Association Rule Mining using FP-Growth Algorithm in Market Basket Analysis

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Abstract: This study was conducted in order to make a Market Basket Analysis by using Association Rules mining through FP-Growth Algorithm. The data used in the study are transactions of customers in a UK based online retail outfit. Data were analyzed in the R Studio program and Spark using a data set containing 541910 transactions and 4070 different products. FP-Growth Algorithm was tried which are Association Rules algorithms, The best rule accordingly a customer who buys Regency Tea Plate Pink and Regency Tea Plate Roses also gets Regency Tea Plate Green with confidence 0.94 and the lift ratio value 64.3 Similarly, also other rules were interpreted in this study. As a result, product placement in the supermarket can be made according to these rules. Thus, sales of these products will increase and revenue will increase directly.

Keywords: Market Basket Analysis, Association Rule Mining, FP-Growth Algorithm, Data mining, R, Spark

1 Introduction

The increasing volume of data and the growing importance of retail analytics made it easy for retailers to know their customers better. With a large amount of data, analytics has become more important to make decisions. The data can help retailers to understand customer behavior, plan and promote products, increase sales, improve customer experience. There are many algorithms and techniques used in retail that help uncover better insights and predict future events. One of the keys and widely used techniques in retail is Market Basket Analysis. This paper talks about Market Basket Analysis using R and spark through FP-Growth Algorithm and highlights the importance of such techniques in retail to boost sales.

2 Literature Review

In this section, we have concentrated on presenting different areas where data mining algorithms are used.

2.1 A Survey on Association Rule Mining in Market Basket Analysis

Data mining refers to extracting knowledge from large amount of data. Market basket analysis is a data mining technique to discover associations between datasets. Association rule mining identifies relationship between a large set of data items. When large quantity of data is constantly obtained and stored in databases, several industries are becoming concerned in mining association rules from their databases. For example, the detection of interesting association relationships between large quantities of business transaction data can help in catalog design, cross-marketing and various business decision making processes [8].

2.2 Market basket analysis using apriori algorithm to find consumer patterns in buying goods through transaction data (case study of Mizan computer retail stores)

Mizan Computer Shop is a shop that is engaged in the trading sector, especially in the field of selling computers and supporting accessories. Growing and increasing number of business actors in the computer sector, can makes the players challenged to be able to create unique differentiation and clear positioning. So, that consumers can differentiate from their competitors. Competitive and dynamic market conditions make every company should always observe competition in their business environment. Retail stores need to use all of available resources including data. Data processing is expected to be able to provide information that can be used to support marketing strategies. One of the data processing methods that are often used in marketing strategies is the use of data mining techniques i.e Market Basket Analysis using a priori algorithm [3].

2.3 Application of market–basket analysis on healthcare

Data analysis plays a vital role in the present era as it helps us to understand the patterns by exploring it in meaningful ways. Market—basket is one of the main methods used to find frequently occurring items in a transactional database and many researchers use the Apriori algorithm for this purpose[4].

3 Methodology

There are two major sections:

- Data preparation
- Exploratory Data Analysis and Data Visualization
- Rules generation by applying FP-Growth Algorithm.

An R program has been developed and implemented in R Studio environment. The following packages were imported:

- dplyr: A Grammar of Data Manipulation
- sparklyr: R interface for Apache Spark
- ggplot2: Data visualization

3.1 Data Pre-Processing

The data used in the study are transactions of customers in a UK based online retail outfit and it taken from UCI ML Repository, it contains 8 column fields and 541910 transactions and 4070 different products. This ".csv" is read using read.csv("file_name") function and stored as a data frame.

df <- read.csv("online_retail_II.csv") head(df)

Invoice StockCode Description Quantity InvoiceDate ## 1 536365 85123A WHITE HANGING HEART T-LIGHT HOLDER 6 12/1/2010 8:26 ## 2 536365 71053 WHITE METAL LANTERN 6 12/1/2010 8:26 ## 3 536365 84406B CREAM CUPID HEARTS COAT HANGER 8 12/1/2010 8:26 ## 4 536365 84029G KNITTED UNION FLAG HOT WATER BOTTLE 6 12/1/2010 8:26 RED WOOLLY HOTTIE WHITE HEART. ## 5 536365 84029E 6 12/1/2010 8:26 ## Price Customer.ID Country ## 1 2.55 17850 United Kingdom 17850 United Kingdom ## 2 3.39 ## 3 2.75 17850 United Kingdom ## 4 3.39 17850 United Kingdom ## 5 3.39 17850 United Kingdom #To get Number of transactions count(df)

n ## 1 541910

to get number of poducts
df%>% distinct(StockCode) %>% summarize(count = n())

count ## 1 4070

Before applying algorithms, the dataset has to be prepared by doing the following data preparation steps:

- 1. Dropping all Null values.
- 2. Dropping all the duplicate items, if one item duplicates in one transaction then just keep one item
- 3. Dropping all transactions with just one item.
- 4. Convert data to transaction structure (Transactional Data) because of this type of data structure can't be used as input to the algorithm.

	Items
1	o("85123A", "71053", "844068", "84029G", "84029E", "22752", "21730")
2	(°22633°, °22632°)
3	c(*84879*, *22745*, *22748*, *22749*, *22310*, *84969*, *22623*, *22622*, *21754*, *21755*, *21777*, *48187*)
4	c("22960", "22913", "22912", "22914")
5	c/'22728', '22728', '22726', '21724', '21883', '10002', '21791', '21035', '22326', '22629', '22639', '22631', '22661', '21731', '22900', '21913', '22540', '22544', '22492'
6	d'22632', '22633')
7	c("85123A", "71053", "844068", "20679", "37370", "21671", "21071", "21068", "82483", "82486", "82482", "82494L", "84029G", "84029G", "22752", "21730")
8	td;"85123A"; "71053"; "844068"; "20679"; "37370"; "21871"; "21071"; "21068"; "82483"; "82486"; "82482"; "82494L"; "84029G"; "84029E"; "22752"; "21730")
9	rd(221141.1217331)
10	0("22632", "22633")

Figure 1: Prepared Data

After previous preparation steps, we have

3.2 Exploratory Data Analysis and Data Visualization In this section, we use visualization and transformation to explore data in a systematic way.



• Most frequent items, top (10)

Figure 2: Most frequent items top (10)

From graph we see that most frequently item is that item with StockCode equal 85123A and its name is WHITE HANGING HEART T-LIGHT HOLDER

• Number of items in each transaction

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Figure 3: Number of Items in each transaction

From graph we can insight that a lot of transactions has only one item, and there are a lot of transactions have item count between (8,32) items.

3.3 Market Basket Analysis

Market basket analysis is also known as association analysis is an unsupervised machine learning method, is one of the key techniques used by large retailers to uncover associations between items. It works by looking for combinations of items that occur together frequently in transactions. To put it another way, it allows retailers to identify relationships between the items that people buy and help identify customer behavior and pattern and also Optimize marketing campaigns and strategies.



Figure 4: Overall picture of market basket analysis

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Market basket analysis gives us insight into the goods by telling us which products tend to be purchased together and which are most enable to purchase. FP-growth algorithm is an efficient algorithm for mining frequent patterns. It does not need to produce the candidate sets and that is quite time consuming. It scans database only twice and frequent item set is mining by using of FP tree. In this paper, R and spark is used to find association rules.

3.4 Association Rule Mining

Association Rule Mining is a rule-based machine learning method to find associations and relationships between large sets of items, this rule also shows how frequently an item occurs in the itemset based on the occurrences of other items in a transaction, Association rules are widely used to analyze basket or transaction data to discover strong rules based on the interestingness and frequency of occurrences and it can be understood as the "if this, then that" rule. For example, if a user buys coffee and sugar, then he/she is likely to buy milk. This rule could be written as: If {A} Then {B}, Here, if part of the rule is known as antecedent and THEN part of the rule is known as consequent. {A} part is the condition and {B} part is considered as the result. These rules are applied to hundreds and thousands of records to obtain closer and accurate results. But it is not considered significantly accurate if applied to a small set of data.

3.5 SUPPORT, CONFIDENCE, LIFT

The association rule has primarily three measures to decide the degree of confidence, these are: Support, Confidence and Lift.

Support: This is one of the important measures to determine how frequently an itemset occurs in the transaction as a percentage of all transactions, Support is the number of transactions that include both $\{A\}$ and $\{B\}$ parts as a percentage of the total number of transactions.

$$support = \frac{(A+B)}{Total}$$

Confidence: This rule is the ratio of the number of transactions that include items in $\{A\}$ and $\{B\}$ to the number of transactions that include items in $\{A\}$. It can be understood as to how often items in B appear in transactions that contain A only. It is a conditional probability.

$$confidence = \frac{(A+B)}{A}$$

Lift: This third measure, lift or lift ratio is the ratio of confidence to expected confidence. Greater lift value tells how strong the association is. It shows us the rate of confidence that B will be purchased given that A was purchased.

$$lift = \frac{\frac{(A+B)}{A}}{\frac{B}{Total}}$$

3.6 Implementation

After Pre-processing the data, now data is ready for modeling, we use Spark through R by using sparklyr (R interface for Apache Spark), the sparklyr library provide ml_fpgrowth

A parallel FP-growth algorithm to mine frequent item sets, with two parameters

- min_support: Minimal support level of the frequent pattern.
- min_confidence: Minimal confidence for generating Association Rule

```
# A parallel FP-growth algorithm to mine frequent itemsets.
#min_support Minimal support level of the frequent pattern.
#min_confidence Minimal confidence for generating Association Rule
fp_model <- items_tbl %>%
ml_fpgrowth(min_support = 0.01, min_confidence = 0.6)
```

After model created successfully, we can call two methods and pass the model as parameter

- The first one is ml_freq_itemsets to get frequency for items
- The second one is ml_association_rules to get generated rules with support, confidence, lift for each one.

	items	9	freq
1	list("85123A")	Q,	1993
2	list("22423")	Q,	1812
3	list("85099B")	Q,	1624
4	list("84879")	Q,	1382
5	list("47566")	Q,	1381
6	list("20725")	Q,	1322
7	list("22720")	Q,	1195
8	list(°23203°)	Q,	1092
9	list("POST")	Q,	1077
10	list("20727")	Q,	1067

Figure 5: item sets frequency

As we show in [figure 6] there are a lot of confidant association rule was generated by the model

For example, the first rule indicates that item [23171] will be purchased given that item [23170] and item [23172] were purchased with rate of confidence **94%**.

Model has generated 151 different rules, these rules allow retailers to identify relationships between the items that people buy and help identify customer behavior and pattern and also Optimize marketing campaigns and strategies

\$	antecedent	consequent	confidence	lift =	support
1	list("23172", "23170") ^Q .	list("23171") Q	0.9400000	64.345401	0.01002346
2	list("23172", "23171") ^Q	list("23170") ^Q	0.9126214	50.943828	0.01002346
3	list("22698", "22699", "22423") ^Q	list("22697") 🤍	0.8892989	22.911662	0.01284922
4	list("23172") Q	list("23171") 9,	0.8841202	60.520284	0.01098315
5	list(*22698*, *22699*) ^Q	list("22697") 🔍	0.8802661	22.678943	0.02116656
6	list("22698", "22697", "22423") 🔍	list("22699") 🔍	0.8795620	19.996443	0.01284922
7	list("22698", "22423")	list("22697") ^Q	0.8589342	22.129353	0.01460866
8	list("23172") Q	list("23170") 🔍	0.8583691	47.915389	0.01066325
9	list(*22746*) Q	list("22748") 🔍	0.8503937	45.701961	0.01151631
10	list(*22698*, *22423*) 9,	list("22699") 9.	0.8495298	19.313673	0.01444871

Figure 6: Generated association rules top (10)

3.7 EXPERIMENTAL RESULT

List Of All generated association rules:

	antecedent	conseque	nt	confidence	lift	support	antecedent		consequent	confidence	lift	support
	l list("22384", "20728", "20727")	Q. Tist(*20725	7 9	0.7394636	10.491210	0.01029004 25	Bst("22384", "23209")	0,	list/"20725") 🔍	0.6891026	9.776708	0.01146300
3	(ist("23254")	G. Ref 23256	7 9	0.7711268	43.695630	0.01167626 26	list("22728")	<u>,</u> 9,	list(*22727*) 🤍	0.6458333	13.489143	0.02149646
j.	1 list("22384", "22382")	Q. list(*20728	9 9	0.6081081	11.579366	0.01199516 27	list("23294")	Q.,	list("23293") ⁽¹⁾	0.6915254	27,714211	0.01087652
- 1	4 list(*22384*, *22382*)	9. list(*20725	9 Q	0.6837838	9,701247	0.01348902 28	Bet(*23294*)	G,	list(*232957) 🤤	0.6610169	34,060533	0.01039667
- i	5 list("22384", "22382")	9. list("20727	7 9	0.6108108	10.736989	0.01204948 29	list("23200", "23203")	Q.	list("23199") 🤤	0.7169118	16.294418	0.01039557
- 3	6 list("21094")	G. list(*21086	9 9	0.7261538	48.126295	0.01258264 30	list(*22745*)	6	list(*22746*)	0.6509434	48,067301	0.01103647
-	1 list("21094")	G. fist(*21080	2 9	0.7046154	18.029695	0.01220943 31	list(*22745*)	9	list("22748")	0.8018868	43.095097	0.01359565
1	B list("20728", "20727", "20725")	Q. list("22384	7 a	0.7338403	14.518891	0.01029004 32	Est(*22696*, *22697*, *22423	95	list(^22699') ^[1]	0.8795620	19.996443	0.01284922
ŝ	9 list("21231")	G. list(*21232	9 9	0.6379310	19.822312	0.01380891 33	list("23343")	9	list("23344") 🔍	0.6382429	20.289633	0.01316912
1	list/"22384", "850998")	Q. Hstr 20725	2 9	0.6773050	9.609328	0.01018341	list("21136")	Q.	list/*848797	0.7252125	9.842319	0.01364897
1	1 Est/"82581")	9. listrazsao	0 9	0.7394137	35.835770	0.01210279 35	list(*22748*)	0,	list(*22746*) 0	0.6189112	45,701961	0.01151631
1	a list/ 20728", "20725")	9. 1601-22384	2 9	0.6051502	11,972782	0.01503519 36	list("22748")	ď	list(*22745*) ^Q	0.7306590	43.095097	0.01359565
1	1 (ist/~475908*)	Q. list: 47590	A') 0.	0.7071823	37,258179	0.01364897 37	list("23206", "22382")	c,	list(*20725*) 🧐	0.6314103	8.955193	0.01050331
1	4 //m/123100* 123202*1	G net*22203	,	0.6608392	1135/457	0.01007578 38	list("22662", "22383")	Q.,	list("20725") 0.	0.6744186	9.568378	0.01082330
1	WW220000 1220291	9 68/22/07	5 Q	0.8589342	22 129353	0.01460866	Bat(*22662*, *22383*)	0,	list(*22382*) 🤍	0.6810631	12,786807	0.01092984
	5 //st/"22698", "22423"	G. Iich*22600	0.0	0.8495368	19,313679	0.01444871 40	list("23200", "23199")	0,	Nst(*23203*) 9	0.6170886	10.599005	0.01039667
	1 lier 226991	G. 16h*22607	m 0.	0.6751515	17.394426	0.02969716 41	Ibt("84997C")	9	list(*84997D*) 🤉	0.7508197	32,979798	0.01220943
	Ket/ 20728* -122382*	G. [54/30736	0.0	0.6000000	8512667	0.01263596 42	list("22630")	9	list("22629") 0,	0.6816720	17.982335	0.02260610
	Ref 20720 1222025	G 100722202	0.0	0.6101366	10,795613	-43	list("21086")	а,	list(*21080*) 🤤	0.6784452	17.360053	0.01023672
	Electrical accord	- mil 22305	m (1)	0.01010000	30.001450	0.012093653	list("21086")	9	list("21094") 🤍	0.8399223	48.126295	0.01258264
-	100 22342 /	 Boj zeree Boj zeree 	n 0	0.0000404	20.091430	45	list(*23172*, *23171*)	9	list(*23170*)	0.9126214	50.943828	0.01002346
	1 (3); 231997, 232037	- 1087 23200	7 7	0.0010019	23.015049	46	list("23206", "22384")	Q.	list("20725") 🤍	0.6712329	9.523180	0.01044999
-	E Aug 226(7)	- IIII 22130	. 0	0.0000000	12.2244214	47	list("21931", "22411")	4	list(*850998*)	0.7401575	8.548272	0.01002346
-	s iisti 22002 ; 20725 7	1131 22383	2 1	0.00000.19	11.013401	48	list("20726", "23206")	Q.	list(*20725')	0.6500000	9.221936	0.01039667
	• 101(22006 / 20/23 /	100 22302	1	0.0363300	15,006377	0.01140200						
-	Internet		115.5			3252			20020120200		1442	10.000331200
	antecesaem	consequent	cor	ufidence lift	supp	port	antecedent		consequent	confidence	nut	support
49	list("22699", "22423") ^Q	lun("22697")	cor	0.7314815 16.2	45696 0.0	port 11684794	73 (kst/*20726*, *22384*)	q	list("20725")	0.7430341	10.541866	0.0127955
49 50	list("22699", "22423") Q. list("22699", "22423") Q.	consequent list("22697") ¹ list("22698") ¹	2, 2,	0.7314815 18.8 0.6273148 20.3	45696 0.0 21100 0.0	port 11684794 11444571	antecedent 73 list("20726", "22384") 74 list("20726", "22384")	a	list("20725") 0 list("20726") 0	0.7430341 0.6160991	10.541866 11.731527	0.0127955 0.0106095
49 50 51	lat("22699", "22423") Q. lat("22699", "22423") Q. lat("22369", "20727") Q.	consequent lut("22697") ¹ lut("22698") ¹ lut("20725") ¹	2, 2, 2,	Infidence lift 0.7314815 163 0.6273148 203 0.6616702 93	45696 0.0 21100 0.0 87509 0.0	port 11684794 11444871 11647473	antecedent 73 lkst("20726", "22384") 74 lkst("20726", "22384") 75 lkst("20726", "22384")	d d d	list("20725") list("20728") list("22383")	0.7430341 0.6160991 0.6130031	10.541866 11.731527 10.836462	0.0127955 0.0106099 0.0105566
49 50 51 52	list(*22699*, *22423*) Q. list(*22699*, *22423*) Q. list(*22369*, *22423*) Q. list(*22364*, *20727*) Q. list(*22662*, *22382*) Q.	consequent list("226997") ⁽ list("22699") ⁽ list("20725") ⁽ list("20725") ⁽	4	Iffdence Ifft 0.7314815 16.8 0.6273148 20.3 0.6616702 9.3 0.6011236 8.3	45695 0.0 21100 0.0 87509 0.0 29498 0.0	port 11684794 11444871 11647473 11140968	antecedent 73 list(*20726', *22384') 74 list(*20726', *22384') 75 list(*20726', *22384') 76 list(*20726', *22384')	a a a a	consequent list(*20725*) list(*20728*) list(*22383*) list(*22383*) list(*20727*)	0.7430341 0.6160991 0.6130031 0.6222910	10.541866 11.731527 10.836462 10.938791	0.0127955 0.0106095 0.0105566 0.0107165
49 50 51 52 53	Kisty 226097, 122423*) Q. Kisty 226097, 122423*) Q. Kisty 226097, 122423*) Q. Kisty 22607, 122302*, 120727*) Q. Kisty 22607, 122302*, 122302*, 12072* Q. Kisty 122607, 122302*, 12072* Q.	consequent list("22697") ¹ list("22698") ¹ list("20725") ¹ list("20725") ¹ list("22383") ¹	4 4	Infidence Iift 0.7314815 16.8 0.6273148 20.3 0.6616702 9.3 0.6011236 6.5 0.6332500 11.1	45695 0.0 (21100 0.0 (87509 0.0 (28498 0.0 (59025 0.0	port 11684794 11444571 11647473 11140968 11076989	antecedent 73 list('20726', '22384') 74 list('20726', '22384') 75 list('20726', '22384') 76 list('20726', '22384') 77 list('20726', '22384')	a a a a a	consequent list("20725") list("20728") list("22383") list("20727") list("20727") list("20727") list("22382")	0.7430341 0.6160991 0.6130031 0.6222910 0.6224830	10.541866 11.731527 10.836462 10.938791 11.799626	0.0127955 0.0106095 0.0105566 0.0107165 0.0108232
49 50 51 52 53 54	Ist("22699", "22423") Q. Ist("22699", "22423") Q. Ist("22662", "20727") Q. Ist("22662", "22382") Q. Ist("23206", "20727") Q. Ist("23206", "20727") Q.	consequent lat("226997") ⁽¹⁾ lat("20725") ⁽¹⁾ lat("20725") ⁽¹⁾ lat("22383") ⁽¹⁾ lat("22383") ⁽¹⁾ lat("20725") ⁽¹⁾	4 4 4	Infidence IIIt 0.7314815 18.8 0.6273148 20.3 0.6616702 9.3 0.6011236 8.3 0.6312500 11.1 0.6375000 9.5	45695 0.0 21100 0.0 887509 0.0 28498 0.0 59025 0.0	port 11684794 11444571 11647473 11140968 11076989 11087652	antecedent 73 list('20726', '22384') 74 list('20726', '22384') 75 list('20726', '22384') 76 list('20726', '22384') 77 list('20726', '22384') 78 list('23301')		consequent list('20725') list('20728') list('22383') list('20727') list('22382') list('22380')	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551	10.541866 11.731527 10.836462 10.938791 11.799626 17.828606	0.0127955 0.0106095 0.0105566 0.0107165 0.0107165 0.0108233 0.0248453
49 50 51 52 53 54 55	Isti'22699', '22423') Q. Isti'22699', '22423') Q. Isti'22662', '22382') Q. Isti'22662', '22382') Q. Isti'23206', '20727') Q.	consequent lat("22699") lat("22699") lat("20725") lat("20725") lat("20725") lat("20725")	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Iffdence Ifft 0.7314815 18.8 0.6273148 20.3 0.6616702 9.3 0.6011236 8.5 0.6312500 11.1 0.6375000 9.6 0.6033151 8.6	supp #5695 0.0 21100 0.0 87509 0.0 28498 0.0 59025 0.0 #45592 0.0 30528 0.0	port 11684794 11444871 11647473 11140968 11076989 11087652 11482192	antecedent 73 list("20726", "22384") 74 list("20726", "22384") 75 list("20726", "22384") 76 list("20726", "22384") 77 list("20726", "22384") 78 list("20726", "22384") 78 list("20726", "22384") 79 list("20726", "2384") 79 list("2320", "850998")		consequent list('20725') list('20728') list('22383') list('20727') list('23282') list('23300') list('23203')	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833	10.541866 11.731527 10.836462 10.938791 11.799526 17.828606 13.566896	0.0127955 0.0106095 0.0105564 0.0107165 0.0108232 0.0248453 0.0108233
49 50 51 52 53 54 55 56	Isti"226697, "22423") Q. Isti"226697, "22423") Q. Isti"226627, "22382") Q. Isti"226627, "22382") Q. Isti"226627, "22382") Q. Isti"232067, "20727") Q. Isti"232067, "20728") Q.	consequent lat("22699") lat("22699") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725")	2, 01 2, 0 2, 0 2, 0 2, 0 2, 0 3, 0 4, 0 4, 0 4, 0 4, 0 4, 0 4, 0 4, 0 4	Iffdence Ifft 0.7314815 18.8 0.62731481 20.3 0.6616702 9.3 0.6011236 8.5 0.6312500 11.1 0.6375000 9.4 0.603151 8.6 0.6033151 8.6	supp #5696 0.0 (21100 0.0 87509 0.0 28498 0.0 59025 0.0 #45592 0.0 30528 0.0 455699 0.0	port 11684794 11444871 11647473 11140968 11076989 11087652 11482192 11151631	antecedent 73 lbst/'20726', '22384') 74 lbst/'20726', '22384') 75 lbst/'20726', '22384') 76 lbst/'20726', '22384') 77 lbst/'20726', '22384') 78 lbst/'20726', '22384') 78 lbst/'23209', '850998') 80 lbst/'22356')	a a a a a a a	consequent list('20725') list('20728') list('22383') list('22383') list('22382') list('23202') list('23203') list('23203') list('23203')	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7898833 0.6468254	10.541666 11.731527 10.836462 10.938791 11.799626 17.828606 13.566896 16.089996	0.0127955 0.0106095 0.0105566 0.0107165 0.0107165 0.0108233 0.0248453 0.0108233 0.0108233
49 50 51 52 53 54 55 56 57	Isti':226997, '22423') Q. Isti':226997, '22423') Q. Isti':226697, '22423') Q. Isti':226667, '22382') Q. Isti':226667, '22382') Q. Isti':226667, '22382') Q. Isti':226067, '20727') Q. Isti':226067, '20727') Q. Isti':227067, '22783') Q. Isti':227307, '22726') Q. Isti':227898') Q.	consequent lat("22697") lat("22698") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22727") lat("22697")	2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	Iffdence Ifft 0.7314815 16.8 0.62731481 20.3 0.6616702 9.3 0.6611236 8.3 0.6312500 11.1 0.6375000 9.4 0.6033151 8.4 0.7826087 16.3 0.8134715 203	45696 0.0 21100 0.0 287509 0.0 28498 0.0 59025 0.0 44592 0.0 30528 0.0 45809 0.0	port 11684794 11448271 11647473 11140968 11076989 11087652 11482192 1151631 12511196	antecedent 73 lkd(*20726', *22384') 74 lkd(*20726', *22384') 75 lkd(*20726', *22384') 76 lkd(*20726', *22384') 78 lkd(*20726', *22384') 78 lkd(*23207', *850908') 80 lkd(*22356') 81 lkd(*22356') 81 lkd(*23205')		consequent list('20725') list('20728') list('22383') list('22383') list('22382') list('23202') list('23203') list('20724') list('20724')	0.7430341 0.6160991 0.6130031 0.6222910 0.6224830 0.6284830 0.6083551 0.7898833 0.6468254 0.6785714	10.541666 11.731527 10.836462 10.938791 11.799626 17.828606 13.566896 16.089996 27.195055	0.0127955 0.0106095 0.0105566 0.0107165 0.0108232 0.0248453 0.0108232 0.0173811 0.0131669
49 50 51 52 53 54 55 56 57 58	Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/22697, '22423') Q. Istr'/22697, '22423') Q. Istr'/22697, '22423') Q. Istr'/226967, '20727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/20728', '22383') Q. Istr'/20728', '22283') Q. Istr'/226987) Q. Istr'/226987) Q.	Consequent lat("22697") lat("22698") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("2097")		Iffdence Ifft 0.7314815 16.2 0.62731481 20.3 0.6616702 9.3 0.6611236 8.3 0.6312500 11.1 0.633500 9.6 0.6083151 8.4 0.7826087 16.3 0.8134715 20.3 0.7789292 17.7	Happ M45695 0.0 121100 0.0 187509 0.0 187509 0.0 25498 0.0 59025 0.0 30528 0.0 44592 0.0 58065 0.0 58065 0.0 08601 0.0	port 11684794 11448271 11647473 11140968 11076989 11087652 11482192 1151631 12511196 12404564	antecedent 73 lkdr (20726', '22384') 74 lkdr (20726', '22384') 75 lkdr (20726', '22384') 76 lkdr (20726', '22384') 77 lkdr (20726', '22384') 78 lkdr (20726', '22384') 79 lkdr (23207') 79 lkdr (23207') 80 lkdr (23255') 81 lkdr (23295')	a a a a a a a a a	consequent list('20725') list('20728') list('22383') list('22383') list('22383') list('22383') list('23207') list('23203') list('20724') list('23293') list('23293') list('23293') list('23293')	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714	10.541866 11.731527 10.836462 10.938791 11.799626 17.828606 13.566896 16.089996 27.195055 40.79455	0.0127951 0.0105566 0.0105566 0.0105566 0.0107165 0.0108232 0.0248452 0.0108232 0.0108232 0.0108232 0.0108232 0.0117381
49 50 51 52 53 54 55 56 57 58 59	Istr'/22699', '22423') Q. Istr'/22699', '22423') Q. Istr'/226692', '22423') Q. Istr'/226692', '22423') Q. Istr'/226962', '20727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/22790', '22726') Q. Istr'/22698') Q. Istr'/22698') Q. Istr'/22790', '22727') Q.	Consequent (ut('22697') (ut('22698') (ut('20725') (ut('20725') (ut('20725') (ut('20725') (ut('20725') (ut('20725') (ut('22727') (ut('2272')) (Iffdence Ifft 0.7314815 16.2 0.6273148 20.3 0.6616702 9.3 0.6011236 8.3 0.6312500 11.1 0.63375000 9.4 0.6083151 8.6 0.7826087 16.3 0.8134715 20.3 0.7789292 17.7 0.67792453 145	Happ 445695 0.00 121100 0.00 82509 0.00 224498 0.00 559025 0.00 30528 0.00 680505 0.00 680505 0.00 680505 0.00 986844 0.00	port 11684794 11448271 11647473 1140968 11076989 11087652 11482192 1151631 12511196 12404564 11151631	antecedent 73 lkdr (20726', '22384') 74 lkdr (20726', '22384') 75 lkdr (20726', '22384') 76 lkdr (20726', '22384') 77 lkdr (20726', '22384') 78 lkdr (20726', '22384') 79 lkdr (23070', '850908') 80 lkdr (23256') 81 lkdr (23295') 82 lkdr (23726', '23720')	a a a a a a a a a a	consequent list('20725') list('20727') list('22383') list('22383') list('22382') list('23202') list('23203') list('20724') list('23293') list('23293') list('23293') list('23293') list('23293') list('23293')	0.7430341 0.6160991 0.6130031 0.6222910 0.62284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6962456	10.541866 11.731527 10.836462 10.938791 11.799626 17.828669 13.566896 16.089996 27.195055 40.796426	3.0000000 0.0127955 0.0106095 0.0105566 0.0107165 0.0108232 0.0248453 0.0108232 0.01248453 0.0108232 0.0173851 0.0131691 0.0131691
49 50 51 52 53 54 55 56 57 58 59 60	Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr//226997, '22423') Q. Istr//22697, '22423') Q. Istr//22697, '22382') Q. Istr//232067, '20727') Q. Istr//232067, '20727') Q. Istr//232067, '20727') Q. Istr//232067, '22727') Q. Istr//227907, '22726') Q. Istr//226987) Q. Istr//226987) Q. Istr//226987) Q. Istr//226987) Q.	Consequent lut("22697") lut("22698") lut("20725") lut("20725") lut("20725") lut("20725") lut("20725") lut("20725") lut("20725") lut("22726") lut("22726") lut("22726") lut("22726") lut("22726") lut("22726") lut("22726") lut("22726") lut("22726")	con 2, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4	Iffdence Ifft 0.7314815 16.2 0.62731481 20.3 0.6616702 9.3 0.6611236 6.2 0.6312500 11.1 0.633151 8.6 0.6083151 8.6 0.7826087 16.3 0.8134715 203 0.7789292 17.7 0.6792453 15.5 0.731771 6.5	Happ 445696 0.00 121100 0.00 82509 0.00 125498 0.00 125498 0.00 125498 0.00 125498 0.00 125498 0.00 125498 0.00 125498 0.00 125498 0.00 1256055 0.00 1266051 0.00 1266051 0.00 1264849 0.00	port 11684794 11448271 11647473 1140968 11076989 11087652 11482192 1151631 12511196 12404564 1151631 11626146	antecedent 73 lkdr (20726', '22384') 74 lkdr (20726', '22384') 75 lkdr (20726', '22384') 76 lkdr (20726', '22384') 77 lkdr (20726', '22384') 78 lkdr (20726', '22384') 79 lkdr (23207', '850998') 80 lkdr (22356') 81 lkdr (23295') 82 lkdr (22729') 84 lkdr (22729')		consequent list('20725') list('20728') list('22383') list('20727') list('20727') list('22382') list('23200') list('23203') list('20724') list('23293') list('23293') list('23293') list('23293') list('23293') list('22726')	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6982456 0.6021505	10.541866 11.731527 10.836462 10.938791 11.796226 13.566896 13.566896 16.089996 27.195055 40.798426 14.170559	3.000001 0.0127951 0.0106099 0.0105566 0.0107165 0.0108233 0.0248453 0.0108233 0.01248453 0.0108233 0.0173851 0.0113169 0.0113169 0.0119420
49 50 51 52 53 54 55 56 57 58 59 60 61	Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/22697, '22423') Q. Istr'/22697, '22727') Q. Istr'/22697, '22382') Q. Istr'/226967, '20727') Q. Istr'/227306, '20727') Q. Istr'/227307, '22726') Q. Istr'/226987) Q. Istr'/226987) Q. Istr'/226987) Q. Istr'/226947) Q. Istr'/226947) Q.	Consequent (ut("22697") (ut("22699") (ut("22725") (ut("22725") (ut("22725") (ut("22725") (ut("22727") (ut("22727") (ut("22726") (ut("2272	con 2, 2, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4	Iffdence Ifft 0.7314815 18.8 0.627314815 18.8 0.627314815 20.3 0.6616702 9.3 0.6011236 8.3 0.6312500 11.1 0.633151 8.6 0.7826087 16.3 0.8134715 20.3 0.7789292 17.3 0.67792453 15.3 0.7331731 6.6	Happ 445696 0.0 121100 0.0 82509 0.0 26498 0.0 259025 0.0 44592 0.0 30528 0.0 45809 0.0 559025 0.0 64859 0.0 56905 0.0 98847 0.0 20044 0.0	port 11684794 11448271 11647473 1140968 11076989 11087652 11482192 11482192 1151631 12511196 12404564 11151631 11526146 11098315	antecedent 73 lkdr/20726', '22384') 74 lkdr/20726', '22384') 75 lkdr/20726', '22384') 76 lkdr/20726', '22384') 77 lkdr/20726', '22384') 78 lkdr/20726', '22384') 79 lkdr/23207', '850998') 80 lkdr/22356') 81 lkdr/22355') 82 lkdr/22729', 84 lkdr/22729',	a a a a a a a a a a a a a	consequent list("20725") list("20728") list("20728") list("20727") list("20727") list("20727") list("20727") list("20727") list("20727") list("20727") list("20724") list("20724") list("20724") list("21932") list("22726") list("22727")	Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6982456 0.6021505 0.6827957	10.541866 11.731527 10.836462 10.938791 11.79628 13.566896 13.566896 27.195055 40.798426 14.170599 14.261154	3.00000127951 0.01027951 0.0106091 0.0105566 0.0107162 0.0108233 0.0248453 0.0108233 0.017381 0.0131691 0.0131691 0.0119422 0.01135423
49 50 51 52 53 54 55 56 57 58 59 60 61 61	Istr/226997, '22423') Q. Istr/226997, '22423') Q. Istr/228697, '22423') Q. Istr/228697, '22423') Q. Istr/228667, '20727') Q. Istr/228697, '22382') Q. Istr/228067, '20727') Q. Istr/227307, '22383') Q. Istr/227307, '22726') Q. Istr/226987) Q. Istr/226987) Q. Istr/227307, '22727') Q. Istr/227371, '22737', '22727') Q. Istr/227371, '22737', '22727') Q. Istr/227371, '22737', '22727', '22727') Q. Istr/227371, '22737', '22727', '22737', '22737', '22737', '22737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737', '23737',	consequent lat("22699") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22727") lat("22699") lat("22726") lat("22726") lat("21726") lat("21727") lat("2172") lat("2	con 2 2 2 2 2 2 2 2 2 2 2 2 2	IIIt IIIt 0.7314815 18.8 0.627314815 18.8 0.627314815 20.3 0.6616702 9.3 0.6011236 8.3 0.6312500 11.1 0.6331500 9.4 0.6033151 8.6 0.7826087 16.3 0.8134715 20.3 0.7789292 17.7 0.67782453 15.3 0.731731 6.4 0.7518240 60.5	Hope 445695 0.0 121100 0.0 82509 0.0 28496 0.0 59025 0.0 30528 0.0 30529 0.0 30529 0.0 30529 0.0 30529 0.0 56065 0.0 0864849 0.0 989847 0.0 20284 0.0	port 11684794 11448271 11647473 11647473 11140968 11076989 11087652 11482192 11151631 12511196 12404564 11151631 11626146 11098315 11246938	anteccoent 73 lbst/'20726', '22384') 74 lbst/'20726', '22384') 75 lbst/'20726', '22384') 76 lbst/'20726', '22384') 77 lbst/'20726', '22384') 78 lbst/'20726', '22384') 79 lbst/'20726', '22384') 78 lbst/'20726', '22384') 79 lbst/'23301') 79 lbst/'23295', '850998') 80 lbst/'22356') 81 lbst/'22795') 82 lbst/'22729') 84 lbst/'22729') 85 lbst/'22569')	a a a a a a a a a a a a a a a	consequent list("20725") list("20728") list("22383") list("20727") list("20727") list("2300") list("23203") list("20724") list("20724") list("20724") list("21932") list("22726") list("22726") list("22570")	0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6962456 0.6021505 0.6827957 0.6847458	10.541866 11.731527 10.836462 10.938791 11.79626 17.828606 13.566896 16.089996 27.195055 40.796426 14.170559 14.261154 39.275505	0.0127955 0.0107566 0.0105566 0.0105566 0.0107165 0.0108232 0.0248453 0.0108232 0.0248453 0.0108232 0.0108233 0.0113169 0.0113169 0.0113169 0.0113422 0.0135422 0.0107694
49 50 51 52 53 54 55 56 57 58 59 60 61 62 62	Istr("226997, "22423") Q. Istr("226997, "22423") Q. Istr("228697, "22423") Q. Istr("228697, "22423") Q. Istr("228697, "22727") Q. Istr("228697, "22882") Q. Istr("228697, "22882") Q. Istr("232067, "20727") Q. Istr("227307, "22726") Q. Istr("227907, "22726") Q. Istr("227907, "22726") Q. Istr("227907, "22727") Q. Istr("227907, "22727") Q. Istr("227971") Q.	Consequent lat("22699") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22699") lat("22726") lat("22726") lat("22726") lat("22726") lat("22726") lat("22726") lat("22726") lat("22726") lat("23772") lat("2377	200 2 2 2 2 2 2 2 2 2 2 2 2 2	IIIt IIIt 0.7314815 16.8 0.627314815 16.8 0.6616702 9.3 0.6611236 8.3 0.6312500 11.1 0.6375000 9.2 0.6083151 8.4 0.7826087 16.3 0.8134715 20.3 0.7789292 17.7 0.6792453 15.3 0.731731 6.8 0.7518248 60.5 0.8467153 47.2	Happ H5695 0.0 121100 0.0 87509 0.0 20498 0.0 59025 0.0 30525 0.0 30526 0.0 30528 0.0 58065 0.0 58065 0.0 98847 0.0 20284 0.0 58065 0.0 52056 0.0 520601 0.0 520847 0.0 520848 0.0 520849 0.0	port 11684794 11448271 11647473 11647473 11647473 11076989 110076989 11007652 11482192 1151631 12511196 12404564 11151631 11626146 11098315 11236938 112343399	anteccoent 73 lbst(*20726*, *22384*) 74 lbst(*20726*, *22384*) 75 lbst(*20726*, *22384*) 76 lbst(*20726*, *22384*) 77 lbst(*20726*, *22384*) 78 lbst(*20726*, *22384*) 79 lbst(*20726*, *22384*) 79 lbst(*2330*) 80 lbst(*2239*, *850908*) 81 lbst(*22395*) 82 lbst(*22729*) 83 lbst(*22729*) 84 lbst(*22729*) 85 lbst(*22382*, *22382*)	a a a a a a a a a a a a a a a	consequent list("20725") list("20728") list("22383") list("22383") list("22383") list("22302") list("23203") list("23203") list("23293") list("23293") list("23293") list("22724") list("22726") list("22726") list("22727") list("22727") list("22727") list("22727") list("22727") list("22727")	Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6982456 0.6021505 0.6827957 0.6847458 0.6053215	10.541866 11.731527 10.836462 10.938791 11.79626 17.828606 13.566896 16.089996 27.195055 14.738426 14.70559 14.261154 39.275505 8.588056	3.00000127951 0.0107564 0.0105564 0.0105564 0.0107162 0.0108232 0.0248452 0.0108233 0.0108233 0.0113169 0.0113169 0.0113169 0.0113169 0.01135422 0.0107694 0.0107694
49 50 51 52 53 54 55 56 57 58 59 60 61 62 63	Istr'226997, '22423') Q. Istr'226997, '22423') Q. Istr'226697, '22423') Q. Istr'226667, '22582') Q. Istr'22667, '22582') Q. Istr'22607, '22782') Q. Istr'232067, '20727') Q. Istr'232067, '22787') Q. Istr'227307, '22726') Q. Istr'22698') Q. Istr'22698') Q. Istr'227307, '22726') Q. Istr'227307, '22727') Q. Istr'227307, '22727') Q. Istr'227307, '22727') Q. Istr'227307, '22726') Q. Istr'227307, '22727') Q. Istr'227307, '22727') Q. Istr'227307, '22727') Q. Istr'227307, '22727') Q. Istr'227371', '2, '2386') Q. Istr'23777', '2, '2386', '2, '2386', '2, '2386', '2, '2386', '2, '2386', '2, '2386', '248', '	consequent lat("22697") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22697") lat("22697") lat("22726") lat("22726") lat("22726") lat("2372") lat("2372") lat("23172") lat("23172") lat("23172")		IIIt IIIt 0.7314815 16.8 0.627314815 16.8 0.6616702 9.3 0.6611236 8.3 0.6611236 8.3 0.6611236 8.4 0.6312500 11.1 0.6375000 9.4 0.6083151 8.6 0.7826087 16.3 0.8134715 203 0.7789292 17.3 0.6792453 15.5 0.731731 6.8 0.7518240 60.5 0.8467153 47.2 0.7925170 5.1	Happ H5695 0.0 121100 0.0 87509 0.0 25498 0.0 59025 0.0 30528 0.0 30528 0.0 66065 0.0 008601 0.0 99847 0.0 20284 0.0 56355 0.0 998467 0.0 563596 0.0	port 11684794 114448271 11647473 11140968 11076989 11087652 11482192 11151631 12511196 12404564 11151631 11526314 11526315 11236938 112442269 11244226 11244226 11244226 112442 112442 112442 11244 1124 112	anteccoent 73 lbd(*20726', *22384') 74 lbd(*20726', *22384') 75 lbd(*20726', *22384') 76 lbd(*20726', *22384') 76 lbd(*20726', *22384') 77 lbd(*20726', *22384') 78 lbd(*20726', *22384') 79 lbd(*23301') 79 lbd(*23290', *850908') 80 lbd(*22326') 81 lbd(*22395') 82 lbd(*22729') 84 lbd(*22729') 85 lbd(*22382', *22382') 86 lbd(*22382', *22382') 87 lbd(*23170')	a a a a a a a a a a a a a a	consequent list("20725") list("20728") list("22383") list("22383") list("22383") list("23207") list("23203") list("23293") list("23293") list("23293") list("23293") list("21932") list("22726") list("22727") list("22725") list("20725") list("20725")	Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6224830 0.6284830 0.6083557 0.7898833 0.6468254 0.6785714 0.6982456 0.6021505 0.6827957 0.6847458 0.6053215 0.6904762	10.541866 11.731527 10.836462 10.938791 11.79626 17.828606 13.566996 27.195055 27.195055 14.0798426 14.170559 14.261154 39.275505 8.588056 47.264859	3.000001 0.0127951 0.0106099 0.0105564 0.0107162 0.0108232 0.0248452 0.0108232 0.0108233 0.017381 0.0131691 0.0131691 0.0131692 0.0119420 0.0135422 0.0135422 0.0175692 0.0123692
49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64	Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/226997, '22423') Q. Istr'/22697, '22727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/232067, '20727') Q. Istr'/227307, '22726') Q. Istr'/226987) Q. Istr'/226987) Q. Istr'/226987) Q. Istr'/226987) Q. Istr'/227307, '22727') Q. Istr'/226987) Q. Istr'/227307, '22727') Q. Istr'/22804') Q. Istr'/228099', '22386') Q. Istr'/227307, '22727') Q. Istr'/22804') Q. Istr'/227307, '22727') Q. Istr'/227307, '22727') Q. Istr'/227307, '22736', '22386') Q. Istr'/227307, '22386', 'Q. Q. Istr'/227307, '22386', 'Q. Q. Istr'/227307, '22386', 'Q. Q. Istr'/23177	Consequent lat("22697") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22727") lat("22697") lat("22697") lat("22726") lat("22726") lat("23172") lat("23172") lat("23172") lat("23172") lat("23172") lat("23172") lat("23172")		didence lift 0.7314815 16.8 0.627314815 16.8 0.6616702 9.3 0.6611236 8.3 0.6312500 11.1 0.6332500 9.6 0.603151 8.4 0.73826087 16.3 0.8134715 203 0.7789292 17.3 0.6792453 15.5 0.731731 6.4 0.7518240 60.3 0.8467153 47.2 0.7925170 5.3 0.56666667 13.5	Happ 445695 0.0 221100 0.0 287509 0.0 284485 0.0 254485 0.0 55025 0.0 30526 0.0 68065 0.0 68065 0.0 68065 0.0 680661 0.0 680861 0.0 680865 0.0 52086 0.0 52086 0.0 52966 0.0 522966 0.0 522966 0.0	port 11684794 114448271 11647473 11140968 11076989 11087652 11482192 1151631 12511196 12404564 11151631 11526346 11626346 11698315 11242269 11695457	anteccoent 73 lkdr(20726', '22384') 74 lkdr(20726', '22384') 75 lkdr(20726', '22384') 76 lkdr(20726', '22384') 76 lkdr(20726', '22384') 77 lkdr(20726', '22384') 78 lkdr(20726', '22384') 79 lkdr(23207') 80 lkdr(23207') 81 lkdr(23295') 82 lkdr(2729') 83 lkdr(22729') 84 lkdr(22382', '22382') 85 lkdr(22382', '22382') 86 lkdr(22727) 87 lkdr(22728', '22787')		consequent list("20725") list("20727") list("22383") list("22383") list("22383") list("23200") list("23203") list("23203") list("21932") list("21932") list("21932") list("22726") list("22726") list("2277")	Contidence 0.7430341 0.6160991 0.6130031 0.6222910 0.62284830 0.6284830 0.6083551 0.7898833 0.6468254 0.6785714 0.6962456 0.6021505 0.6827957 0.6847458 0.6904762 0.6904762 0.6650124	10.541866 11.731527 10.836462 10.938791 11.79626 17.828606 13.566996 27.195055 14.170559 14.261154 39.275505 8.588056 47.264859 15.649903	3.00000127951 0.0127951 0.0106099 0.0105566 0.0107162 0.0108232 0.0248452 0.0108232 0.0108233 0.0108233 0.0108233 0.0107698 0.0119428 0.01123697 0.01123697 0.01142883
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49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66	Istr' 22699', '22423') Q. Istr' 22699', '22423') Q. Istr' 22699', '22423') Q. Istr' 22699', '22382') Q. Istr' 22306', '20727') Q. Istr' 23206', '20727') Q. Istr' 23206', '20727') Q. Istr' 23206', '20727') Q. Istr' 22730', '22726') Q. Istr' 22698') Q. Istr' 22608') Q. Istr' 22804') Q.	Consequent lat("22697") lat("22698") lat("20725") la		fildence lift 0.7314815 16.2 0.627314815 16.2 0.6616702 9.3 0.6611236 6.3 0.6312500 11.1 0.633151 8.4 0.7826087 16.3 0.8033151 8.4 0.7826087 16.3 0.8134715 20.3 0.7738292 17.3 0.6792453 15.3 0.7518240 60.5 0.8467153 47.2 0.7925170 5.1 0.6666667 13.3 0.6666667 17.4 0.6666667 17.4 0.6666667 17.4	Happ 445695 0.0 221100 0.0 82509 0.0 26498 0.0 55025 0.0 30528 0.0 68055 0.0 680655 0.0 680655 0.0 680656 0.0 680657 0.0 680658 0.0 52056 0.0 52056 0.0 520566 0.0 522956 0.0 722455 0.0 4422455 0.0	port 11684794 11448271 11647473 11647473 11140968 11076989 11087652 11482192 1151631 12511196 12404564 11151631 11626146 11098315 11242269 11685457 11685457 116854794 10013009	anteccoent 73 lkdr (20726', '22384') 74 lkdr (20726', '22384') 75 lkdr (20726', '22384') 76 lkdr (20726', '22384') 77 lkdr (20726', '22384') 78 lkdr (20726', '22384') 79 lkdr (20726', '22384') 78 lkdr (20726', '22384') 79 lkdr (2330') 80 lkdr (2320', '850908') 81 lkdr (23295') 82 lkdr (21933') 83 lkdr (22729') 84 lkdr (22729') 85 lkdr (2380', '22383') 86 lkdr (2370', '22383') 87 lkdr (23170') 88 lkdr (20728', '22727') 89 lkdr (20728', '22727') 89 <tdlkdr '20727')<="" (20728',="" td=""> 80 lkdr (20728', '20727')</tdlkdr>	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	consequent list("20725") list("20727") list("22383") list("22383") list("22383") list("23207") list("23200") list("23203") list("23203") list("20724") list("20724") list("21932") list("22726")	Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6962456 0.6021505 0.6847458 0.6653215 0.6650124 0.6188235	10.541866 11.731527 10.836462 10.938791 11.799626 17.828606 13.566896 15.689996 27.195055 40.798426 14.170559 14.261154 39.275505 8.588056 47.264859 15.649903 12.150201 8.779617	3.00000127951 0.0127951 0.0106091 0.0105566 0.0107162 0.0108232 0.0248453 0.0108232 0.0108232 0.0108232 0.0107381 0.013569 0.0142883 0.0133693 0.0142883 0.0139155 0.0142883
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Q.	consequent lat("22697") lat("22698") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("20725") lat("22726") lat("22726") lat("22726") lat("22726") lat("22726") lat("23172") lat("23172") <td>(0) (0) (0) (0) (0) (0) (0) (0) (0) (0)</td> <td>Internet Int 0.7314815 16.2 0.627314815 16.2 0.6616702 9.3 0.6611236 6.3 0.6611236 8.3 0.6611236 8.4 0.6312500 11.1 0.6312500 9.4 0.6083151 8.4 0.7826087 16.3 0.8134715 20.3 0.7798282 17.7 0.6732453 15.3 0.7917373 6.4 0.7925170 5.1 0.6666667 13.3 0.66666667 17.4 0.76661290 8.4 0.6614320 10.4</td> <td>Heipi 445656 0.0 221100 0.0 287509 0.0 25498 0.0 25498 0.0 25498 0.0 30525 0.0 44552 0.0 30526 0.0 56065 0.0 66065 0.0 56065 0.0 56065 0.0 56065 0.0 56266 0.0 56266 0.0 56266 0.0 52966 0.0 52966 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 5297 0.0</td> <td>port 11684794 11448271 11647473 11647473 11140968 11076989 11087652 11087652 11482192 1151631 12511196 12404564 1151631 11626146 11098315 11236938 11242269 116854794 11013009 11370228</td> <td>anteccoent 73 lkdr (20726', 22384') 74 lkdr (20726', 22384') 75 lkdr (20726', 22384') 76 lkdr (20726', 22384') 77 lkdr (20726', 22384') 78 lkdr (20726', 22384') 79 lkdr (20726', 22384') 79 lkdr (20726', 22384') 79 lkdr (20726', 22384') 80 lkdr (2330') 80 lkdr (2330') 81 lkdr (23285') 82 lkdr (22729') 83 lkdr (22729') 84 lkdr (22729') 85 lkdr (22729') 86 lkdr (22728', 22382') 87 lkdr (22728', 22382') 88 lkdr (22728', 22727') 89 lkdr (20728', 20727') 90 lkdr (20728', 20727') 91 lkdr (22697', 22699') 92 lkdr (23170', 23170')</td> <td>2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2</td> <td>consequent list("20725") list("20727") list("22383") list("20727") list("20727") list("20727") list("20727") list("2380") list("23200") list("23200") list("20724") list("20724") list("22726") list("22784") list("22784") list("22786") list("22688") list("22688") list("22688")</td> <td>Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6962456 0.6021505 0.6827957 0.6847458 0.6053215 0.6904762 0.6650124 0.6188235 0.7127469 0.9400000</td> <td>10.541866 11.731527 10.836462 10.938791 11.799626 13.566896 13.566896 16.089996 27.195055 40.796426 14.170559 14.261154 39.275505 8.588056 47.264859 15.649903 12.150201 8.779617 23.088567 64.345401</td> <td>3.00000127951 0.0127951 0.0106091 0.0105566 0.0107162 0.0108232 0.0248452 0.0108232 0.0173851 0.013169 0.0119421 0.0135422 0.0135422 0.014288 0.014288 0.0139151 0.014288 0.0139151 0.014022 0.0211661 0.010023</td>	(0) (0) (0) (0) (0) (0) (0) (0) (0) (0)	Internet Int 0.7314815 16.2 0.627314815 16.2 0.6616702 9.3 0.6611236 6.3 0.6611236 8.3 0.6611236 8.4 0.6312500 11.1 0.6312500 9.4 0.6083151 8.4 0.7826087 16.3 0.8134715 20.3 0.7798282 17.7 0.6732453 15.3 0.7917373 6.4 0.7925170 5.1 0.6666667 13.3 0.66666667 17.4 0.76661290 8.4 0.6614320 10.4	Heipi 445656 0.0 221100 0.0 287509 0.0 25498 0.0 25498 0.0 25498 0.0 30525 0.0 44552 0.0 30526 0.0 56065 0.0 66065 0.0 56065 0.0 56065 0.0 56065 0.0 56266 0.0 56266 0.0 56266 0.0 52966 0.0 52966 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 52965 0.0 5297 0.0	port 11684794 11448271 11647473 11647473 11140968 11076989 11087652 11087652 11482192 1151631 12511196 12404564 1151631 11626146 11098315 11236938 11242269 116854794 11013009 11370228	anteccoent 73 lkdr (20726', 22384') 74 lkdr (20726', 22384') 75 lkdr (20726', 22384') 76 lkdr (20726', 22384') 77 lkdr (20726', 22384') 78 lkdr (20726', 22384') 79 lkdr (20726', 22384') 79 lkdr (20726', 22384') 79 lkdr (20726', 22384') 80 lkdr (2330') 80 lkdr (2330') 81 lkdr (23285') 82 lkdr (22729') 83 lkdr (22729') 84 lkdr (22729') 85 lkdr (22729') 86 lkdr (22728', 22382') 87 lkdr (22728', 22382') 88 lkdr (22728', 22727') 89 lkdr (20728', 20727') 90 lkdr (20728', 20727') 91 lkdr (22697', 22699') 92 lkdr (23170', 23170')	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	consequent list("20725") list("20727") list("22383") list("20727") list("20727") list("20727") list("20727") list("2380") list("23200") list("23200") list("20724") list("20724") list("22726") list("22784") list("22784") list("22786") list("22688") list("22688") list("22688")	Confidence 0.7430341 0.6160991 0.6130031 0.6222910 0.6284830 0.6083551 0.7896833 0.6468254 0.6785714 0.6962456 0.6021505 0.6827957 0.6847458 0.6053215 0.6904762 0.6650124 0.6188235 0.7127469 0.9400000	10.541866 11.731527 10.836462 10.938791 11.799626 13.566896 13.566896 16.089996 27.195055 40.796426 14.170559 14.261154 39.275505 8.588056 47.264859 15.649903 12.150201 8.779617 23.088567 64.345401	3.00000127951 0.0127951 0.0106091 0.0105566 0.0107162 0.0108232 0.0248452 0.0108232 0.0173851 0.013169 0.0119421 0.0135422 0.0135422 0.014288 0.014288 0.0139151 0.014288 0.0139151 0.014022 0.0211661 0.010023
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*	antecedent	- 5	consequent	24	confidence	lift ⁼	support	A] *	antecedent	consequent		confidence	lift =	support
97	list("22579")	9,	list("22577")	О,	0.7256318	29.268709	0.01071657	128	list("22728", "22726") 9	list("22727")	٩	0,7790698	16.271974	0.01428876
98	list("22579")	О,	list("22578")	Q,	0.8194946	35.334346	0.01210279	129	list("23171", "23170") 🤍	list("23172")	О,	0.8103448	65.231020	0.01002346
99	list("22577")	а,	list(*22578*)	а,	0.6881720	29.672080	0.01706121	130	list("23256") 0.	(ist(~23254~)	Q,	0.6616314	43.695630	0.01167626
100	list("20726", "20728")	Q,	list("20725")	Q,	0.6368564	9.035460	0.01252932	131	list("23202", "23209") ^{(3,}	list("23203")	Q,	0.8306452	14.267015	0.01096315
101	list("22725")	ġ,	list("22726")	Q,	0,6374622	15.001558	0.01124973	132	list("22384", "20728") ^Q .	(ist(*20725*)	q.	0.6527778	9.261346	0.01503519
102	list("22725")	Q,	Fist("22727")	a,	0.6948640	14.513218	0.01226274	133	list(*22384*, *20728*) ⁽¹⁾	list(*20727*)	q,	0.6041667	10.620197	0.01391555
103	list("23174")	а,	list(*23173*)	Q,	0.7007042	36.204982	0.01060994	134	list("22570") 🤤	list("22569")	٩	0.6177370	39.275509	0.01076989
104	list("23174")	Q,	fist("23175")	а,	0.7323944	49.059960	0.01108978	135	list("22570")	list("22568")	٩,	0.6207951	27,526319	0.01082320
105	list("22698", "22697", "	а,	list("22423")	α,	0.6070529	6.283601	0.01284922	136	list("22386", "23203") 🤍	list("850998")	Q,	0.7255639	8.379727	0.01029004
106	list("23209", "20727")	0,	list("20725")	Q,	0.6197605	8.792910	0.01103647	137	list("22750") 9	list("22749")	О,	0.6279683	29.372005	0.01268927
107	list("23175")	α,	list(*23174*)	О,	0.7428571	49.059960	0.01108978	138	list("21668") Q	(ist(~21669*)	Q,	0.6268222	32.566971	0.01146300
108	list("23175")	Q,	list("23173")	0,	0.7000000	36.168595	0.01044999	139	list("22384", "22383") ^{(3,}	list(~20725*)	Q,	0.7004950	9.938340	0.01508851
109	list("22697", "22423")	Q,	list(*22699*)	Q,	0.8250653	18.757484	0.01684794	140	list("22384", "22383") ⁽¹⁾	(ist(*20727*)	q,	0.6039604	10.616571	0.01300917
110	list("22697", "22423")	Q,	list("22698")	à,	0.7154047	23.174664	0.01460866	141	(lst(*22697*)	list("22699")	a,	0.7651099	17.394426	0.02969716
111	list("22726")	Q,	list("22727")	а,	0.6725220	14.046572	0.02857752	142	list("22697")	list("22698")	٩	0.6469780	20.958065	0.02511196
112	list("21931", "22386")	Q,	fist("850998")	0,	0.7852113	9.068610	0.01188953	143	list("22384", "20728", " 🔍	list("20727")	α,	0.6843972	12.030509	0.01029004
113	list("23296")	٩,	list("23293")	α,	0.6718266	26.924744	0.01156963	144	list("22697", "22699", " 9	list("22698")	Q,	0.7626582	24.705385	0.01284922
114	list("23209", "22383")	Q,	list("20725")	9,	0.6404834	9.086919	0.01130305	145	list("845968")	list("84596F")	О,	0.6243094	40.517464	0.01204948
115	list("23209", "22383")	α,	list(*23206*)	а,	0.6042296	12.937135	0.01066325	146	list("22383", "20727") ^Q	(ist/~20725*)	Q,	0.6038544	8.567241	0.01503519
116	list("20726", "22382")	Q,	fist("20725")	Q,	0.6356968	9.019009	0.01386223	147	list("20726", "20727") 0.	list(*20725*)	Q,	0.6590909	9.350915	0.01236938
117	list("23206", "22383")	G,	list("20725")	Q,	0.6077348	8.622295	0.01172958	148	llst(*22384*, *20727*, * ^Q	list(*20728*)	q.	0.6245955	11.893312	0.01029004
118	list("21733")	à,	Fist("85123A")	a,	0.6695652	6.301237	0.02463212	149	llst(*22910*)	list("22086")	q,	0.6467236	12.390142	0.02420559
119	list("84596F")	Q,	list("845968")	Q,	0.7820069	40.517464	0.01204948	150	list("22746")	list("22748")	9	0.8503937	45,701961	0.01151631
120	list("22386")	à	fist/"850998")	Q,	0.6288309	7.262532	0.02953721	a.	list("22746")	list("22745")	α,	0.8149606	48.067301	0.01103647

Conclusion

This study was conducted in order to make a Market Basket Analysis by using Association Rules mining through FP-Growth Algorithm. Data were analyzed in the R Studio program and Spark using a data set containing 541910 transactions and 4070 different products. The best rule accordingly a customer who buys Regency Tea Plate Pink and Regency Tea Plate Roses also gets Regency Tea Plate Green with confidence 0.94 and the lift ratio value 64.3 As a result, product placement in the supermarket can be made according to these rules. Thus, sales of these products will increase and revenue will increase directly.

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