

MARKET-BASKET-INSIGHTS

Documentation

October 30, 2023

[1]: *#This is a kaggle notebook.*

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames: print(os.path.join(dirname, filename))

/kaggle/input/market-basket-analysis/Assignment-1_Data.xlsx
/kaggle/input/market-basket-analysis/Assignment-1_Data.csv
```

1 Market Basket Analysis Project

1.1 Overview

This notebook is part of a project focused on market basket analysis. We will begin by loading and preprocessing the dataset.

1.2 Dataset Information

The dataset is stored in the file Assignment-1_Data.xlsx located at /kaggle/input/market-basket-analysis/. It contains information related to market transactions.

[2]: 1.3 Loading the Dataset

Let's start by loading the dataset into a DataFrame using pandas.

```
import pandas as pd

# Load the dataset
dataset_path = '/kaggle/input/market-basket-analysis/Assignment-1_Data.xlsx' df =
pd.read_excel(dataset_path)
```

2 Initial Exploration

We'll perform an initial exploration of the dataset to understand its structure and

characteristics.

[3]:

```
# Display basic information about the dataset
print("Number of rows and columns:", df.shape)
print("\nData Types and Missing Values:")
print(df.info())
print("\nFirst few rows of the dataset:")
print(df.head())
```

Number of rows and columns: (522064, 7)

Data Types and Missing Values:

<class 'pandas.core.frame.DataFrame'>

RangelIndex: 522064 entries, 0 to 522063Data

columns (total 7 columns):

#	Column	Non-Null Count	Dtype
0	BillNo	522064 non-null	object
1	Itemname	520609 non-null	object
2	Quantity	522064 non-null	int64
3	Date	522064 non-null	datetime64[ns]
4	Price	522064 non-null	float64
5	CustomerID	388023 non-null	float64
6	Country	522064 non-null	object

dtypes: datetime64[ns](1), float64(2), int64(1), object(3)memory

usage: 27.9+ MB

None

First few rows of the dataset:

BillNo	Itemname	Quantity	Date
0 536365	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00
1 536365	WHITE METAL LANTERN	6	2010-12-01 08:26:00
2 536365	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00
3 536365	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00
4 536365	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00

Price	CustomerID	Country
0 2.55	17850.0	United Kingdom
1 3.39	17850.0	United Kingdom
2 2.75	17850.0	United Kingdom
3 3.39	17850.0	United Kingdom
4 3.39	17850.0	United Kingdom

3 Preprocessing

We'll preprocess the data to ensure it's ready for analysis.

[4]:

```
#Check Missing Values
print("Missing Values:")
```

```
print(df.isnull().sum())

#Drop Rows with Missing Values
df.dropna(inplace=True)
```

Missing Values: BillNo

	0
Itemname	1455
Quantity	0
Date	0
Price	0
CustomerID	134041
Country	0

dtype: int64

```
# Convert dataframe into transaction data
transaction_data = df.groupby(['BillNo', 'Date'])['Itemname'].apply(lambda x:_
[5]:    ', '.join(x)).reset_index()
```

#Drop Unnecessary Columns

```
columns_to_drop = ['BillNo', 'Date'] transaction_data.drop(columns=columns_to_drop,
inplace=True)
```

```
# Save the transaction data to a CSV file
transaction_data_path = '/kaggle/working/transaction_data.csv'
transaction_data.to_csv(transaction_data_path, index=False)
```

```
[6]: # Display the first few rows of the transaction data
print("\nTransaction Data for Association Rule Mining:")
print(transaction_data.head())
transaction_data.shape
```

Transaction Data for Association Rule Mining:

	Itemname
0	WHITE HANGING HEART T-LIGHT HOLDER, WHITE METAL...
1	HAND WARMER UNION JACK, HAND WARMER RED POLKA DOT
2	ASSORTED COLOUR BIRD ORNAMENT, POPPY'S PLAYHOUSE...
3	JAM MAKING SET WITH JARS, RED COAT RACK PARIS ...
4	BATH BUILDING BLOCK WORD

[6]: (18192, 1)

4.1 Formatting the transaction data in a suitable format for analysis

Developing the preprocessed data into analysis. Split the ‘Itemname’ column in transaction_data into individual items using str.split(', ', expand=True).Concatenate the original DataFrame (transaction_data) with the items DataFrame (items_df) using pd.concat.Drop the original ‘Itemname’ column since individual items are now in

[7]: separate columns.Display the resulting DataFrame.

```
# Split the 'Itemname' column into individual items
items_df = transaction_data['Itemname'].str.split(', ', expand=True)

# Concatenate the original DataFrame with the new items DataFrame
transaction_data = pd.concat([transaction_data, items_df], axis=1)

# Drop the original 'Itemname' column
transaction_data = transaction_data.drop('Itemname', axis=1)

# Display the resulting DataFrame
print(transaction_data.head())
```

	0	1	2	3	4	5	6	7
0	WHITE HANGING HEART T-LIGHT HOLDER							
1	HAND WARMER UNION JACK							
2	ASSORTED COLOUR BIRD ORNAMENT							
3	JAM MAKING SET WITH JARS							
4	BATH BUILDING BLOCK WORD							
		WHITE METAL LANTERN						
		HAND WARMER RED POLKA DOT						
		POPPY'S PLAYHOUSE BEDROOM						
		RED COAT RACK PARIS FASHION						
		None						
0	CREAM CUPID HEARTS COAT HANGER	KNITTED UNION FLAG HOT WATER BOTTLE						
1	None	None						
2	POPPY'S PLAYHOUSE KITCHEN	FELTCRAFT PRINCESS CHARLOTTE DOLL						
3	YELLOW COAT RACK PARIS FASHION	BLUE COAT RACK PARIS FASHION						
4	None	None						
0	RED WOOLLY HOTTIE WHITE HEART.	SET 7 BABUSHKA NESTING BOXES						
1	None	None						
2	IVORY KNITTED MUG COSY	BOX OF 6 ASSORTED COLOUR TEASPOONS						
3	None	None						
4	None	None						
0	GLASS STAR FROSTED T-LIGHT HOLDER							
1	None	None						
2	BOX OF VINTAGE JIGSAW BLOCKS	BOX OF VINTAGE ALPHABET BLOCKS						
3	None	None						

```

          8           9   ... 534 535 536 \
0      None       None   ...  None  None  None
1      None       None   ...  None  None  None
2 HOME BUILDING BLOCK WORD LOVE BUILDING BLOCK WORD   ...  None  None  None
3      None       None   ...  None  None  None
4      None       None   ...  None  None  None

      537 538 539 540 541 542 543
0  None  None  None  None  None  None  None
1  None  None  None  None  None  None  None
2  None  None  None  None  None  None  None
3  None  None  None  None  None  None  None
4  None  None  None  None  None  None  None

```

[5 rows x 544 columns]

4 Association Rules - Data Mining

4.1 Converting Items to Boolean Columns

To prepare the data for association rule mining, we convert the items in the transaction_data DataFrame into boolean columns using one-hot encoding. This is achieved through the pd.get_dummies function, which creates a new DataFrame [8]: (df_encoded) with boolean columns representing the presence or absence of each item.

```

# Convert items to boolean columns
df_encoded = pd.get_dummies(transaction_data, prefix=' ', prefix_sep=' ')
    ↳ groupby(level=0, axis=1).max()

# Save the transaction data to a CSV file
df_encoded.to_csv('transaction_data_encoded.csv', index=False)

```

4.2 Association Rule Mining

We apply the Apriori algorithm to perform association rule mining on the encoded transaction data. The min_support parameter is set to 0.007 to filter out infrequent itemsets. The resulting frequent itemsets are then used to generate association rules based on a minimum confidence threshold of 0.5. Finally, we print the generated

```

# Load transaction data into a DataFrame
[9]: df_encoded = pd.read_csv('transaction_data_encoded.csv')

from mlxtend.frequent_patterns import apriori, association_rules

# Association Rule Mining
frequent_itemsets = apriori(df_encoded, min_support=0.007, use_colnames=True)

```

```
rules = association_rules(frequent_itemsets, metric="confidence",  
                         min_threshold=0.5)
```

```
# Display information of the rules  
print("Association Rules:")  
print(rules.head())
```

Association Rules:

	antecedents	consequents \
0	(CHOCOLATE BOX RIBBONS)	(6 RIBBONS RUSTIC CHARM)
1	(60 CAKE CASES DOLLY GIRL DESIGN)	(PACK OF 72 RETROSPOT CAKE CASES)
2	(60 TEATIME FAIRY CAKE CASES)	(PACK OF 72 RETROSPOT CAKE CASES)
3	(ALARM CLOCK BAKELIKE CHOCOLATE)	(ALARM CLOCK BAKELIKE GREEN)
4	(ALARM CLOCK BAKELIKE CHOCOLATE)	(ALARM CLOCK BAKELIKE PINK)

	antecedent support	consequent support	support	confidence	lift	\
0	0.012368	0.039193	0.007036	0.568889	14.515044	
1	0.018525	0.054529	0.010059	0.543027	9.958409	
2	0.034631	0.054529	0.017315	0.500000	9.169355	
3	0.017150	0.042931	0.011379	0.663462	15.454151	
4	0.017150	0.032652	0.009125	0.532051	16.294742	

	leverage	conviction	zhangs_metric
0	0.006551	2.228676	0.942766
1	0.009049	2.068984	0.916561
2	0.015427	1.890941	0.922902
3	0.010642	2.843862	0.951613
4	0.008565	2.067210	0.955009

5 Visualization

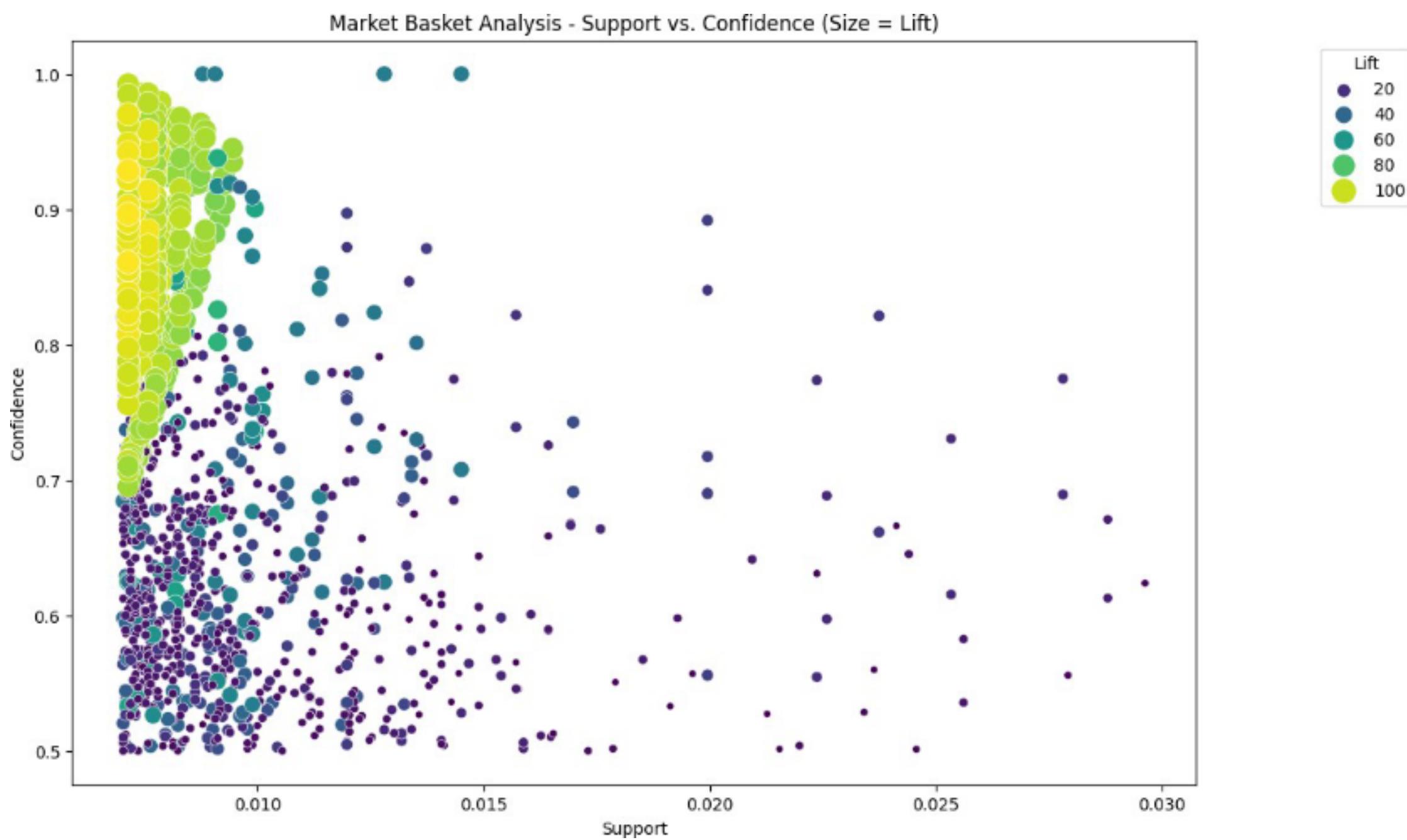
5.1 Visualizing Market Basket Analysis Results

We use matplotlib and seaborn libraries to create a scatterplot visualizing the results of

[10]: the market basket analysis. The plot depicts the relationship between support, confidence, and lift for the generated association rules.

```
import matplotlib.pyplot as plt  
import seaborn as sns  
  
# Plot scatterplot for Support vs. Confidence  
plt.figure(figsize=(12, 8))  
sns.scatterplot(x="support", y="confidence", size="lift", data=rules,  
                 hue="lift", palette="viridis", sizes=(20, 200))  
plt.title('Market Basket Analysis - Support vs. Confidence (Size = Lift)')  
plt.xlabel('Support')  
plt.ylabel('Confidence')
```

```
plt.legend(title='Lift', loc='upper right', bbox_to_anchor=(1.2, 1)) plt.show()
```



5.2 Interactive Market Basket Analysis Visualization

We leverage the Plotly Express library to create an interactive scatter plot visualizing the results of the market basket analysis. This plot provides an interactive exploration of the relationship between support, confidence, and lift for the

```
[11]: import plotly.express as px
```

```
# Convert frozensets to lists for serialization
rules['antecedents'] = rules['antecedents'].apply(list)
rules['consequents'] = rules['consequents'].apply(list)

# Create an interactive scatter plot using plotly express
fig = px.scatter(rules, x="support", y="confidence", size="lift", color="lift",
                  hover_name="consequents",
                  title='Market Basket Analysis - Support vs. Confidence',
                  labels={'support': 'Support', 'confidence': 'Confidence'}))

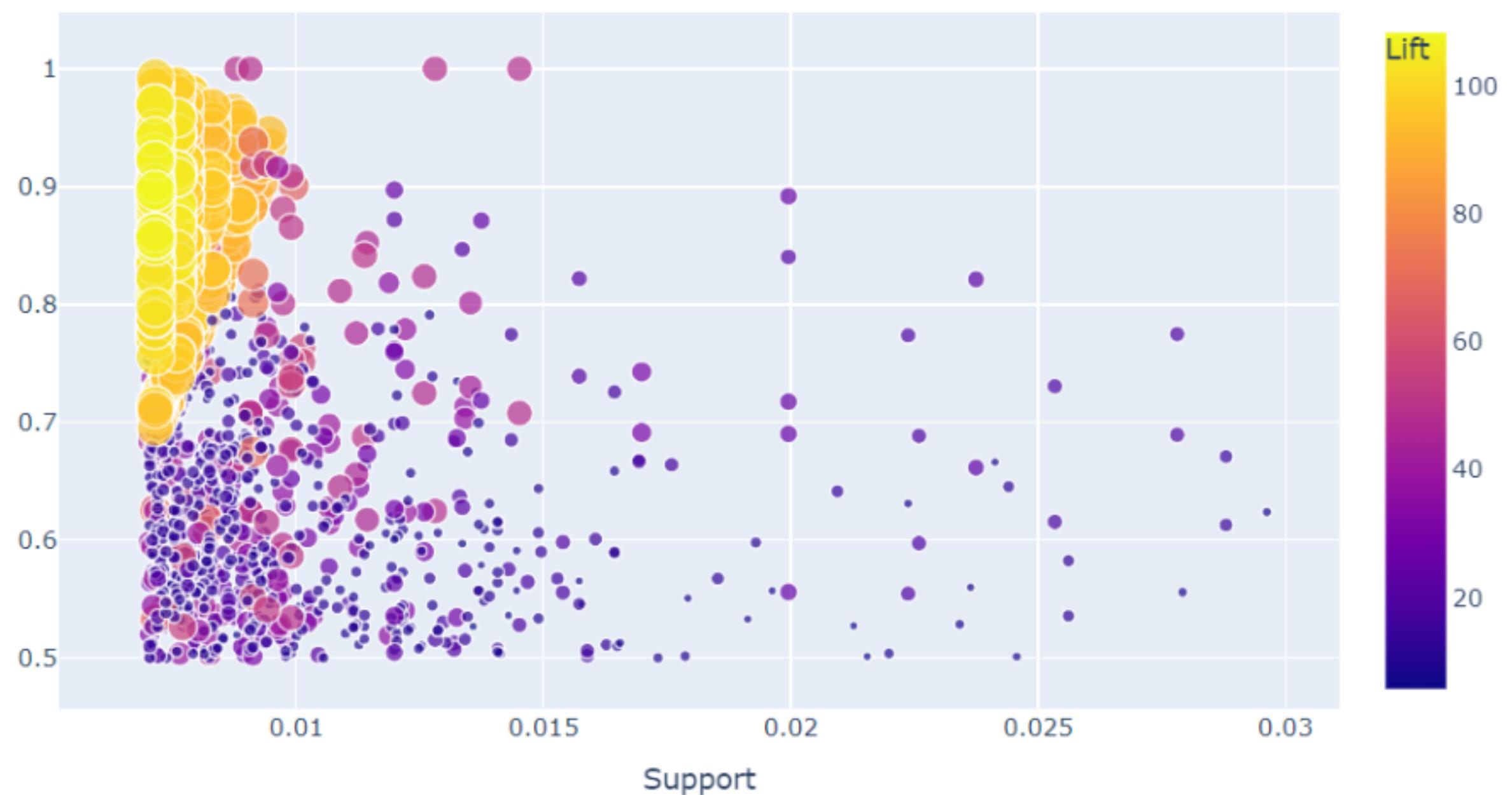
# Customize the layout
fig.update_layout(
    xaxis_title='Support',
    yaxis_title='Confidence',
    coloraxis_colorbar_title='Lift',
```

```

    showlegend=True
)
# Show the interactive plot
fig.show()

```

Market Basket Analysis - Support vs. Confidence



5.3 Interactive Network Visualization for Association Rules

We utilize the NetworkX and Plotly libraries to create an interactive network graph visualizing the association rules. This graph represents relationships between antecedent and consequent items, showcasing support as edge weights.

```

[12]: import networkx as nx
import matplotlib.pyplot as plt
import plotly.graph_objects
as go

# Create a directed graph
G = nx.DiGraph()

# Add nodes and edges from association rules
for idx, row in rules.iterrows():
    G.add_node(tuple(row['antecedents']), color='skyblue')
    G.add_node(tuple(row['consequents']), color='orange')
    G.add_edge(tuple(row['antecedents']), tuple(row['consequents']),
               weight=row['support'])

# Set node positions using a spring layout
pos = nx.spring_layout(G)

# Create an interactive plot using plotly

```

```

node_x=[]
node_y=[]
for node in G.nodes():
    y= pos[node]
    node_x.append(x)
    node_y.append(y)

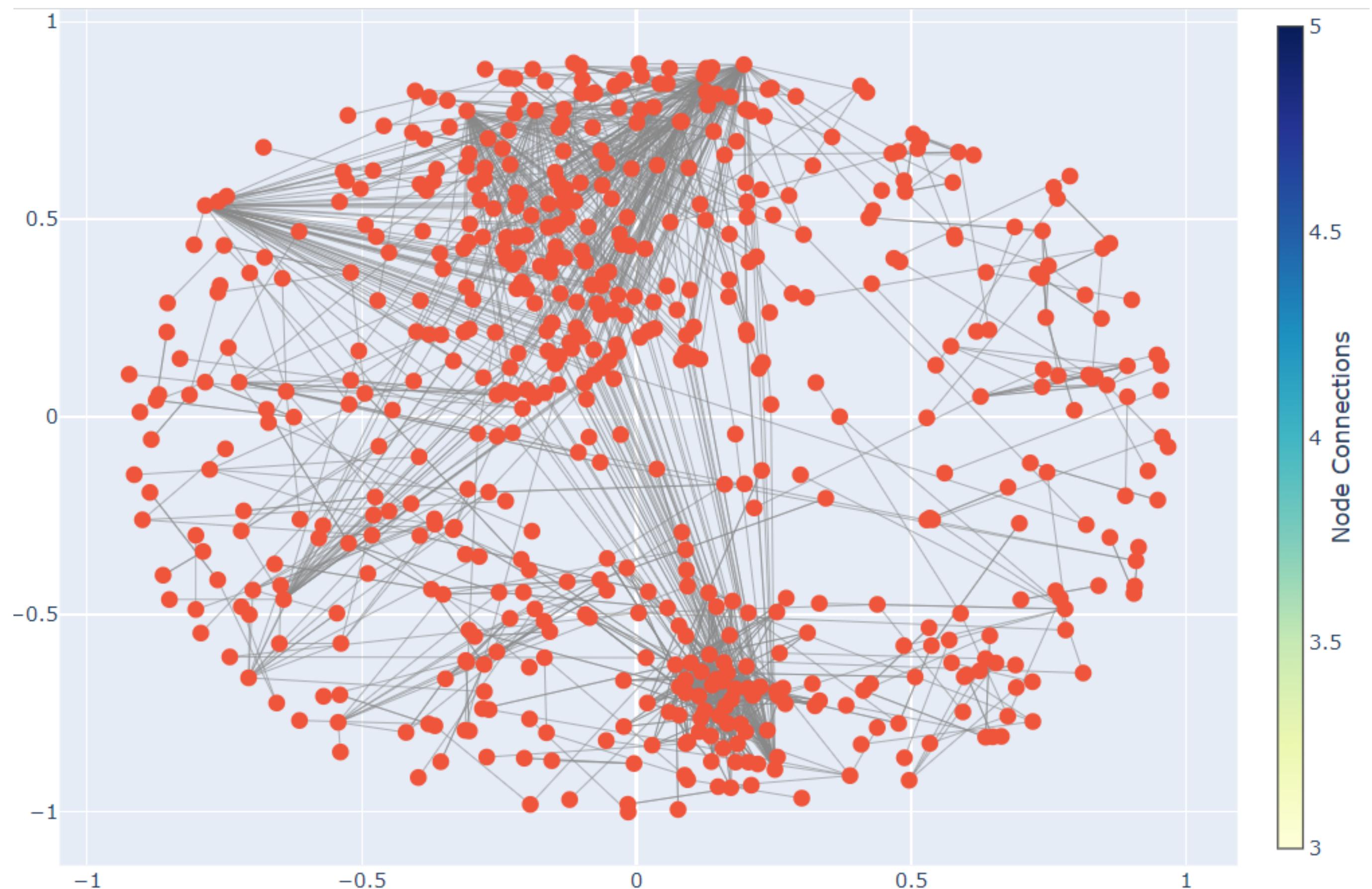
node_trace=go.Scatter(
    x=node_x, y=node_y,
    mode='markers',
    hoverinfo='text',
    marker=dict(
        showscale=True,
        colorscale='YIGnBu',
        size=10,
        colorbar=dict(
            thickness=15,
            title='Node Connections',
            xanchor='left', titleside='right'
        )
    )
)

# Customize the layout
layout=go.Layout(showlegend=False,
    hovermode='closest',
    margin=dict(b=0, l=0, r=0, t=0),
)

# Create the figure
fig = go.Figure(data=[edge_trace, node_trace], layout=layout)

# Show the interactive graph
fig.show()

```



5.4 Interactive Sunburst Chart for Association Rules

We use Plotly Express to create an interactive sunburst chart visualizing association rules. This chart represents the relationships between antecedent and consequent items, showcasing lift as well as support through color intensity.

```
[13]: import plotly.express as px  
  
# Combine antecedents and consequents into a single column for each
```

```

rules['rule'] = rules['antecedents'].astype(str) + ' -> ' + \
    rules['consequents'].astype(str)

# Create a sunburst chart
fig = px.sunburst(rules, path=['rule'], values='lift',
                   title='Market Basket Analysis - Sunburst Chart', color='support',
                   color_continuous_scale='YIGnBu')

# Customize the layout
fig.update_layout(
    margin=dict(l=0, r=0, b=0, t=40),
)

# Show the interactive plot
fig.show()

```

Market Basket Analysis - Sunburst Chart

