▼ Association Analysis

Frequent Itemset Mining using Apriori Algorithm

```python
import pandas as pd
from mlxtend.preprocessing import TransactionEncoder

from mlxtend.frequent_patterns import apriori, association_rules
import matplotlib.pyplot as plt
%matplotlib inline
from google.colab import drive
drive.mount('/content/drive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=9473189

Enter your authorization code:
..........
Mounted at /content/drive
```

```python
from google.colab import files
import io
import pandas as pd
pd.set_option('display.max_columns', None)
uploaded = files.upload()
```

```
Choose Files   Online Retail.xlsx
    • Online Retail.xlsx(application/vnd.openxmlformats-
    officedocument.spreadsheetml.sheet) - 23715344 bytes, last modified: 9/21/2019 - 100%
    done
```

```python
Convert_csv = pd.read_excel('Online Retail.xlsx', index_col=None)
Convert_csv.to_csv('csvfile.csv', encoding='utf-8')
```

▼ Loading the Data

```python
df = pd.read_csv('csvfile.csv', sep=',')
```

```python
df.head(10)
```

```

```

	Unnamed: 0	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	Custon
0	0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17
1	1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17
2	2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17
3	3	536365	84029G	KNITTED UNION FLAG HOT	6	2010-12-01 08:26:00	3.39	17

```
a = df.filter(like='StockCode').values.T.ravel()
b = df.filter(like='Country').values.T.ravel()
c = df.filter(like='Quantity').values.T.ravel()
df1 = pd.DataFrame({'StockCode':a, 'Country':b , 'Quantity':c}, columns=['StockCode','Country
df2=df1.drop_duplicates()
print (df2)
```

```
        StockCode         Country  Quantity
0          85123A  United Kingdom         6
1           71053  United Kingdom         6
2          84406B  United Kingdom         8
3          84029G  United Kingdom         6
4          84029E  United Kingdom         6
...           ...             ...       ...
541781      22549         Germany        24
541786      22622         Germany         6
541798      22081         Germany        10
541814      23350  United Kingdom        25
541868      85038  United Kingdom        48

[67427 rows x 3 columns]
```

```
df3=df2.head(20000)
print (df3)
```

```
       StockCode         Country   Quantity
0          85123A  United Kingdom          6
1           71053  United Kingdom          6
2          84406B  United Kingdom          8
3          84029G  United Kingdom          6
4          84029E  United Kingdom          6
...           ...             ...        ...
70593       22967  United Kingdom          3
70594       22021  United Kingdom          4
70595      85206A  United Kingdom          4
70601       21626  United Kingdom         10
70607       21472  United Kingdom         12

[20000 rows x 3 columns]
```

```
df4=df2.sort_values(by=['Country'])

df9=df4.Country.value_counts()
print (df9)
```

```
United Kingdom            42929
EIRE                       3697
Germany                    3339
France                     2959
Spain                      1655
Switzerland                1444
Netherlands                1396
Australia                  1049
Portugal                   1040
Belgium                    1011
Norway                      764
Italy                       602
Cyprus                      566
Finland                     548
Channel Islands             537
Unspecified                 409
Sweden                      359
Austria                     334
Denmark                     324
Japan                       311
Israel                      286
USA                         283
Poland                      256
Hong Kong                   253
Singapore                   199
Canada                      148
Greece                      140
Iceland                     126
Malta                       113
United Arab Emirates         68
RSA                          58
European Community           56
Lebanon                      45
Lithuania                    34
Brazil                       32
Czech Republic               28
Bahrain                      19
Saudi Arabia                 10
Name: Country, dtype: int64
```

```
df5=df4.sort_values(by=['Quantity'], ascending=False)
print (df5)
```

	StockCode	Country	Quantity
540421	23843	United Kingdom	80995
61619	23166	United Kingdom	74215
502122	84826	United Kingdom	12540
74614	37413	United Kingdom	5568
421632	84077	United Kingdom	4800
206121	22197	United Kingdom	4300
220843	85123A	United Kingdom	4000
97432	22053	United Kingdom	3906
270885	18007	United Kingdom	3186
52711	21108	United Kingdom	3114
263885	23343	United Kingdom	3100
433788	16014	United Kingdom	3000
115807	84988	United Kingdom	3000
291249	84879	United Kingdom	2880
4945	84077	United Kingdom	2880
201149	21977	United Kingdom	2700
80742	84077	United Kingdom	2592
74615	79063D	United Kingdom	2560
91772	18007	United Kingdom	2400
32671	22693	United Kingdom	2400
421601	23084	Netherlands	2400
125282	21967	United Kingdom	2160
437480	21915	United Kingdom	2100
511421	23084	Japan	2040
52710	21175	United Kingdom	2000
177702	16014	United Kingdom	2000
424310	22197	United Kingdom	1992
348317	23288	United Kingdom	1944
348318	23285	United Kingdom	1944
52709	85123A	United Kingdom	1930
...	...	...	...
229728	23113	United Kingdom	-1440
151033	21620	United Kingdom	-1479
472841	16008	United Kingdom	-1510
174654	79164	United Kingdom	-1512
224419	22920	United Kingdom	-1515
445127	85036C	United Kingdom	-1560
431376	79323B	United Kingdom	-1671
242906	22618	United Kingdom	-1681
323469	21829	United Kingdom	-1897
160143	85123A	United Kingdom	-1930
160144	21175	United Kingdom	-2000
431379	79323P	United Kingdom	-2003
185113	23059	United Kingdom	-2376
131399	72732	United Kingdom	-2472
50849	22617	United Kingdom	-2600
431378	79323LP	United Kingdom	-2618
270886	18007	United Kingdom	-2834
375429	23270	United Kingdom	-2880
113580	84598	United Kingdom	-3000
263884	20713	United Kingdom	-3100
160145	21108	United Kingdom	-3114
323458	16259	United Kingdom	-3167
341601	16045	United Congdom	-3667
431381	79323W	United Kingdom	-4830
115818	72140F	United Kingdom	-5368

```
225528      23003  United Kingdom      -9058
4287        84347  United Kingdom      -9360
225529      23005  United Kingdom      -9600
61624       23166  United Kingdom     -74215
540422      23843  United Kingdom     -80995

[67427 rows x 3 columns]
```

```
df6=df5.loc[df['Country'] == 'United Kingdom']
print (df6)
```

	StockCode	Country	Quantity
540421	23843	United Kingdom	80995
61619	23166	United Kingdom	74215
502122	84826	United Kingdom	12540
74614	37413	United Kingdom	5568
421632	84077	United Kingdom	4800
206121	22197	United Kingdom	4300
220843	85123A	United Kingdom	4000
97432	22053	United Kingdom	3906
270885	18007	United Kingdom	3186
52711	21108	United Kingdom	3114
263885	23343	United Kingdom	3100
433788	16014	United Kingdom	3000
115807	84988	United Kingdom	3000
291249	84879	United Kingdom	2880
4945	84077	United Kingdom	2880
201149	21977	United Kingdom	2700
80742	84077	United Kingdom	2592
74615	79063D	United Kingdom	2560
91772	18007	United Kingdom	2400
32671	22693	United Kingdom	2400
125282	21967	United Kingdom	2160
437480	21915	United Kingdom	2100
52710	21175	United Kingdom	2000
177702	16014	United Kingdom	2000
424310	22197	United Kingdom	1992
348317	23288	United Kingdom	1944
348318	23285	United Kingdom	1944
52709	85123A	United Kingdom	1930
291247	22197	United Kingdom	1900
348316	23286	United Kingdom	1878
...	...	...	...
229728	23113	United Kingdom	-1440
151033	21620	United Kingdom	-1479
472841	16008	United Kingdom	-1510
174654	79164	United Kingdom	-1512
224419	22920	United Kingdom	-1515
445127	85036C	United Kingdom	-1560
431376	79323B	United Kingdom	-1671
242906	22618	United Kingdom	-1681
323469	21829	United Kingdom	-1897
160143	85123A	United Kingdom	-1930
160144	21175	United Kingdom	-2000
431379	79323P	United Kingdom	-2003
185113	23059	United Kingdom	-2376
131399	72732	United Kingdom	-2472
50849	22617	United Kingdom	-2600
431378	79323LP	United Kingdom	-2618
270886	18007	United Kingdom	-2834
375429	23270	United Kingdom	-2880
113580	84598	United Kingdom	-3000
263884	20713	United Kingdom	-3100
160145	21108	United Kingdom	-3114
323458	16259	United Kingdom	-3167
341601	16045	United Congdom	-3667
431381	79323W	United Kingdom	-4830
115818	72140F	United Kingdom	-5368

```
225528    23003   United Kingdom    -9058
4287      84347   United Kingdom    -9360
225529    23005   United Kingdom    -9600
61624     23166   United Kingdom   -74215
540422    23843   United Kingdom   -80995

[42929 rows x 3 columns]
```

Each row of the dataset represents items that were purchased together on the same day at same sto

The dataset is a **sparse dataset** as relatively high percentage of data is NA or NAN or equivalent.

Let's see all the unique items in the dataset.

```
basket = (df[df['Country'] =="United Kingdom"]
          .groupby(['InvoiceNo', 'Description'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('InvoiceNo'))
print (basket)
```

```
Description   4 PURPLE FLOCK DINNER CANDLES   50'S CHRISTMAS GIFT BAG LARGE  \
InvoiceNo
536365                                  0.0                              0.0
536366                                  0.0                              0.0
536367                                  0.0                              0.0
536368                                  0.0                              0.0
536369                                  0.0                              0.0
536371                                  0.0                              0.0
536372                                  0.0                              0.0
536373                                  0.0                              0.0
536374                                  0.0                              0.0
536375                                  0.0                              0.0
536376                                  0.0                              0.0
536377                                  0.0                              0.0
536378                                  0.0                              0.0
536380                                  0.0                              0.0
536381                                  0.0                              0.0
536382                                  0.0                              0.0
536384                                  0.0                              0.0
536385                                  0.0                              0.0
536386                                  0.0                              0.0
536387                                  0.0                              0.0
536388                                  0.0                              0.0
536390                                  0.0                              0.0
536392                                  0.0                              0.0
536393                                  0.0                              0.0
536394                                  0.0                              0.0
536395                                  0.0                              0.0
536396                                  0.0                              0.0
536397                                  0.0                              0.0
536398                                  0.0                              0.0
536399                                  0.0                              0.0
...                                     ...                              ...
C581012                                 0.0                              0.0
C581100                                 0.0                              0.0
C581106                                 0.0                              0.0
C581117                                 0.0                              0.0
C581121                                 0.0                              0.0
C581124                                 0.0                              0.0
C581145                                 0.0                              0.0
C581162                                 0.0                              0.0
C581178                                 0.0                              0.0
C581228                                 0.0                              0.0
C581235                                 0.0                              0.0
C581305                                 0.0                              0.0
C581322                                 0.0                              0.0
C581330                                 0.0                              0.0
C581384                                 0.0                              0.0
C581390                                 0.0                              0.0
C581393                                 0.0                              0.0
C581460                                 0.0                              0.0
C581462                                 0.0                              0.0
C581463                                 0.0                              0.0
C581464                                 0.0                              0.0
C581465                                 0.0                              0.0
C581466                                 0.0                              0.0
C581468                                 0.0                              0.0
```

```
C581470                                    0.0                              0.0
C581484                                    0.0                              0.0
C581490                                    0.0                              0.0
C581499                                    0.0                              0.0
C581568                                    0.0                              0.0
C581569                                    0.0                              0.0


Description    DOLLY GIRL BEAKER    I LOVE LONDON MINI BACKPACK   \
InvoiceNo
536365                          0.0                             0.0
536366                          0.0                             0.0
536367                          0.0                             0.0
536368                          0.0                             0.0
536369                          0.0                             0.0
536371                          0.0                             0.0
536372                          0.0                             0.0
536373                          0.0                             0.0
536374                          0.0                             0.0
536375                          0.0                             0.0
536376                          0.0                             0.0
536377                          0.0                             0.0
536378                          0.0                             0.0
536380                          0.0                             0.0
536381                          0.0                             0.0
536382                          0.0                             0.0
536384                          0.0                             0.0
536385                          0.0                             0.0
536386                          0.0                             0.0
536387                          0.0                             0.0
536388                          0.0                             0.0
536390                          0.0                             0.0
536392                          0.0                             0.0
536393                          0.0                             0.0
536394                          0.0                             0.0
536395                          0.0                             0.0
536396                          0.0                             0.0
536397                          0.0                             0.0
536398                          0.0                             0.0
536399                          0.0                             0.0
...                             ...                             ...
C581012                         0.0                             0.0
C581100                         0.0                             0.0
C581106                         0.0                             0.0
C581117                         0.0                             0.0
C581121                         0.0                             0.0
C581124                         0.0                             0.0
C581145                         0.0                             0.0
C581162                         0.0                             0.0
C581178                         0.0                             0.0
C581228                         0.0                             0.0
C581235                         0.0                             0.0
C581305                         0.0                             0.0
C581322                         0.0                             0.0
C581330                         0.0                             0.0
C581384                         0.0                             0.0
C581390                         0.0                             0.0
C581393                         0.0                             0.0
C581460                         0.0                             0.0
```

```
C581462              0.0                        0.0
C581463              0.0                        0.0
C581464              0.0                        0.0
C581465              0.0                        0.0
C581466              0.0                        0.0
C581468              0.0                        0.0
C581470              0.0                        0.0
C581484              0.0                        0.0
C581490              0.0                        0.0
C581499              0.0                        0.0
C581568              0.0                        0.0
C581569              0.0                        0.0

Description    NINE DRAWER OFFICE TIDY    OVAL WALL MIRROR DIAMANTE    \
InvoiceNo
536365                            0.0                            0.0
536366                            0.0                            0.0
536367                            0.0                            0.0
536368                            0.0                            0.0
536369                            0.0                            0.0
536371                            0.0                            0.0
536372                            0.0                            0.0
536373                            0.0                            0.0
536374                            0.0                            0.0
536375                            0.0                            0.0
536376                            0.0                            0.0
536377                            0.0                            0.0
536378                            0.0                            0.0
536380                            0.0                            0.0
536381                            0.0                            0.0
536382                            0.0                            0.0
536384                            0.0                            0.0
536385                            0.0                            0.0
536386                            0.0                            0.0
536387                            0.0                            0.0
536388                            0.0                            0.0
536390                            0.0                            0.0
536392                            0.0                            0.0
536393                            0.0                            0.0
536394                            0.0                            0.0
536395                            0.0                            0.0
536396                            0.0                            0.0
536397                            0.0                            0.0
536398                            0.0                            0.0
536399                            0.0                            0.0
...                               ...                            ...
C581012                           0.0                            0.0
C581100                           0.0                            0.0
C581106                           0.0                            0.0
C581117                           0.0                            0.0
C581121                           0.0                            0.0
C581124                           0.0                            0.0
C581145                           0.0                            0.0
C581162                           0.0                            0.0
C581178                           0.0                            0.0
C581228                           0.0                            0.0
C581235                           0.0                            0.0
C581305                           0.0                            0.0
```

C581305	0.0	0.0
C581322	0.0	0.0
C581330	0.0	0.0
C581384	0.0	0.0
C581390	0.0	0.0
C581393	0.0	0.0
C581460	0.0	0.0
C581462	0.0	0.0
C581463	0.0	0.0
C581464	0.0	0.0
C581465	0.0	0.0
C581466	0.0	0.0
C581468	0.0	0.0
C581470	0.0	0.0
C581484	0.0	0.0
C581490	0.0	0.0
C581499	0.0	0.0
C581568	0.0	0.0
C581569	0.0	0.0

Description	RED SPOT GIFT BAG LARGE	SET 2 TEA TOWELS I LOVE LONDON \
InvoiceNo		
536365	0.0	0.0
536366	0.0	0.0
536367	0.0	0.0
536368	0.0	0.0
536369	0.0	0.0
536371	0.0	0.0
536372	0.0	0.0
536373	0.0	0.0
536374	0.0	0.0
536375	0.0	0.0
536376	0.0	0.0
536377	0.0	0.0
536378	0.0	0.0
536380	0.0	0.0
536381	0.0	0.0
536382	0.0	0.0
536384	0.0	0.0
536385	0.0	0.0
536386	0.0	0.0
536387	0.0	0.0
536388	0.0	0.0
536390	0.0	0.0
536392	0.0	0.0
536393	0.0	0.0
536394	0.0	0.0
536395	0.0	0.0
536396	0.0	0.0
536397	0.0	0.0
536398	0.0	0.0
536399	0.0	0.0
...	...	...
C581012	0.0	0.0
C581100	0.0	0.0
C581106	0.0	0.0
C581117	0.0	0.0
C581121	0.0	0.0

```
C581124                   0.0                                0.0
C581145                   0.0                                0.0
C581162                   0.0                                0.0
C581178                   0.0                                0.0
C581228                   0.0                                0.0
C581235                   0.0                                0.0
C581305                   0.0                                0.0
C581322                   0.0                                0.0
C581330                   0.0                                0.0
C581384                   0.0                                0.0
C581390                   0.0                                0.0
C581393                   0.0                                0.0
C581460                   0.0                                0.0
C581462                   0.0                                0.0
C581463                   0.0                                0.0
C581464                   0.0                                0.0
C581465                   0.0                                0.0
C581466                   0.0                                0.0
C581468                   0.0                                0.0
C581470                   0.0                                0.0
C581484                   0.0                                0.0
C581490                   0.0                                0.0
C581499                   0.0                                0.0
C581568                   0.0                                0.0
C581569                   0.0                                0.0

Description   SPACEBOY BABY GIFT SET   TOADSTOOL BEDSIDE LIGHT   ...  \
InvoiceNo                                                           ...
536365                    0.0                        0.0  ...
536366                    0.0                        0.0  ...
536367                    0.0                        0.0  ...
536368                    0.0                        0.0  ...
536369                    0.0                        0.0  ...
536371                    0.0                        0.0  ...
536372                    0.0                        0.0  ...
536373                    0.0                        0.0  ...
536374                    0.0                        0.0  ...
536375                    0.0                        0.0  ...
536376                    0.0                        0.0  ...
536377                    0.0                        0.0  ...
536378                    0.0                        0.0  ...
536380                    0.0                        0.0  ...
536381                    0.0                        0.0  ...
536382                    0.0                        0.0  ...
536384                    0.0                        0.0  ...
536385                    0.0                        0.0  ...
536386                    0.0                        0.0  ...
536387                    0.0                        0.0  ...
536388                    0.0                        0.0  ...
536390                    0.0                        0.0  ...
536392                    0.0                        0.0  ...
536393                    0.0                        0.0  ...
536394                    0.0                        0.0  ...
536395                    0.0                        0.0  ...
536396                    0.0                        0.0  ...
536397                    0.0                        0.0  ...
536398                    0.0                        0.0  ...
536399                    0.0                        0.0  ...
```

```
...                       ...                   ... ...
C581012                   0.0                   0.0 ...
C581100                   0.0                   0.0 ...
C581106                   0.0                   0.0 ...
C581117                   0.0                   0.0 ...
C581121                   0.0                   0.0 ...
C581124                   0.0                   0.0 ...
C581145                   0.0                   0.0 ...
C581162                   0.0                   0.0 ...
C581178                   0.0                   0.0 ...
C581228                   0.0                   0.0 ...
C581235                   0.0                   0.0 ...
C581305                   0.0                   0.0 ...
C581322                   0.0                   0.0 ...
C581330                   0.0                   0.0 ...
C581384                   0.0                   0.0 ...
C581390                   0.0                   0.0 ...
C581393                   0.0                   0.0 ...
C581460                   0.0                   0.0 ...
C581462                   0.0                   0.0 ...
C581463                   0.0                   0.0 ...
C581464                   0.0                   0.0 ...
C581465                   0.0                   0.0 ...
C581466                   0.0                   0.0 ...
C581468                   0.0                   0.0 ...
C581470                   0.0                   0.0 ...
C581484                   0.0                   0.0 ...
C581490                   0.0                   0.0 ...
C581499                   0.0                   0.0 ...
C581568                   0.0                   0.0 ...
C581569                   0.0                   0.0 ...

Description  wrongly coded 20713  wrongly coded 23343  wrongly coded-23343  \
InvoiceNo
536365                     0.0                  0.0                  0.0
536366                     0.0                  0.0                  0.0
536367                     0.0                  0.0                  0.0
536368                     0.0                  0.0                  0.0
536369                     0.0                  0.0                  0.0
536371                     0.0                  0.0                  0.0
536372                     0.0                  0.0                  0.0
536373                     0.0                  0.0                  0.0
536374                     0.0                  0.0                  0.0
536375                     0.0                  0.0                  0.0
536376                     0.0                  0.0                  0.0
536377                     0.0                  0.0                  0.0
536378                     0.0                  0.0                  0.0
536380                     0.0                  0.0                  0.0
536381                     0.0                  0.0                  0.0
536382                     0.0                  0.0                  0.0
536384                     0.0                  0.0                  0.0
536385                     0.0                  0.0                  0.0
536386                     0.0                  0.0                  0.0
536387                     0.0                  0.0                  0.0
536388                     0.0                  0.0                  0.0
536390                     0.0                  0.0                  0.0
536392                     0.0                  0.0                  0.0
536393                     0.0                  0.0                  0.0
```

```
536393         0.0         0.0         0.0
536394         0.0         0.0         0.0
536395         0.0         0.0         0.0
536396         0.0         0.0         0.0
536397         0.0         0.0         0.0
536398         0.0         0.0         0.0
536399         0.0         0.0         0.0
...            ...         ...         ...
C581012        0.0         0.0         0.0
C581100        0.0         0.0         0.0
C581106        0.0         0.0         0.0
C581117        0.0         0.0         0.0
C581121        0.0         0.0         0.0
C581124        0.0         0.0         0.0
C581145        0.0         0.0         0.0
C581162        0.0         0.0         0.0
C581178        0.0         0.0         0.0
C581228        0.0         0.0         0.0
C581235        0.0         0.0         0.0
C581305        0.0         0.0         0.0
C581322        0.0         0.0         0.0
C581330        0.0         0.0         0.0
C581384        0.0         0.0         0.0
C581390        0.0         0.0         0.0
C581393        0.0         0.0         0.0
C581460        0.0         0.0         0.0
C581462        0.0         0.0         0.0
C581463        0.0         0.0         0.0
C581464        0.0         0.0         0.0
C581465        0.0         0.0         0.0
C581466        0.0         0.0         0.0
C581468        0.0         0.0         0.0
C581470        0.0         0.0         0.0
C581484        0.0         0.0         0.0
C581490        0.0         0.0         0.0
C581499        0.0         0.0         0.0
C581568        0.0         0.0         0.0
C581569        0.0         0.0         0.0

Description  wrongly marked  wrongly marked 23343  \
InvoiceNo
536365                  0.0                   0.0
536366                  0.0                   0.0
536367                  0.0                   0.0
536368                  0.0                   0.0
536369                  0.0                   0.0
536371                  0.0                   0.0
536372                  0.0                   0.0
536373                  0.0                   0.0
536374                  0.0                   0.0
536375                  0.0                   0.0
536376                  0.0                   0.0
536377                  0.0                   0.0
536378                  0.0                   0.0
536380                  0.0                   0.0
536381                  0.0                   0.0
536382                  0.0                   0.0
536384                  0.0                   0.0
```

```
536385                        0.0                        0.0
536386                        0.0                        0.0
536387                        0.0                        0.0
536388                        0.0                        0.0
536390                        0.0                        0.0
536392                        0.0                        0.0
536393                        0.0                        0.0
536394                        0.0                        0.0
536395                        0.0                        0.0
536396                        0.0                        0.0
536397                        0.0                        0.0
536398                        0.0                        0.0
536399                        0.0                        0.0
...                           ...                        ...
C581012                       0.0                        0.0
C581100                       0.0                        0.0
C581106                       0.0                        0.0
C581117                       0.0                        0.0
C581121                       0.0                        0.0
C581124                       0.0                        0.0
C581145                       0.0                        0.0
C581162                       0.0                        0.0
C581178                       0.0                        0.0
C581228                       0.0                        0.0
C581235                       0.0                        0.0
C581305                       0.0                        0.0
C581322                       0.0                        0.0
C581330                       0.0                        0.0
C581384                       0.0                        0.0
C581390                       0.0                        0.0
C581393                       0.0                        0.0
C581460                       0.0                        0.0
C581462                       0.0                        0.0
C581463                       0.0                        0.0
C581464                       0.0                        0.0
C581465                       0.0                        0.0
C581466                       0.0                        0.0
C581468                       0.0                        0.0
C581470                       0.0                        0.0
C581484                       0.0                        0.0
C581490                       0.0                        0.0
C581499                       0.0                        0.0
C581568                       0.0                        0.0
C581569                       0.0                        0.0

Description  wrongly marked carton 22804  wrongly marked. 23343 in box  \
InvoiceNo
536365                                0.0                        0.0
536366                                0.0                        0.0
536367                                0.0                        0.0
536368                                0.0                        0.0
536369                                0.0                        0.0
536371                                0.0                        0.0
536372                                0.0                        0.0
536373                                0.0                        0.0
536374                                0.0                        0.0
536375                                0.0                        0.0
536376                                0.0                        0.0
```

```
536377                               0.0                      0.0
536378                               0.0                      0.0
536380                               0.0                      0.0
536381                               0.0                      0.0
536382                               0.0                      0.0
536384                               0.0                      0.0
536385                               0.0                      0.0
536386                               0.0                      0.0
536387                               0.0                      0.0
536388                               0.0                      0.0
536390                               0.0                      0.0
536392                               0.0                      0.0
536393                               0.0                      0.0
536394                               0.0                      0.0
536395                               0.0                      0.0
536396                               0.0                      0.0
536397                               0.0                      0.0
536398                               0.0                      0.0
536399                               0.0                      0.0
...                                  ...                      ...
C581012                              0.0                      0.0
C581100                              0.0                      0.0
C581106                              0.0                      0.0
C581117                              0.0                      0.0
C581121                              0.0                      0.0
C581124                              0.0                      0.0
C581145                              0.0                      0.0
C581162                              0.0                      0.0
C581178                              0.0                      0.0
C581228                              0.0                      0.0
C581235                              0.0                      0.0
C581305                              0.0                      0.0
C581322                              0.0                      0.0
C581330                              0.0                      0.0
C581384                              0.0                      0.0
C581390                              0.0                      0.0
C581393                              0.0                      0.0
C581460                              0.0                      0.0
C581462                              0.0                      0.0
C581463                              0.0                      0.0
C581464                              0.0                      0.0
C581465                              0.0                      0.0
C581466                              0.0                      0.0
C581468                              0.0                      0.0
C581470                              0.0                      0.0
C581484                              0.0                      0.0
C581490                              0.0                      0.0
C581499                              0.0                      0.0
C581568                              0.0                      0.0
C581569                              0.0                      0.0


Description   wrongly sold (22719) barcode   wrongly sold as sets  \
InvoiceNo
536365                               0.0                      0.0
536366                               0.0                      0.0
536367                               0.0                      0.0
536368                               0.0                      0.0
536369                               0.0                      0.0
```

```
536369      0.0      0.0
536371      0.0      0.0
536372      0.0      0.0
536373      0.0      0.0
536374      0.0      0.0
536375      0.0      0.0
536376      0.0      0.0
536377      0.0      0.0
536378      0.0      0.0
536380      0.0      0.0
536381      0.0      0.0
536382      0.0      0.0
536384      0.0      0.0
536385      0.0      0.0
536386      0.0      0.0
536387      0.0      0.0
536388      0.0      0.0
536390      0.0      0.0
536392      0.0      0.0
536393      0.0      0.0
536394      0.0      0.0
536395      0.0      0.0
536396      0.0      0.0
536397      0.0      0.0
536398      0.0      0.0
536399      0.0      0.0
...         ...      ...
C581012     0.0      0.0
C581100     0.0      0.0
C581106     0.0      0.0
C581117     0.0      0.0
C581121     0.0      0.0
C581124     0.0      0.0
C581145     0.0      0.0
C581162     0.0      0.0
C581178     0.0      0.0
C581228     0.0      0.0
C581235     0.0      0.0
C581305     0.0      0.0
C581322     0.0      0.0
C581330     0.0      0.0
C581384     0.0      0.0
C581390     0.0      0.0
C581393     0.0      0.0
C581460     0.0      0.0
C581462     0.0      0.0
C581463     0.0      0.0
C581464     0.0      0.0
C581465     0.0      0.0
C581466     0.0      0.0
C581468     0.0      0.0
C581470     0.0      0.0
C581484     0.0      0.0
C581490     0.0      0.0
C581499     0.0      0.0
C581568     0.0      0.0
C581569     0.0      0.0
```

```
Description    wrongly sold sets
InvoiceNo
536365                    0.0
536366                    0.0
536367                    0.0
536368                    0.0
536369                    0.0
536371                    0.0
536372                    0.0
536373                    0.0
536374                    0.0
536375                    0.0
536376                    0.0
536377                    0.0
536378                    0.0
536380                    0.0
536381                    0.0
536382                    0.0
536384                    0.0
536385                    0.0
536386                    0.0
536387                    0.0
536388                    0.0
536390                    0.0
536392                    0.0
536393                    0.0
536394                    0.0
536395                    0.0
536396                    0.0
536397                    0.0
536398                    0.0
536399                    0.0
...                       ...
C581012                   0.0
C581100                   0.0
C581106                   0.0
C581117                   0.0
C581121                   0.0
C581124                   0.0
C581145                   0.0
C581162                   0.0
C581178                   0.0
C581228                   0.0
C581235                   0.0
C581305                   0.0
C581322                   0.0
C581330                   0.0
C581384                   0.0
C581390                   0.0
C581393                   0.0
C581460                   0.0
C581462                   0.0
C581463                   0.0
C581464                   0.0
C581465                   0.0
C581466                   0.0
C581468                   0.0
C581470                   0.0
```

```
            C581484                      0.0
            C581490                      0.0
            C581499                      0.0
            C581568                      0.0
            C581569                      0.0

            [22040 rows x 4202 columns]
```

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

basket_sets = basket.applymap(encode_units)



print(basket_sets)
```

```
Description   4 PURPLE FLOCK DINNER CANDLES   50'S CHRISTMAS GIFT BAG LARGE   \
InvoiceNo
536365                                   0                               0
536366                                   0                               0
536367                                   0                               0
536368                                   0                               0
536369                                   0                               0
536371                                   0                               0
536372                                   0                               0
536373                                   0                               0
536374                                   0                               0
536375                                   0                               0
536376                                   0                               0
536377                                   0                               0
536378                                   0                               0
536380                                   0                               0
536381                                   0                               0
536382                                   0                               0
536384                                   0                               0
536385                                   0                               0
536386                                   0                               0
536387                                   0                               0
536388                                   0                               0
536390                                   0                               0
536392                                   0                               0
536393                                   0                               0
536394                                   0                               0
536395                                   0                               0
536396                                   0                               0
536397                                   0                               0
536398                                   0                               0
536399                                   0                               0
...                                    ...                             ...
C581012                                  0                               0
C581100                                  0                               0
C581106                                  0                               0
C581117                                  0                               0
C581121                                  0                               0
C581124                                  0                               0
C581145                                  0                               0
C581162                                  0                               0
C581178                                  0                               0
C581228                                  0                               0
C581235                                  0                               0
C581305                                  0                               0
C581322                                  0                               0
C581330                                  0                               0
C581384                                  0                               0
C581390                                  0                               0
C581393                                  0                               0
C581460                                  0                               0
C581462                                  0                               0
C581463                                  0                               0
C581464                                  0                               0
C581465                                  0                               0
C581466                                  0                               0
C581468                                  0                               0
```

```
C581470                                          0                              0
C581484                                          0                              0
C581490                                          0                              0
C581499                                          0                              0
C581568                                          0                              0
C581569                                          0                              0


Description   DOLLY GIRL BEAKER   I LOVE LONDON MINI BACKPACK   \
InvoiceNo
536365                            0                              0
536366                            0                              0
536367                            0                              0
536368                            0                              0
536369                            0                              0
536371                            0                              0
536372                            0                              0
536373                            0                              0
536374                            0                              0
536375                            0                              0
536376                            0                              0
536377                            0                              0
536378                            0                              0
536380                            0                              0
536381                            0                              0
536382                            0                              0
536384                            0                              0
536385                            0                              0
536386                            0                              0
536387                            0                              0
536388                            0                              0
536390                            0                              0
536392                            0                              0
536393                            0                              0
536394                            0                              0
536395                            0                              0
536396                            0                              0
536397                            0                              0
536398                            0                              0
536399                            0                              0
...                             ...                            ...
C581012                           0                              0
C581100                           0                              0
C581106                           0                              0
C581117                           0                              0
C581121                           0                              0
C581124                           0                              0
C581145                           0                              0
C581162                           0                              0
C581178                           0                              0
C581228                           0                              0
C581235                           0                              0
C581305                           0                              0
C581322                           0                              0
C581330                           0                              0
C581384                           0                              0
C581390                           0                              0
C581393                           0                              0
C581460                           0                              0
```

```
C581462                          0                          0
C581463                          0                          0
C581464                          0                          0
C581465                          0                          0
C581466                          0                          0
C581468                          0                          0
C581470                          0                          0
C581484                          0                          0
C581490                          0                          0
C581499                          0                          0
C581568                          0                          0
C581569                          0                          0

Description   NINE DRAWER OFFICE TIDY   OVAL WALL MIRROR DIAMANTE   \
InvoiceNo
536365                           0                          0
536366                           0                          0
536367                           0                          0
536368                           0                          0
536369                           0                          0
536371                           0                          0
536372                           0                          0
536373                           0                          0
536374                           0                          0
536375                           0                          0
536376                           0                          0
536377                           0                          0
536378                           0                          0
536380                           0                          0
536381                           0                          0
536382                           0                          0
536384                           0                          0
536385                           0                          0
536386                           0                          0
536387                           0                          0
536388                           0                          0
536390                           0                          0
536392                           0                          0
536393                           0                          0
536394                           0                          0
536395                           0                          0
536396                           0                          0
536397                           0                          0
536398                           0                          0
536399                           0                          0
...                            ...                        ...
C581012                          0                          0
C581100                          0                          0
C581106                          0                          0
C581117                          0                          0
C581121                          0                          0
C581124                          0                          0
C581145                          0                          0
C581162                          0                          0
C581178                          0                          0
C581228                          0                          0
C581235                          0                          0
C581305                          0                          0
```

```
C581303                           0                    0
C581322                           0                    0
C581330                           0                    0
C581384                           0                    0
C581390                           0                    0
C581393                           0                    0
C581460                           0                    0
C581462                           0                    0
C581463                           0                    0
C581464                           0                    0
C581465                           0                    0
C581466                           0                    0
C581468                           0                    0
C581470                           0                    0
C581484                           0                    0
C581490                           0                    0
C581499                           0                    0
C581568                           0                    0
C581569                           0                    0
```

```
Description   RED SPOT GIFT BAG LARGE   SET 2 TEA TOWELS I LOVE LONDON    \
InvoiceNo
536365                           0                              0
536366                           0                              0
536367                           0                              0
536368                           0                              0
536369                           0                              0
536371                           0                              0
536372                           0                              0
536373                           0                              0
536374                           0                              0
536375                           0                              0
536376                           0                              0
536377                           0                              0
536378                           0                              0
536380                           0                              0
536381                           0                              0
536382                           0                              0
536384                           0                              0
536385                           0                              0
536386                           0                              0
536387                           0                              0
536388                           0                              0
536390                           0                              0
536392                           0                              0
536393                           0                              0
536394                           0                              0
536395                           0                              0
536396                           0                              0
536397                           0                              0
536398                           0                              0
536399                           0                              0
...                            ...                            ...
C581012                          0                              0
C581100                          0                              0
C581106                          0                              0
C581117                          0                              0
C581121                          0                              0
```

```
C581124                          0                              0
C581145                          0                              0
C581162                          0                              0
C581178                          0                              0
C581228                          0                              0
C581235                          0                              0
C581305                          0                              0
C581322                          0                              0
C581330                          0                              0
C581384                          0                              0
C581390                          0                              0
C581393                          0                              0
C581460                          0                              0
C581462                          0                              0
C581463                          0                              0
C581464                          0                              0
C581465                          0                              0
C581466                          0                              0
C581468                          0                              0
C581470                          0                              0
C581484                          0                              0
C581490                          0                              0
C581499                          0                              0
C581568                          0                              0
C581569                          0                              0

Description    SPACEBOY BABY GIFT SET    TOADSTOOL BEDSIDE LIGHT    ...  \
InvoiceNo                                                           ...
536365                          0                              0  ...
536366                          0                              0  ...
536367                          0                              0  ...
536368                          0                              0  ...
536369                          0                              0  ...
536371                          0                              0  ...
536372                          0                              0  ...
536373                          0                              0  ...
536374                          0                              0  ...
536375                          0                              0  ...
536376                          0                              0  ...
536377                          0                              0  ...
536378                          0                              0  ...
536380                          0                              0  ...
536381                          0                              0  ...
536382                          0                              0  ...
536384                          0                              0  ...
536385                          0                              0  ...
536386                          0                              0  ...
536387                          0                              0  ...
536388                          0                              0  ...
536390                          0                              0  ...
536392                          0                              0  ...
536393                          0                              0  ...
536394                          0                              0  ...
536395                          0                              0  ...
536396                          0                              0  ...
536397                          0                              0  ...
536398                          0                              0  ...
536399                          0                              0  ...
```

```
...                              ...                              ...  ...
C581012                            0                                0  ...
C581100                            0                                0  ...
C581106                            0                                0  ...
C581117                            0                                0  ...
C581121                            0                                0  ...
C581124                            0                                0  ...
C581145                            0                                0  ...
C581162                            0                                0  ...
C581178                            0                                0  ...
C581228                            0                                0  ...
C581235                            0                                0  ...
C581305                            0                                0  ...
C581322                            0                                0  ...
C581330                            0                                0  ...
C581384                            0                                0  ...
C581390                            0                                0  ...
C581393                            0                                0  ...
C581460                            0                                0  ...
C581462                            0                                0  ...
C581463                            0                                0  ...
C581464                            0                                0  ...
C581465                            0                                0  ...
C581466                            0                                0  ...
C581468                            0                                0  ...
C581470                            0                                0  ...
C581484                            0                                0  ...
C581490                            0                                0  ...
C581499                            0                                0  ...
C581568                            0                                0  ...
C581569                            0                                0  ...

Description  wrongly coded 20713  wrongly coded 23343  wrongly coded-23343  \
InvoiceNo
536365                         0                    0                     0
536366                         0                    0                     0
536367                         0                    0                     0
536368                         0                    0                     0
536369                         0                    0                     0
536371                         0                    0                     0
536372                         0                    0                     0
536373                         0                    0                     0
536374                         0                    0                     0
536375                         0                    0                     0
536376                         0                    0                     0
536377                         0                    0                     0
536378                         0                    0                     0
536380                         0                    0                     0
536381                         0                    0                     0
536382                         0                    0                     0
536384                         0                    0                     0
536385                         0                    0                     0
536386                         0                    0                     0
536387                         0                    0                     0
536388                         0                    0                     0
536390                         0                    0                     0
536392                         0                    0                     0
536393                         0                    0                     0
```

```
536393               0               0               0
536394               0               0               0
536395               0               0               0
536396               0               0               0
536397               0               0               0
536398               0               0               0
536399               0               0               0
...                ...             ...             ...
C581012              0               0               0
C581100              0               0               0
C581106              0               0               0
C581117              0               0               0
C581121              0               0               0
C581124              0               0               0
C581145              0               0               0
C581162              0               0               0
C581178              0               0               0
C581228              0               0               0
C581235              0               0               0
C581305              0               0               0
C581322              0               0               0
C581330              0               0               0
C581384              0               0               0
C581390              0               0               0
C581393              0               0               0
C581460              0               0               0
C581462              0               0               0
C581463              0               0               0
C581464              0               0               0
C581465              0               0               0
C581466              0               0               0
C581468              0               0               0
C581470              0               0               0
C581484              0               0               0
C581490              0               0               0
C581499              0               0               0
C581568              0               0               0
C581569              0               0               0

Description  wrongly marked  wrongly marked 23343  \
InvoiceNo
536365                    0                     0
536366                    0                     0
536367                    0                     0
536368                    0                     0
536369                    0                     0
536371                    0                     0
536372                    0                     0
536373                    0                     0
536374                    0                     0
536375                    0                     0
536376                    0                     0
536377                    0                     0
536378                    0                     0
536380                    0                     0
536381                    0                     0
536382                    0                     0
536384                    0                     0
```

```
536385                  0                  0
536386                  0                  0
536387                  0                  0
536388                  0                  0
536390                  0                  0
536392                  0                  0
536393                  0                  0
536394                  0                  0
536395                  0                  0
536396                  0                  0
536397                  0                  0
536398                  0                  0
536399                  0                  0
...                   ...                ...
C581012                 0                  0
C581100                 0                  0
C581106                 0                  0
C581117                 0                  0
C581121                 0                  0
C581124                 0                  0
C581145                 0                  0
C581162                 0                  0
C581178                 0                  0
C581228                 0                  0
C581235                 0                  0
C581305                 0                  0
C581322                 0                  0
C581330                 0                  0
C581384                 0                  0
C581390                 0                  0
C581393                 0                  0
C581460                 0                  0
C581462                 0                  0
C581463                 0                  0
C581464                 0                  0
C581465                 0                  0
C581466                 0                  0
C581468                 0                  0
C581470                 0                  0
C581484                 0                  0
C581490                 0                  0
C581499                 0                  0
C581568                 0                  0
C581569                 0                  0

Description  wrongly marked carton 22804  wrongly marked. 23343 in box  \
InvoiceNo
536365                              0                            0
536366                              0                            0
536367                              0                            0
536368                              0                            0
536369                              0                            0
536371                              0                            0
536372                              0                            0
536373                              0                            0
536374                              0                            0
536375                              0                            0
536376                              0                            0
```

```
536377                                       0                                0
536378                                       0                                0
536380                                       0                                0
536381                                       0                                0
536382                                       0                                0
536384                                       0                                0
536385                                       0                                0
536386                                       0                                0
536387                                       0                                0
536388                                       0                                0
536390                                       0                                0
536392                                       0                                0
536393                                       0                                0
536394                                       0                                0
536395                                       0                                0
536396                                       0                                0
536397                                       0                                0
536398                                       0                                0
536399                                       0                                0
...                                        ...                              ...
C581012                                      0                                0
C581100                                      0                                0
C581106                                      0                                0
C581117                                      0                                0
C581121                                      0                                0
C581124                                      0                                0
C581145                                      0                                0
C581162                                      0                                0
C581178                                      0                                0
C581228                                      0                                0
C581235                                      0                                0
C581305                                      0                                0
C581322                                      0                                0
C581330                                      0                                0
C581384                                      0                                0
C581390                                      0                                0
C581393                                      0                                0
C581460                                      0                                0
C581462                                      0                                0
C581463                                      0                                0
C581464                                      0                                0
C581465                                      0                                0
C581466                                      0                                0
C581468                                      0                                0
C581470                                      0                                0
C581484                                      0                                0
C581490                                      0                                0
C581499                                      0                                0
C581568                                      0                                0
C581569                                      0                                0

Description   wrongly sold (22719) barcode   wrongly sold as sets   \
InvoiceNo
536365                                       0                                0
536366                                       0                                0
536367                                       0                                0
536368                                       0                                0
536369                                       0                                0
```

536369	0	0
536371	0	0
536372	0	0
536373	0	0
536374	0	0
536375	0	0
536376	0	0
536377	0	0
536378	0	0
536380	0	0
536381	0	0
536382	0	0
536384	0	0
536385	0	0
536386	0	0
536387	0	0
536388	0	0
536390	0	0
536392	0	0
536393	0	0
536394	0	0
536395	0	0
536396	0	0
536397	0	0
536398	0	0
536399	0	0
...	...	...
C581012	0	0
C581100	0	0
C581106	0	0
C581117	0	0
C581121	0	0
C581124	0	0
C581145	0	0
C581162	0	0
C581178	0	0
C581228	0	0
C581235	0	0
C581305	0	0
C581322	0	0
C581330	0	0
C581384	0	0
C581390	0	0
C581393	0	0
C581460	0	0
C581462	0	0
C581463	0	0
C581464	0	0
C581465	0	0
C581466	0	0
C581468	0	0
C581470	0	0
C581484	0	0
C581490	0	0
C581499	0	0
C581568	0	0
C581569	0	0

```
Description   wrongly sold sets
InvoiceNo
536365                        0
536366                        0
536367                        0
536368                        0
536369                        0
536371                        0
536372                        0
536373                        0
536374                        0
536375                        0
536376                        0
536377                        0
536378                        0
536380                        0
536381                        0
536382                        0
536384                        0
536385                        0
536386                        0
536387                        0
536388                        0
536390                        0
536392                        0
536393                        0
536394                        0
536395                        0
536396                        0
536397                        0
536398                        0
536399                        0
...                         ...
C581012                       0
C581100                       0
C581106                       0
C581117                       0
C581121                       0
C581124                       0
C581145                       0
C581162                       0
C581178                       0
C581228                       0
C581235                       0
C581305                       0
C581322                       0
C581330                       0
C581384                       0
C581390                       0
C581393                       0
C581460                       0
C581462                       0
C581463                       0
C581464                       0
C581465                       0
C581466                       0
C581468                       0
C581470                       0
```

```
        C581484                       0
        C581490                       0
        C581499                       0
        C581568                       0
        C581569                       0

        [22040 rows x 4202 columns]
```

Data Preprocessing

To make use of the apriori module given by mlxtend library, we need to convert the dataset according dataframe that has either 0 and 1 or True and False as data. The data we have is all string (name of it data.

Custom One Hot Encoding

```
frequent_itemsets = apriori(basket_sets, min_support=0.049, use_colnames=True)
print (frequent_itemsets)
```

```
      support                                itemsets
0    0.062205          (ASSORTED COLOUR BIRD ORNAMENT)
1    0.052813                 (HEART OF WICKER SMALL)
2    0.052586                 (JUMBO BAG PINK POLKADOT)
3    0.087931                 (JUMBO BAG RED RETROSPOT)
4    0.051407    (JUMBO SHOPPER VINTAGE RED PAISLEY)
5    0.051270                 (JUMBO STORAGE BAG SUKI)
6    0.055172                 (LUNCH BAG  BLACK SKULL.)
7    0.063158                 (LUNCH BAG RED RETROSPOT)
8    0.055309    (NATURAL SLATE HEART CHALKBOARD )
9    0.051225    (PACK OF 72 RETROSPOT CAKE CASES)
10   0.051044    (PAPER CHAIN KIT 50'S CHRISTMAS )
11   0.072323                           (PARTY BUNTING)
12   0.076452            (REGENCY CAKESTAND 3 TIER)
13   0.056307    (SET OF 3 CAKE TINS PANTRY DESIGN )
14   0.098276  (WHITE HANGING HEART T-LIGHT HOLDER)
```

Applying Apriori

apriori module from mlxtend library provides fast and efficient apriori implementation.

> **apriori(df, min_support=0.5, use_colnames=False, max_len=None, verbose=0, low_memory=Fa**

Parameters

- `df` : One-Hot-Encoded DataFrame or DataFrame that has 0 and 1 or True and False as values
- `min_support` : Floating point value between 0 and 1 that indicates the mininmum support requi

  > # of observation with item / total observation

- `use_colnames` : This allows to preserve column names for itemset making it more readable.
- `max_len` : Max length of itemset generated. If not set, all possible lengths are evaluated.
- `verbose` : Shows the number of iterations if >= 1 and low_memory is True. If =1 and low_memo combinations.
- `low_memory` :
  If True, uses an iterator to search for combinations above min_support. Note that while low_me dataset if memory resources are limited, because this implementation is approx. 3-6x slower th

```
#Applying Apriori
frequent_itemsets = apriori(basket_sets, min_support=0.03, use_colnames=True)
print (frequent_itemsets)
```

```
       support                                         itemsets
0      0.038793                       (6 RIBBONS RUSTIC CHARM)
1      0.034165                    (60 TEATIME FAIRY CAKE CASES)
2      0.039746                    (ALARM CLOCK BAKELIKE GREEN)
3      0.042196                    (ALARM CLOCK BAKELIKE RED )
4      0.030672                   (ANTIQUE SILVER T-LIGHT GLASS)
5      0.062205                   (ASSORTED COLOUR BIRD ORNAMENT)
6      0.035799                   (BAKING SET 9 PIECE RETROSPOT )
7      0.030581                   (CHARLOTTE BAG PINK POLKADOT)
8      0.036479                    (CHARLOTTE BAG SUKI DESIGN)
9      0.037205                    (CHOCOLATE HOT WATER BOTTLE)
10     0.031171                (CLOTHES PEGS RETROSPOT PACK 24 )
11     0.031261                   (COOK WITH WINE METAL SIGN )
12     0.031715                       (DOLLY GIRL LUNCH BOX)
13     0.031579                (DOORMAT KEEP CALM AND COME IN)
14     0.032123                            (DOTCOM POSTAGE)
15     0.034029               (GARDENERS KNEELING PAD CUP OF TEA )
16     0.040744               (GARDENERS KNEELING PAD KEEP CALM )
17     0.033167                   (GIN + TONIC DIET METAL SIGN)
18     0.042377               (GREEN REGENCY TEACUP AND SAUCER)
19     0.030309              (HAND OVER THE CHOCOLATE    SIGN )
20     0.031307              (HANGING HEART JAR T-LIGHT HOLDER)
21     0.041515                      (HEART OF WICKER LARGE)
22     0.052813                      (HEART OF WICKER SMALL)
23     0.033938                   (HOME BUILDING BLOCK WORD)
24     0.034256                  (HOT WATER BOTTLE KEEP CALM)
25     0.045735                     (JAM MAKING SET PRINTED)
26     0.045327                   (JAM MAKING SET WITH JARS)
27     0.041289               (JUMBO  BAG BAROQUE BLACK WHITE)
28     0.030490                  (JUMBO BAG 50'S CHRISTMAS )
29     0.038475                      (JUMBO BAG ALPHABET)
..        ...                                         ...
57     0.036978               (PLEASE ONE PERSON METAL SIGN)
58     0.033893                         (POPCORN HOLDER)
59     0.037795                       (RABBIT NIGHT LIGHT)
60     0.046869               (RECIPE BOX PANTRY YELLOW DESIGN)
61     0.032214                    (RECYCLING BAG RETROSPOT )
62     0.031942              (RED HANGING HEART T-LIGHT HOLDER)
63     0.041062                   (RED RETROSPOT CHARLOTTE BAG)
64     0.076452                    (REGENCY CAKESTAND 3 TIER)
65     0.036887                (RETROSPOT TEA SET CERAMIC 11 PC )
66     0.039065                 (REX CASH+CARRY JUMBO SHOPPER)
67     0.043421              (ROSES REGENCY TEACUP AND SAUCER )
68     0.033303                (SCOTTIE DOG HOT WATER BOTTLE)
69     0.056307               (SET OF 3 CAKE TINS PANTRY DESIGN )
70     0.032940                   (SET OF 3 REGENCY CAKE TINS)
71     0.045372                 (SET OF 4 PANTRY JELLY MOULDS)
72     0.034936              (SET OF 6 SPICE TINS PANTRY DESIGN)
73     0.038113              (SET/20 RED RETROSPOT PAPER NAPKINS )
74     0.037024              (SET/5 RED RETROSPOT LID GLASS BOWLS)
75     0.031806                       (SPACEBOY LUNCH BOX )
76     0.047232                          (SPOTTY BUNTING)
77     0.030535                  (STRAWBERRY CHARLOTTE BAG)
78     0.045463              (VICTORIAN GLASS HANGING T-LIGHT)
79     0.039701                       (VINTAGE SNAP CARDS)
80     0.098276              (WHITE HANGING HEART T-LIGHT HOLDER)
81     0.042740                 (WOODEN FRAME ANTIQUE WHITE )
```

```
82  0.048820                   (WOODEN PICTURE FRAME WHITE FINISH)
83  0.030989                            (WOODLAND CHARLOTTE BAG)
84  0.031806  (GREEN REGENCY TEACUP AND SAUCER, ROSES REGENC...
85  0.035617  (JUMBO BAG PINK POLKADOT, JUMBO BAG RED RETROS...
86  0.031670  (JUMBO BAG RED RETROSPOT, JUMBO STORAGE BAG SUKI)

[87 rows x 2 columns]
```

```
frequent_itemsets = apriori(basket_sets, min_support=0.02, use_colnames=True)
print (frequent_itemsets)
```

```
rules = association_rules(frequent_itemsets, metric="lift", min_threshold=1)
rules
```

	antecedents	consequents	antecedent support	consequent support	su
0	(GREEN REGENCY TEACUP AND SAUCER)	(ROSES REGENCY TEACUP AND SAUCER)	0.042377	0.043421	0.03
1	(ROSES REGENCY TEACUP AND SAUCER)	(GREEN REGENCY TEACUP AND SAUCER)	0.043421	0.042377	0.03
2	(JUMBO BAG PINK POLKADOT)	(JUMBO BAG RED RETROSPOT)	0.052586	0.087931	0.03
3	(JUMBO BAG RED RETROSPOT)	(JUMBO BAG PINK POLKADOT)	0.087931	0.052586	0.03
4	(JUMBO BAG RED RETROSPOT)	(JUMBO STORAGE BAG SUKI)	0.087931	0.051270	0.03
5	(JUMBO STORAGE BAG SUKI)	(JUMBO BAG RED RETROSPOT)	0.051270	0.087931	0.03

```
rules[ (rules['lift'] >= 0.6) &
       (rules['confidence'] >= 0.5) ]
```

```
rules[ (rules['lift'] >= 0.6) &
       (rules['confidence'] >= 0.3) ]
```

▾ Visualizing results

1. **Support vs Confidence**

```
plt.scatter(rules['support'], rules['confidence'], alpha=0.5)
plt.xlabel('support')
plt.ylabel('confidence')
plt.title('Support vs Confidence')
plt.show()
```