In [91]:
```
# Importing libraries
```

In [92]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from apyori import apriori
```

In [93]:
```
# Loading the dataset
```

In [94]:
```
store_data = pd.read_csv('I:\\Datasets\\store_data.csv')
```

In [95]:
```
#checking the dataset
    #check its dimension
    #check null values
    #count null values
```

In [96]:
```
store_data.shape
```

Out[96]:
```
(7500, 20)
```

In [71]:
```
store_data.isnull()
```

Out[71]:

	shrimp	almonds	avocado	vegetables mix	green grapes	whole weat flour	yams	cottage cheese	energy drink	tomato juice	low fat yogurt	green tea	honey	salad	mineral water	salmon	an
0	False	False	False	True	True	True	True	True	True	True	True	True	True	True	True	True	
1	False	True	True	True	True	True	True	True	True	True	True	True	True	True	True	True	
2	False	False	True	True	True	True	True	True	True	True	True	True	True	True	True	True	
3	False	False	False	False	False	True	True	True	True	True	True	True	True	True	True	True	
4	False	True	True	True	True	True	True	True	True	True	True	True	True	True	True	True	

	shrimp	almonds	avocado	vegetables mix	green grapes	whole weat flour	yams	cottage cheese	energy drink	tomato juice	low fat yogurt	green tea	honey	salad	mineral water	salmon	an
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
7495	False	False	False	True	True	True	True	True	True	True	True	True	True	True	True	True	
7496	False	False	False	False	False	False	True	True	True	True	True	True	True	True	True	True	
7497	False	True	True	True	True	True	True	True	True	True	True	True	True	True	True	True	
7498	False	False	True	True	True	True	True	True	True	True	True	True	True	True	True	True	
7499	False	False	False	False	True	True	True	True	True	True	True	True	True	True	True	True	

7500 rows × 20 columns

In [82]:
```
#for our processing we do not need a header row
```

In [83]:
```
store_data = pd.read_csv('I:\\Datasets\\store_data.csv', header=None)
```

In [84]:
```
store_data.head()
```

Out[84]:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
0	shrimp	almonds	avocado	vegetables mix	green grapes	whole weat flour	yams	cottage cheese	energy drink	tomato juice	low fat yogurt	green tea	honey	salad	mineral water	salmon	antioxyda ju
1	burgers	meatballs	eggs	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
2	chutney	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
3	turkey	avocado	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
4	mineral water	milk	energy bar	whole wheat rice	green tea	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N

In [85]:
```
store_data.isnull().sum()
```

Out[85]:
```
0       0
1    1754
2    3112
3    4156
4    4972
5    5637
6    6132
7    6520
8    6847
9    7106
10   7245
11   7347
12   7414
13   7454
14   7476
15   7493
16   7497
17   7497
18   7498
19   7500
dtype: int64
```

In [86]:
```
#as we can see from the result the 20th column has all null values so we can elimintate it.
store_data.drop(store_data.columns[[19]], axis=1, inplace=True)
```

In [87]:
```
store_data.isnull().sum()
```

Out[87]:
```
0       0
1    1754
2    3112
3    4156
4    4972
5    5637
6    6132
7    6520
8    6847
9    7106
10   7245
11   7347
12   7414
13   7454
14   7476
15   7493
```

```
16    7497
17    7497
18    7498
dtype: int64
```

In [88]:
```
store_data.head()
```

Out[88]:

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
0	shrimp	almonds	avocado	vegetables mix	green grapes	whole weat flour	yams	cottage cheese	energy drink	tomato juice	low fat yogurt	green tea	honey	salad	mineral water	salmon	antioxyda ju
1	burgers	meatballs	eggs	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
2	chutney	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
3	turkey	avocado	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
4	mineral water	milk	energy bar	whole wheat rice	green tea	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N

In [7]:
```
#Data Proprocessing
#The Apriori library we are going to use requires our dataset to be in the form of a list of lists,
#where the whole dataset is a big list and each transaction in the dataset is an inner list within the outer big list.
#Currently we have data in the form of a pandas dataframe.
#To convert our pandas dataframe into a list of lists, execute the following script:
```

In [8]:
```
records = []
for i in range(0, 7501):
    records.append([str(store_data.values[i,j]) for j in range(0, 20)])
```

In [9]:
```
#Applying Apriori
# The first parameter is the list of list that you want to extract rules from.
# The second parameter is the min_support parameter.
# This parameter is used to select the items with support values greater than the value specified by the parameter.
# Next, the min_confidence parameter filters those rules that have confidence greater than the confidence threshold specifi
# Similarly, the min_lift parameter specifies the minimum lift value for the short listed rules.
# Finally, the min_length parameter specifies the minimum number of items that you want in your rules.
```

In [10]:
```
# Let's suppose that we want rules for only those items that are purchased at least 5 times a day,or 7 x 5 = 35 times in on
# since our dataset is for a one-week time period.
# The support for those items can be calculated as 35/7500 = 0.0045.
# The minimum confidence for the rules is 20% or 0.2.
# Similarly, we specify the value for lift as 3 and finally min_length is 2 since we want at least two products in our rule
```

In [11]:
```
association_rules = apriori(records, min_support=0.0045, min_confidence=0.2, min_lift=3, min_length=2)
```

In [12]:
```
# Viewing the Results
```

In [13]:
```
association_results = list(association_rules)
```

In [16]:
```
print(association_results)
```

```
[RelationRecord(items=frozenset({'chicken', 'light cream'}), support=0.004532728969470737, ordered_statistics=[OrderedStatis
tic(items_base=frozenset({'light cream'}), items_add=frozenset({'chicken'}), confidence=0.29059829059829057, lift=4.84395061
728395)]), RelationRecord(items=frozenset({'mushroom cream sauce', 'escalope'}), support=0.005732568990801226, ordered_stati
stics=[OrderedStatistic(items_base=frozenset({'mushroom cream sauce'}), items_add=frozenset({'escalope'}), confidence=0.3006
993006993007, lift=3.790832696715049)]), RelationRecord(items=frozenset({'pasta', 'escalope'}), support=0.00586588454872683
7, ordered_statistics=[OrderedStatistic(items_base=frozenset({'pasta'}), items_add=frozenset({'escalope'}), confidence=0.372
8813559322034, lift=4.700811850163794)]), RelationRecord(items=frozenset({'herb & pepper', 'ground beef'}), support=0.015997
866951073192, ordered_statistics=[OrderedStatistic(items_base=frozenset({'herb & pepper'}), items_add=frozenset({'ground bee
f'}), confidence=0.3234501347708895, lift=3.2919938411349285)]), RelationRecord(items=frozenset({'tomato sauce', 'ground bee
f'}), support=0.005332622317024397, ordered_statistics=[OrderedStatistic(items_base=frozenset({'tomato sauce'}), items_add=f
rozenset({'ground beef'}), confidence=0.3773584905660377, lift=3.840659481324083)]), RelationRecord(items=frozenset({'olive
oil', 'whole wheat pasta'}), support=0.007998933475536596, ordered_statistics=[OrderedStatistic(items_base=frozenset({'whole
wheat pasta'}), items_add=frozenset({'olive oil'}), confidence=0.2714932126696833, lift=4.122410097642296)]), RelationRecord
(items=frozenset({'shrimp', 'pasta'}), support=0.005065991201173177, ordered_statistics=[OrderedStatistic(items_base=frozens
et({'pasta'}), items_add=frozenset({'shrimp'}), confidence=0.3220338983050847, lift=4.506672147735896)]), RelationRecord(ite
ms=frozenset({'nan', 'chicken', 'light cream'}), support=0.004532728969470737, ordered_statistics=[OrderedStatistic(items_ba
se=frozenset({'light cream'}), items_add=frozenset({'nan', 'chicken'}), confidence=0.29059829059829057, lift=4.8439506172839
5), OrderedStatistic(items_base=frozenset({'nan', 'light cream'}), items_add=frozenset({'chicken'}), confidence=0.2905982905
9829057, lift=4.84395061728395)]), RelationRecord(items=frozenset({'shrimp', 'frozen vegetables', 'chocolate'}), support=0.0
05332622317024397, ordered_statistics=[OrderedStatistic(items_base=frozenset({'frozen vegetables', 'chocolate'}), items_add=
frozenset({'shrimp'}), confidence=0.23255813953488375, lift=3.2545123221103784), OrderedStatistic(items_base=frozenset({'shr
imp', 'chocolate'}), items_add=frozenset({'frozen vegetables'}), confidence=0.29629629629629634, lift=3.1084175084175087)]),
RelationRecord(items=frozenset({'spaghetti', 'ground beef', 'cooking oil'}), support=0.004799360085321957, ordered_statistic
s=[OrderedStatistic(items_base=frozenset({'ground beef', 'cooking oil'}), items_add=frozenset({'spaghetti'}), confidence=0.5
```

714285714285714, lift=3.2819951870487856), OrderedStatistic(items_base=frozenset({'spaghetti', 'cooking oil'}), items_add=fr
ozenset({'ground beef'}), confidence=0.3025210084033613, lift=3.0789824749438446)]), RelationRecord(items=frozenset({'mushro
om cream sauce', 'nan', 'escalope'}), support=0.005732568990801226, ordered_statistics=[OrderedStatistic(items_base=frozense
t({'mushroom cream sauce'}), items_add=frozenset({'nan', 'escalope'}), confidence=0.3006993006993007, lift=3.790832696715049
9), OrderedStatistic(items_base=frozenset({'mushroom cream sauce', 'nan'}), items_add=frozenset({'escalope'}), confidence=0.
3006993006993007, lift=3.790832696715049)]), RelationRecord(items=frozenset({'nan', 'pasta', 'escalope'}), support=0.005865
84548726837, ordered_statistics=[OrderedStatistic(items_base=frozenset({'pasta'}), items_add=frozenset({'nan', 'escalope'}),
confidence=0.3728813559322034, lift=4.700811850163794), OrderedStatistic(items_base=frozenset({'nan', 'pasta'}), items_add=f
rozenset({'escalope'}), confidence=0.3728813559322034, lift=4.700811850163794)]), RelationRecord(items=frozenset({'spaghett
i', 'frozen vegetables', 'ground beef'}), support=0.008665511265164644, ordered_statistics=[OrderedStatistic(items_base=froz
enset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'ground beef'}), confidence=0.31100478468899523, lift=3.1653
28208890303)]), RelationRecord(items=frozenset({'olive oil', 'frozen vegetables', 'milk'}), support=0.004799360085321957, or
dered_statistics=[OrderedStatistic(items_base=frozenset({'frozen vegetables', 'milk'}), items_add=frozenset({'olive oil'}),
confidence=0.20338983050847456, lift=3.088314005352364), OrderedStatistic(items_base=frozenset({'olive oil', 'frozen vegetab
les'}), items_add=frozenset({'milk'}), confidence=0.4235294117647058, lift=3.2684095860566447)]), RelationRecord(items=froze
nset({'shrimp', 'frozen vegetables', 'mineral water'}), support=0.007199040127982935, ordered_statistics=[OrderedStatistic(i
tems_base=frozenset({'shrimp', 'mineral water'}), items_add=frozenset({'frozen vegetables'}), confidence=0.3050847457627118
3, lift=3.200616332819722)]), RelationRecord(items=frozenset({'olive oil', 'spaghetti', 'frozen vegetables'}), support=0.005
732568990801226, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=fr
ozenset({'olive oil'}), confidence=0.20574162679425836, lift=3.1240241752707125)]), RelationRecord(items=frozenset({'shrim
p', 'spaghetti', 'frozen vegetables'}), support=0.005999200106652446, ordered_statistics=[OrderedStatistic(items_base=frozen
set({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'shrimp'}), confidence=0.21531100478468898, lift=3.01314896807
82684)]), RelationRecord(items=frozenset({'tomatoes', 'spaghetti', 'frozen vegetables'}), support=0.006665777896280496, orde
red_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'tomatoe
s'}), confidence=0.23923444976076558, lift=3.4980460188216425), OrderedStatistic(items_base=frozenset({'tomatoes', 'spaghett
i'}), items_add=frozenset({'frozen vegetables'}), confidence=0.3184713375796179, lift=3.341053850607991)]), RelationRecord(i
tems=frozenset({'grated cheese', 'spaghetti', 'ground beef'}), support=0.005332622317024397, ordered_statistics=[OrderedStat
istic(items_base=frozenset({'grated cheese', 'spaghetti'}), items_add=frozenset({'ground beef'}), confidence=0.3225806451612
903, lift=3.283144395325426)]), RelationRecord(items=frozenset({'mineral water', 'herb & pepper', 'ground beef'}), support=
0.006665777896280496, ordered_statistics=[OrderedStatistic(items_base=frozenset({'herb & pepper', 'mineral water'}), items_a
dd=frozenset({'ground beef'}), confidence=0.39062500000000006, lift=3.975682666214383)]), RelationRecord(items=frozenset({'n
an', 'herb & pepper', 'ground beef'}), support=0.015997866951073192, ordered_statistics=[OrderedStatistic(items_base=frozens
et({'herb & pepper'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.3234501347708895, lift=3.2919938411349285),
OrderedStatistic(items_base=frozenset({'nan', 'herb & pepper'}), items_add=frozenset({'ground beef'}), confidence=0.32345013
47708895, lift=3.2919938411349285)]), RelationRecord(items=frozenset({'spaghetti', 'herb & pepper', 'ground beef'}), support
=0.006399146780429276, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'herb & pepper'}), items_add=
frozenset({'ground beef'}), confidence=0.3934426229508197, lift=4.004359721511667)]), RelationRecord(items=frozenset({'olive
oil', 'milk', 'ground beef'}), support=0.004932675643247567, ordered_statistics=[OrderedStatistic(items_base=frozenset({'mil
k', 'ground beef'}), items_add=frozenset({'olive oil'}), confidence=0.22424242424242427, lift=3.40494417862839)]), RelationR
ecord(items=frozenset({'tomato sauce', 'nan', 'ground beef'}), support=0.005332622317024397, ordered_statistics=[OrderedStat
istic(items_base=frozenset({'tomato sauce'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.3773584905660377, li
ft=3.840659481324083), OrderedStatistic(items_base=frozenset({'tomato sauce', 'nan'}), items_add=frozenset({'ground beef'}),
confidence=0.3773584905660377, lift=3.840659481324083)]), RelationRecord(items=frozenset({'shrimp', 'spaghetti', 'ground bee
f'}), support=0.005999200106652446, ordered_statistics=[OrderedStatistic(items_base=frozenset({'shrimp', 'ground beef'}), it
ems_add=frozenset({'spaghetti'}), confidence=0.5232558139534884, lift=3.005315360233627)]), RelationRecord(items=frozenset

({'olive oil', 'spaghetti', 'milk'}), support=0.007199040127982935, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'milk'}), items_add=frozenset({'olive oil'}), confidence=0.20300751879699247, lift=3.0825089038385434)]), RelationRecord(items=frozenset({'soup', 'olive oil', 'mineral water'}), support=0.005199306759098787, ordered_statistics=[OrderedStatistic(items_base=frozenset({'soup', 'mineral water'}), items_add=frozenset({'olive oil'}), confidence=0.22543352601156072, lift=3.4230301186492245)]), RelationRecord(items=frozenset({'olive oil', 'nan', 'whole wheat pasta'}), support=0.007998933475536596, ordered_statistics=[OrderedStatistic(items_base=frozenset({'whole wheat pasta'}), items_add=frozenset({'olive oil', 'nan'}), confidence=0.2714932126696833, lift=4.13077198425009), OrderedStatistic(items_base=frozenset({'nan', 'whole wheat pasta'}), items_add=frozenset({'olive oil'}), confidence=0.2714932126696833, lift=4.122410097642296)]), RelationRecord(items=frozenset({'shrimp', 'nan', 'pasta'}), support=0.005065991201173177, ordered_statistics=[OrderedStatistic(items_base=frozenset({'pasta'}), items_add=frozenset({'shrimp', 'nan'}), confidence=0.3220338983050847, lift=4.515095833993347), OrderedStatistic(items_base=frozenset({'nan', 'pasta'}), items_add=frozenset({'shrimp'}), confidence=0.3220338983050847, lift=4.506672147735896)]), RelationRecord(items=frozenset({'olive oil', 'spaghetti', 'pancakes'}), support=0.005065991201173177, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'pancakes'}), items_add=frozenset({'olive oil'}), confidence=0.20105820105820105, lift=3.0529100529100526)]), RelationRecord(items=frozenset({'shrimp', 'nan', 'frozen vegetables', 'chocolate'}), support=0.005332622317024397, ordered_statistics=[OrderedStatistic(items_base=frozenset({'frozen vegetables', 'chocolate'}), items_add=frozenset({'shrimp', 'nan'}), confidence=0.23255813953488375, lift=3.260595522712454), OrderedStatistic(items_base=frozenset({'shrimp', 'chocolate'}), items_add=frozenset({'nan', 'frozen vegetables'}), confidence=0.29629629629629634, lift=3.1084175084175087), OrderedStatistic(items_base=frozenset({'nan', 'frozen vegetables', 'chocolate'}), items_add=frozenset({'shrimp'}), confidence=0.23255813953488375, lift=3.2545123221103784), OrderedStatistic(items_base=frozenset({'shrimp', 'nan', 'chocolate'}), items_add=frozenset({'frozen vegetables'}), confidence=0.29629629629629634, lift=3.1084175084175087)]), RelationRecord(items=frozenset({'spaghetti', 'nan', 'ground beef', 'cooking oil'}), support=0.004799360085321957, ordered_statistics=[OrderedStatistic(items_base=frozenset({'ground beef', 'cooking oil'}), items_add=frozenset({'spaghetti', 'nan'}), confidence=0.5714285714285714, lift=3.2819951870487856), OrderedStatistic(items_base=frozenset({'spaghetti', 'cooking oil'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.3025210084033613, lift=3.0789824749438446), OrderedStatistic(items_base=frozenset({'nan', 'ground beef', 'cooking oil'}), items_add=frozenset({'spaghetti'}), confidence=0.5714285714285714, lift=3.2819951870487856), OrderedStatistic(items_base=frozenset({'spaghetti', 'nan', 'cooking oil'}), items_add=frozenset({'ground beef'}), confidence=0.3025210084033613, lift=3.0789824749438446)]), RelationRecord(items=frozenset({'nan', 'spaghetti', 'frozen vegetables', 'ground beef'}), support=0.008665511265164644, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.31100478468899523, lift=3.165328208890303), OrderedStatistic(items_base=frozenset({'nan', 'spaghetti', 'frozen vegetables'}), items_add=frozenset({'ground beef'}), confidence=0.31100478468899523, lift=3.165328208890303)]), RelationRecord(items=frozenset({'spaghetti', 'frozen vegetables', 'milk', 'mineral water'}), support=0.004532728969470737, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'milk', 'mineral water'}), items_add=frozenset({'frozen vegetables'}), confidence=0.28813559322033894, lift=3.0228043143297376)]), RelationRecord(items=frozenset({'olive oil', 'nan', 'frozen vegetables', 'milk'}), support=0.004799360085321957, ordered_statistics=[OrderedStatistic(items_base=frozenset({'frozen vegetables', 'milk'}), items_add=frozenset({'olive oil', 'nan'}), confidence=0.20338983050847456, lift=3.094578333963626), OrderedStatistic(items_base=frozenset({'olive oil', 'frozen vegetables'}), items_add=frozenset({'nan', 'milk'}), confidence=0.4235294117647058, lift=3.2684095860566447), OrderedStatistic(items_base=frozenset({'nan', 'frozen vegetables', 'milk'}), items_add=frozenset({'olive oil'}), confidence=0.20338983050847456, lift=3.088314005352364), OrderedStatistic(items_base=frozenset({'olive oil', 'nan', 'frozen vegetables'}), items_add=frozenset({'milk'}), confidence=0.4235294117647058, lift=3.2684095860566447)]), RelationRecord(items=frozenset({'shrimp', 'nan', 'frozen vegetables', 'mineral water'}), support=0.007199040127982935, ordered_statistics=[OrderedStatistic(items_base=frozenset({'shrimp', 'mineral water'}), items_add=frozenset({'nan', 'frozen vegetables'}), confidence=0.30508474576271183, lift=3.200616332819722), OrderedStatistic(items_base=frozenset({'shrimp', 'nan', 'mineral water'}), items_add=frozenset({'frozen vegetables'}), confidence=0.3068181818181818, lift=3.218801652892562)]), RelationRecord(items=frozenset({'olive oil', 'nan', 'spaghetti', 'frozen vegetables'}), support=0.005732568990801226, ordered_s

tatistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'olive oil', 'na
n'}), confidence=0.20574162679425836, lift=3.1303609383037156), OrderedStatistic(items_base=frozenset({'nan', 'spaghetti',
'frozen vegetables'}), items_add=frozenset({'olive oil'}), confidence=0.20574162679425836, lift=3.1240241752707125)]), Relat
ionRecord(items=frozenset({'shrimp', 'nan', 'spaghetti', 'frozen vegetables'}), support=0.005999200106652446, ordered_statis
tics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'shrimp', 'nan'}), con
fidence=0.21531100478468898, lift=3.0187810222242093), OrderedStatistic(items_base=frozenset({'nan', 'spaghetti', 'frozen ve
getables'}), items_add=frozenset({'shrimp'}), confidence=0.21531100478468898, lift=3.0131489680782684)]), RelationRecord(ite
ms=frozenset({'tomatoes', 'nan', 'spaghetti', 'frozen vegetables'}), support=0.006665777896280496, ordered_statistics=[Order
edStatistic(items_base=frozenset({'spaghetti', 'frozen vegetables'}), items_add=frozenset({'tomatoes', 'nan'}), confidence=
0.23923444976076558, lift=3.4980460188216425), OrderedStatistic(items_base=frozenset({'tomatoes', 'spaghetti'}), items_add=f
rozenset({'nan', 'frozen vegetables'}), confidence=0.3184713375796179, lift=3.341053850607991), OrderedStatistic(items_base=
frozenset({'nan', 'spaghetti', 'frozen vegetables'}), items_add=frozenset({'tomatoes'}), confidence=0.23923444976076558, lif
t=3.4980460188216425), OrderedStatistic(items_base=frozenset({'tomatoes', 'spaghetti', 'nan'}), items_add=frozenset({'frozen
vegetables'}), confidence=0.3184713375796179, lift=3.341053850607991)]), RelationRecord(items=frozenset({'grated cheese', 's
paghetti', 'nan', 'ground beef'}), support=0.005332622317024397, ordered_statistics=[OrderedStatistic(items_base=frozenset
({'grated cheese', 'spaghetti'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.3225806451612903, lift=3.2831443
95325426), OrderedStatistic(items_base=frozenset({'grated cheese', 'spaghetti', 'nan'}), items_add=frozenset({'ground bee
f'}), confidence=0.3225806451612903, lift=3.283144395325426)]), RelationRecord(items=frozenset({'mineral water', 'nan', 'her
b & pepper', 'ground beef'}), support=0.006665777896280496, ordered_statistics=[OrderedStatistic(items_base=frozenset({'herb
& pepper', 'mineral water'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.39062500000000006, lift=3.9756826662
14383), OrderedStatistic(items_base=frozenset({'nan', 'herb & pepper', 'mineral water'}), items_add=frozenset({'ground bee
f'}), confidence=0.39062500000000006, lift=3.975682666214383)]), RelationRecord(items=frozenset({'nan', 'spaghetti', 'herb &
pepper', 'ground beef'}), support=0.006399146780429276, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghett
i', 'herb & pepper'}), items_add=frozenset({'nan', 'ground beef'}), confidence=0.3934426229508197, lift=4.004359721511667),
OrderedStatistic(items_base=frozenset({'nan', 'spaghetti', 'herb & pepper'}), items_add=frozenset({'ground beef'}), confiden
ce=0.3934426229508197, lift=4.004359721511667)]), RelationRecord(items=frozenset({'olive oil', 'nan', 'milk', 'ground bee
f'}), support=0.004932675643247567, ordered_statistics=[OrderedStatistic(items_base=frozenset({'milk', 'ground beef'}), item
s_add=frozenset({'olive oil', 'nan'}), confidence=0.22424242424242427, lift=3.4118507591124225), OrderedStatistic(items_base
=frozenset({'nan', 'milk', 'ground beef'}), items_add=frozenset({'olive oil'}), confidence=0.22424242424242427, lift=3.40494
417862839)]), RelationRecord(items=frozenset({'shrimp', 'spaghetti', 'nan', 'ground beef'}), support=0.005999200106652446, o
rdered_statistics=[OrderedStatistic(items_base=frozenset({'shrimp', 'ground beef'}), items_add=frozenset({'spaghetti', 'na
n'}), confidence=0.5232558139534884, lift=3.005315360233627), OrderedStatistic(items_base=frozenset({'shrimp', 'nan', 'groun
d beef'}), items_add=frozenset({'spaghetti'}), confidence=0.5232558139534884, lift=3.005315360233627)]), RelationRecord(item
s=frozenset({'olive oil', 'spaghetti', 'nan', 'milk'}), support=0.007199040127982935, ordered_statistics=[OrderedStatistic(i
tems_base=frozenset({'spaghetti', 'milk'}), items_add=frozenset({'olive oil', 'nan'}), confidence=0.20300751879699247, lift=
3.088761457396025), OrderedStatistic(items_base=frozenset({'spaghetti', 'nan', 'milk'}), items_add=frozenset({'olive oil'}),
confidence=0.20300751879699247, lift=3.0825089038385434)]), RelationRecord(items=frozenset({'soup', 'olive oil', 'nan', 'min
eral water'}), support=0.005199306759098787, ordered_statistics=[OrderedStatistic(items_base=frozenset({'soup', 'mineral wat
er'}), items_add=frozenset({'olive oil', 'nan'}), confidence=0.22543352601156072, lift=3.429973384609973), OrderedStatistic
(items_base=frozenset({'soup', 'nan', 'mineral water'}), items_add=frozenset({'olive oil'}), confidence=0.22543352601156072,
lift=3.4230301186492245)]), RelationRecord(items=frozenset({'olive oil', 'spaghetti', 'nan', 'pancakes'}), support=0.0050659
91201173177, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'pancakes'}), items_add=frozenset({'oli
ve oil', 'nan'}), confidence=0.20105820105820105, lift=3.0591025682303568), OrderedStatistic(items_base=frozenset({'spaghett
i', 'nan', 'pancakes'}), items_add=frozenset({'olive oil'}), confidence=0.20105820105820105, lift=3.0529100529100526)]), Rel
ationRecord(items=frozenset({'nan', 'frozen vegetables', 'milk', 'mineral water', 'spaghetti'}), support=0.00453272896947073

```
7, ordered_statistics=[OrderedStatistic(items_base=frozenset({'spaghetti', 'milk', 'mineral water'}), items_add=frozenset
({'nan', 'frozen vegetables'}), confidence=0.28813559322033894, lift=3.0228043143297376), OrderedStatistic(items_base=frozen
set({'spaghetti', 'nan', 'milk', 'mineral water'}), items_add=frozenset({'frozen vegetables'}), confidence=0.288135593220338
94, lift=3.0228043143297376)])]
```

In [17]:

```
print(association_results[0])
```

```
RelationRecord(items=frozenset({'chicken', 'light cream'}), support=0.004532728969470737, ordered_statistics=[OrderedStatist
ic(items_base=frozenset({'light cream'}), items_add=frozenset({'chicken'}), confidence=0.29059829059829057, lift=4.843950617
28395)])
```

In [18]:

```
for item in association_results:

    # first index of the inner list
    # Contains base item and add item
    pair = item[0]
    items = [x for x in pair]
    print("Rule: " + items[0] + " -> " + items[1])

    #second index of the inner list
    print("Support: " + str(item[1]))

    #third index of the list located at 0th
    #of the third index of the inner list

    print("Confidence: " + str(item[2][0][2]))
    print("Lift: " + str(item[2][0][3]))
    print("====================================")
```

```
Rule: chicken -> light cream
Support: 0.004532728969470737
Confidence: 0.29059829059829057
Lift: 4.84395061728395
====================================
Rule: mushroom cream sauce -> escalope
Support: 0.005732568990801226
Confidence: 0.3006993006993007
Lift: 3.790832696715049
====================================
Rule: pasta -> escalope
Support: 0.005865884548726837
Confidence: 0.3728813559322034
Lift: 4.700811850163794
====================================
```

```
Rule: herb & pepper -> ground beef
Support: 0.015997866951073192
Confidence: 0.3234501347708895
Lift: 3.2919938411349285
====================================
Rule: tomato sauce -> ground beef
Support: 0.005332622317024397
Confidence: 0.3773584905660377
Lift: 3.840659481324083
====================================
Rule: olive oil -> whole wheat pasta
Support: 0.007998933475536596
Confidence: 0.2714932126696833
Lift: 4.122410097642296
====================================
Rule: shrimp -> pasta
Support: 0.005065991201173177
Confidence: 0.3220338983050847
Lift: 4.506672147735896
====================================
Rule: nan -> chicken
Support: 0.004532728969470737
Confidence: 0.29059829059829057
Lift: 4.84395061728395
====================================
Rule: shrimp -> frozen vegetables
Support: 0.005332622317024397
Confidence: 0.23255813953488375
Lift: 3.2545123221103784
====================================
Rule: spaghetti -> ground beef
Support: 0.004799360085321957
Confidence: 0.5714285714285714
Lift: 3.2819951870487856
====================================
Rule: mushroom cream sauce -> nan
Support: 0.005732568990801226
Confidence: 0.3006993006993007
Lift: 3.790832696715049
====================================
Rule: nan -> pasta
Support: 0.005865884548726837
Confidence: 0.3728813559322034
Lift: 4.700811850163794
====================================
```

```
Rule: spaghetti -> frozen vegetables
Support: 0.008665511265164644
Confidence: 0.31100478468899523
Lift: 3.165328208890303
====================================
Rule: olive oil -> frozen vegetables
Support: 0.004799360085321957
Confidence: 0.20338983050847456
Lift: 3.088314005352364
====================================
Rule: shrimp -> frozen vegetables
Support: 0.007199040127982935
Confidence: 0.30508474576271183
Lift: 3.200616332819722
====================================
Rule: olive oil -> spaghetti
Support: 0.005732568990801226
Confidence: 0.20574162679425836
Lift: 3.1240241752707125
====================================
Rule: shrimp -> spaghetti
Support: 0.005999200106652446
Confidence: 0.21531100478468898
Lift: 3.0131489680782684
====================================
Rule: tomatoes -> spaghetti
Support: 0.006665777896280496
Confidence: 0.23923444976076558
Lift: 3.4980460188216425
====================================
Rule: grated cheese -> spaghetti
Support: 0.005332622317024397
Confidence: 0.3225806451612903
Lift: 3.283144395325426
====================================
Rule: mineral water -> herb & pepper
Support: 0.006665777896280496
Confidence: 0.39062500000000006
Lift: 3.975682666214383
====================================
Rule: nan -> herb & pepper
Support: 0.015997866951073192
Confidence: 0.3234501347708895
Lift: 3.2919938411349285
====================================
```

```
Rule: spaghetti -> herb & pepper
Support: 0.006399146780429276
Confidence: 0.3934426229508197
Lift: 4.004359721511667
====================================
Rule: olive oil -> milk
Support: 0.004932675643247567
Confidence: 0.22424242424242427
Lift: 3.40494417862839
====================================
Rule: tomato sauce -> nan
Support: 0.005332622317024397
Confidence: 0.3773584905660377
Lift: 3.840659481324083
====================================
Rule: shrimp -> spaghetti
Support: 0.005999200106652446
Confidence: 0.5232558139534884
Lift: 3.005315360233627
====================================
Rule: olive oil -> spaghetti
Support: 0.007199040127982935
Confidence: 0.20300751879699247
Lift: 3.0825089038385434
====================================
Rule: soup -> olive oil
Support: 0.005199306759098787
Confidence: 0.22543352601156072
Lift: 3.4230301186492245
====================================
Rule: olive oil -> nan
Support: 0.007998933475536596
Confidence: 0.2714932126696833
Lift: 4.13077198425009
====================================
Rule: shrimp -> nan
Support: 0.005065991201173177
Confidence: 0.3220338983050847
Lift: 4.515095833993347
====================================
Rule: olive oil -> spaghetti
Support: 0.005065991201173177
Confidence: 0.20105820105820105
Lift: 3.0529100529100526
====================================
```

```
Rule: shrimp -> nan
Support: 0.005332622317024397
Confidence: 0.23255813953488375
Lift: 3.260595522712454
====================================
Rule: spaghetti -> nan
Support: 0.004799360085321957
Confidence: 0.5714285714285714
Lift: 3.2819951870487856
====================================
Rule: nan -> spaghetti
Support: 0.008665511265164644
Confidence: 0.31100478468899523
Lift: 3.165328208890303
====================================
Rule: spaghetti -> frozen vegetables
Support: 0.004532728969470737
Confidence: 0.28813559322033894
Lift: 3.0228043143297376
====================================
Rule: olive oil -> nan
Support: 0.004799360085321957
Confidence: 0.20338983050847456
Lift: 3.094578333963626
====================================
Rule: shrimp -> nan
Support: 0.007199040127982935
Confidence: 0.30508474576271183
Lift: 3.200616332819722
====================================
Rule: olive oil -> nan
Support: 0.005732568990801226
Confidence: 0.20574162679425836
Lift: 3.1303609383037156
====================================
Rule: shrimp -> nan
Support: 0.005999200106652446
Confidence: 0.21531100478468898
Lift: 3.0187810222242093
====================================
Rule: tomatoes -> nan
Support: 0.006665777896280496
Confidence: 0.23923444976076558
Lift: 3.4980460188216425
====================================
```

```
Rule: grated cheese -> spaghetti
Support: 0.005332622317024397
Confidence: 0.3225806451612903
Lift: 3.283144395325426
====================================
Rule: mineral water -> nan
Support: 0.006665777896280496
Confidence: 0.39062500000000006
Lift: 3.975682666214383
====================================
Rule: nan -> spaghetti
Support: 0.006399146780429276
Confidence: 0.3934426229508197
Lift: 4.004359721511667
====================================
Rule: olive oil -> nan
Support: 0.004932675643247567
Confidence: 0.22424242424242427
Lift: 3.4118507591124225
====================================
Rule: shrimp -> spaghetti
Support: 0.005999200106652446
Confidence: 0.5232558139534884
Lift: 3.005315360233627
====================================
Rule: olive oil -> spaghetti
Support: 0.007199040127982935
Confidence: 0.20300751879699247
Lift: 3.088761457396025
====================================
Rule: soup -> olive oil
Support: 0.005199306759098787
Confidence: 0.22543352601156072
Lift: 3.429973384609973
====================================
Rule: olive oil -> spaghetti
Support: 0.005065991201173177
Confidence: 0.20105820105820105
Lift: 3.059102568230356 8
====================================
Rule: nan -> frozen vegetables
Support: 0.004532728969470737
Confidence: 0.28813559322033894
Lift: 3.0228043143297376
====================================
```

In [ ]: