```python
#@title Default title text
import pandas as pd

# Load the dataset from the CSV file
df = pd.read_csv('OnlineRetail.csv', encoding='unicode_escape')


# Get the number of rows and columns in the dataset
num_rows = df.shape[0]
num_cols = df.shape[1]

# Print the number of rows and columns
print('Number of rows:', num_rows)
print('Number of columns:', num_cols)

countries = df['Country'].unique()
print(countries)


# Display the first 5 rows of the dataframe
print(df.head())
```

```
Number of rows: 541909
Number of columns: 8
['United Kingdom' 'France' 'Australia' 'Netherlands' 'Germany'
'Norway'
 'EIRE' 'Switzerland' 'Spain' 'Poland' 'Portugal' 'Italy' 'Belgium'
 'Lithuania' 'Japan' 'Iceland' 'Channel Islands' 'Denmark' 'Cyprus'
 'Sweden' 'Austria' 'Israel' 'Finland' 'Bahrain' 'Greece' 'Hong Kong'
 'Singapore' 'Lebanon' 'United Arab Emirates' 'Saudi Arabia'
 'Czech Republic' 'Canada' 'Unspecified' 'Brazil' 'USA'
 'European Community' 'Malta' 'RSA']
  InvoiceNo StockCode                          Description
Quantity  \
0    536365    85123A   WHITE HANGING HEART T-LIGHT HOLDER         6

1    536365     71053                  WHITE METAL LANTERN         6

2    536365    84406B       CREAM CUPID HEARTS COAT HANGER         8

3    536365    84029G  KNITTED UNION FLAG HOT WATER BOTTLE         6

4    536365    84029E       RED WOOLLY HOTTIE WHITE HEART.         6


      InvoiceDate  UnitPrice  CustomerID         Country
0  12/1/2010 8:26       2.55     17850.0  United Kingdom
1  12/1/2010 8:26       3.39     17850.0  United Kingdom
2  12/1/2010 8:26       2.75     17850.0  United Kingdom
```

```
3  12/1/2010 8:26       3.39     17850.0  United Kingdom
4  12/1/2010 8:26       3.39     17850.0  United Kingdom
```

DATA PREPROCESSING

CHECK FOR THE MISSING VALUE IN THE DESCRIPTION COLUMN

```
# Check for missing values in the 'Description' column
print(df['Description'].isnull().sum())

# Fill in missing values with mode value
mode_value = df['Description'].mode()[0]
df['Description'].fillna(mode_value, inplace=True)
```

```
1454
```

```
# Check for missing values in the 'Description' column
print(df['Description'].isnull().sum())
```

```
0
```

Create a new column for total amount spent per customer

```
# Create a new column for total amount spent per customer
df['TotalAmount'] = df['Quantity'] * df['UnitPrice']

# Group the data by customer ID and calculate total amount spent and
frequency of purchases
customer_data = df.groupby('CustomerID').agg({
    'InvoiceNo': 'nunique',     # Frequency of purchases
    'TotalAmount': 'sum'        # Total amount spent
}).reset_index()

print(customer_data.head())
```

```
   CustomerID  InvoiceNo  TotalAmount
0     12346.0          2         0.00
1     12347.0          7      4310.00
2     12348.0          4      1797.24
3     12349.0          1      1757.55
4     12350.0          1       334.40
```

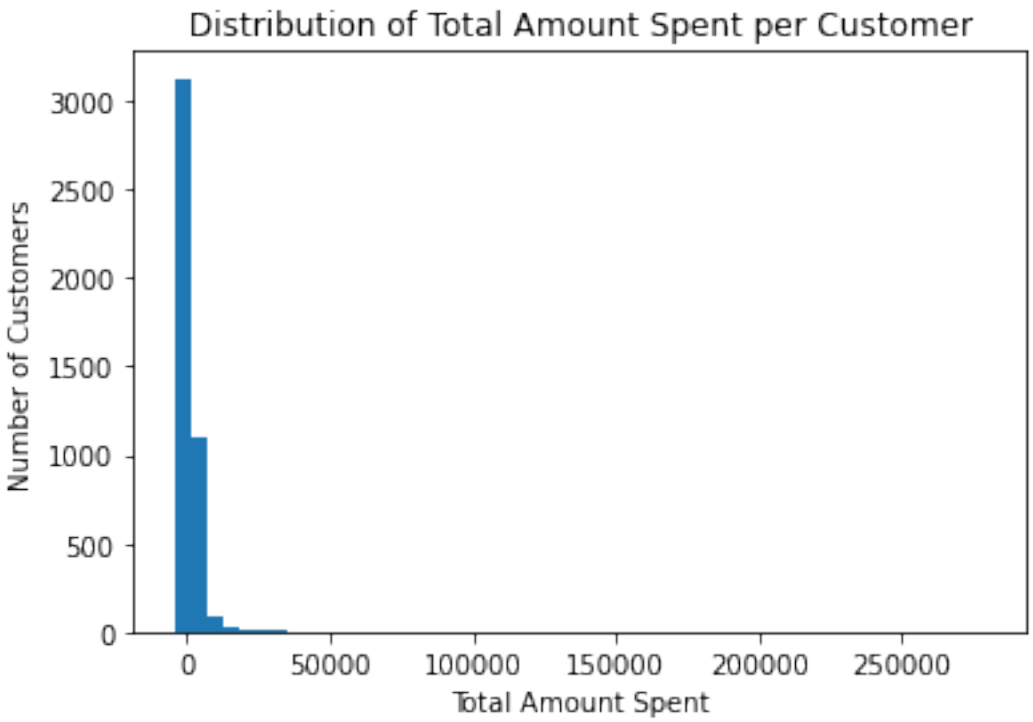
```
# Rename the columns to more descriptive names
customer_data.rename(columns={'InvoiceNo': 'Frequency', 'TotalAmount':
'MonetaryValue'}, inplace=True)

# Write the dataframe to a CSV file
customer_data.to_csv('customer_metrics.csv', index=False)

# Display a message to confirm that the file has been created
print('CSV file created successfully')
```

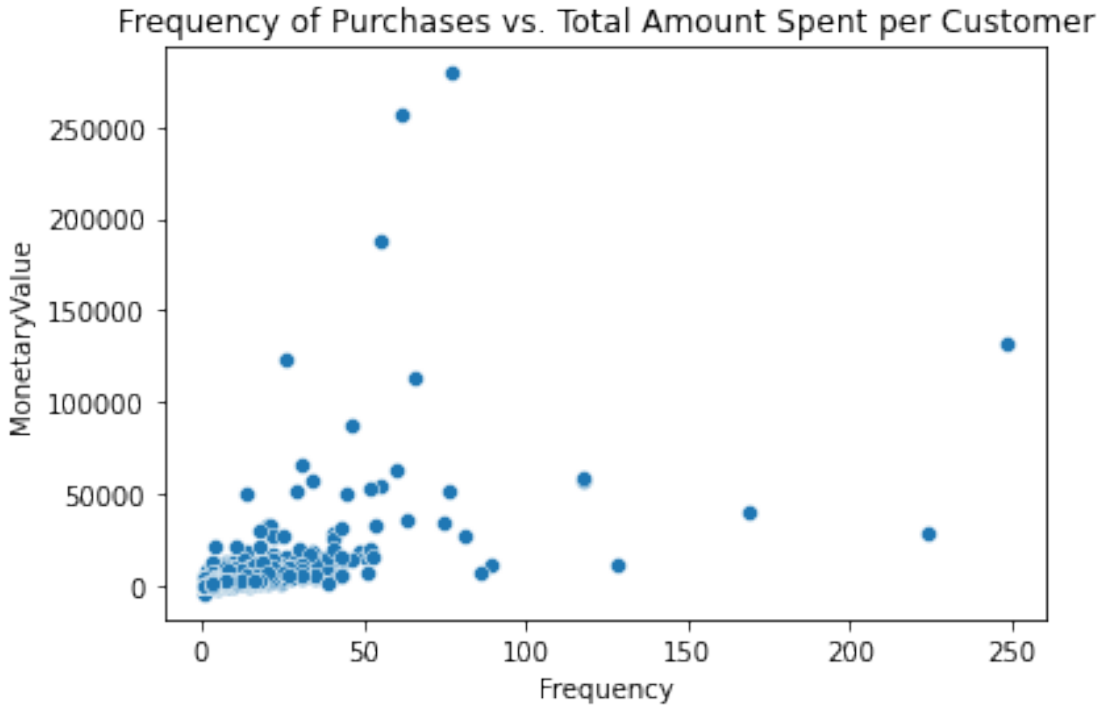
```
CSV file created successfully
```

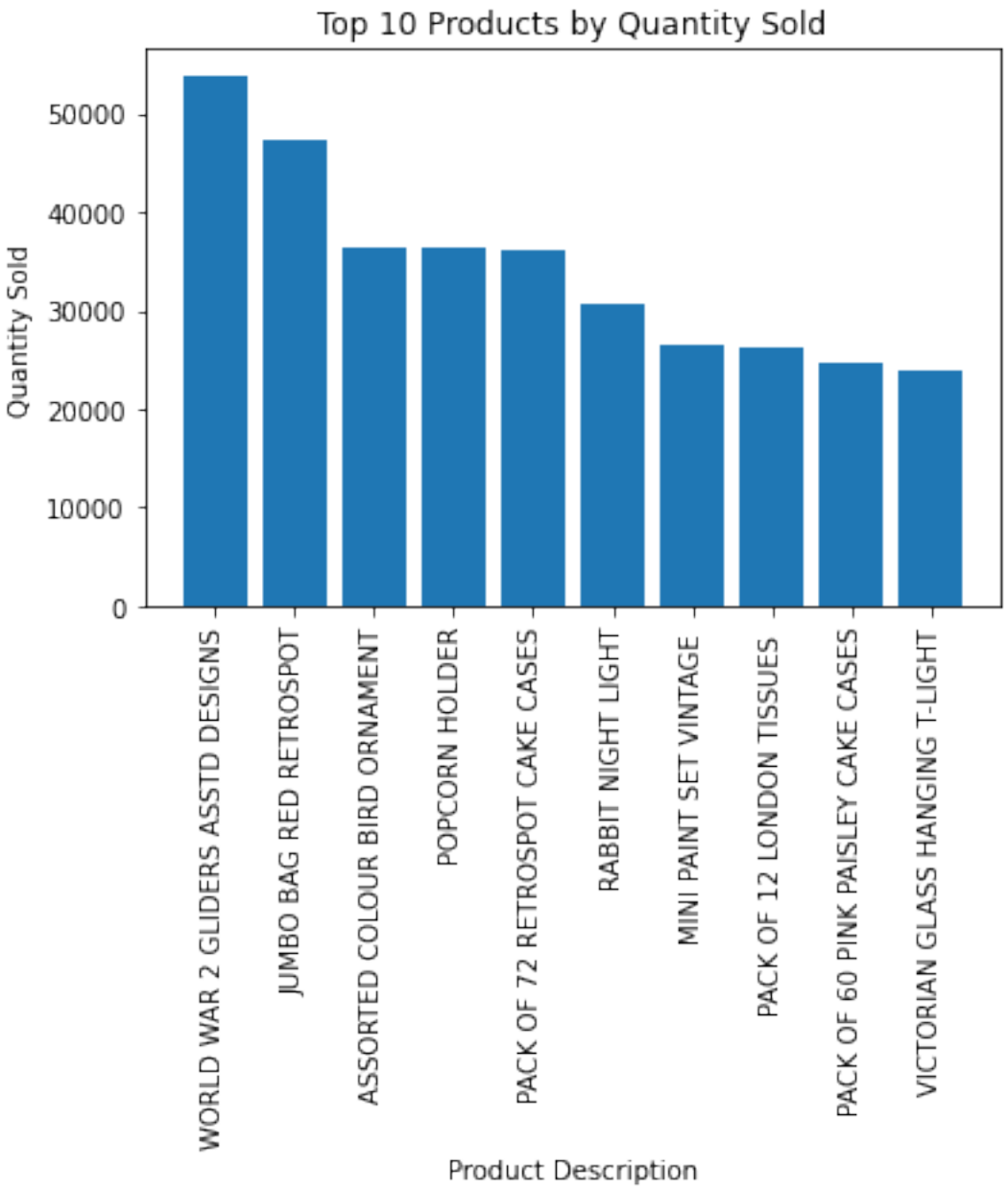
Exp Data Analytics

VISUALIZATION OF CUSTOMER METRICS CSV FILE USING DIFFERNET PLOTTING TECHNIQUE

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
# Plot a histogram of the total amount spent per customer
plt.hist(customer_data['MonetaryValue'], bins=50)
plt.title('Distribution of Total Amount Spent per Customer')
plt.xlabel('Total Amount Spent')
plt.ylabel('Number of Customers')
plt.show()

# Plot a scatterplot of frequency of purchases vs. total amount spent
sns.scatterplot(data=customer_data, x='Frequency', y='MonetaryValue')
plt.title('Frequency of Purchases vs. Total Amount Spent per
Customer')
plt.show()

# Plot a bar chart of the top 10 products by quantity sold
top_products = df.groupby('Description')
['Quantity'].sum().nlargest(10)
plt.bar(top_products.index, top_products.values)
plt.xticks(rotation=90)
plt.title('Top 10 Products by Quantity Sold')
plt.xlabel('Product Description')
plt.ylabel('Quantity Sold')
plt.show()
```


Distribution of Total Amount Spent per Customer
Number of Customers
3000
2500
2000
1500
1000
500
0
0
50000
100000
150000
200000
250000
Total Amount Spent


Frequency of Purchases vs. Total Amount Spent per Customer
MonetaryValue
250000
200000
150000
100000
50000
0
0
50
100
150
200
250
Frequency



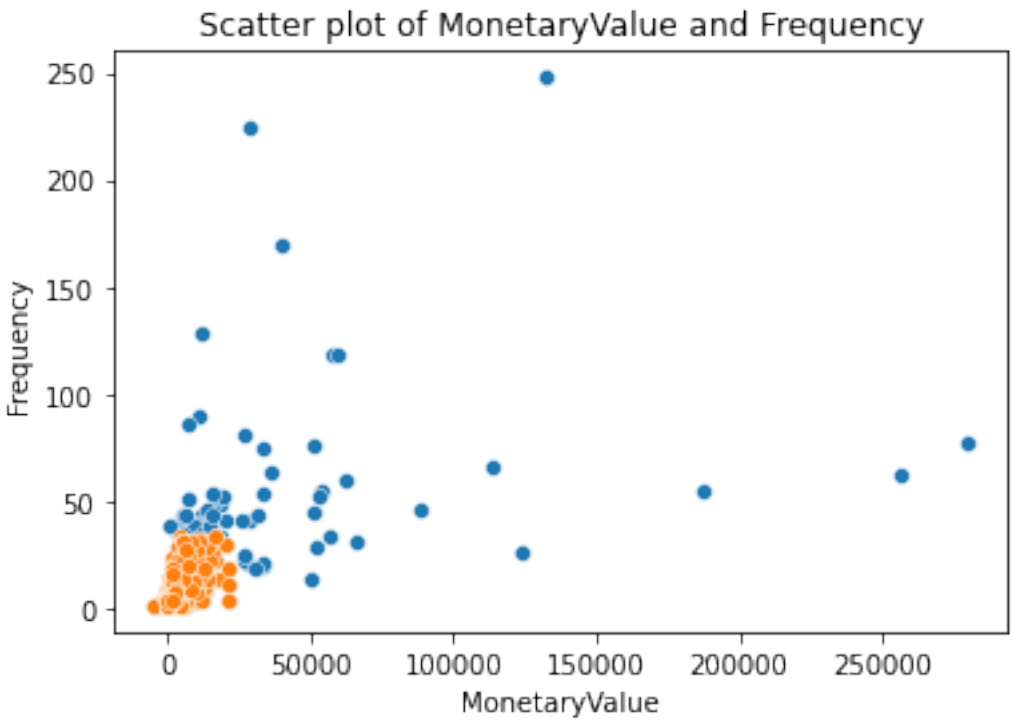

```
# Find potential outliers
q1 = customer_data['MonetaryValue'].quantile(0.25)
q3 = customer_data['MonetaryValue'].quantile(0.75)
iqr = q3 - q1
upper_bound = q3 + (1.5 * iqr)
lower_bound = q1 - (1.5 * iqr)
potential_outliers = customer_data[(customer_data['MonetaryValue'] >
upper_bound) | (customer_data['MonetaryValue'] < lower_bound)]
print('Potential outliers:', potential_outliers)
```

```
Potential outliers:       CustomerID  Frequency  MonetaryValue
1          12347.0          7        4310.00
10         12357.0          1        6207.67
```

```
12       12359.0           6        6245.53
15       12362.0          13        5154.58
27       12378.0           1        4008.62
...          ...         ...            ...
4324     18223.0          27        6315.23
4326     18225.0          17        5361.02
4327     18226.0          14        5192.10
4330     18229.0          20        7276.90
4347     18251.0           1        4314.72

[423 rows x 3 columns]
```

```python
import seaborn as sns
import matplotlib.pyplot as plt

# Create scatter plot
sns.scatterplot(x='MonetaryValue', y='Frequency', data=customer_data)

# Calculate z-scores
z_scores = (customer_data[['MonetaryValue', 'Frequency']] -
customer_data[['MonetaryValue', 'Frequency']].mean()) /
customer_data[['MonetaryValue', 'Frequency']].std()

# Identify outliers using z-scores
outliers = (z_scores['MonetaryValue'].abs() > 3) |
(z_scores['Frequency'].abs() > 3)

# Mask outliers from the scatter plot
sns.scatterplot(x='MonetaryValue', y='Frequency',
data=customer_data[~outliers])

# Add title and axis labels
plt.title('Scatter plot of MonetaryValue and Frequency')
plt.xlabel('MonetaryValue')
plt.ylabel('Frequency')
```

```
Text(0, 0.5, 'Frequency')
```



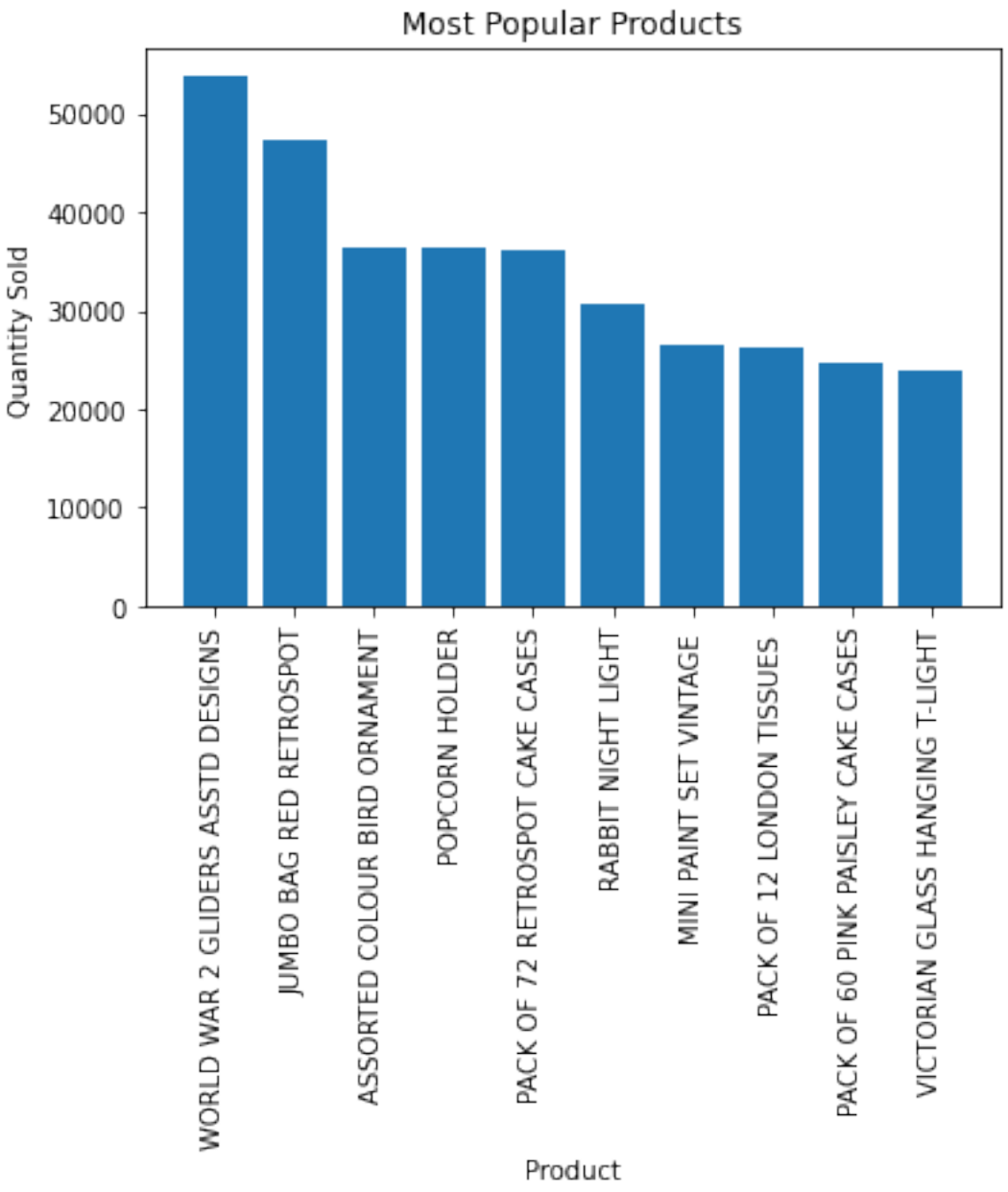
Calculate the most popular product

```
# Calculate the most popular products
most_popular_products = df.groupby(['Description'])
['Quantity'].sum().sort_values(ascending=False)[:10]
print('Most popular products:')
print(most_popular_products)
print(df.columns)
```

```
# Create a bar chart of the most popular products
plt.bar(most_popular_products.index, most_popular_products.values)
plt.xticks(rotation=90)
plt.title('Most Popular Products')
plt.xlabel('Product')
plt.ylabel('Quantity Sold')
plt.show()
```

```
Most popular products:
Description
WORLD WAR 2 GLIDERS ASSTD DESIGNS     53847
JUMBO BAG RED RETROSPOT               47363
```

```
ASSORTED COLOUR BIRD ORNAMENT         36381
POPCORN HOLDER                        36334
PACK OF 72 RETROSPOT CAKE CASES       36039
RABBIT NIGHT LIGHT                    30680
MINI PAINT SET VINTAGE                26437
PACK OF 12 LONDON TISSUES             26315
PACK OF 60 PINK PAISLEY CAKE CASES    24753
VICTORIAN GLASS HANGING T-LIGHT       23854
Name: Quantity, dtype: int64
Index(['InvoiceNo', 'StockCode', 'Description', 'Quantity',
'InvoiceDate',
       'UnitPrice', 'CustomerID', 'Country', 'TotalAmount',
       'TotalPurchaseAmount'],
      dtype='object')
```



VISUALIZATION OF DATA W.R.T COUNTRIES + APRIORI ALGORITHM DATA MINING TECHNIQUE

```
countries = df['Country'].unique()
print(countries)
```

```
['United Kingdom' 'France' 'Australia' 'Netherlands' 'Germany'
'Norway'
 'EIRE' 'Switzerland' 'Spain' 'Poland' 'Portugal' 'Italy' 'Belgium'
 'Lithuania' 'Japan' 'Iceland' 'Channel Islands' 'Denmark' 'Cyprus'
 'Sweden' 'Austria' 'Israel' 'Finland' 'Bahrain' 'Greece' 'Hong Kong'
 'Singapore' 'Lebanon' 'United Arab Emirates' 'Saudi Arabia'
```

```
 'Czech Republic' 'Canada' 'Unspecified' 'Brazil' 'USA'
 'European Community' 'Malta' 'RSA']
```

```
import pandas as pd

# Create a new dataframe with the total quantities for each country
country_totals = df.groupby('Country')['Quantity'].sum().reset_index()

# Pivot the data to create a table
table = pd.pivot_table(country_totals, values='Quantity',
index='Country')

# Display the table
print(table)
```

```
                     Quantity
Country
Australia               83653
Austria                  4827
Bahrain                   260
Belgium                 23152
Brazil                    356
Canada                   2763
Channel Islands          9479
Cyprus                   6317
Czech Republic            592
Denmark                  8188
EIRE                   142637
European Community        497
Finland                 10666
France                 110480
Germany                117448
Greece                   1556
Hong Kong                4769
Iceland                  2458
Israel                   4353
Italy                    7999
Japan                   25218
Lebanon                   386
Lithuania                 652
Malta                     944
Netherlands            200128
Norway                  19247
Poland                   3653
Portugal                16180
RSA                       352
Saudi Arabia               75
Singapore                5234
Spain                   26824
Sweden                  35637
```

```
Switzerland              30325
USA                       1034
United Arab Emirates       982
United Kingdom          4263829
Unspecified               3300
```

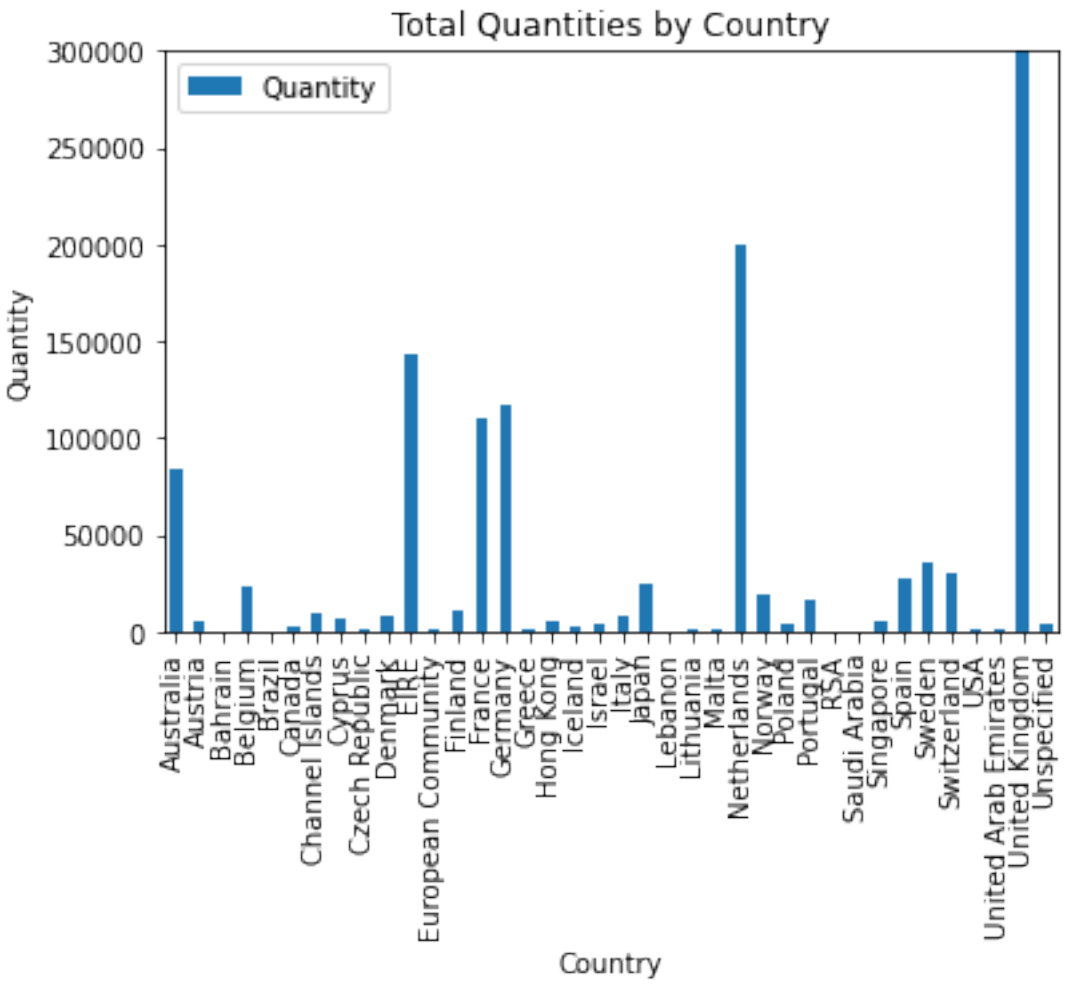
SORTING

```
# Sort the country_totals dataframe in descending order based on
'Quantity' column
sorted_country_totals = country_totals.sort_values('Quantity',
ascending=False)

# Get the country with the highest quantity
highest_country = sorted_country_totals.iloc[0]['Country']
highest_quantity = sorted_country_totals.iloc[0]['Quantity']

# Print the country with the highest quantity
print(f"The country with the highest quantity is {highest_country}
with {highest_quantity} total quantity.")
```

```
The country with the highest quantity is United Kingdom with 4263829
total quantity.
```

DATA PLOTTING

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

# Create a new dataframe with the total quantities for each country
country_totals = df.groupby('Country')['Quantity'].sum().reset_index()

# Create a table plot using pandas
country_totals.plot(kind='bar', x='Country', y='Quantity')

# Set the plot title and axis labels
plt.title('Total Quantities by Country')
plt.xlabel('Country')
plt.ylabel('Quantity')

# Set the y-axis limits
plt.ylim(0, 300000)

# Show the plot
plt.show()
```



CHOROPLETH MAP

```
import plotly.express as px

# Calculate the total number of products sold in each country
country_product_counts = df.groupby('Country')
['Quantity'].sum().reset_index()

# Create the choropleth map
fig = px.choropleth(country_product_counts, locations='Country',
locationmode='country names', color='Quantity',
                    color_continuous_scale='RdBu', title='Number of
Products Sold by Country')
fig.show()
```

APRIORI ALGORITHM - RECOMMENDATION SYSTEM - DATA MINING

```
pip install mlxtend
```

```
Looking in indexes: https://pypi.org/simple, https://us-
python.pkg.dev/colab-wheels/public/simple/
```

```
Requirement already satisfied: mlxtend in
/usr/local/lib/python3.9/dist-packages (0.14.0)
Requirement already satisfied: pandas>=0.17.1 in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (1.5.3)
Requirement already satisfied: scikit-learn>=0.18 in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (1.2.2)
Requirement already satisfied: scipy>=0.17 in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (1.10.1)
Requirement already satisfied: numpy>=1.10.4 in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (1.22.4)
Requirement already satisfied: matplotlib>=1.5.1 in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (3.7.1)
Requirement already satisfied: setuptools in
/usr/local/lib/python3.9/dist-packages (from mlxtend) (67.7.2)
Requirement already satisfied: kiwisolver>=1.0.1 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (1.4.4)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (3.0.9)
Requirement already satisfied: importlib-resources>=3.2.0 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (5.12.0)
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (2.8.2)
Requirement already satisfied: cycler>=0.10 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (0.11.0)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (23.1)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (4.39.3)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (1.0.7)
Requirement already satisfied: pillow>=6.2.0 in
/usr/local/lib/python3.9/dist-packages (from matplotlib>=1.5.1-
>mlxtend) (8.4.0)
Requirement already satisfied: pytz>=2020.1 in
/usr/local/lib/python3.9/dist-packages (from pandas>=0.17.1->mlxtend)
(2022.7.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/usr/local/lib/python3.9/dist-packages (from scikit-learn>=0.18-
>mlxtend) (3.1.0)
Requirement already satisfied: joblib>=1.1.1 in
/usr/local/lib/python3.9/dist-packages (from scikit-learn>=0.18-
>mlxtend) (1.2.0)
```

```
Requirement already satisfied: zipp>=3.1.0 in
/usr/local/lib/python3.9/dist-packages (from importlib-
resources>=3.2.0->matplotlib>=1.5.1->mlxtend) (3.15.0)
Requirement already satisfied: six>=1.5 in
/usr/local/lib/python3.9/dist-packages (from python-dateutil>=2.7-
>matplotlib>=1.5.1->mlxtend) (1.16.0)
```

```
import pandas as pd
df = pd.read_csv('OnlineRetail.csv', encoding='unicode_escape')
df.isnull().any()
```

```
InvoiceNo      False
StockCode      False
Description     True
Quantity       False
InvoiceDate    False
UnitPrice      False
CustomerID      True
Country        False
dtype: bool
```

```
df.dropna(inplace=True)
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 406829 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    406829 non-null  object
 1   StockCode    406829 non-null  object
 2   Description  406829 non-null  object
 3   Quantity     406829 non-null  int64
 4   InvoiceDate  406829 non-null  object
 5   UnitPrice    406829 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      406829 non-null  object
dtypes: float64(2), int64(1), object(5)
memory usage: 27.9+ MB
```

```
df.dropna(axis=0, subset=['InvoiceNo'], inplace=True)
```

```
basket = (df[df['Country'] =="France"]
          .groupby(['InvoiceNo', 'Description'])
['Quantity'].sum().unstack().fillna(0)
         )
basket.head()
```

```
Description   50'S CHRISTMAS GIFT BAG LARGE   DOLLY GIRL BEAKER  \
InvoiceNo
536370                                  0.0                 0.0
```

```
536852                                  0.0                 0.0
536974                                  0.0                 0.0
537065                                  0.0                 0.0
537463                                  0.0                 0.0

Description   I LOVE LONDON MINI BACKPACK   NINE DRAWER OFFICE TIDY  \
InvoiceNo
536370                                0.0                      0.0
536852                                0.0                      0.0
536974                                0.0                      0.0
537065                                0.0                      0.0
537463                                0.0                      0.0

Description   SET 2 TEA TOWELS I LOVE LONDON    SPACEBOY BABY GIFT SET
\
InvoiceNo

536370                                  24.0                     0.0

536852                                   0.0                     0.0

536974                                   0.0                     0.0

537065                                   0.0                     0.0

537463                                   0.0                     0.0


Description   TRELLIS COAT RACK  10 COLOUR SPACEBOY PEN  \
InvoiceNo
536370                     0.0                    0.0
536852                     0.0                    0.0
536974                     0.0                    0.0
537065                     0.0                    0.0
537463                     0.0                    0.0

Description  12 COLOURED PARTY BALLOONS  12 EGG HOUSE PAINTED
WOOD  ...  \
InvoiceNo                                                    ..
.
536370                              0.0
0.0  ...
536852                              0.0
0.0  ...
536974                              0.0
0.0  ...
537065                              0.0
0.0  ...
537463                              0.0
```

```
0.0  ...

Description  WRAP SUKI AND FRIENDS  WRAP VINTAGE PETALS  DESIGN  \
InvoiceNo
536370                         0.0                          0.0
536852                         0.0                          0.0
536974                         0.0                          0.0
537065                         0.0                          0.0
537463                         0.0                          0.0

Description  YELLOW COAT RACK PARIS FASHION  YELLOW GIANT GARDEN
THERMOMETER  \
InvoiceNo

536370                                   0.0
0.0
536852                                   0.0
0.0
536974                                   0.0
0.0
537065                                   0.0
0.0
537463                                   0.0
0.0

Description  ZINC  STAR T-LIGHT HOLDER   ZINC FOLKART SLEIGH BELLS  \
InvoiceNo
536370                              0.0                         0.0
536852                              0.0                         0.0
536974                              0.0                         0.0
537065                              0.0                         0.0
537463                              0.0                         0.0

Description  ZINC HERB GARDEN CONTAINER  ZINC METAL HEART
DECORATION  \
InvoiceNo

536370                              0.0                           0.0

536852                              0.0                           0.0

536974                              0.0                           0.0

537065                              0.0                           0.0

537463                              0.0                           0.0


Description  ZINC T-LIGHT HOLDER STAR LARGE  ZINC T-LIGHT HOLDER STARS
```

```
SMALL
InvoiceNo

536370                                    0.0
0.0
536852                                    0.0
0.0
536974                                    0.0
0.0
537065                                    0.0
0.0
537463                                    0.0
0.0

[5 rows x 1545 columns]
```

```
def encode_units(x):
    if x <= 0:
        return 0
    if x >= 1:
        return 1

basket_sets = basket.applymap(encode_units)
basket_sets.head()
```

```
Description   50'S CHRISTMAS GIFT BAG LARGE   DOLLY GIRL BEAKER  \
InvoiceNo
536370                                    0                   0
536852                                    0                   0
536974                                    0                   0
537065                                    0                   0
537463                                    0                   0

Description   I LOVE LONDON MINI BACKPACK   NINE DRAWER OFFICE TIDY  \
InvoiceNo
536370                                    0                         0
536852                                    0                         0
536974                                    0                         0
537065                                    0                         0
537463                                    0                         0

Description   SET 2 TEA TOWELS I LOVE LONDON    SPACEBOY BABY GIFT SET
\
InvoiceNo

536370                                       1                        0

536852                                       0                        0

536974                                       0                        0
```

```
537065                                        0                          0

537463                                        0                          0


Description   TRELLIS COAT RACK  10 COLOUR SPACEBOY PEN  \
InvoiceNo
536370                          0                       0
536852                          0                       0
536974                          0                       0
537065                          0                       0
537463                          0                       0

Description  12 COLOURED PARTY BALLOONS  12 EGG HOUSE PAINTED
WOOD  ...  \
InvoiceNo                                                      ..
.
536370                                  0
0  ...
536852                                  0
0  ...
536974                                  0
0  ...
537065                                  0
0  ...
537463                                  0
0  ...

Description  WRAP SUKI AND FRIENDS  WRAP VINTAGE PETALS  DESIGN  \
InvoiceNo
536370                            0                              0
536852                            0                              0
536974                            0                              0
537065                            0                              0
537463                            0                              0

Description  YELLOW COAT RACK PARIS FASHION  YELLOW GIANT GARDEN
THERMOMETER  \
InvoiceNo

536370                                     0
0
536852                                     0
0
536974                                     0
0
537065                                     0
0
```

```
537463                                        0
0

Description  ZINC  STAR T-LIGHT HOLDER   ZINC FOLKART SLEIGH BELLS  \
InvoiceNo
536370                                    0                           0
536852                                    0                           0
536974                                    0                           0
537065                                    0                           0
537463                                    0                           0

Description  ZINC HERB GARDEN CONTAINER  ZINC METAL HEART
DECORATION  \
InvoiceNo

536370                                    0                             0

536852                                    0                             0

536974                                    0                             0

537065                                    0                             0

537463                                    0                             0


Description  ZINC T-LIGHT HOLDER STAR LARGE  ZINC T-LIGHT HOLDER STARS
SMALL
InvoiceNo

536370                                       0
0
536852                                       0
0
536974                                       0
0
537065                                       0
0
537463                                       0
0

[5 rows x 1545 columns]
```

```
from mlxtend.frequent_patterns import apriori
frequent_itemsets = apriori(basket_sets, min_support=0.050,
use_colnames=True)
```

```
from mlxtend.frequent_patterns import association_rules
rules = association_rules(frequent_itemsets, metric="lift",
```

```
min_threshold=1)
rules.head()
```

```
                   antecedents                    consequents  \
0   (ALARM CLOCK BAKELIKE PINK)  (ALARM CLOCK BAKELIKE GREEN)
1  (ALARM CLOCK BAKELIKE GREEN)   (ALARM CLOCK BAKELIKE PINK)
2   (ALARM CLOCK BAKELIKE RED )  (ALARM CLOCK BAKELIKE GREEN)
3  (ALARM CLOCK BAKELIKE GREEN)   (ALARM CLOCK BAKELIKE RED )
4                     (POSTAGE)  (ALARM CLOCK BAKELIKE GREEN)

   antecedent support  consequent support   support  confidence
lift  \
0            0.087336            0.082969  0.063319    0.725000
8.738158
1            0.082969            0.087336  0.063319    0.763158
8.738158
2            0.080786            0.082969  0.067686    0.837838
10.098151
3            0.082969            0.080786  0.067686    0.815789
10.098151
4            0.655022            0.082969  0.072052    0.110000
1.325789

   leverage  conviction
0  0.056073    3.334657
1  0.056073    3.853469
2  0.060983    5.655022
3  0.060983    4.990019
4  0.017706    1.030371
```

```
rules[(rules['lift'] >= 2) &
       (rules['confidence'] >= 0.5) ]
```

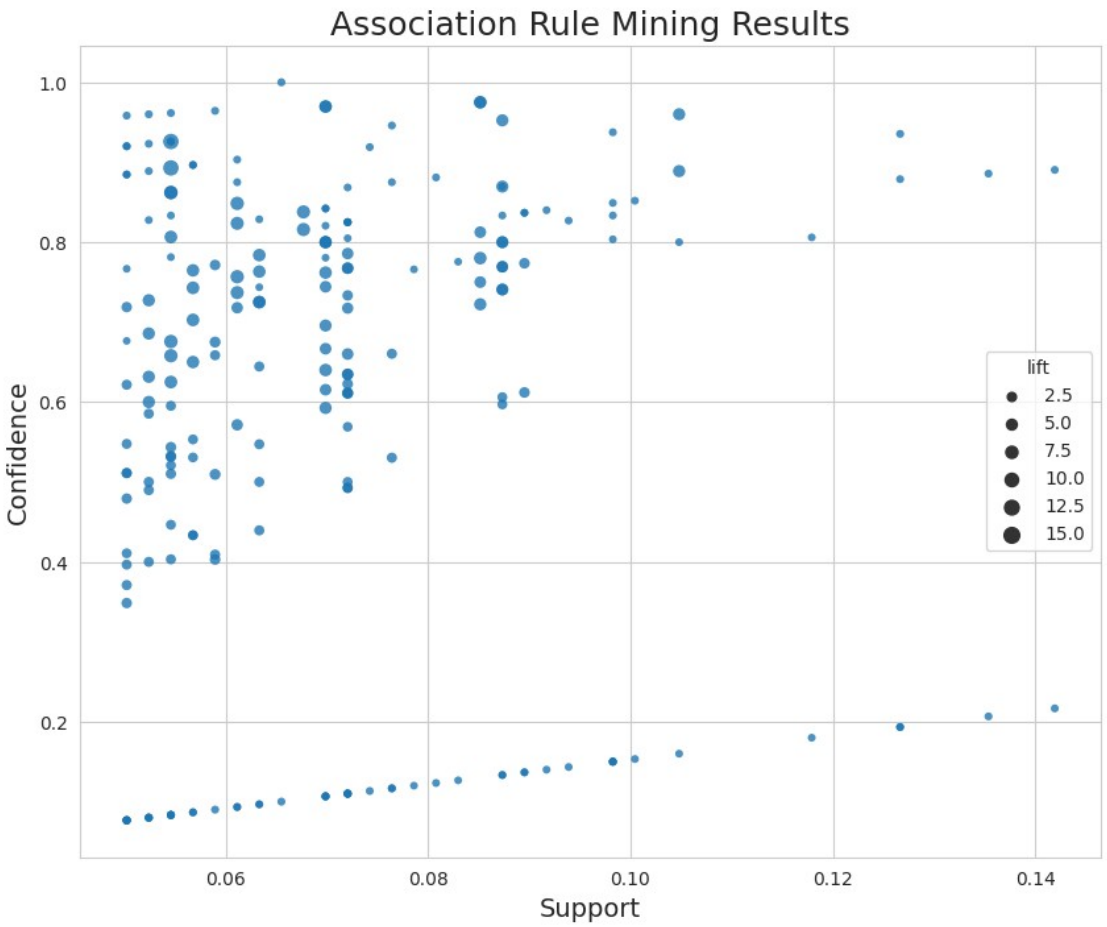
```
                                          antecedents  \
0                          (ALARM CLOCK BAKELIKE PINK)
1                         (ALARM CLOCK BAKELIKE GREEN)
2                          (ALARM CLOCK BAKELIKE RED )
3                         (ALARM CLOCK BAKELIKE GREEN)
6                          (ALARM CLOCK BAKELIKE PINK)
..                                                 ...
222     (SET/20 RED RETROSPOT PAPER NAPKINS , POSTAGE)
223  (SET/20 RED RETROSPOT PAPER NAPKINS , SET/6 RE...
224                    (SET/6 RED SPOTTY PAPER PLATES)
226                      (SET/6 RED SPOTTY PAPER CUPS)
227              (SET/20 RED RETROSPOT PAPER NAPKINS )

                                          consequents  antecedent
support  \
0                         (ALARM CLOCK BAKELIKE GREEN)
0.087336
```

```
1                          (ALARM CLOCK BAKELIKE PINK)
0.082969
2                         (ALARM CLOCK BAKELIKE GREEN)
0.080786
3                          (ALARM CLOCK BAKELIKE RED )
0.082969
6                          (ALARM CLOCK BAKELIKE RED )
0.087336
..                                                  ...
...
222  (SET/6 RED SPOTTY PAPER PLATES, SET/6 RED SPOT...
0.093886
223           (SET/6 RED SPOTTY PAPER PLATES, POSTAGE)
0.087336
224  (SET/20 RED RETROSPOT PAPER NAPKINS , POSTAGE,...
0.109170
226  (SET/6 RED SPOTTY PAPER PLATES, POSTAGE, SET/2...
0.117904
227  (SET/6 RED SPOTTY PAPER PLATES, POSTAGE, SET/6...
0.113537

     consequent support   support  confidence       lift  leverage
conviction
0              0.082969  0.063319    0.725000   8.738158  0.056073
3.334657
1              0.087336  0.063319    0.763158   8.738158  0.056073
3.853469
2              0.082969  0.067686    0.837838  10.098151  0.060983
5.655022
3              0.080786  0.067686    0.815789  10.098151  0.060983
4.990019
6              0.080786  0.063319    0.725000   8.974324  0.056263
3.342596
..                  ...       ...         ...        ...       ...
...
222            0.104803  0.069869    0.744186   7.100775  0.060029
3.499405
223            0.091703  0.069869    0.800000   8.723810  0.061860
4.541485
224            0.072052  0.069869    0.640000   8.882424  0.062003
2.577632
226            0.072052  0.069869    0.592593   8.224467  0.061374
2.277690
227            0.087336  0.069869    0.615385   7.046154  0.059953
2.372926

[98 rows x 9 columns]
```

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

```
def plot_association_rules(data, x, y, size):
    """
    Plots association rule mining results as a scatterplot.

    Parameters:
    data (pandas DataFrame): The data to plot.
    x (str): The name of the column to plot on the x-axis.
    y (str): The name of the column to plot on the y-axis.
    size (str): The name of the column to use for the marker size.
    """
    sns.set_style("whitegrid")  # set the style of the plot
    fig, ax = plt.subplots(figsize=(10, 8))  # set the size of the
plot

    # plot the scatterplot with customized aesthetics
    sns.scatterplot(x=x, y=y, size=size, data=data,
                    alpha=0.8, edgecolor='none', palette='viridis',
                    ax=ax)

    # add title and axis labels
    ax.set_title("Association Rule Mining Results", fontsize=18)
    ax.set_xlabel(x.title(), fontsize=14)
    ax.set_ylabel(y.title(), fontsize=14)

    # show the plot
    plt.show()

plot_association_rules(rules, "support", "confidence", "lift")
```

```
<ipython-input-22-1f3dbbba5223>:18: UserWarning: Ignoring `palette`
because no `hue` variable has been assigned.
  sns.scatterplot(x=x, y=y, size=size, data=data,
```



RECOMMENDATION SYSTEM USING COLLABORATIVE FILTERING

Collaborative filtering is a technique commonly used in recommendation systems to suggest items to users based on the preferences of other similar users. In this code, two different types of collaborative filtering are used: user-user collaborative filtering and item-item collaborative filtering.

```
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity
```

```
import pandas as pd
from sklearn.metrics.pairwise import cosine_similarity

# Load the data
df = pd.read_csv('OnlineRetail.csv', encoding='unicode_escape')

# Filter out rows with missing CustomerID values
df = df[df['CustomerID'].notna()]

# Filter out customers with IDs outside the specified range
```

```
df = df[(df['CustomerID'] >= 12346) & (df['CustomerID'] <= 18287)]

# Convert Quantity column to integers
df.loc[:, 'Quantity'] = df['Quantity'].astype(int)

# Drop rows with missing values
df.dropna(inplace=True)

# Pivot the table to get customer-item matrix
customer_item_matrix = df.pivot_table(values='Quantity',
index='CustomerID', columns='StockCode', aggfunc='sum', fill_value=0)

# Calculate user-user similarity matrix
user_user_sim_matrix =
pd.DataFrame(cosine_similarity(customer_item_matrix))
user_user_sim_matrix.index = customer_item_matrix.index
user_user_sim_matrix.columns = customer_item_matrix.index

# Define function to get items to recommend to a customer based on
customer similarity
def get_items_to_recommend_cust(cust_a):
    # Check if customer exists in the customer-item matrix
    if cust_a not in customer_item_matrix.index:
        print(f"Customer {cust_a} is not available in the customer-
item matrix.")
        return None

    # Find most similar customer
    most_similar_user =
user_user_sim_matrix.loc[cust_a].sort_values(ascending=False).index[1]

    # Get items bought by both customers
    items_bought_by_cust_a = set(customer_item_matrix.loc[cust_a]
[customer_item_matrix.loc[cust_a] > 0].index)
    items_bought_by_cust_b =
set(customer_item_matrix.loc[most_similar_user]
[customer_item_matrix.loc[most_similar_user] > 0].index)

    # Get items to recommend to the customer
    items_to_recommend_to_a = items_bought_by_cust_b -
items_bought_by_cust_a
    items_description =
df.loc[df['StockCode'].isin(items_to_recommend_to_a), ['StockCode',
'Description']].drop_duplicates().set_index('StockCode')

    return items_description

# Get user input for customer ID
cust_id = input("Please enter a customer ID between 12346 and 18287:
")
```

```
cust_id = int(cust_id)

# Test the function with the user input
get_items_to_recommend_cust(cust_id)

# Calculate item-item similarity matrix
item_item_sim_matrix =
pd.DataFrame(cosine_similarity(customer_item_matrix.T))
item_item_sim_matrix.index = customer_item_matrix.columns
item_item_sim_matrix.columns = customer_item_matrix.columns

# Define function to get top similar items to an item
def get_top_similar_items(item):
    # Get top 10 most similar items
    top_10_similar_items =
item_item_sim_matrix[item].sort_values(ascending=False).iloc[1:11].ind
ex

    # Get descriptions of the top similar items
    top_10 = df.loc[df['StockCode'].isin(top_10_similar_items),
['StockCode',
'Description']].drop_duplicates().set_index('StockCode').loc[top_10_si
milar_items]

    return top_10

# Get user input for item code
item_code = input("Please enter an item code sample 22423, 47566: ")

# Test the function with the user input
get_top_similar_items(item_code)
```

```
Please enter a customer ID between 12346 and 18287: 18287
Please enter an item code: 22423

                                  Description
StockCode
23509              MINI PLAYING CARDS FUN FAIR
23382      BOX OF 6 CHRISTMAS CAKE DECORATIONS
84952B          BLACK LOVE BIRD T-LIGHT HOLDER
84952C         MIRROR LOVE BIRD T-LIGHT HOLDER
71459           HANGING JAM JAR T-LIGHT HOLDER
71459          HANGING JAM JAR T-LIGHT HOLDERS
21499                      BLUE POLKADOT WRAP
22752             SET 7 BABUSHKA NESTING BOXES
16237                    SLEEPING CAT ERASERS
22452             MEASURING TAPE BABUSHKA PINK
21500                      PINK POLKADOT WRAP
```

```
stock_codes = customer_item_matrix.columns
print(stock_codes)
```

```
Index(['10002', '10080', '10120', '10123C', '10124A', '10124G',
'10125',
       '10133', '10135', '11001',
       ...
       '90214Y', '90214Z', 'BANK CHARGES', 'C2', 'CRUK', 'D', 'DOT',
'M',
       'PADS', 'POST'],
      dtype='object', name='StockCode', length=3684)
```