	0.287201
1	(cookies cakes)	(buns rolls)	0.172	0.200	0.056	0.325581	1.627907	1.0	0.021600	1.186207	0.465839	0.177215	0.156977	0.302791
2	(buns rolls)	(dish detergents)	0.200	0.266	0.064	0.320000	1.203008	1.0	0.010800	1.079412	0.210937	0.159204	0.073569	0.280301




```
Accuracy: 1.00
Precision: 1.00
Recall: 1.00
```


Customer Segmentation Based on Aisle Preferences
0
1
2
1.0
0.5
0.0
−0.5
−1.0
−1.5
PCA 2
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
1.25
PCA 1

References/Credits

- Mlxtend Documentation
- Scikit-learn Documentation
- Dataset: Market Basket Analysis
- Google Colab