DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

TEAM MEMBERS:

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(https://github.com/suresh-2003/AI_Phase1.git)

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(https://github.com/veerahariprasath-2005/ai_phase1.git)

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MARKET BASKET INSIGHTS

[10]:
```
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
```

[11]:
```
pip install openpyxl
```

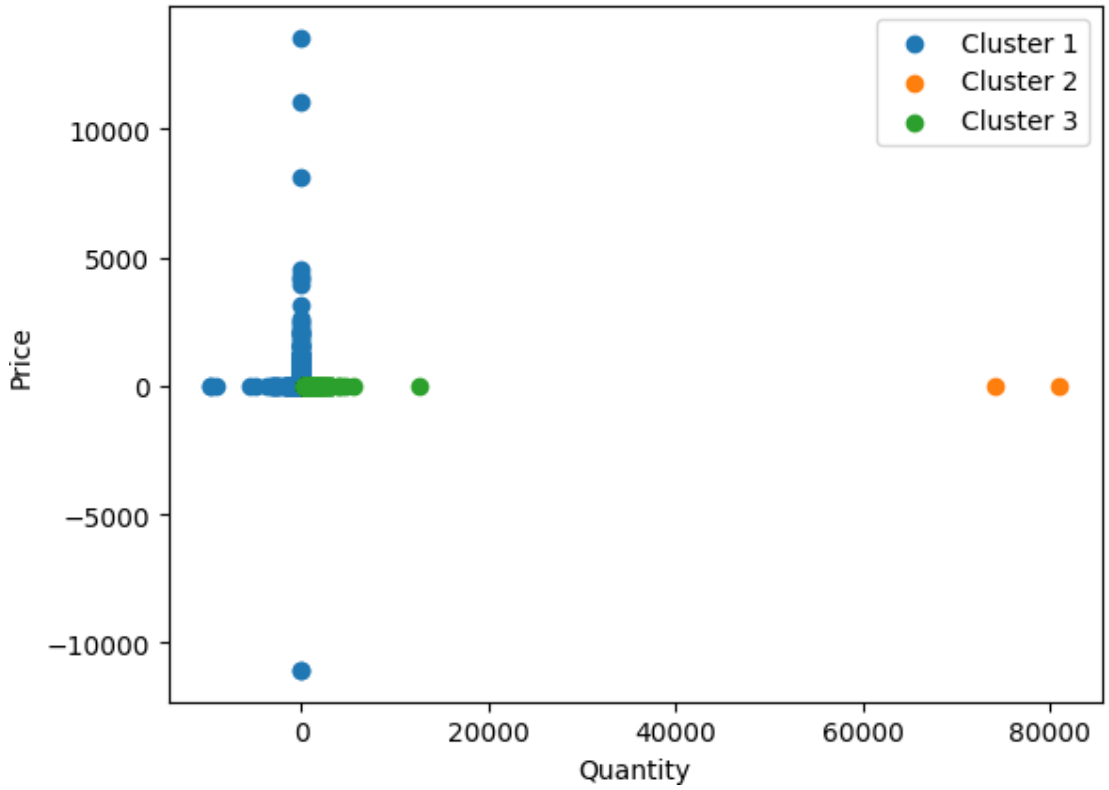
```
Requirement already satisfied: openpyxl in c:\users\d e l
l\appdata\local\programs\python\python310\lib\site-packages (3.1.2)
Requirement already satisfied: et-xmlfile in c:\users\d e l
l\appdata\local\programs\python\python310\lib\site-packages (from openpyxl)
(1.1.0)


[notice] A new release of pip available: 22.2.1 -> 23.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
```

[12]:
```
data = pd.read_excel("Assignment-1_Data.xlsx")

selected_features = data[['Quantity', 'Price']]
num_clusters = 3
kmeans = KMeans(n_clusters=num_clusters)
data['Cluster'] = kmeans.fit_predict(selected_features)
```

```
C:\Users\D E L L\AppData\Local\Programs\Python\Python310\lib\site-
packages\sklearn\cluster\_kmeans.py:1416: FutureWarning: The default value of
`n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init`
explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
```

[13]:
```
for cluster in range(num_clusters):
    cluster_data = data[data['Cluster'] == cluster]
    plt.scatter(cluster_data['Quantity'], cluster_data['Price'],
 ↪label=f'Cluster {cluster + 1}')

plt.xlabel('Quantity')
plt.ylabel('Price')
plt.legend()
```

```
plt.show()
```



[14]:
```
for cluster in range(num_clusters):
    cluster_data = data[data['Cluster'] == cluster]
    print(f'Cluster {cluster + 1}:')
    print(cluster_data.describe())
    centroid = kmeans.cluster_centers_[cluster]
    print(f'Centroid for Cluster: {cluster + 1}')
    print(f'Quantity: {centroid[0]}')
    print(f'Price: {centroid[1]}')
    plt.figure(figsize=(10, 6))
    plt.hist(cluster_data['Quantity'], bins=20, alpha=0.5, label='Quantity')
    plt.hist(cluster_data['Price'], bins=20, alpha=0.5, label='Price')
    plt.xlabel('Feature Values')
    plt.ylabel('Frequency')
    plt.title(f'Cluster {cluster + 1} Feature Distributions')
    plt.legend()
    plt.show()
```

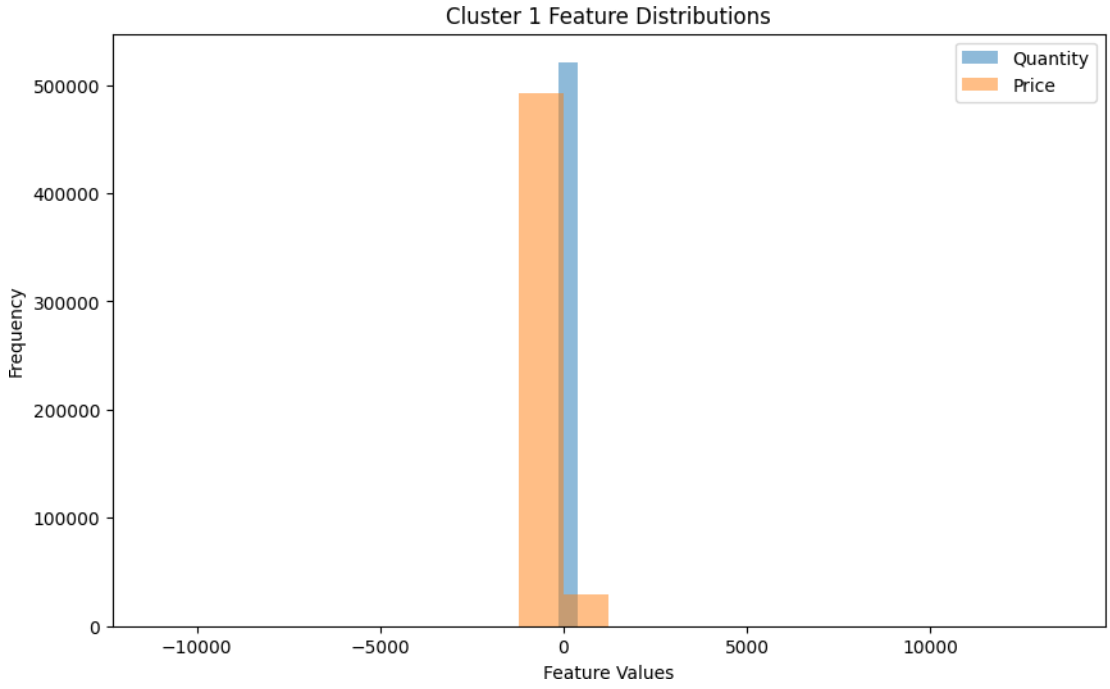
Cluster 1:

	Quantity	Date	Price	\
count	521308.000000	521308	521308.000000	

	Quantity	Date	Price	CustomerID
mean	8.723591	2011-07-04 12:57:38.102695680		3.830624
min	-9600.000000	2010-12-01 08:26:00		-11062.060000
25%	1.000000	2011-03-28 10:15:00		1.250000
50%	3.000000	2011-07-20 08:59:00		2.080000
75%	10.000000	2011-10-19 14:22:00		4.130000
max	378.000000	2011-12-09 12:50:00		13541.330000
std	36.890530		NaN	41.930819

	CustomerID	Cluster
count	387303.000000	521308.0
mean	15315.979801	0.0
min	12347.000000	0.0
25%	13950.000000	0.0
50%	15261.000000	0.0
75%	16837.000000	0.0
max	18287.000000	0.0
std	1721.397926	0.0

Centroid for Cluster: 1
Quantity: 8.72359142771426
Price: 3.830624436993143



Cluster 2:

	Quantity	Date	Price	CustomerID	Cluster
count	2.000000	2	2.000000	2.000000	2.0
mean	77605.000000	2011-06-29 21:38:00	1.560000	14396.000000	1.0

min	74215.000000	2011-01-18 10:01:00	1.040000	12346.000000	1.0
25%	75910.000000	2011-04-09 15:49:30	1.300000	13371.000000	1.0
50%	77605.000000	2011-06-29 21:38:00	1.560000	14396.000000	1.0
75%	79300.000000	2011-09-19 03:26:30	1.820000	15421.000000	1.0
max	80995.000000	2011-12-09 09:15:00	2.080000	16446.000000	1.0
std	4794.183976	NaN	0.735391	2899.137803	0.0

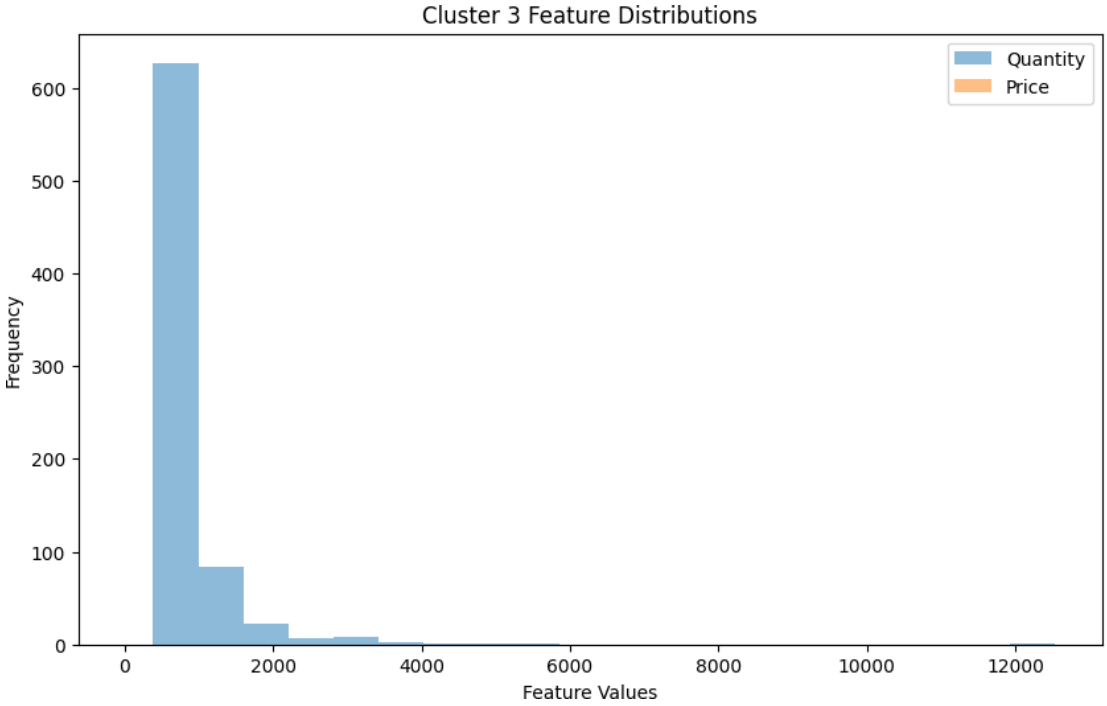
Centroid for Cluster: 2
Quantity: 77605.0
Price: 1.56

Cluster 3:

	Quantity	Date	Price	CustomerID	\
count	754.000000	754	754.000000	718.000000	
mean	749.290451	2011-07-01 12:41:03.740052992	1.189589	15832.974930	
min	384.000000	2010-12-01 09:58:00	0.000000	12415.000000	
25%	432.000000	2011-04-01 12:25:30	0.360000	14101.000000	
50%	576.000000	2011-07-24 12:58:30	0.720000	16333.000000	
75%	748.500000	2011-10-05 10:06:00	1.650000	17450.000000	
max	12540.000000	2011-12-08 18:46:00	8.150000	18251.000000	
std	694.918323	NaN	1.327377	1879.120714	

	Cluster
count	754.0
mean	2.0
min	2.0

25% 2.0
50% 2.0
75% 2.0
max 2.0
std 0.0
Centroid for Cluster: 3
Quantity: 749.2904509283826
Price: 1.1895888594164465



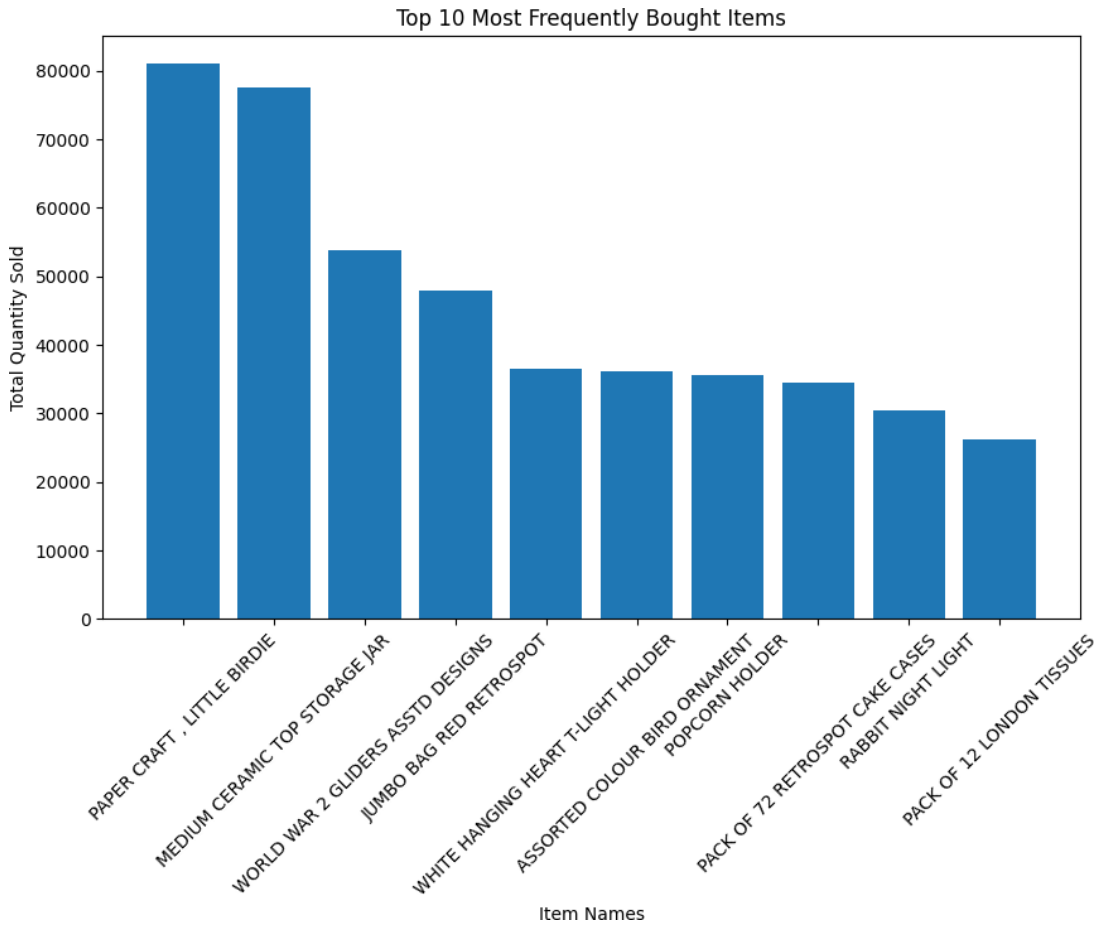
[15]:
```
from mlxtend.frequent_patterns import apriori
from mlxtend.frequent_patterns import association_rules


basket = (data.groupby(['BillNo', 'Itemname'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('BillNo'))
basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1))
frequent_itemsets = apriori(basket_sets, min_support=0.01, use_colnames=True)
rules = association_rules(frequent_itemsets, metric="lift", min_threshold=1.0)
print("Association Rules:")
print(rules)
```

C:\Users\D E L L\AppData\Local\Temp\ipykernel_12816\3169484420.py:10: FutureWarning: DataFrame.applymap has been deprecated. Use DataFrame.map instead.

```
  basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1))
Association Rules:
                          antecedents  \
0           (JAM MAKING SET PRINTED)
1           (6 RIBBONS RUSTIC CHARM)
2           (6 RIBBONS RUSTIC CHARM)
3         (JAM MAKING SET WITH JARS)
4           (6 RIBBONS RUSTIC CHARM)
...                               ...
2999     (STRAWBERRY CHARLOTTE BAG)
3000   (CHARLOTTE BAG SUKI DESIGN)
3001  (RED RETROSPOT CHARLOTTE BAG)
3002  (CHARLOTTE BAG PINK POLKADOT)
3003        (WOODLAND CHARLOTTE BAG)

                                              consequents  antecedent support  \
0                                (6 RIBBONS RUSTIC CHARM)  0.055226
1                                (JAM MAKING SET PRINTED)          0.046615
2                              (JAM MAKING SET WITH JARS)          0.046615
3                                (6 RIBBONS RUSTIC CHARM)          0.053890
4                               (JUMBO BAG RED RETROSPOT)          0.046615
...                                                   ...                ...
2999  (RED RETROSPOT CHARLOTTE BAG, CHARLOTTE BAG PI...          0.035432
3000  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...          0.043300
3001  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...          0.050871
3002  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...          0.036520
3003  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...          0.040924

      consequent support   support  confidence       lift  leverage  \
0               0.046615  0.011530    0.208781   4.478826  0.008956
1               0.055226  0.011530    0.247346   4.478826  0.008956
2               0.053890  0.010095    0.216561   4.018599  0.007583
3               0.046615  0.010095    0.187328   4.018599  0.007583
4               0.102138  0.010689    0.229299   2.245001  0.005928
...                  ...       ...         ...        ...       ...
2999            0.012371  0.010046    0.283520  22.917453  0.009607
3000            0.011926  0.010046    0.232000  19.453344  0.009529
3001            0.010936  0.010046    0.197471  18.056517  0.009489
3002            0.012767  0.010046    0.275068  21.544841  0.009579
3003            0.012074  0.010046    0.245466  20.329375  0.009551

      conviction  zhangs_metric
0       1.204957       0.822130
1       1.255257       0.814705
2       1.207637       0.787884
3       1.173148       0.793942
4       1.164995       0.581681
```

```
...          ...          ...
2999    1.378445     0.991495
3000    1.286555     0.991528
3001    1.232433     0.995248
3002    1.361828     0.989730
3003    1.309318     0.991382

[3004 rows x 10 columns]
```

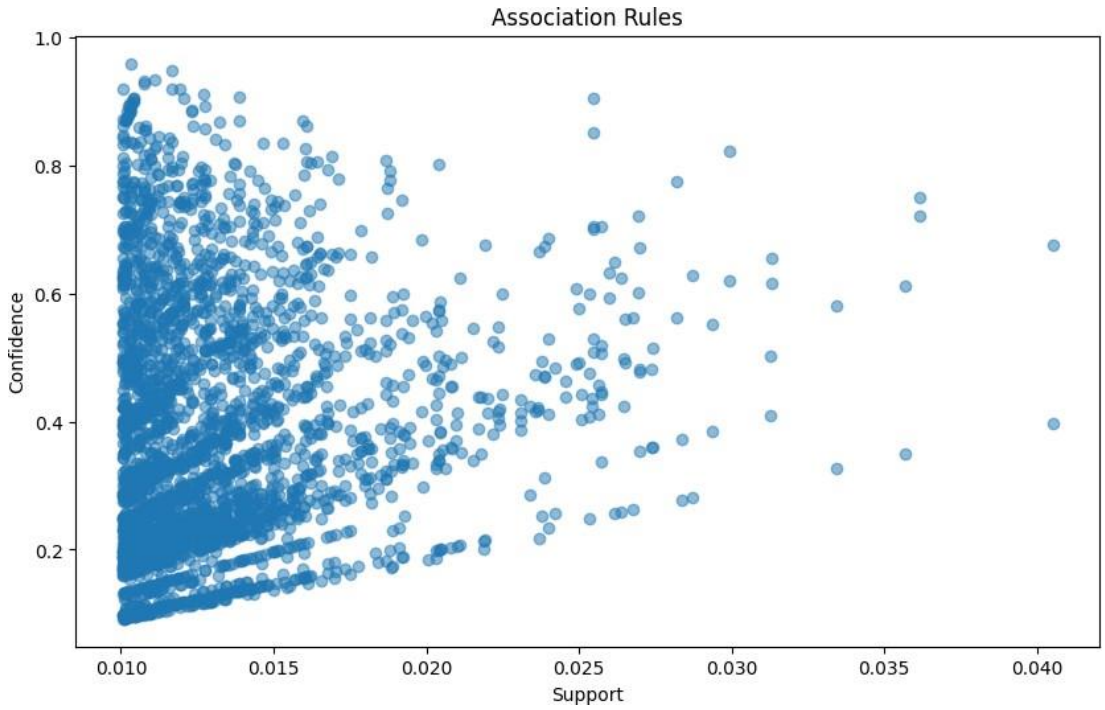
[16]:
```
item_sales = data.groupby("Itemname")["Quantity"].sum().
  ↪sort_values(ascending=False)

top_n = 10;
plt.figure(figsize=(10, 6))
plt.bar(item_sales.index[:top_n], item_sales.values[:top_n])
plt.xlabel("Item Names")
plt.ylabel("Total Quantity Sold")
plt.title(f"Top {top_n} Most Frequently Bought Items")
plt.xticks(rotation=45)
plt.show()
```



[17]:
```
basket = (data.groupby(['BillNo', 'Itemname'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('BillNo'));
basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1))
frequent_itemsets = apriori(basket_sets, min_support=0.01, use_colnames=True)
rules = association_rules(frequent_itemsets, metric="lift", min_threshold=1.0)
print("Association Rules:")
print(rules)
plt.figure(figsize=(10, 6))
plt.scatter(rules['support'], rules['confidence'], alpha=0.5)
plt.xlabel('Support')
plt.ylabel('Confidence')
plt.title('Association Rules')
plt.show()
```

```
C:\Users\D E L L\AppData\Local\Temp\ipykernel_12816\303242403.py:11:
FutureWarning: DataFrame.applymap has been deprecated. Use DataFrame.map
instead.
  basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1))

Association Rules:
                          antecedents  \
0           (JAM MAKING SET PRINTED)
1           (6 RIBBONS RUSTIC CHARM)
2           (6 RIBBONS RUSTIC CHARM)
3         (JAM MAKING SET WITH JARS)
4           (6 RIBBONS RUSTIC CHARM)
...                              ...
2999     (STRAWBERRY CHARLOTTE BAG)
3000   (CHARLOTTE BAG SUKI DESIGN)
3001  (RED RETROSPOT CHARLOTTE BAG)
3002  (CHARLOTTE BAG PINK POLKADOT)
3003       (WOODLAND CHARLOTTE BAG)

                                          consequents  antecedent support  \
0                                (6 RIBBONS RUSTIC CHARM)           0.055226
1                                (JAM MAKING SET PRINTED)           0.046615
2                              (JAM MAKING SET WITH JARS)           0.046615
3                                (6 RIBBONS RUSTIC CHARM)           0.053890
4                               (JUMBO BAG RED RETROSPOT)           0.046615
...                                                   ...                ...
2999  (RED RETROSPOT CHARLOTTE BAG, CHARLOTTE BAG PI...           0.035432
3000  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...           0.043300
3001  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...           0.050871
3002  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...           0.036520
```

```
3003  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...           0.040924

      consequent support   support   confidence      lift  leverage  \
0               0.046615  0.011530    0.208781  4.478826  0.008956
1               0.055226  0.011530    0.247346  4.478826  0.008956
2               0.053890  0.010095    0.216561  4.018599  0.007583
3               0.046615  0.010095    0.187328  4.018599  0.007583
4               0.102138  0.010689    0.229299  2.245001  0.005928
...                  ...       ...         ...       ...       ...
2999            0.012371  0.010046    0.283520 22.917453  0.009607
3000            0.011926  0.010046    0.232000 19.453344  0.009529
3001            0.010936  0.010046    0.197471 18.056517  0.009489
3002            0.012767  0.010046    0.275068 21.544841  0.009579
3003            0.012074  0.010046    0.245466 20.329375  0.009551

      conviction  zhangs_metric
0       1.204957       0.822130
1       1.255257       0.814705
2       1.207637       0.787884
3       1.173148       0.793942
4       1.164995       0.581681
...          ...            ...
2999    1.378445       0.991495
3000    1.286555       0.991528
3001    1.232433       0.995248
3002    1.361828       0.989730
3003    1.309318       0.991382

[3004 rows x 10 columns]
```



[18]:
```
basket = (data.groupby(['BillNo', 'Itemname'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('BillNo'));
basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1));
frequent_itemsets = apriori(basket_sets, min_support=0.01, use_colnames=True);
rules = association_rules(frequent_itemsets, metric="lift", min_threshold=1.0);
print("Association Rules:")
print(rules)
sorted_rules = rules.sort_values(by=['lift'], ascending=False)
print("Sorted Association Rules:")
print(sorted_rules)
```

```
C:\Users\D E L L\AppData\Local\Temp\ipykernel_12816\3757603289.py:9:
FutureWarning: DataFrame.applymap has been deprecated. Use DataFrame.map
instead.
  basket_sets = basket.applymap(lambda quantity: bool(quantity >= 1));
Association Rules:
                          antecedents  \
0          (JAM MAKING SET PRINTED)
1          (6 RIBBONS RUSTIC CHARM)
2          (6 RIBBONS RUSTIC CHARM)
3        (JAM MAKING SET WITH JARS)
4          (6 RIBBONS RUSTIC CHARM)
...                              ...
```

```
2999      (STRAWBERRY CHARLOTTE BAG)
3000    (CHARLOTTE BAG SUKI DESIGN)
3001  (RED RETROSPOT CHARLOTTE BAG)
3002  (CHARLOTTE BAG PINK POLKADOT)
3003        (WOODLAND CHARLOTTE BAG)

                                                consequents  antecedent support  \
0                                  (6 RIBBONS RUSTIC CHARM)   0.055226
1                                   (JAM MAKING SET PRINTED)          0.046615
2                                  (JAM MAKING SET WITH JARS)          0.046615
3                                   (6 RIBBONS RUSTIC CHARM)          0.053890
4                                  (JUMBO BAG RED RETROSPOT)          0.046615
...                                                      ...               ...
2999  (RED RETROSPOT CHARLOTTE BAG, CHARLOTTE BAG PI...          0.035432
3000  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...          0.043300
3001  (CHARLOTTE BAG PINK POLKADOT, STRAWBERRY CHARL...          0.050871
3002  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...          0.036520
3003  (RED RETROSPOT CHARLOTTE BAG, STRAWBERRY CHARL...          0.040924

      consequent support   support  confidence      lift  leverage  \
0               0.046615  0.011530    0.208781  4.478826  0.008956
1               0.055226  0.011530    0.247346  4.478826  0.008956
2               0.053890  0.010095    0.216561  4.018599  0.007583
3               0.046615  0.010095    0.187328  4.018599  0.007583
4               0.102138  0.010689    0.229299  2.245001  0.005928
...                  ...       ...         ...       ...       ...
2999            0.012371  0.010046    0.283520 22.917453  0.009607
3000            0.011926  0.010046    0.232000 19.453344  0.009529
3001            0.010936  0.010046    0.197471 18.056517  0.009489
3002            0.012767  0.010046    0.275068 21.544841  0.009579
3003            0.012074  0.010046    0.245466 20.329375  0.009551

      conviction  zhangs_metric
0       1.204957       0.822130
1       1.255257       0.814705
2       1.207637       0.787884
3       1.173148       0.793942
4       1.164995       0.581681
...          ...            ...
2999    1.378445       0.991495
3000    1.286555       0.991528
3001    1.232433       0.995248
3002    1.361828       0.989730
3003    1.309318       0.991382

[3004 rows x 10 columns]
 Sorted Association Rules:
                                    antecedents  \
```

482	(HERB MARKER ROSEMARY)
483	(HERB MARKER THYME)
481	(HERB MARKER THYME)
480	(HERB MARKER PARSLEY)
479	(HERB MARKER PARSLEY)
...	...
1429	(REGENCY CAKESTAND 3 TIER)
1308	(WHITE HANGING HEART T-LIGHT HOLDER)
1309	(PAPER CHAIN KIT 50'S CHRISTMAS)
827	(JUMBO BAG RED RETROSPOT)
826	(REGENCY CAKESTAND 3 TIER)

	consequents	antecedent support \
482	(HERB MARKER THYME)	0.011580
483	(HERB MARKER ROSEMARY)	0.011530
481	(HERB MARKER PARSLEY)	0.011530
480	(HERB MARKER THYME)	0.011481
479	(HERB MARKER ROSEMARY)	0.011481
...	...	...
1429	(WHITE HANGING HEART T-LIGHT HOLDER)	0.094220
1308	(PAPER CHAIN KIT 50'S CHRISTMAS)	0.108967
1309	(WHITE HANGING HEART T-LIGHT HOLDER)	0.056562
827	(REGENCY CAKESTAND 3 TIER)	0.102138
826	(JUMBO BAG RED RETROSPOT)	0.094220

	consequent support	support	confidence	lift	leverage \
482	0.011530	0.010738	0.927350	80.428744	0.010605
483	0.011580	0.010738	0.931330	80.428744	0.010605
481	0.011481	0.010392	0.901288	78.505254	0.010260
480	0.011530	0.010392	0.905172	78.505254	0.010260
479	0.011580	0.010392	0.905172	78.169761	0.010259
...	...	...	...	...	...
1429	0.108967	0.016973	0.180147	1.653230	0.006707
1308	0.056562	0.010095	0.092643	1.637910	0.003932
1309	0.108967	0.010095	0.178478	1.637910	0.003932
827	0.094220	0.013757	0.134690	1.429524	0.004133
826	0.102138	0.013757	0.146008	1.429524	0.004133

	conviction	zhangs_metric
482	13.605998	0.999136
483	14.393872	0.999086
481	10.014131	0.998778
480	10.423865	0.998728
479	10.423343	0.998673
...	...	...
1429	1.086821	0.436224
1308	1.039765	0.437094
1309	1.084612	0.412815

827 1.046769 0.334647
826 1.051371 0.331721

[3004 rows x 10 columns]

This part you will document your project and prepare it for submission.

Title and Cover Page:

- Start with a clear and concise title that reflects the project's purpose.
- Create a cover page that includes the project title, your name, contact information, and the date.

Abstract:

Write a brief summary (usually 150-250 words) that provides an overview of the project's objectives, methods, key findings, and implications.

Table of Contents:

Include a table of contents to help readers navigate your project easily.

Introduction:

- Describe the background and motivation for your project.
- Clearly state the research questions, objectives, or hypotheses you are addressing.

Literature Review:

- Review relevant prior research and theories that inform your project.
- Cite the sources properly using a consistent citation style (e.g., APA, MLA).

Methodology:

- Detail the methods and procedures used in your project.
- Include information on data collection, tools, software, and equipment used.
- Explain the sampling process, data analysis methods, and any statistical techniques employed.

Results:

- Present your project's findings using text, tables, charts, graphs, and figures.
- Interpret the results and explain their significance in the context of your research questions.

Discussion:

- Analyze and discuss the implications of your findings.
- Address the limitations and potential sources of bias in your project.
- Compare your results to previous research or theories mentioned in the literature review.

Conclusion:

- Summarize the key takeaways from your project.
- Discuss the broader implications and potential future research directions.

References:

List all the sources you cited in your project using a consistent citation style.

Appendices:

Include any supplementary material that supports your project but may be too detailed or extensive for the main document. This could include additional data, code, questionnaires, or other supporting documents.

Acknowledgments:

Acknowledge anyone who contributed to your project, whether through direct collaboration or indirect support.

Review and Proofread:

- Carefully proofread your document for grammar, spelling, and formatting errors.
- Seek feedback from colleagues or mentors to ensure clarity and accuracy.

Formatting:

Ensure your document adheres to any specific formatting guidelines or templates provided by the institution or publication where you plan to submit your project.

Submission:

Follow the submission guidelines of the institution, journal, or organization you are submitting your project to.

Sharing:

Consider sharing your project publicly through a platform like a personal website, a research repository, or a scientific journal, depending on your project's nature.

Certainly, I'll provide an outline for documenting your project, covering the problem statement, design thinking process, development phases, dataset, data preprocessing, association analysis techniques, discovered association rules, and their business implications:

1. Problem Statement:

- Begin by defining the problem you're addressing in your project.
- Highlight the significance and relevance of the problem in the context of your field.
- Explain the specific challenges or questions you aim to solve through association analysis.

2. Design Thinking Process:

- Describe the design thinking process you followed, which typically includes stages like empathize, define, ideate, prototype, and test.
- Explain how this approach helped shape your project and find innovative solutions.

3. Phases of Development:

- Provide an overview of the development process, including the key phases.
- Detail the steps, milestones, and iterations in each phase.
- Highlight any challenges or pivots made during development.

4. Dataset Used:

- Specify the dataset you utilized, including its source and any relevant information about its size and structure.
- Explain why this dataset was chosen and how it relates to the problem statement.

5. Data Preprocessing Steps:

- Describe the preprocessing steps you applied to clean and prepare the dataset.
- Include details about handling missing data, data transformation, and any noise reduction techniques used.

6. Association Analysis Techniques:

- Explain the association analysis techniques employed, such as Apriori, FP-growth, or other algorithms.
- Discuss why you chose these techniques and how they are suitable for your project.

7. Discovered Association Rules:

- Present the association rules that you discovered from the dataset.

- Include the support, confidence, and lift values for each rule.
- Discuss the significance of these rules in the context of the problem statement.

8. Business Implications:

- Explain how the discovered association rules can be applied in a business or real-world context.
- Discuss the practical implications and potential benefits for stakeholders.
- Address any limitations or constraints that may affect the implementation of these rules in a business setting.