lab13_ulugbek_KMeans_Clustering

November 10, 2024

0.1 KMeans Clustering

Use the dataset in link: https://www.kaggle.com/datasets/yasserh/customer-segmentation-dataset

1. Load the dataset – 0.5 marks
2. Clean the dataset – 0.5 marks
3. EDA – 2 marks
4. Split the dataset – 0.5 marks
5. Encode and Standardization – 0.5 marks
6. Select the correct number of ks – 2 marks
7. Modelling – 2 marks
8. Result visualization – 2 marks

[ ]:
```
import kagglehub

path = kagglehub.dataset_download("yasserh/customer-segmentation-dataset")

print("Path to dataset files:", path)
```

```
Downloading from
https://www.kaggle.com/api/v1/datasets/download/yasserh/customer-segmentation-
dataset?dataset_version_number=1…

100%|      | 21.8M/21.8M [00:00<00:00, 32.4MB/s]

Extracting files…


Path to dataset files: /root/.cache/kagglehub/datasets/yasserh/customer-
segmentation-dataset/versions/1
```

[ ]:
```
!mv /root/.cache/kagglehub/datasets/yasserh/customer-segmentation-dataset/
↪versions/1 .
```

[ ]:
```
!mv 1/* .
```

[ ]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
```

[ ]:
```
df = pd.read_excel('Online Retail.xlsx')
df.head()
```

[ ]:
```
  InvoiceNo StockCode                          Description  …  UnitPrice
CustomerID         Country
0    536365    85123A   WHITE HANGING HEART T-LIGHT HOLDER  …       2.55
17850.0  United Kingdom
1    536365     71053                  WHITE METAL LANTERN  …       3.39
17850.0  United Kingdom
2    536365    84406B       CREAM CUPID HEARTS COAT HANGER  …       2.75
17850.0  United Kingdom
3    536365    84029G  KNITTED UNION FLAG HOT WATER BOTTLE  …       3.39
17850.0  United Kingdom
4    536365    84029E       RED WOOLLY HOTTIE WHITE HEART.  …       3.39
17850.0  United Kingdom

[5 rows x 8 columns]
```

[ ]:
```
print("Missing values:\n", df.isnull().sum())

df.drop(columns=['CustomerID', 'InvoiceNo'], inplace=True)

df['Description'].fillna("No Description", inplace=True)

df.drop_duplicates(inplace=True)
print("Data shape after cleaning:", df.shape)
```

```
Missing values:
 InvoiceNo          0
StockCode           0
Description      1454
Quantity            0
InvoiceDate         0
UnitPrice           0
CustomerID     135080
Country             0
dtype: int64
```

```
<ipython-input-29-a50b961cd0ef>:5: FutureWarning: A value is trying to be set on
a copy of a DataFrame or Series through chained assignment using an inplace
```

```
method.
The behavior will change in pandas 3.0. This inplace method will never work
because the intermediate object on which we are setting values always behaves as
a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using
'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)
instead, to perform the operation inplace on the original object.


  df['Description'].fillna("No Description", inplace=True)

Data shape after cleaning: (535885, 6)
```

[ ]:
```
df.columns
```

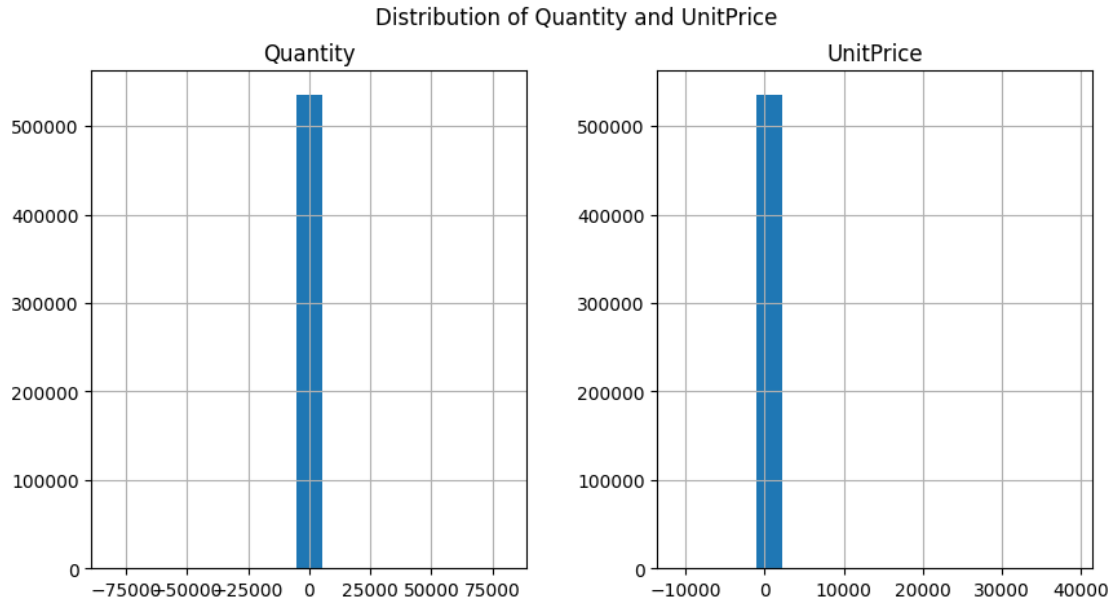
[ ]:
```
Index(['StockCode', 'Description', 'Quantity', 'InvoiceDate', 'UnitPrice',
       'Country'],
      dtype='object')
```

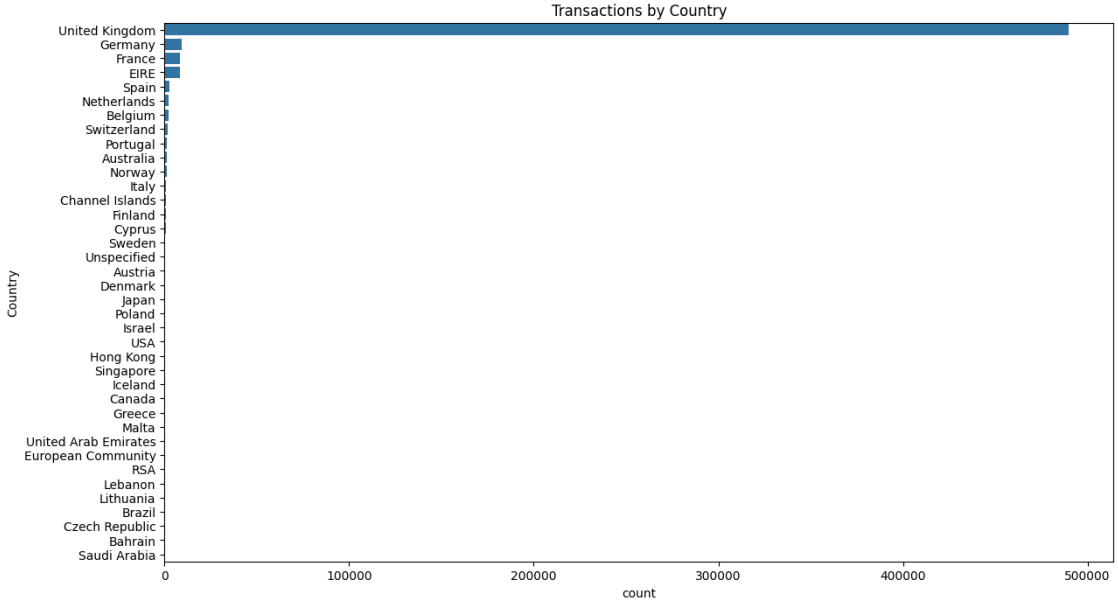
[ ]:
```
df.describe()
```

[ ]:

	Quantity	InvoiceDate	UnitPrice
count	535885.000000	535885	535885.000000
mean	9.646844	2011-07-04 10:53:40.231355648	4.631516
min	-80995.000000	2010-12-01 08:26:00	-11062.060000
25%	1.000000	2011-03-28 11:34:00	1.250000
50%	3.000000	2011-07-19 15:29:00	2.080000
75%	10.000000	2011-10-18 17:05:00	4.130000
max	80995.000000	2011-12-09 12:50:00	38970.000000
std	218.890996	NaN	97.301528

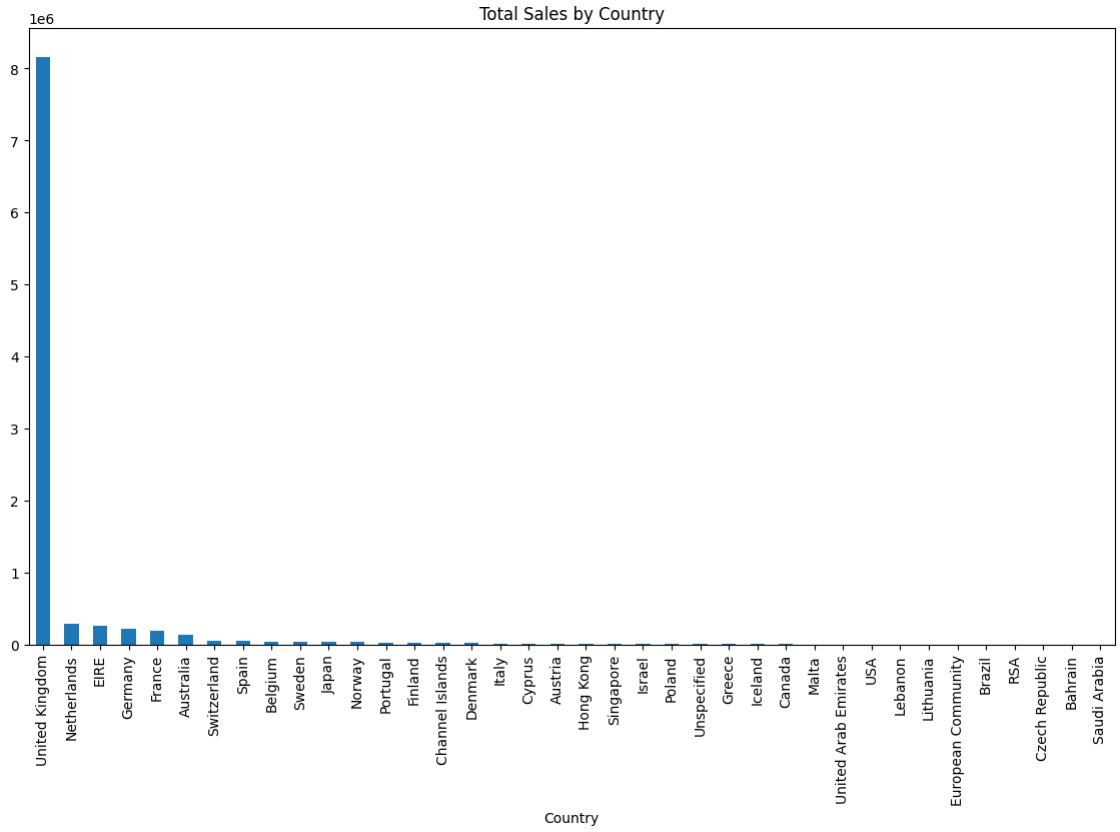
[ ]:
```
df[['Quantity', 'UnitPrice']].hist(bins=15, figsize=(10, 5))
plt.suptitle("Distribution of Quantity and UnitPrice")

plt.figure(figsize=(14, 8))
sns.countplot(y='Country', data=df, order=df['Country'].value_counts().index)
plt.title("Transactions by Country")
plt.show()
```





[ ]:
```
df['TotalPrice'] = df['Quantity'] * df['UnitPrice']

df['Year'] = df['InvoiceDate'].dt.year
df['Month'] = df['InvoiceDate'].dt.month
df['DayOfWeek'] = df['InvoiceDate'].dt.dayofweek
df['Hour'] = df['InvoiceDate'].dt.hour
```

```
country_sales = df.groupby('Country')['TotalPrice'].sum().
  ↪sort_values(ascending=False)
plt.figure(figsize=(14, 8))
country_sales.plot(kind='bar')
plt.title("Total Sales by Country")
plt.show()
```



[ ]:
```
X = df[['Quantity', 'UnitPrice', 'TotalPrice', 'Country']]

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

[ ]:
```
numerical_features = ['Quantity', 'UnitPrice', 'TotalPrice']
categorical_features = ['Country']

numerical_transformer = Pipeline(steps=[
    ('scaler', StandardScaler())
])

categorical_transformer = Pipeline(steps=[
    ('onehot', OneHotEncoder(handle_unknown='ignore'))
```

```
])

preprocessor = ColumnTransformer(
    transformers=[
        ('num', numerical_transformer, numerical_features),
        ('cat', categorical_transformer, categorical_features)
    ]
)

X_preprocessed = preprocessor.fit_transform(X)
X_preprocessed.shape
```

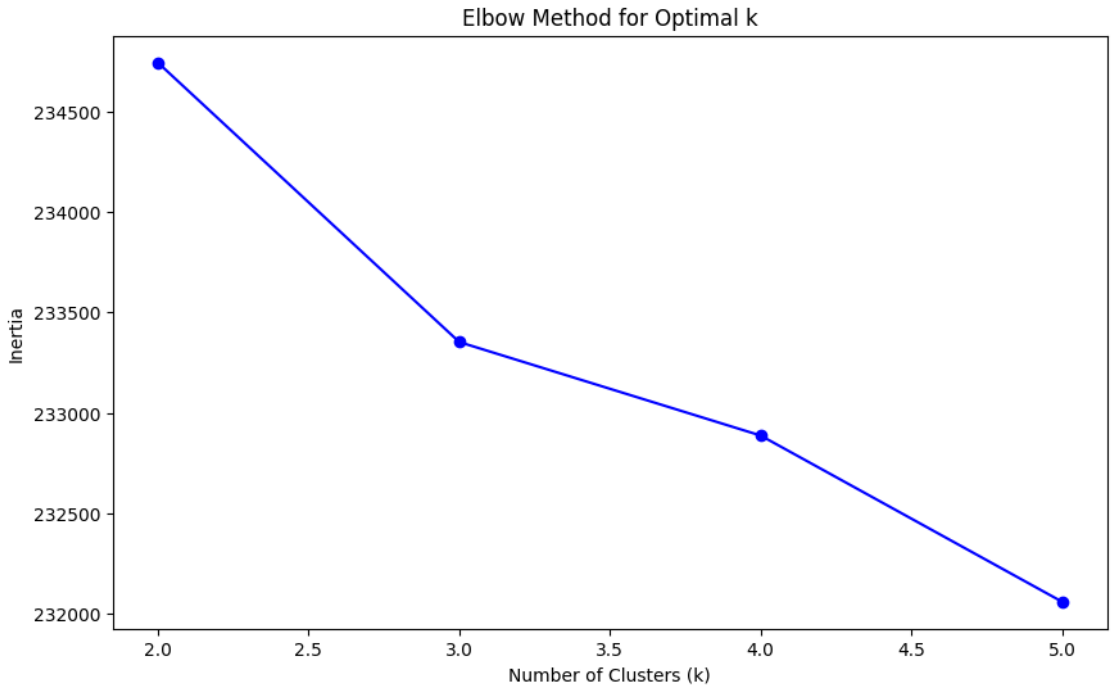
[ ]: (535885, 41)

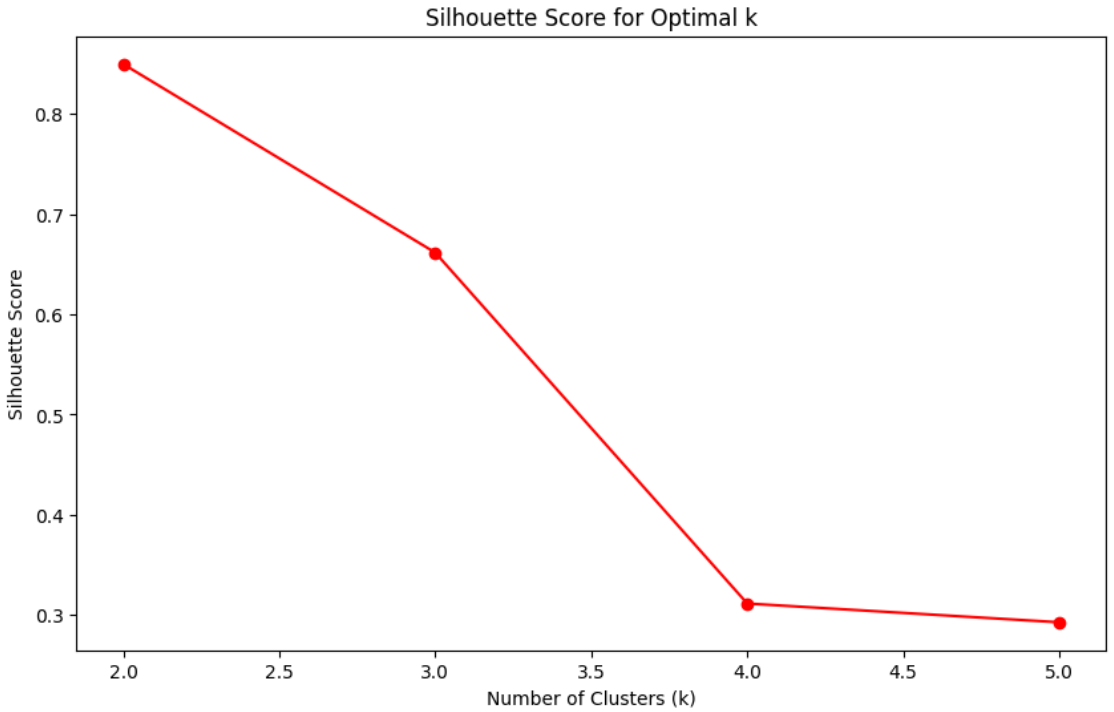
[ ]:
```
from sklearn.cluster import MiniBatchKMeans

k_values = range(2, 6)

inertia = []
silhouette_scores = []

sample_size = int(0.1 * X_preprocessed.shape[0])
sampled_data = X_preprocessed[np.random.choice(X_preprocessed.shape[0],␣
 ↪sample_size, replace=False)]

for k in k_values:
    print(f'k={k}')
    kmeans = MiniBatchKMeans(n_clusters=k, random_state=42, batch_size=1024)
    kmeans.fit(sampled_data)
    inertia.append(kmeans.inertia_)
    silhouette_scores.append(silhouette_score(sampled_data, kmeans.labels_))
```

```
k=2
k=3
k=4
k=5
```

[ ]:
```
plt.figure(figsize=(10, 6))
plt.plot(k_values, inertia, 'bo-')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Inertia')
plt.title('Elbow Method for Optimal k')
plt.show()

# Plot Silhouette Score
plt.figure(figsize=(10, 6))
plt.plot(k_values, silhouette_scores, 'ro-')
plt.xlabel('Number of Clusters (k)')
```

```
plt.ylabel('Silhouette Score')
plt.title('Silhouette Score for Optimal k')
plt.show()
```

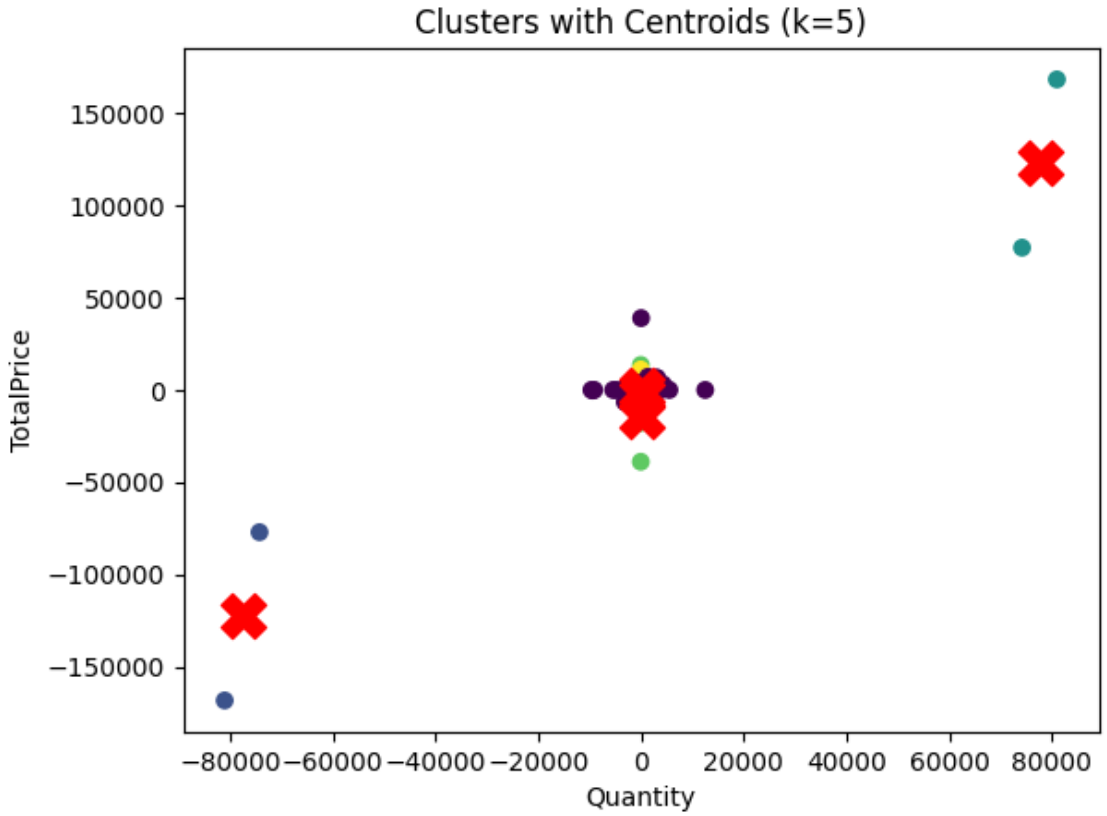




[ ]:
```
optimal_k = 5
kmeans = KMeans(n_clusters=optimal_k, random_state=42)
clusters = kmeans.fit_predict(X_preprocessed)

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

[ ]:
```
plt.figure(figsize=(10, 6))
sns.scatterplot(x=df['Quantity'], y=df['TotalPrice'], hue=df['Cluster'],␣
 ↪palette='viridis')
plt.title(f'Customer Segments with {optimal_k} Clusters')
plt.show()

# Centroid Visualization
centroids = kmeans.cluster_centers_
centroids_original_space = preprocessor.named_transformers_['num'].
 ↪inverse_transform(centroids[:, :len(numerical_features)])

plt.scatter(df['Quantity'], df['TotalPrice'], c=clusters, cmap='viridis',␣
 ↪marker='o')
plt.scatter(centroids_original_space[:, 0], centroids_original_space[:, 2],␣
 ↪c='red', s=300, marker='X')  # Centroids
plt.xlabel('Quantity')
plt.ylabel('TotalPrice')
plt.title(f'Clusters with Centroids (k={optimal_k})')
plt.show()
```


Customer Segments with 5 Clusters
Cluster
0
1
2
3
4
TotalPrice
Quantity
150000
100000
50000
0
−50000
−100000
−150000
−80000
−60000
−40000
−20000
0
20000
40000
60000
80000


Clusters with Centroids (k=5)
TotalPrice
Quantity
150000
100000
50000
0
−50000
−100000
−150000
−80000
−60000
−40000
−20000
0
20000
40000
60000
80000