

CATALOG CROSS-SELLING

Market Basket Analysis

FRAMEWORK

Road to rules on cross-selling catalogs



Section 1 Objective

Identify Objectives for Cross-Selling



Section 3 Results

Results of Analysis – Creation of Cross-selling guidelines



Section 2 Exploration

Data Preparation > Market Basket Analysis - Association Rule Mining via Apriori Algorithm > Measure Association – Support, Lift and Confidence



Section 4 Recommendations

How should the success of the campaign be measured



OBJECTIVE

The primary objective is to improve profitability through higher revenue and lower cost.

- ☐ Improve the Return on Ad Spending (ROAS). So that the biggest cost of operation; the cost of promotions is being used effectively
- ☐ Increase the sales revenue through up-selling and effective cross-selling strategies
- ☐ Introduce effective cross-promotion strategy to send out the most convincing discount coupons to customers

Exploration

The process to creating Rules for Cross-Selling

1

DATA PREPARATION

Involves basic data evaluation, cleaning and streamlining

2

MARKET BASKET ANALYSIS

The chosen algorithms for this project is Association Mining algorithm via Apriori algorithm.

Association algorithm is about building the rules.

Apriori algorithm is used to get the most frequent itemsets.

3

CREATING RULES

Rules are analyzed using support, confidence and lift.

Data Preparation



Data consistency:

- No missing values were detected
- There is just one transaction per user
- All the transactions involve a product from ***Health Product Division***



Health Product Division was removed from the analysis:

- Lacks in variation;
- May distort other rules' metrics;
- It's a category that doesn't need to be "pushed"

Measure Association

The metrics we used to evaluate the rules are the following:

SUPPORT

$$\frac{\text{freq}(A, B)}{\text{all transactions}}$$

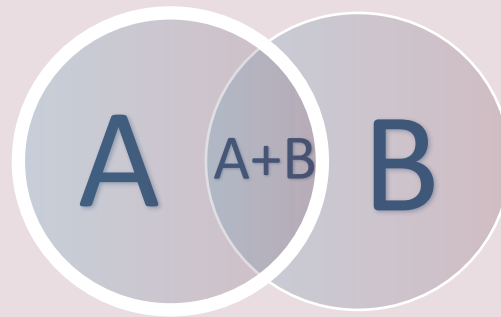
Measures the how frequent an itemset is in all the transactions.



CONFIDENCE

$$\frac{\text{freq}(A, B)}{\text{freq } A}$$

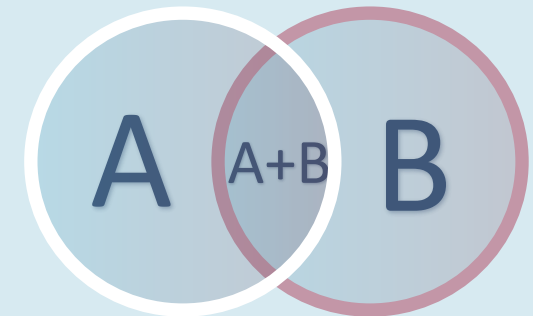
Defines the likeliness of occurrence of Product B to be purchased given that Product A is purchased.



LIFT

$$\frac{\text{freq}(A, B) / \text{freq}(A)}{\text{fraction of freq}(B)}$$

Measures the strength of the association using the independent probability of (A,B) occurring together. A higher probability of (A,B) occurring together will create a stronger rule.



GROUP 4
BUS 4023 CASE STUDY 2

Rules

RULE	ANTECEDENTS	CONSEQUENTS	SUPPORT	CONFIDENCE	LIFT
0	(Personal Electronics Division)	(Housewares Division)	0.235494	0.503853	1.280252
1	(Housewares Division)	(Personal Electronics Division)	0.235494	0.598373	1.280252
2	(Garden Division)	(Housewares Division)	0.132853	0.488235	1.240569
3	(Housewares Division)	(Garden Division)	0.132853	0.33757	1.240569
4	(Novelty Gift Division)	(Housewares Division)	0.134854	0.592788	1.50623
5	(Housewares Division)	(Novelty Gift Division)	0.134854	0.342654	1.50623
6	(Jewelry Division)	(Housewares Division)	0.194878	0.545964	1.387254
7	(Housewares Division)	(Jewelry Division)	0.194878	0.49517	1.387254
8	(Garden Division)	(Personal Electronics Division)	0.163265	0.6	1.283733
9	(Personal Electronics Division)	(Garden Division)	0.163265	0.349315	1.283733
10	(Novelty Gift Division)	(Personal Electronics Division)	0.169068	0.743184	1.590082
11	(Personal Electronics Division)	(Novelty Gift Division)	0.169068	0.361729	1.590082
12	(Jewelry Division)	(Personal Electronics Division)	0.197479	0.553251	1.183711
13	(Personal Electronics Division)	(Jewelry Division)	0.197479	0.422517	1.183711
14	(Novelty Gift Division)	(Garden Division)	0.112245	0.493404	1.813259
15	(Garden Division)	(Novelty Gift Division)	0.112245	0.4125	1.813259
16	(Garden Division)	(Jewelry Division)	0.127251	0.467647	1.310146
17	(Jewelry Division)	(Garden Division)	0.127251	0.356502	1.310146

RULE	ANTECEDENTS	CONSEQUENTS	SUPPORT	CONFIDENCE	LIFT
18	(Novelty Gift Division)	(Jewelry Division)	0.107243	0.471416	1.320705
19	(Jewelry Division)	(Novelty Gift Division)	0.107243	0.300448	1.320705
20	(Novelty Gift Division, Personal Electronics Division)	(Housewares Division)	0.107843	0.63787	1.62078
21	(Novelty Gift Division, Housewares Division)	(Personal Electronics Division)	0.107843	0.799703	1.711009
22	(Personal Electronics Division, Housewares Division)	(Novelty Gift Division)	0.107843	0.457944	2.01302
23	(Novelty Gift Division)	(Personal Electronics Division, Housewares Division)	0.107843	0.474055	2.01302
24	(Personal Electronics Division)	(Novelty Gift Division, Housewares Division)	0.107843	0.230736	1.711009
25	(Housewares Division)	(Novelty Gift Division, Personal Electronics Division)	0.107843	0.274021	1.62078
26	(Jewelry Division, Personal Electronics Division)	(Housewares Division)	0.132053	0.668693	1.699099
27	(Jewelry Division, Housewares Division)	(Personal Electronics Division)	0.132053	0.677618	1.449801
28	(Personal Electronics Division, Housewares Division)	(Jewelry Division)	0.132053	0.560748	1.570974
29	(Jewelry Division)	(Personal Electronics Division, Housewares Division)	0.132053	0.369955	1.570974
30	(Personal Electronics Division)	(Jewelry Division, Housewares Division)	0.132053	0.282534	1.449801
31	(Housewares Division)	(Jewelry Division, Personal Electronics Division)	0.132053	0.335536	1.699099

Cross-Selling Rules

How do these rules work?

SUPPORT

out of the all the transactions, baskets with items from Divisions A and B have the most occurrences

- Rule 1 (highest Support at 0.235) depicts a strong association between Personal Electronics and Housewares Division

CONFIDENCE

all the transactions with items from Division A should predictably have items from Division B

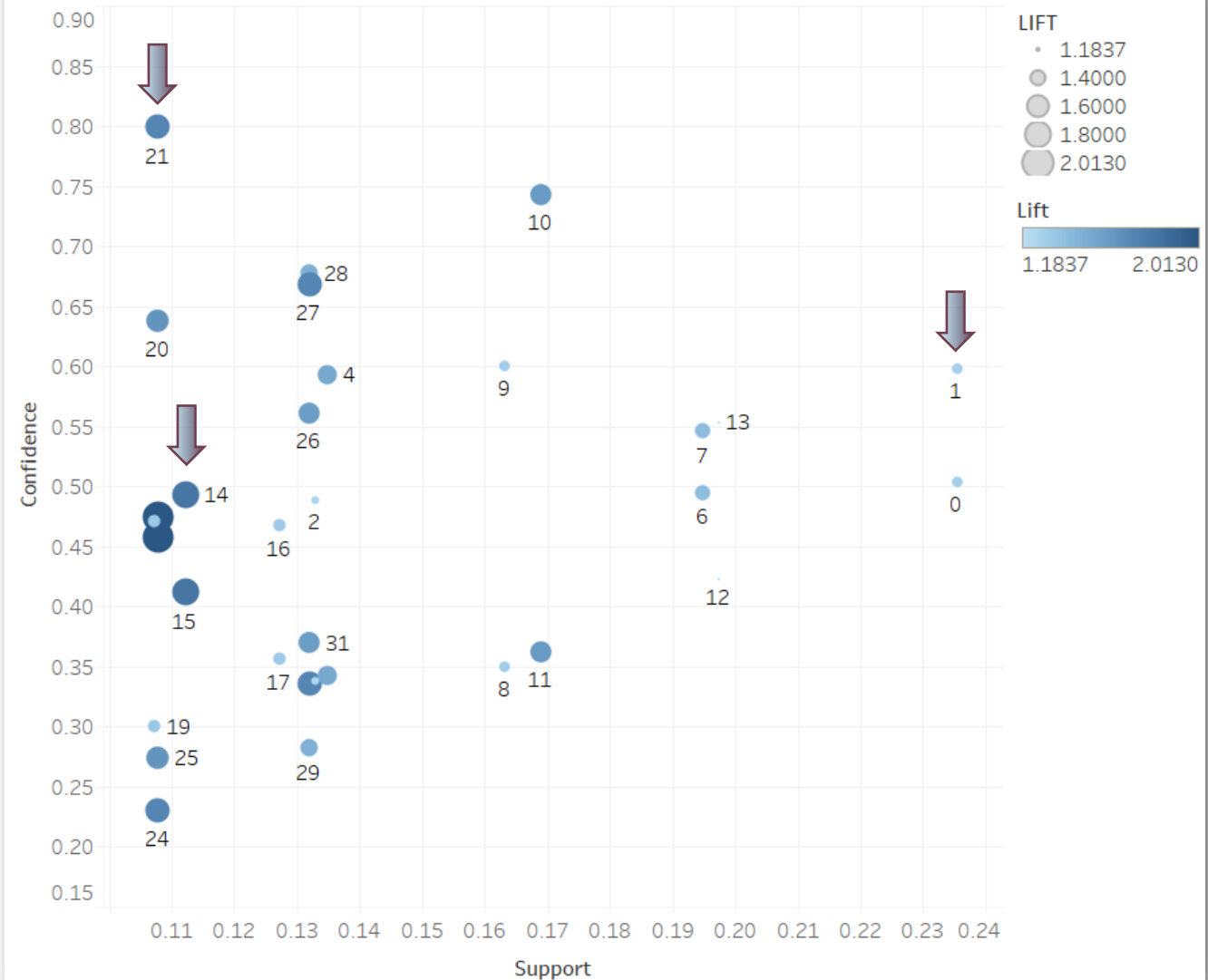
- Highest confidence value is for Rule 21 (at 0.799), between Novelty Gift Division and Personal Electronics Division.

LIFT

the rise in probability of having a purchase from Division A knowing that an item from Division B is also present in the same basket

- One of the rules with the highest lift is Rule 14 at 1.813 value between Garden (X) and Novelty Gift (Y) Division.

Support, Confidence and Lift



Cross-Selling Rules

How are these rules applied?



Rule 1: Given by high
SUPPORT value: Personal
Electronics and Housewares



Rule 21: Given by high
CONFIDENCE value: Novelty
Gift and Personal Electronics



Rule 14: Given by high LIFT:
Garden and Novelty Gift

Division	Merchandise		
CLOTHING			
HOUSEWARES			
HEALTH			
PERSONAL ELECTRONICS			
COMPUTERS			
GARDEN			
NOVELTY GIFT			

Strongest Rules by Measure of Association

Rules with Highest Support

Antecedents	Consequents		
	(Housewares Division)	(Jewelry Division)	(Personal Electronics Division)
(Housewares Division)		0.19488	0.23549
(Jewelry Division)	0.19488		0.19748
(Personal Electronics Division)	0.23549	0.19748	

Rules with Highest Confidence

Antecedents	Consequents		Confidence (Confi..)
	(Housewares Division)	(Personal Electronics Division)	
(Novelty Gift Division)		0.7432	
(Housewares Division, Jewelry Division)		0.6776	
(Jewelry Division, Personal Electronics Division)	0.6687		
(Novelty Gift Division, Housewares Division)		0.7997	
(Novelty Gift Division, Personal Electronics Division)	0.6379		

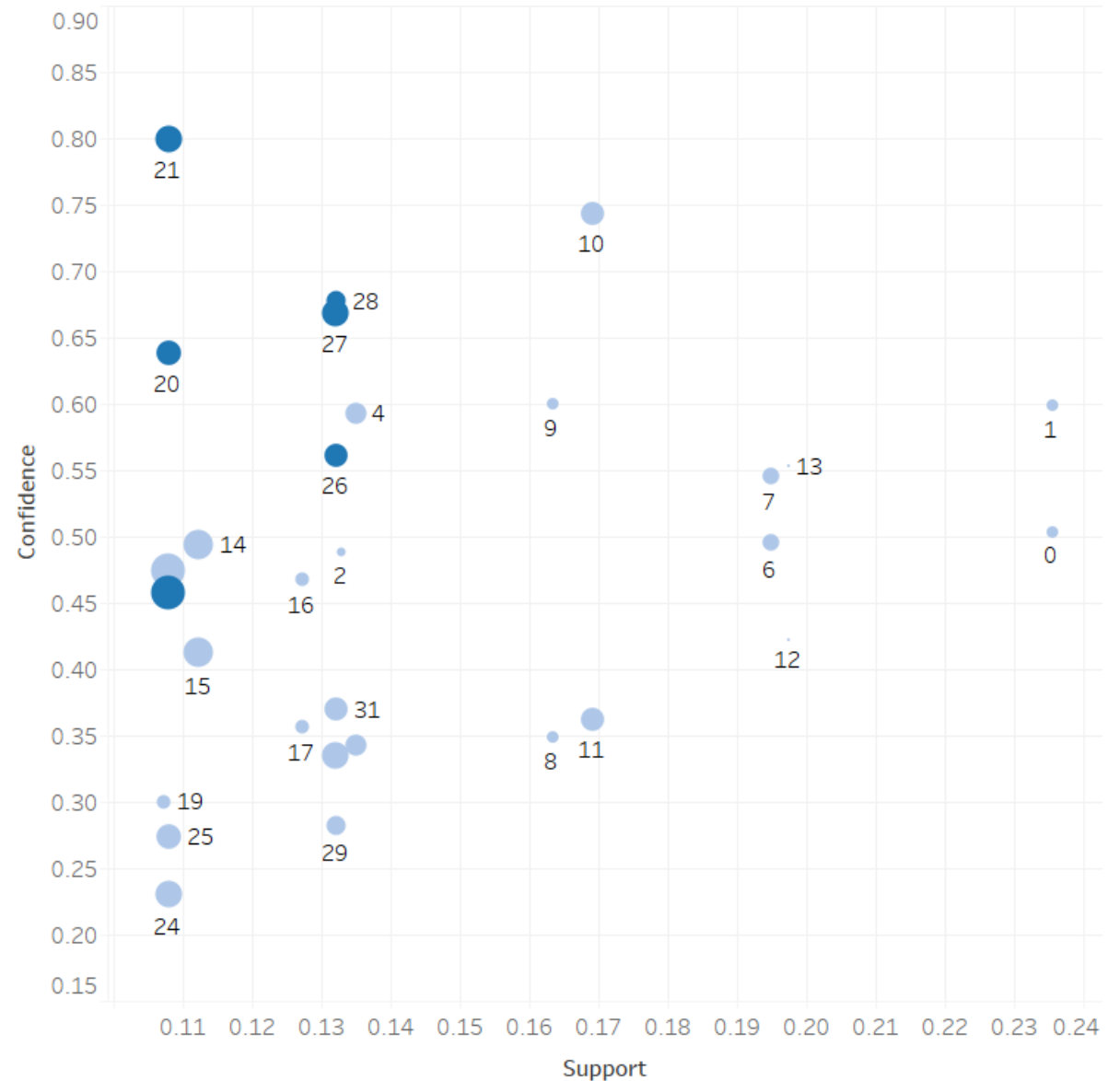
Strongest Rules by Measurement of Association

Rules with Highest Lift

Antecedents	Consequents							
	(Garden Division)	(Housewares Division, Novelty Gift Division)	(Housewares Division, Personal Electronics Division)	(Housewares Division)	(Novelty Gift Division)	(Personal Electronics Division, Jewelry Division)	(Personal Electronics Division, Novelty Gift Division)	(Personal Electronics Division)
(Garden Division)					1.8133			
(Housewares Division)						1.6991	1.6208	
(Novelty Gift Division)	1.8133		2.0130					
(Housewares Division, Novelty Gift Division)								1.7110
(Housewares Division, Personal Electronics Division)					2.0130			
(Personal Electronics Division, Jewelry Division)				1.6991				
(Personal Electronics Division, Novelty Gift Division)				1.6208				
(Personal Electronics Division)		1.7110						

2 Antecedents – 1 Consequent

	antecedents	consequents	support	Confidence	lift
22	(Housewares Division, Personal Electronics Division)	(Novelty Gift Division)	0.107843	0.457944	2.01302
20	(Novelty Gift Division, Housewares Division)	(Personal Electronics Division)	0.107843	0.799703	1.711009
27	(Jewelry Division, Personal Electronics Division)	(Housewares Division)	0.132053	0.668693	1.699099
21	(Novelty Gift Division, Personal Electronics Division)	(Housewares Division)	0.107843	0.63787	1.62078
28	(Housewares Division, Personal Electronics Division)	(Jewelry Division)	0.132053	0.560748	1.570974
26	(Housewares Division, Jewelry Division)	(Personal Electronics Division)	0.132053	0.677618	1.449801

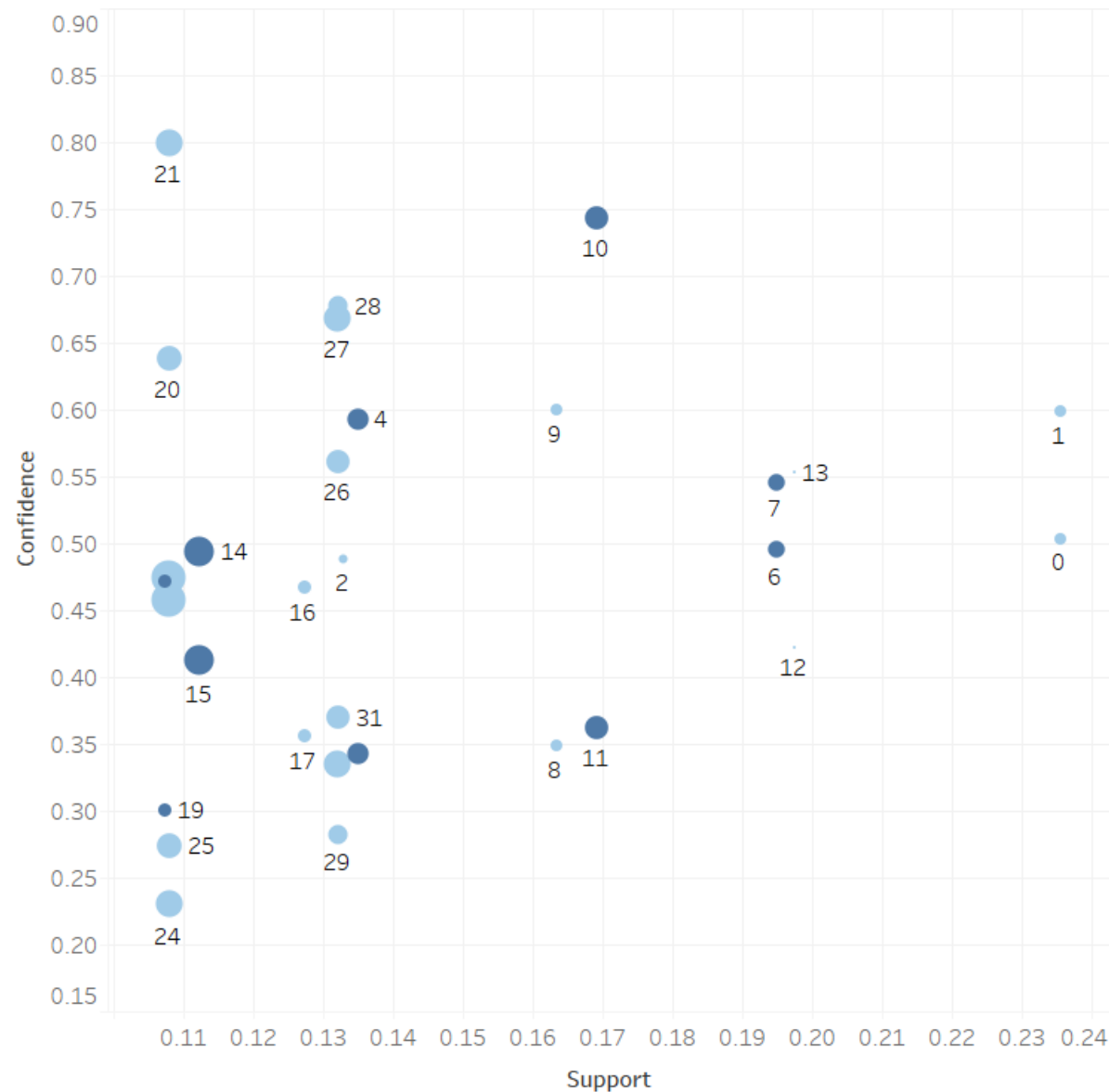


1 Antecedent – 1 Consequent

	antecedents	consequents	support	confidence	lift
4	(Novelty Gift Division)	(Housewares Division)	0.134854	0.592788	1.50623
5	(Housewares Division)	(Novelty Gift Division)	0.134854	0.342654	1.50623
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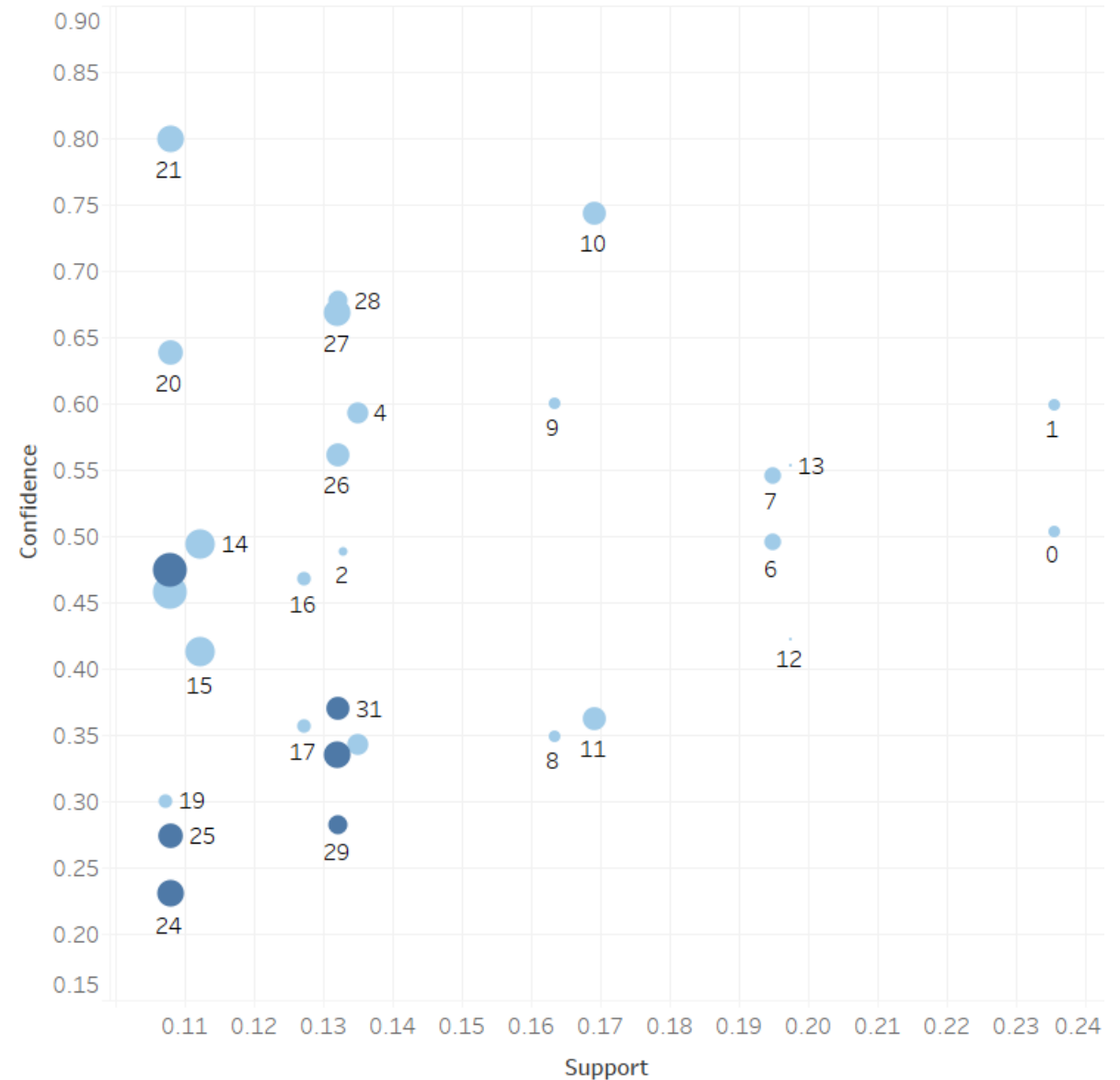
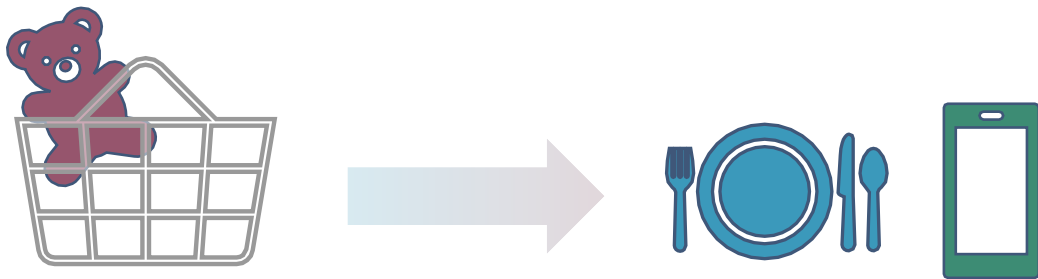


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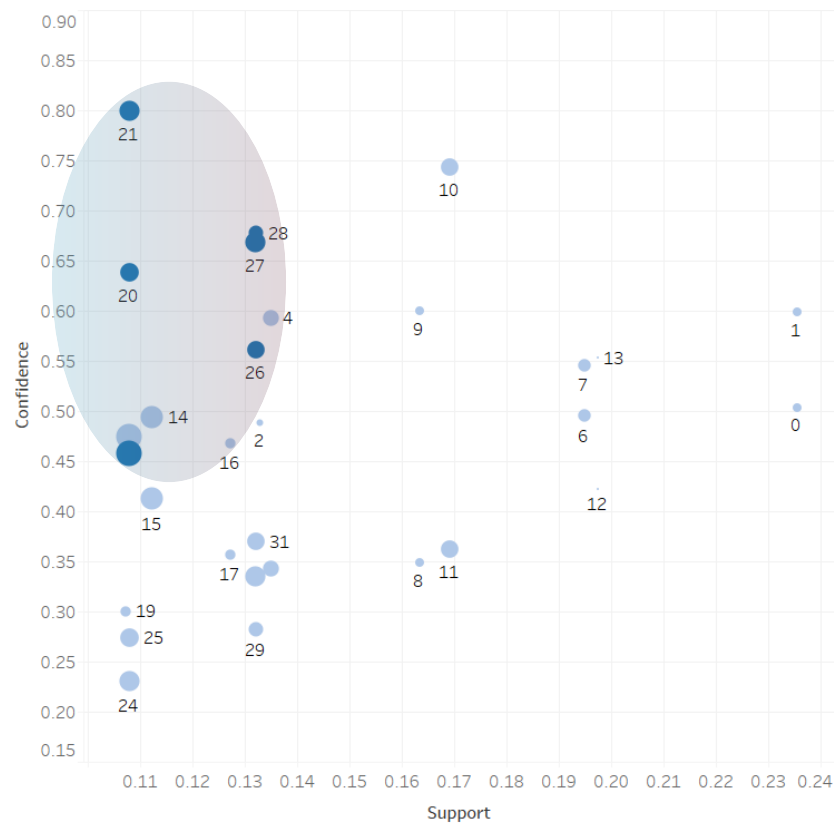


1 Antecedent – 2 Consequents

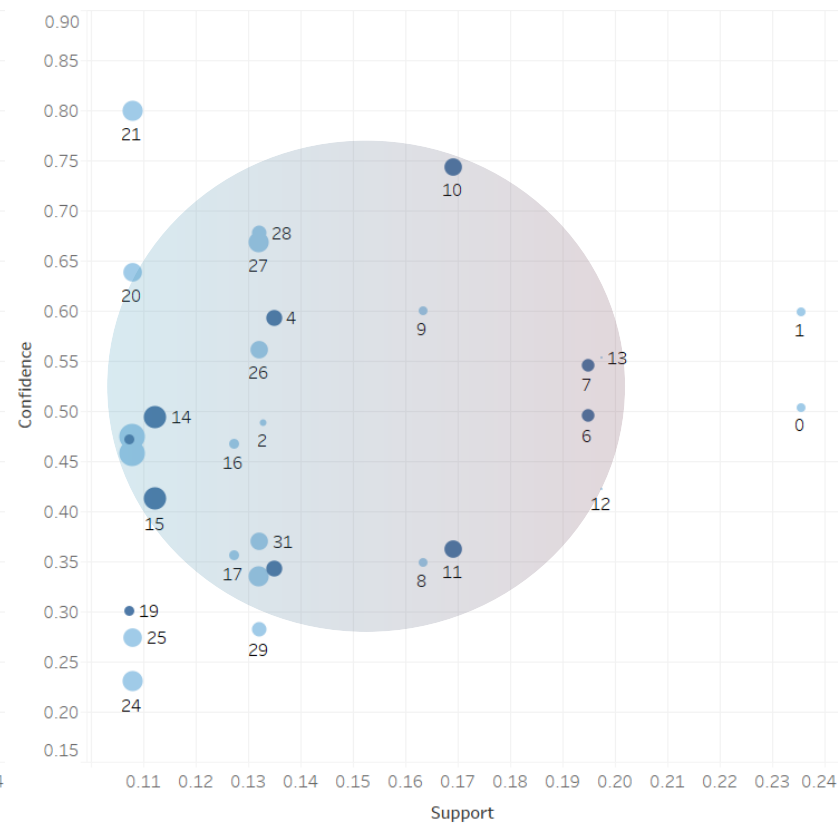
	antecedents	consequents	support	confidence	lift
23	(Novelty Gift Division)	(Housewares Division, Personal Electronics Division)	0.107843	0.474055	2.01302
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30	(Housewares Division)	(Jewelry Division, Personal Electronics Division)	0.132053	0.335536	1.699099
31	(Personal Electronics Division)	(Housewares Division, Jewelry Division)	0.132053	0.282534	1.449801



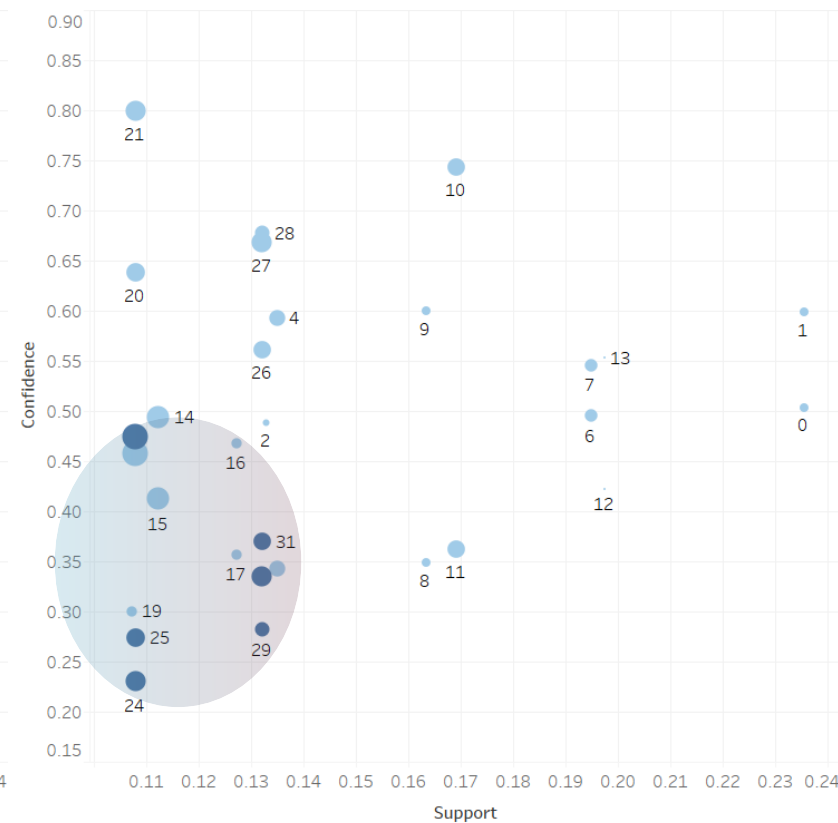
Comparison of Antecedent and Consequent Combinations



2 Antecedents – 1 Consequent



1 Antecedent – 1 Consequent



1 Antecedent – 2 Consequent

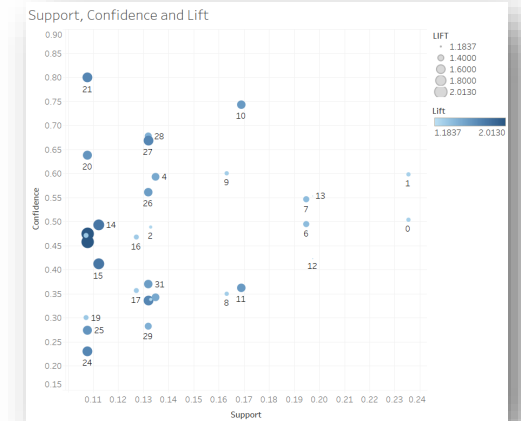
RECOMMENDATIONS

We recommend the following order in which the catalogue should be compiled **to improve cross-selling**.

1. Clothing
2. Computers
3. Automotive
4. Garden
5. Novelty gift
6. Personal Electronics
7. Housewares
8. Jewelry
9. Health

Reasons for this arrangement are;

- Clothing, Computers and Automotive are the least frequently purchased good therefore having them in the front will increase the likelihood of them being sold
- Health is at the end because it is always purchased
- Others are arranged based on the highest levels of support, confidence and lift. In other words, they are the most frequently purchased, purchased together and most likely to purchased together in the future.



RECOMMENDATIONS (Cont..)



Strategy to boost sales revenue through **cross-promotion**

Product(s) bought	Discount coupon to sent out
Clothing	Health
Computers	Health
Automotive	Health
Garden	Novelty gift
Novelty gift	Personal Electronics / Housewares / Garden
Personal Electronics	Housewares / Novelty gift / Jewelry
Housewares	Personal Electronics / Novelty gift / Housewares / Jewelry
Jewelry	Personal Electronics / Housewares

Also recommended conducting a customer segmentation to better understand their behaviour and buying patters.

RECOMMENDATION (Cont..)



Strategy to boost sales revenue through **cross-promotion**

Product(s) bought	Discount coupon to sent out
Personal Electronics and Housewares	Novelty Gift
Novelty Gift and Housewares	Personal Electronics
Personal Electronics and Jewelry	Housewares
Personal Electronics and Novelty Gift	Housewares
Jewelry and Housewares	Personal Electronics

Discount coupons should not be issued for Clothing, Computers and Automotive because those are least likely to be used.

Our Team



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Thank you!

GROUP 4

BUS 4023

BUSINESS, WEB AND SOCIAL MEDIA METRICS AND ANALYSIS