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Market Basket Analysis

Aim : In this mini project on implemented market basket analysis using a big data from kaggle data repository.

Theory: While all of this sounded really easy when we took an example of 3 items but think how complicated it will get when you combine data sets from different items from grocery, personal hygiene, clothing, food and beverages, bathroom accessories, stationery, electronics, bags and wallets, and many other items found in a common retail store. According to Walmart's official website, A Walmart Superstore has 142,000 different items in its store. These items can result in a tremendous number of possible subsets. If we start forming sets of 3 from a data small set of 100 items then 161,700 combinations are possible. Think how massive is the amount of data that is needed to be analyzed to figure out best combinations from 142,000 items. Additionally, there can be data sets from 2 items to 2000 items in this calculation. In e-commerce, this problem can increase to an even larger extent because of a wider range of items. According to export-x, as of 2015 Amazon had 488 million items in store. A successful and efficient analysis and recommendation can not only increase revenue but also gives more satisfaction to the customers. Big data tools can easily help us perform this process efficiently.

Implementation (Code):

```
In [ ]: import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

/kaggle/input/groceries-dataset/Groceries_dataset.csv

```
In [ ]: data=pd.read_csv("../input/groceries-dataset/Groceries_dataset.csv")
```

```
In [ ]: data.shape
```

```
Out[ ]: (38765, 3)
```

The dataset has 38765 rows of the purchase orders of people from the grocery stores. These orders can be analysed and association rules can be generated using Market Basket Analysis by algorithms like Apriori Algorithm.

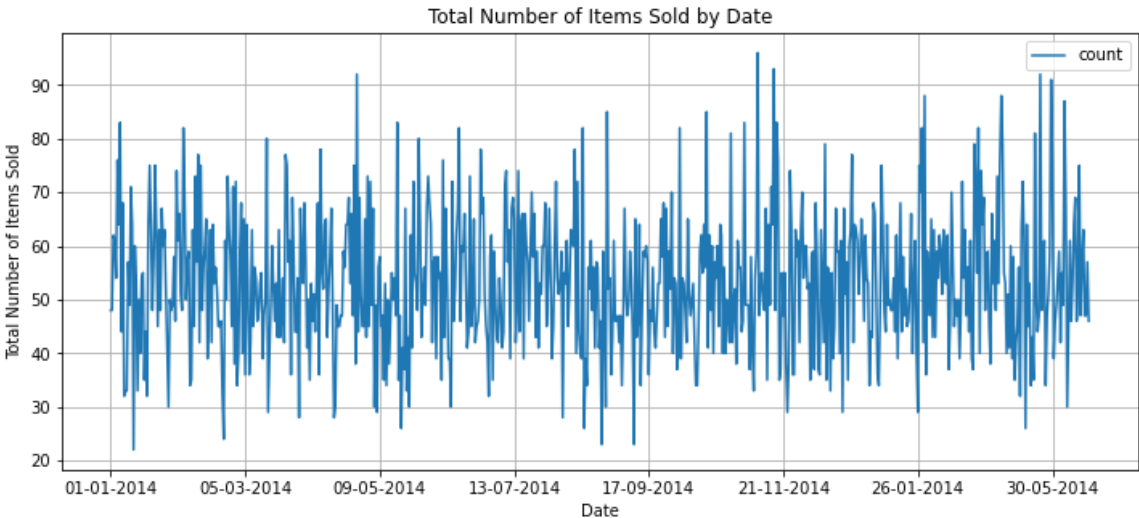
```
In [ ]: data.head()
```

```
Out[ ]:
```

	Member_number	Date	itemDescription
0	1808	21-07-2015	tropical fruit
1	2552	05-01-2015	whole milk
2	2300	19-09-2015	pip fruit
3	1187	12-12-2015	other vegetables
4	3037	01-02-2015	whole milk

```
In [ ]: data.groupby(['Date'])['itemDescription'].agg(['count']).plot(figsize=(12, 10))
```

```
Out[ ]: [Text(0, 0.5, 'Total Number of Items Sold'), Text(0.5, 0, 'Date')]
```



```
In [ ]: d=data.set_index(['Date'])
```

```
In [ ]: d
```

```
Out[ ]:
```

	Member_number	itemDescription
Date		
21-07-2015	1808	tropical fruit
05-01-2015	2552	whole milk
19-09-2015	2300	pip fruit
12-12-2015	1187	other vegetables
01-02-2015	3037	whole milk
...
08-10-2014	4471	sliced cheese
23-02-2014	2022	candy
16-04-2014	1097	cake bar
03-12-2014	1510	fruit/vegetable juice
26-12-2014	1521	cat food

38765 rows × 2 columns

```
In [ ]: d.index=pd.to_datetime(d.index)
```

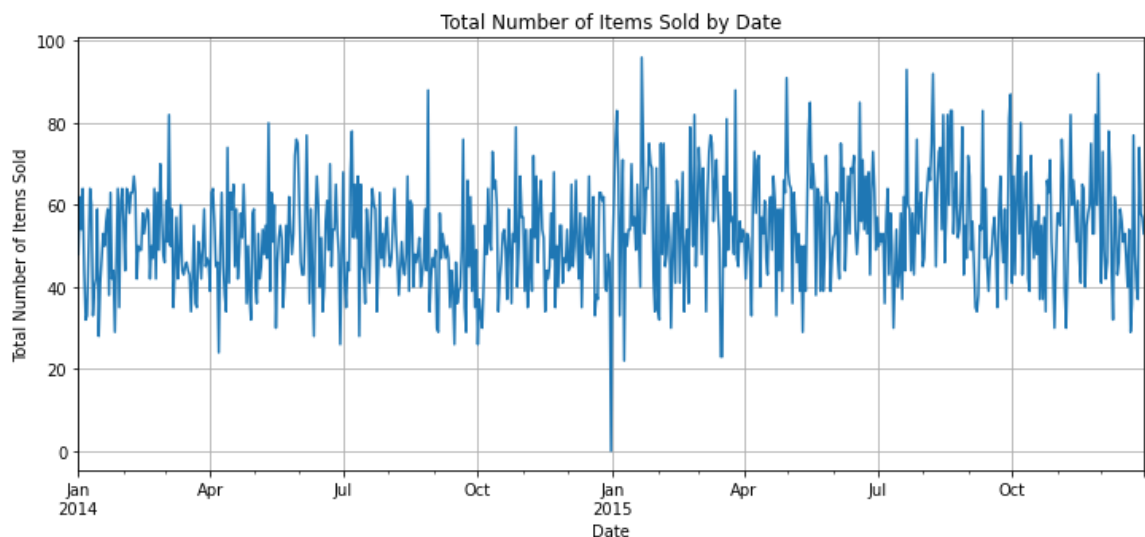
```
In [ ]: total_items = len(d)
total_days = len(np.unique(d.index.date))
total_months = len(np.unique(d.index.month))
average_items = total_items / total_days
unique_items = d.itemDescription.unique().size

print("There are {} unique items sold ".format(unique_items))
print("Total {} items sold in {} days throughout {} months".format(total_items, total_days, total_months))
print("With an average of {} items sold daily".format(average_items))
```

There are 167 unique items sold
Total 38765 items sold in 728 days throughout 12 months
With an average of 53.24862637362637 items sold daily

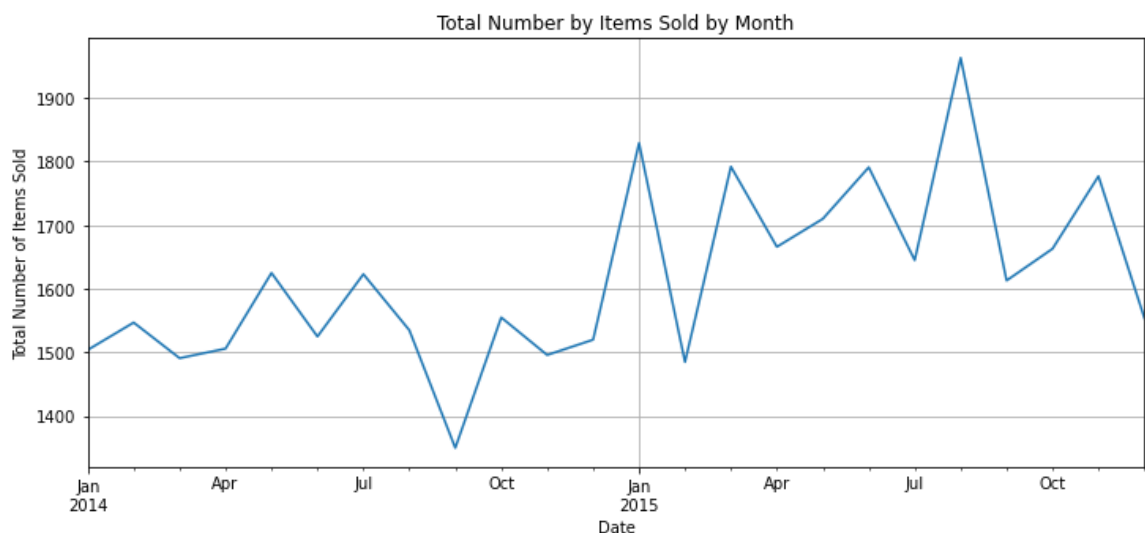
```
In [ ]: d.resample("D")['itemDescription'].count().plot(figsize=(12,5), grid=True)
```

```
Out[ ]: [Text(0, 0.5, 'Total Number of Items Sold'), Text(0.5, 0, 'Date')]
```



```
In [ ]: d.resample("M")['itemDescription'].count().plot(figsize=(12,5), grid=True)
```

```
Out[ ]: [Text(0, 0.5, 'Total Number of Items Sold'), Text(0.5, 0, 'Date')]
```



```
In [ ]: d["Hour"] = d.index.hour
        d["Weekday"] = d.index.weekday + 1

        d.head(10)
```

```
Out[ ]:      Member_number  itemDescription  Hour  Weekday
      Date
2015-07-21          1808      tropical fruit    0         2
2015-05-01          2552        whole milk    0         5
2015-09-19          2300         pip fruit    0         6
2015-12-12          1187  other vegetables    0         6
2015-01-02          3037        whole milk    0         5
2015-02-14          4941        rolls/buns    0         6
2015-08-05          4501  other vegetables    0         3
2015-12-23          3803         pot plants    0         3
2015-03-20          2762        whole milk    0         5
2015-12-02          4119      tropical fruit    0         3
```

```
In [ ]: data['itemDescription'].value_counts()
```

```
Out[ ]: whole milk          2502
        other vegetables    1898
        rolls/buns         1716
        soda               1514
        yogurt             1334
        ...
        frozen chicken      5
        bags                4
        baby cosmetics       3
        preservation products 1
        kitchen utensil      1
        Name: itemDescription, Length: 167, dtype: int64
```

```
In [ ]: data['Date'].nunique()
```

```
Out[ ]: 728
```

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

```
In [ ]: def bar_plot(df,col):

        fig = px.bar(df,
                    x = df[col].value_counts().keys(),
                    y = df[col].value_counts().values,
                    color= df[col].value_counts().keys()
        )
        fig.update_layout(
            xaxis_title= col,
            yaxis_title="Count",
            legend_title=col,
            font_family="Courier New",
```

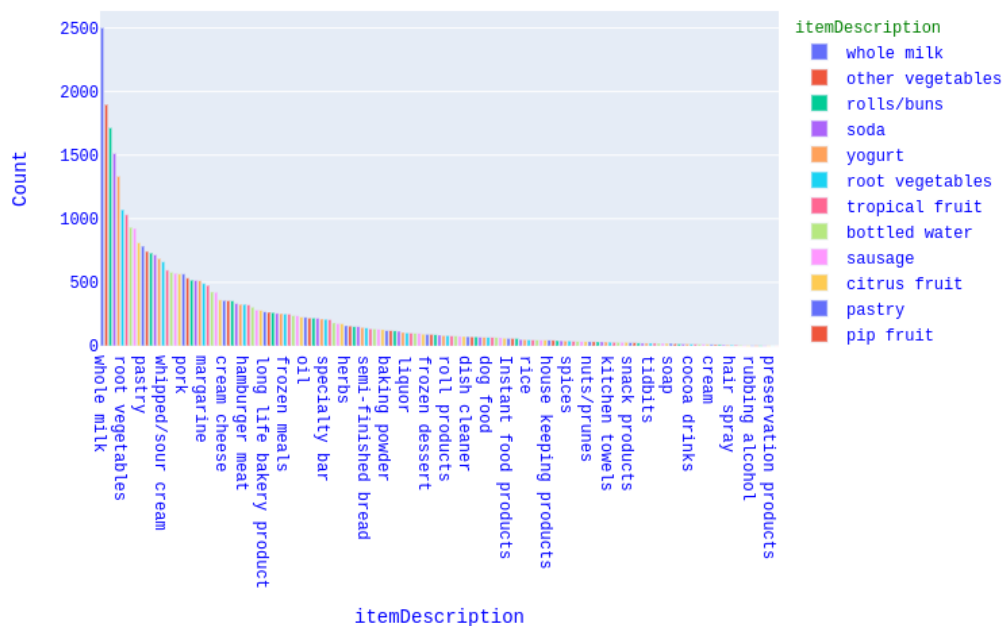
```

font_color="blue",
title_font_family="Times New Roman",
title_font_color="red",
legend_title_font_color="green"
)

fig.show()

```

```
In [ ]: bar_plot(data, 'itemDescription')
```



```
In [ ]: df=data.groupby(['Member_number', 'Date'])['itemDescription'].apply(sum)
```

```
In [ ]: df
```

```

Out[ ]: Member_number  Date
1000                15-03-2015      sausagewhole milksemi-finished bready
ogurt                                24-06-2014      whole milkpastrysalty
snack                                24-07-2015      canned beermisc. beve
rages                                25-11-2015      sausagehygiene art
icles                                27-05-2015      sodapickled veget
ables                                ...
4999                24-01-2015      tropical fruitberriesother vegetablesyogurtk
it...                26-12-2015                                bottled water
herbs                09-03-2014                                fruit/vegetable juiceo
5000                10-02-2015      sodaroot vegetablessemi-finished
nions                16-11-2014      bottled beerother veget
ables
Name: itemDescription, Length: 14963, dtype: object

```

```
In [ ]: df.values
```

```
Out[ ]: array(['sausagewhole milksemi-finished breadyogurt',  
              'whole milkpastrysalty snack', 'canned beermisc. beverages', ...,  
              'fruit/vegetable juiceonions',  
              'sodaroot vegetablessemi-finished bread',  
              'bottled beerother vegetables'], dtype=object)
```

```
In [ ]: pd.set_option('display.max_colwidth', -1)
```

/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:1: FutureWarning:

Passing a negative integer is deprecated in version 1.0 and will not be supported in future version. Instead, use None to not limit the column width.

```
In [ ]: transactions = [a[1]['itemDescription'].tolist() for a in list(data.groupby('itemCategory'))]
```

```
In [ ]: transactions
```

```
Out[ ]: [['sausage', 'whole milk', 'semi-finished bread', 'yogurt'],  
         ['whole milk', 'pastry', 'salty snack'],  
         ['canned beer', 'misc. beverages'],  
         ['sausage', 'hygiene articles'],  
         ['soda', 'pickled vegetables'],  
         ['frankfurter', 'curd'],  
         ['sausage', 'whole milk', 'rolls/buns'],  
         ['whole milk', 'soda'],  
         ['beef', 'white bread'],  
         ['frankfurter', 'soda', 'whipped/sour cream'],  
         ['frozen vegetables', 'other vegetables'],  
         ['butter', 'whole milk'],  
         ['tropical fruit', 'sugar'],  
         ['butter milk', 'specialty chocolate'],  
         ['sausage', 'rolls/buns'],  
         ['root vegetables', 'detergent'],  
         ['frozen meals', 'dental care'],  
         ['rolls/buns', 'rolls/buns'],  
         ['dish cleaner', 'cling film/bags'],  
         ['canned beer', 'frozen fish'],  
         ['other vegetables', 'hygiene articles'],  
         ['pip fruit', 'whole milk', 'tropical fruit'],  
         ['rolls/buns', 'red/blush wine', 'chocolate'],  
         ['other vegetables', 'shopping bags'],  
         ['whole milk', 'chocolate', 'packaged fruit/vegetables', 'rolls/buns'],  
         ['root vegetables', 'whole milk', 'pastry'],  
         ['rolls/buns', 'rolls/buns'],  
         ['whipped/sour cream', 'margarine'],  
         ['bottled water', 'softener', 'rolls/buns'],  
         ['whole milk', 'rice'],  
         ['shopping bags', 'skin care'],  
         ['whole milk',  
          'frankfurter',  
          'chicken',  
          'frankfurter',  
          'flour',  
          'chocolate',  
          'bottled beer',  
          'rolls/buns'],  
         ['hamburger meat', 'liquor (appetizer)', 'liver loaf', 'dessert'],  
         ['tropical fruit',
```

'soda',
'yogurt',
'root vegetables',
'yogurt',
'domestic eggs',
'white wine',
'photo/film'],
['herbs', 'yogurt', 'newspapers'],
['tropical fruit', 'yogurt'],
['pastry', 'ketchup'],
['canned fish', 'cocoa drinks'],
['pip fruit', 'coffee', 'UHT-milk'],
['kitchen towels', 'sliced cheese'],
['bottled water', 'specialty bar'],
['frankfurter', 'bottled water'],
['pip fruit', 'candles', 'rolls/buns'],
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'root vegetables',
'rolls/buns',
'onions',
'shopping bags'],
['frozen vegetables', 'brown bread'],
['processed cheese', 'whole milk'],
['frozen meals', 'whole milk'],
['white bread', 'meat', 'domestic eggs', 'roll products '],
['root vegetables', 'mayonnaise'],
['other vegetables', 'mustard'],
['hard cheese', 'napkins', 'bottled water'],
['whole milk', 'candy'],
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['rolls/buns', 'frankfurter', 'oil', 'pip fruit', 'mayonnaise'],
['brown bread', 'pet care'],
['other vegetables', 'rolls/buns'],
['yogurt', 'beef'],
['other vegetables', 'root vegetables'],
['soda', 'dessert', 'shopping bags'],
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['beverages', 'domestic eggs'],
['butter milk', 'root vegetables'],
['berries', 'cake bar'],
['hamburger meat', 'red/blush wine'],
['canned beer', 'shopping bags'],
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['frozen meals', 'butter', 'newspapers', 'yogurt'],
['rolls/buns', 'baking powder'],
['liquor', 'curd', 'yogurt', 'tropical fruit'],
['sliced cheese', 'butter'],

```
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['beef', 'napkins'],
['whole milk', 'whipped/sour cream'],
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 'root vegetables',
 'rolls/buns',
 'packaged fruit/vegetables'],
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['male cosmetics', 'curd'],
['white bread', 'bottled beer', 'yogurt', 'berries'],
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['fish', 'root vegetables', 'tropical fruit', 'other vegetables'],
['coffee', 'shopping bags'],
['ham', 'cream cheese '],
['canned beer', 'UHT-milk'],
['sausage', 'dessert', 'rolls/buns', 'pickled vegetables'],
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r'],
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r'],
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```



```
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```

['brown bread', 'salt'],
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['oil', 'shopping bags'],
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y'],
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['ham', 'white bread'],
['herbs', 'pot plants', 'cake bar'],
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['yogurt', 'berries'],
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'meat',
'other vegetables',
'domestic eggs',
'baking powder'],
['yogurt', 'sauces'],

```

```
['beef', 'yogurt'],
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 'specialty chocolate',
 'dishes',
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 'napkins',
 'detergent',
 'pastry'],
['photo/film', 'shopping bags'],
['frankfurter', 'other vegetables', 'bottled beer'],
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 'other vegetables',
 'frozen vegetables'],
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 'sausage',
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['finished products', 'yogurt', 'bottled beer', 'bottled water'],
['brown bread', 'tropical fruit'],
['frozen vegetables',
 'sausage',
 'whole milk',
 'frozen vegetables',
 'rolls/buns',
 'other vegetables',
 'oil',
 'frozen fish',
 'baking powder'],
['onions', 'hard cheese'],
['soda', 'shopping bags'],
['oil', 'margarine'],
['whole milk', 'specialty cheese'],
['specialty chocolate', 'pasta', 'soda', 'long life bakery product'],
['meat', 'other vegetables', 'pasta'],
['citrus fruit', 'other vegetables'],
['sausage', 'dog food', 'bottled beer', 'bottled water'],
['beverages', 'beverages', 'sugar', 'pasta', 'domestic eggs'],
['shopping bags', 'tropical fruit'],
['butter', 'chocolate'],
['sausage', 'frozen meals'],
['soda', 'cling film/bags'],
['UHT-milk', 'soft cheese'],
['candy', 'soda'],
['rolls/buns', 'salty snack', 'bottled water', 'shopping bags'],
['dessert', 'condensed milk', 'rolls/buns', 'shopping bags'],
['turkey', 'shopping bags'],
['tropical fruit', 'rolls/buns'],
['onions', 'soft cheese'],
['grapes', 'other vegetables'],
['soda', 'soda', 'canned fruit', 'processed cheese', 'soda', 'shopping b
ags'],
['coffee', 'white bread'],
['yogurt', 'canned beer'],
['whipped/sour cream', 'yogurt'],
['tropical fruit', 'berries'],
['other vegetables', 'UHT-milk'],
['frozen vegetables', 'other vegetables'],
['butter', 'candy'],
['chicken', 'butter'],
['citrus fruit', 'skin care'],
['root vegetables', 'frozen vegetables'],
['tropical fruit', 'pip fruit'],
['frankfurter', 'whole milk'],
['dessert', 'packaged fruit/vegetables'],
['margarine', 'margarine'],
['beef', 'curd'],
['citrus fruit', 'coffee'],

```

['soda', 'frozen meals', 'bottled beer'],
['other vegetables', 'chewing gum'],
['canned beer', 'dessert', 'fruit/vegetable juice'],
['chicken', 'pastry'],
['pork', 'turkey', 'pot plants', 'whole milk', 'soda', 'dishes'],
['grapes', 'other vegetables'],
['pastry', 'liqueur'],
['sausage', 'processed cheese', 'baking powder', 'specialty cheese'],
['ham', 'napkins'],
['white wine', 'specialty bar', 'specialty chocolate'],
['soda', 'red/blush wine'],
['sausage', 'coffee'],
['berries', 'domestic eggs'],
['sugar', 'other vegetables'],
['tea', 'coffee'],
['UHT-milk', 'herbs', 'butter', 'oil'],
['rolls/buns', 'yogurt'],
['frozen dessert', 'cream cheese '],
['yogurt', 'coffee'],
['rolls/buns',
 'fruit/vegetable juice',
 'frozen vegetables',
 'whipped/sour cream'],
['hamburger meat', 'coffee'],
['whole milk', 'shopping bags'],
['ice cream', 'whole milk'],
['sausage', 'grapes', 'sliced cheese', 'napkins'],
['fruit/vegetable juice', 'berries'],
['pork', 'root vegetables'],
['pip fruit', 'shopping bags'],
['sausage', 'curd'],
['whole milk', 'domestic eggs', 'canned vegetables', 'flower (seeds)'],
['rolls/buns', 'hard cheese', 'rolls/buns', 'flour'],
['organic sausage', 'frozen meals', 'sugar'],
['whole milk', 'onions', 'pickled vegetables'],
['citrus fruit', 'other vegetables'],
['frozen meals', 'bottled beer'],
['tropical fruit', 'yogurt', 'semi-finished bread', 'soda'],
['tropical fruit', 'white bread', 'butter'],
['specialty bar', 'tropical fruit'],
['bottled water', 'pastry'],
['sugar', 'curd'],
['sausage', 'other vegetables', 'tropical fruit', 'mayonnaise'],
['other vegetables', 'whole milk', 'soda'],
['pork', 'brown bread'],
['UHT-milk', 'canned fish', 'root vegetables', 'waffles'],
['cream cheese ',
 'pip fruit',
 'citrus fruit',
 'chicken',
 'other vegetables',
 'curd',
 'specialty chocolate',
 'pastry'],
['pork', 'yogurt'],
['hamburger meat', 'other vegetables', 'domestic eggs'],
['shopping bags', 'tropical fruit', 'red/blush wine'],
['other vegetables', 'sliced cheese'],
['butter', 'whole milk'],
['oil', 'canned fish'],
['whole milk', 'misc. beverages'],
['white wine', 'sauces'],
['other vegetables', 'margarine', 'brown bread'],
['red/blush wine', 'frozen meals', 'canned fruit'],
['other vegetables', 'liquor', 'whole milk', 'butter milk'],
['rolls/buns', 'seasonal products'],
['tropical fruit', 'root vegetables'],
['other vegetables', 'whole milk', 'softener'],

```

['citrus fruit', 'cereals'],
['cake bar', 'flower soil/fertilizer'],
['pork', 'napkins'],
['specialty bar', 'cleaner'],
['artif. sweetener', 'whole milk'],
['pork', 'pastry'],
['coffee', 'other vegetables', 'specialty cheese'],
['dessert', 'rolls/buns'],
['tidbits', 'cream cheese '],
['curd', 'hygiene articles'],
['rolls/buns', 'dental care'],
['root vegetables', 'butter', 'dessert'],
['citrus fruit', 'pastry'],
['salt', 'citrus fruit'],
['other vegetables', 'whole milk'],
['sausage', 'onions', 'mustard'],
['frozen potato products', 'domestic eggs', 'shopping bags', 'butter mil
k'],
['white bread', 'specialty chocolate'],
['ice cream', 'butter'],
['dessert', 'house keeping products'],
['condensed milk', 'hard cheese'],
['hard cheese', 'yogurt'],
['sausage', 'whole milk', 'rolls/buns', 'bottled beer'],
['whole milk', 'cream cheese ', 'semi-finished bread'],
['sausage', 'rolls/buns'],
['frankfurter', 'shopping bags'],
['photo/film',
'whole milk',
'yogurt',
'whole milk',
'white bread',
'pot plants',
'dessert'],
...]
```

```
In [ ]: from mlxtend.preprocessing import TransactionEncoder
```

```
In [ ]: te_ary = te.fit(transactions).transform(transactions)
```

```
In [ ]: te.columns_
```

```
Out[ ]: ['Instant food products',
'UHT-milk',
'abrasive cleaner',
'artif. sweetener',
'baby cosmetics',
'bags',
'baking powder',
'bathroom cleaner',
'beef',
'berries',
'beverages',
'bottled beer',
'bottled water',
'brandy',
'brown bread',
'butter',
'butter milk',
'cake bar',
'candles',
'candy',
'canned beer',
```


'canned fish',
'canned fruit',
'canned vegetables',
'cat food',
'cereals',
'chewing gum',
'chicken',
'chocolate',
'chocolate marshmallow',
'citrus fruit',
'cleaner',
'cling film/bags',
'cocoa drinks',
'coffee',
'condensed milk',
'cooking chocolate',
'cookware',
'cream',
'cream cheese ',
'curd',
'curd cheese',
'decalcifier',
'dental care',
'dessert',
'detergent',
'dish cleaner',
'dishes',
'dog food',
'domestic eggs',
'female sanitary products',
'finished products',
'fish',
'flour',
'flower (seeds)',
'flower soil/fertilizer',
'frankfurter',
'frozen chicken',
'frozen dessert',
'frozen fish',
'frozen fruits',
'frozen meals',
'frozen potato products',
'frozen vegetables',
'fruit/vegetable juice',
'grapes',
'hair spray',
'ham',
'hamburger meat',
'hard cheese',
'herbs',
'honey',
'house keeping products',
'hygiene articles',
'ice cream',
'instant coffee',
'jam',
'ketchup',
'kitchen towels',
'kitchen utensil',
'light bulbs',
'liqueur',
'liquor',
'liquor (appetizer)',
'liver loaf',
'long life bakery product',
'make up remover',
'male cosmetics',
'margarine',

'mayonnaise',
'meat',
'meat spreads',
'misc. beverages',
'mustard',
'napkins',
'newspapers',
'nut snack',
'nuts/prunes',
'oil',
'onions',
'organic products',
'organic sausage',
'other vegetables',
'packaged fruit/vegetables',
'pasta',
'pastry',
'pet care',
'photo/film',
'pickled vegetables',
'pip fruit',
'popcorn',
'pork',
'pot plants',
'potato products',
'preservation products',
'processed cheese',
'prosecco',
'pudding powder',
'ready soups',
'red/blush wine',
'rice',
'roll products ',
'rolls/buns',
'root vegetables',
'rubbing alcohol',
'rum',
'salad dressing',
'salt',
'salty snack',
'sauces',
'sausage',
'seasonal products',
'semi-finished bread',
'shopping bags',
'skin care',
'sliced cheese',
'snack products',
'soap',
'soda',
'soft cheese',
'softener',
'soups',
'sparkling wine',
'specialty bar',
'specialty cheese',
'specialty chocolate',
'specialty fat',
'specialty vegetables',
'spices',
'spread cheese',
'sugar',
'sweet spreads',
'syrup',
'tea',
'tidbits',
'toilet cleaner',
'tropical fruit',

```
'turkey',
'vinegar',
'waffles',
'whipped/sour cream',
'whisky',
'white bread',
'white wine',
'whole milk',
'yogurt',
'zwieback']
```

```
In [ ]: te_ary
```

```
Out[ ]: array([[False, False, False, ..., True, True, False],
               [False, False, False, ..., True, False, False],
               [False, False, False, ..., False, False, False],
               ...,
               [False, False, False, ..., False, False, False],
               [False, False, False, ..., False, False, False],
               [False, False, False, ..., False, False, False]])
```

```
In [ ]: transactions = pd.DataFrame(te_ary, columns=te.columns_)
pf = transactions.describe()
```

```
In [ ]: pf
```

```
Out[ ]:
```

	Instant food products	UHT- milk	abrasive cleaner	artif. sweetener	baby cosmetics	bags	baking powder	bathroom cleaner	beef
count	14963	14963	14963	14963	14963	14963	14963	14963	14963
unique	2	2	2	2	2	2	2	2	2
top	False	False	False	False	False	False	False	False	False
freq	14903	14643	14941	14934	14960	14959	14842	14946	14455

4 rows × 167 columns

```
In [ ]: pf.iloc[0]-pf.iloc[3]
```

```
Out[ ]: Instant food products      60
UHT-milk                        320
abrasive cleaner                 22
artif. sweetener                 29
baby cosmetics                   3
..
white bread                      359
white wine                       175
whole milk                      2363
yogurt                          1285
zwieback                         60
Length: 167, dtype: object
```

```
In [ ]: f = pf.iloc[0]-pf.iloc[3]
a = f.tolist()
b = list(f.index)
item = pd.DataFrame([[a[r],b[r]]for r in range(len(a))], columns=['Count',
item = item.sort_values(['Count'], ascending=False).head(50)
transactions
```

Out[]:

	Instant food products	UHT- milk	abrasive cleaner	artif. sweetener	baby cosmetics	bags	baking powder	bathroom cleaner	beef	b
0	False	False	False	False	False	False	False	False	False	
1	False	False	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	False	False	
3	False	False	False	False	False	False	False	False	False	
4	False	False	False	False	False	False	False	False	False	
...
14958	False	False	False	False	False	False	False	False	False	
14959	False	False	False	False	False	False	False	False	False	
14960	False	False	False	False	False	False	False	False	False	
14961	False	False	False	False	False	False	False	False	False	
14962	False	False	False	False	False	False	False	False	False	

14963 rows × 167 columns

In []:

item

Out[]:

	Count	Item
164	2363	whole milk
102	1827	other vegetables
122	1646	rolls/buns
138	1453	soda
165	1285	yogurt
123	1041	root vegetables
156	1014	tropical fruit
12	908	bottled water
130	903	sausage
30	795	citrus fruit
105	774	pastry
109	734	pip fruit
133	712	shopping bags
20	702	canned beer
11	678	bottled beer
160	654	whipped/sour cream
95	582	newspapers
56	565	frankfurter
14	563	brown bread
111	555	pork

49	555	domestic eggs
15	527	butter
64	509	fruit/vegetable juice
8	508	beef
40	504	curd
88	482	margarine
34	473	coffee
63	419	frozen vegetables
27	417	chicken
162	359	white bread
39	354	cream cheese
28	353	chocolate
44	353	dessert
94	331	napkins
68	327	hamburger meat
9	326	berries
1	320	UHT-milk
99	303	onions
128	281	salty snack
159	277	waffles
85	268	long life bakery product
150	265	sugar
16	263	butter milk
67	256	ham
90	252	meat
61	251	frozen meals
10	248	beverages
145	239	specialty chocolate
92	236	misc. beverages
74	227	ice cream

```
In [ ]: fig = px.treemap(item, path=['Item'], values='Count')
fig.show()
```



Apriori is an algorithm for frequent item set mining and association rule learning over relational databases. It proceeds by identifying the frequent individual items in the database and extending them to larger and larger item sets as long as those item sets appear sufficiently often in the database. The frequent item sets determined by Apriori can be used to determine association rules which highlight general trends in the database: this has applications in domains such as market basket analysis.

```
In [ ]: from mlxtend.frequent_patterns import apriori, association_rules
import matplotlib.pyplot as plt
```

Support: The support of item I is defined as the ratio between the number of transactions containing the item I by the total number of transactions expressed as :

Support(I)=Number of transactions containing I/Total number of Transactions

Confidence: This is measured by the proportion of transactions with item I1, in which item I2 also appears. The confidence between two items I1 and I2, in a transaction is defined as the total number of transactions containing both items I1 and I2 divided by the total number of transactions containing I1.

Confidence(I1->I2)=Number of Transactions containing I1 and I2/(Total Number of Transactions containing I1)

Lift: Lift is the ratio between the confidence and support expressed as :

Lift(I1->I2)=Confidence(I1->I2)/Support(I2)

```
In [ ]: freq_items = apriori(transactions, min_support=0.001, use_colnames=True,
freq_items.head(7)
```

Processing 28 combinations | Sampling itemset size 4e 3

```
Out[ ]: support itemsets
```

0	0.004010	(Instant food products)
1	0.021386	(UHT-milk)
2	0.001470	(abrasive cleaner)
3	0.001938	(artif. sweetener)
4	0.008087	(baking powder)
5	0.001136	(bathroom cleaner)
6	0.033950	(beef)

```
In [ ]: freq_items['length'] = freq_items['itemsets'].apply(lambda x: len(x))
```

```
In [ ]: freq_items.head(10)
```

```
Out[ ]:
```

	support	itemsets	length
0	0.004010	(Instant food products)	1
1	0.021386	(UHT-milk)	1
2	0.001470	(abrasive cleaner)	1
3	0.001938	(artif. sweetener)	1
4	0.008087	(baking powder)	1
5	0.001136	(bathroom cleaner)	1
6	0.033950	(beef)	1
7	0.021787	(berries)	1
8	0.016574	(beverages)	1
9	0.045312	(bottled beer)	1

```
In [ ]: freq_items.tail(10)
```

```
Out[ ]:
```

	support	itemsets	length
740	0.011161	(yogurt, whole milk)	2
741	0.001136	(other vegetables, rolls/buns, soda)	3
742	0.001203	(other vegetables, rolls/buns, whole milk)	3
743	0.001136	(other vegetables, whole milk, soda)	3
744	0.001136	(yogurt, other vegetables, whole milk)	3
745	0.001136	(sausage, rolls/buns, whole milk)	3
746	0.001002	(rolls/buns, soda, whole milk)	3
747	0.001337	(yogurt, rolls/buns, whole milk)	3
748	0.001069	(whole milk, soda, sausage)	3
749	0.001470	(yogurt, whole milk, sausage)	3

```
In [ ]: rules = association_rules(freq_items, metric="confidence", min_threshold=0.5)
rules.head()
```

Out []:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
0	(bottled water)	(UHT-milk)	0.060683	0.021386	0.001069	0.017621	0.823954	-0.0
1	(UHT-milk)	(bottled water)	0.021386	0.060683	0.001069	0.050000	0.823954	-0.0
2	(other vegetables)	(UHT-milk)	0.122101	0.021386	0.002139	0.017515	0.818993	-0.0
3	(UHT-milk)	(other vegetables)	0.021386	0.122101	0.002139	0.100000	0.818993	-0.0
4	(rolls/buns)	(UHT-milk)	0.110005	0.021386	0.001804	0.016403	0.767013	-0.0

In []:

rules

Out []:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
0	(bottled water)	(UHT-milk)	0.060683	0.021386	0.001069	0.017621	0.823954
1	(UHT-milk)	(bottled water)	0.021386	0.060683	0.001069	0.050000	0.823954
2	(other vegetables)	(UHT-milk)	0.122101	0.021386	0.002139	0.017515	0.818993
3	(UHT-milk)	(other vegetables)	0.021386	0.122101	0.002139	0.100000	0.818993
4	(rolls/buns)	(UHT-milk)	0.110005	0.021386	0.001804	0.016403	0.767013
...
1195	(yogurt, whole milk)	(sausage)	0.011161	0.060349	0.001470	0.131737	2.182917
1196	(yogurt, sausage)	(whole milk)	0.005748	0.157923	0.001470	0.255814	1.619866
1197	(sausage, whole milk)	(yogurt)	0.008955	0.085879	0.001470	0.164179	1.911760
1198	(yogurt)	(sausage, whole milk)	0.085879	0.008955	0.001470	0.017121	1.911760
1199	(sausage)	(yogurt, whole milk)	0.060349	0.011161	0.001470	0.024363	2.182917

1200 rows × 9 columns

In []:

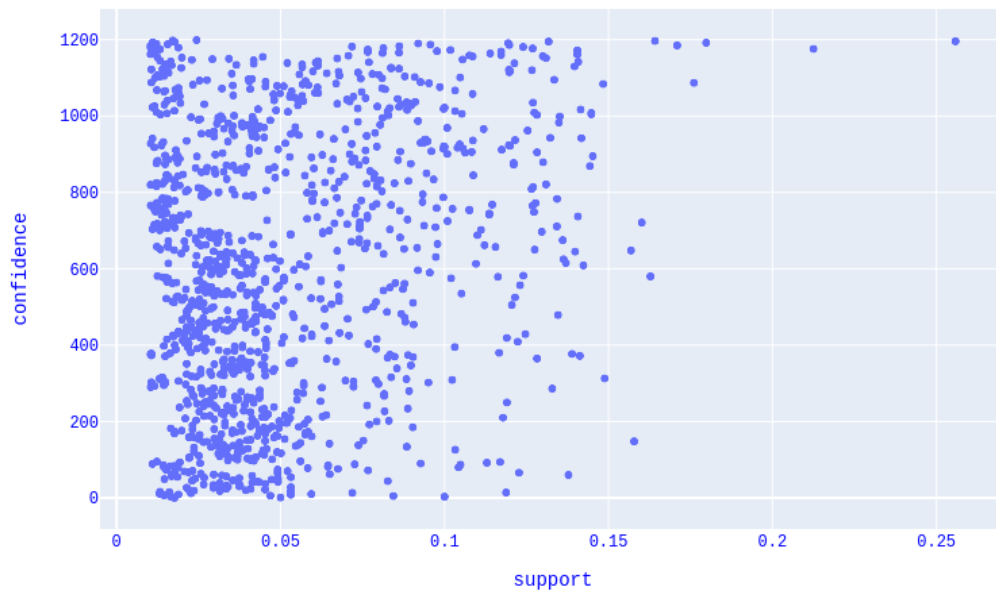
```
fig=px.scatter(rules['support'], rules['confidence'])
fig.update_layout(
    xaxis_title="support",
    yaxis_title="confidence",

    font_family="Courier New",
    font_color="blue",
    title_font_family="Times New Roman",
    title_font_color="red",
    title=('Support vs Confidence')
```



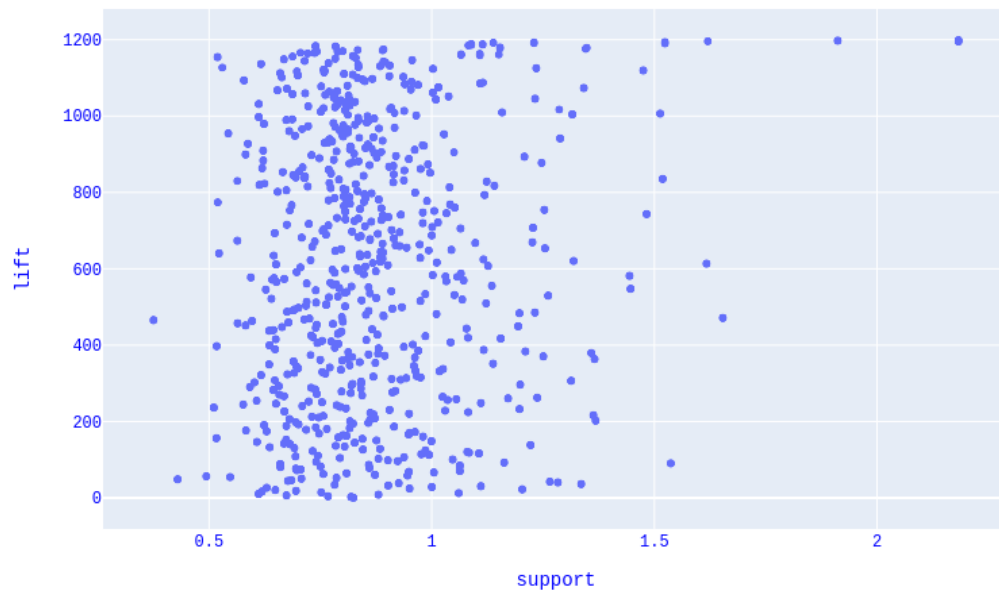
```
)  
  
fig.show()
```

Support vs Confidence



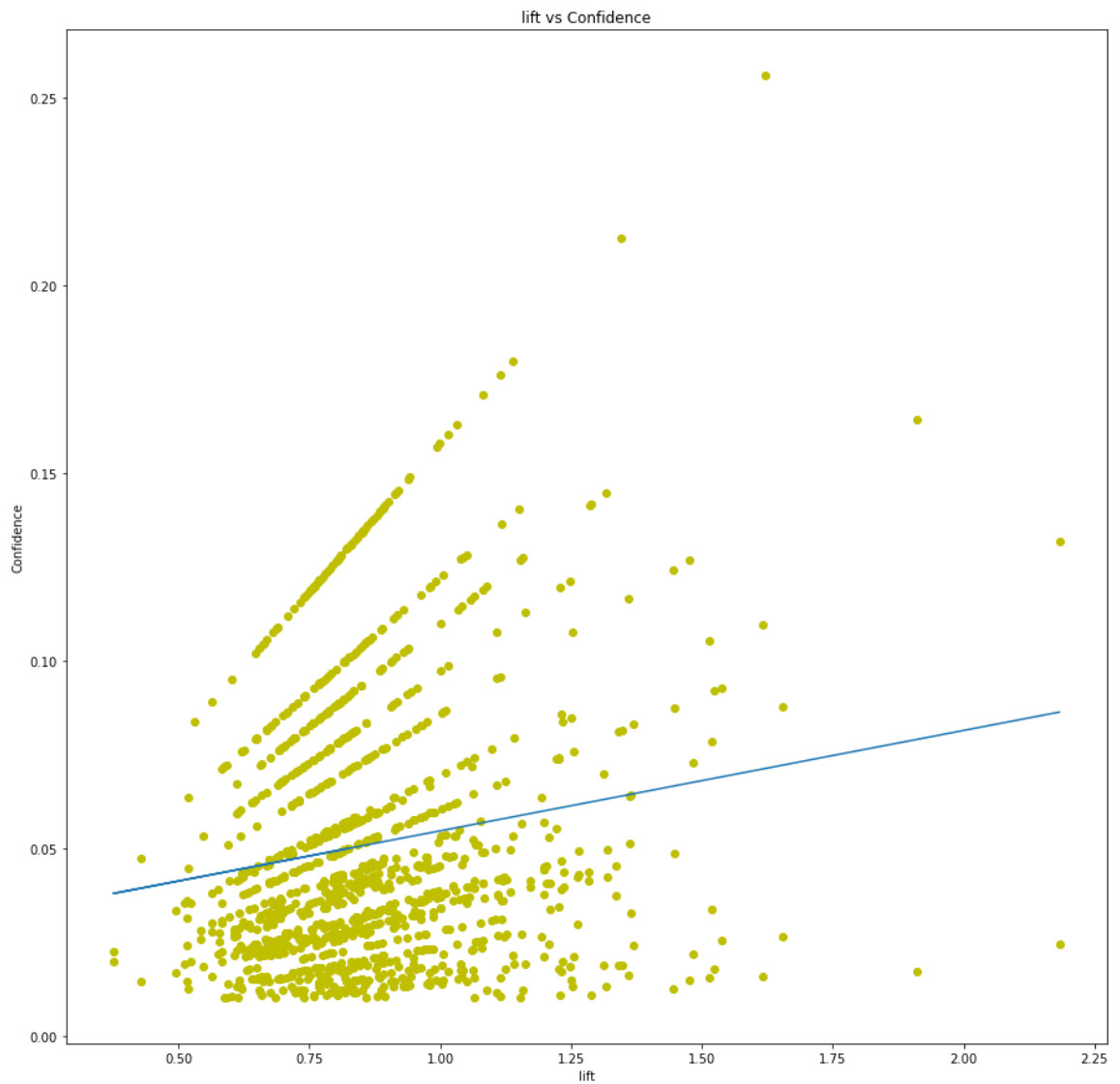
```
In [ ]: fig=px.scatter(rules['support'], rules['lift'])  
fig.update_layout(  
    xaxis_title="support",  
    yaxis_title="lift",  
  
    font_family="Courier New",  
    font_color="blue",  
    title_font_family="Times New Roman",  
    title_font_color="red",  
    title=('Support vs Lift')  
  
)  
  
fig.show()
```

Support vs Lift



```
In [ ]: fit = np.polyfit(rules['lift'], rules['confidence'], 1)
fit_fn = np.polyld(fit)
plt.plot(rules['lift'], rules['confidence'], 'yo', rules['lift'],
fit_fn(rules['lift']))
plt.xlabel('lift')
plt.ylabel('Confidence')
plt.title('lift vs Confidence')
```

```
Out[ ]: Text(0.5, 1.0, 'lift vs Confidence')
```



Conclusion: In this project we have used apriori algorithm to perform basket analysis and mine association rules for products. We have mined 1200 rules that can be recommended for the various products purchased from the store. These rules will help sellers increase their revenue and also give satisfaction and help them remember and buy associated products easily.

In []: