



Application of Association Rule Learning in Customer Relationship Management

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ABSTRACT

Association Rule Learning (ARL) is a machine learning method for discovering interesting relations between varieties in large databases. It is used to identify rules that are discovered in databases. ARL is introduced for discovering regularities between products in large scale transaction data recorded by point of sale (POS) systems in supermarkets. This research work was aimed at discovering items (products) that are bought together by customers using three (3) weeks sales dataset of the Federal Polytechnic, Ile-Oluji, Ondo State Tuck Shop using association rule. Excel format was used to generate interesting rules from the dataset. Result from this research work was analysed to increase the company's sales and revenue, soft drinks which is the only item with low level of patronage should be placed in between or adjacent the shelves that contains the items with the high level of patronage such as chewing gum, popcorn and water to help in developing promotional strategies so that items with low level of patronages.

Keywords: Association rule learning, customer relationship management.

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1. BACKGROUND TO THE STUDY

Association Rule Learning (ARL) is a machine learning method for discovering interesting relations between varieties in large databases. It is used to identify rules that are discovered in databases. ARL is introduced for discovering regularities between products in large scale transaction data recorded by point of sale (POS) systems in supermarkets. Customer Relationship Management (CRM) refers to the methodologies and tools used to help entrepreneur manage their business in an organized way. Customer relationship manages customer interactions which require using information about your customers in all stages of your relationship with them Gaurav, G. and Himanshu, A. (2012).

There are four basic tasks that are used to achieve the basic goals in CRM:

- 1) Customer Identification: It is used to identify the customers through website marketing.
- 2) Customer Differentiation: Every customer has their own lifetime value from the company's point of view.
- 3) Customer Interaction: Customer demands change every time and there are four stages of customer lifecycle which are the initiation, integration, intelligence and value creation.
- 4) Customization: Treat the customers uniquely through the entire customer relationship management process.

The benefits of CRM include better client relationship and enables you to have a much stronger connection and a deeper relationship with the customer. It also increases team collaboration. Sales teams can use CRM to understand their sales pipeline better. Marketing teams can use CRM to make forecasting simpler and more accurate. CRM has some reasons which include a future view into the CRM and events that will be leading indicators of your revenue and profits metrics and it also includes Risk Management. ARL has application in various disciplines such as: computer, security management, market basket analysis, business management, customer relationship management.



Market Basket Analysis (MBA) as one of the disciplines of ARL is a modelling technique based upon the theory that if you buy a certain group of items, you are more or less likely to buy another group of items. The set of items a customer buy is referred to as item set, and MBA seeks to find relationship between purchases. MBA can be used in deciding the location and promotion of goods inside a store. MBA gives clues as to what a customer might have bought if the idea had occurred to them. The benefits of MBA is to help customers with fruitful suggestions instead of annoying them with marketing blasts and it will also help to improve the allocations of resources to different items of the inventory and it will also help to reduce bounce rate, improve engagement and result in better performance in search results. The uses of MBA is to organize store to increase revenues and it is also used to display content which consumer is most likely to read next and it is also use to suggest the next best product which a customer is likely to buy.

1.1 Statement of the Problem

In any business, customers are the most important aspect of a successful company. In the past, many customers took their customers for granted and uncared for, this situation has led into many of these companies losing their loyal customers to competitors, and lack of Customer Relationship Management will lead to sales reduction and business failure. The application of customer is business has greatly help in determining customer needs and making recommendation to provide for it. ARL is a computer tool used for discovering customer needs and providing satisfactory for those needs. There is a great need to company and organization to put in place a very good Customer Relationship Management to forestall business failure.

1.2 Research Objective

The main objective of this study is to generate strong rules from transactional data for Customer Relationship Management.

2. METHODOLOGY

A database of customer was created in order to track customer transaction using Excel, ARL algorithm, in order to discover relationship association among products bought by customers. Promotion was applied to product not frequently bought; product being bought together regularly was shelved close to each other.

2.1 The Research Design

The dataset used for this research is a transactional data of The Federal Polytechnic, Ile-Oluji Tuck Shop. A total of 100 transactions records were obtained from three weeks sales record. Table 1 shows the sample of the raw dataset. Each row in the table represent a single transaction. The transaction detail columns are the columns needed and were used for analysis. To select interesting rules from the set of all possible rules constraints on various measure of the significance and interest are used. The best known constraints are minimum thresholds on support and confidence.

2.2 Support

The support $supp(X)$ of an item set X is defined as the proportion of transactions in the dataset which contain the item set, which is denoted by equation 1 below

$$Supp(X) = \frac{\text{item of } x}{\text{Total Sales record}} \dots\dots\dots 1$$

Support denotes the frequency of the rule within transactions. A high value means that the rule involve a great part of the sales database.

2.3 Confidence

The confidence of a rule is defined by equation 2 below

$$Conf(X \Rightarrow Y) = \frac{Supp(X \cup Y)}{Supp(X)} \dots\dots\dots 2$$

Confidence denotes the percentage of transaction containing A which contain also B. In this study, sales obtained were used as data. The data were taken in excel format.



3. DATA PRESENTATION

3.1 Minimum Support Level Generation

From the transactional data record taken, the appearance of each item set were obtained and the support of each item sets were generated. The item sets were classified into seven (7) which are:

1. A = Soft drink
2. B = Chewing gum
3. C = Popcorn
4. D = Water
5. E = Sweet
6. F = Biscuit
7. G = Chin chin / Phocus

These seven (7) items were used to throughout this research work such as generating minimum support level which the pre-defined value given is 20%. The transactional data records was taken through direct observation of the customers of The Federal Polytechnic, Ile-Oluji Tuck Shop. With this process the data below was recorded.

Table 1: Sample Transactional Data Record.

S/N	ITEMS	CUSTOMER'S NAMES
1	Biscuit (2), water, Chin chin, chewing gum	Bisola
2	Biscuit (3) , Soft Drink, Chewing gum, Phocus	Miracle
3	Soft Drink, Popcorn, Water, Biscuit	Elizabeth
4	Biscuit, Water, Sweet	Kehinde
5	Water, Sweet, Biscuit	Bose
6	Biscuit, SoftDrink, Sweet (3)	Ronke
7	Biscuit, Water	Bukola
8	Biscuit (5), Soft Drink	Funmi
9	Water, Popcorn, Softdrink	Adaramola

In process of generating the minimum support level with the pre-defined value of 20%, the number of appearance which is denoted as (n) of the item sets are generated as shown in Table 2.



Table 2: Appearance of Items sample

	Soft Drink	Chewing Gum	Popcorn	Water	Sweet	Biscuit	Chin Chin/Phocus
TID	ITEM A	ITEM B	ITEM C	ITEM D	ITEM E	ITEM F	ITEM G
T1	0	1	0	1	0	2	1
T2	1	1	0	0	0	3	1
T3	1	0	1	1	0	1	0
T4	0	0	0	1	1	1	0
T5	0	0	0	1	1	1	0
T6	1	0	0	0	3	1	0
T7	0	0	0	1	0	1	0
T8	1	0	0	0	0	5	0

With the appearance (n) generated, support were generated as shown in Table 3.

Taking Item A as an example: Item A appeared 55 times in the transactional data record, hence generating support, appearance (n) was divided by the total record taken which is 100.

Table 3: Support generating sample

S/N	ITEM	APPEARANCE (n)	SUPPORT (n/100)
1	A	55	0.55
2	B	24	0.24
3	C	36	0.36
4	D	71	0.71
5	E	45	0.45
6	F	75	0.75
7	G	43	0.43

The support generated was used to generate the minimum support level of the pre-defined value of 20%.

Table 4: Sample of Minimum support level of 20%

S/N	ITEMS	SUPPORT
1	A	0.55
2	B	0.24
3	C	0.36
4	D	0.71
5	E	0.45
6	F	0.75
7	G	0.43
8	AC	0.22



4. DISCUSSION OF FINDINGS

The generation of the minimum support level with the pre-defined value of 20% were used to calculate the confidence shown in Table 4.

Table 4: Sample of Confidence Generating

S/N	ITEMS	SUPPORT (x)	CONFIDENCE
1	A	0.55	0
2	B	0.24	0
3	C	0.36	0
4	D	0.71	0
5	E	0.45	0
6	F	0.75	0
7	G	0.43	0
8	AC	0.22	0.4
9	AD	0.27	0.490909091
10	AE	0.25	0.454545455
11	AF	0.38	0.690909091
12	AG	0.29	0.527272727
13	BD	0.2	0.833333333

The pre-defined value for minimum confidence level are 50%, 60%, 70% and 80% which are shown in Table 5, Table 6, Table 7 and Table 8 respectively.

Table 5: Minimum confidence level of 50%

RULES	ITEMS
Rule 1	AF { Softdrinks → Biscuit }
Rule 2	AG { Softdrinks → Chin chin/Phocus }
Rule 3	BD { Chewing gum → Water }
Rule 4	CD { Popcorn → Water }
Rule 5	CE { Popcorn → Sweet }
Rule 6	CF { Popcorn → Biscuit }
Rule 7	CG { Popcorn → Chin chin/phocus }
Rule 8	DE { Water → Sweet }
Rule 9	DF { Water → Biscuit }
Rule 10	EF { Sweet → Chin chin/phocus }
Rule 11	EG { Sweet → Biscuit }
Rule 12	CDE { Popcorn → Water, Sweet }
Rule 13	DEF { Water → Sweet, Biscuit }



Table 6: Minimum confidence level of 60%

RULES	ITEMS
Rule 1	AF { Softdrinks →Biscuit}
Rule 2	BD {Chewing gum→Water}
Rule 3	CD {Popcorn →Water}
Rule 4	CE {Popcorn →Sweet}
Rule 5	CF {Popcorn→Biscuit}
Rule 6	DF {Water→Biscuit}
Rule 7	EF {Sweet→Chin chin/phocus}

Table 7: Minimum confidence level of 70%

RULES	ITEMS
Rule 1	BD {Chewing gum→Water}
Rule 2	CD {Popcorn →Water}
Rule 3	DF{Water→Biscuit}
Rule 4	EF{Sweet→Chin chin/phocus}

Table 8: Minimum confidence level of 80%

RULES	ITEMS
Rule 1	BD {Chewing gum→Water}
Rule 2	CD {Popcorn →Water}



5. CONCLUDING REMARKS

The analysis of this work has shown that the higher the percentage of the pre-defined value, the lower the rules.

According to the minimum confidence level of 60%, Six (6) rules were generated which indicates that:

- Rule 1: 60 % of customers that buy soft drinks also buy biscuit.
- Rule 2: 60% of customers that buy chewing gum also buy water.
- Rule 3: 60% of customers that buy popcorn also buy water.
- Rule 4: 60% of customers that buy popcorn also buy sweet.
- Rule 5: 60% of customers that buy popcorn also buy biscuit.
- Rule 6: 60% of customers that buy Water also buy biscuit.

According to the minimum confidence level of 70%, Four (4) rules were generated which indicates that:

- Rule 1: 70% of customers that buy chewing gum also buy water.
- Rule 2: 70% of customers that buy popcorn also buy water.
- Rule 3: 70% of customers that buy water also buy biscuit.
- Rule 4: 70% of customers that buy sweet also buy chin chin/phocus.

According to the minimum confidence level of 80%, Two (2) rules were generated which indicates that:

- Rule 1: 80% of customers that buy chewing gum also buy water.
- Rule 2: 80% of customers that buy popcorn also buy water.

Conclusively, the association rule analyzed that soft drink is the only item with low level of patronage. Hence, to increase the company's sales and revenue, soft drinks should be placed in between or adjacent the shelves that contains the items with the high level of patronage such as chewing gum, popcorn and water.

6. CONTRIBUTIONS TO KNOWLEDGE

From the analysis carried out in this study, the following recommendations can be offered:

- 1) Products that appear together in pruned rules must never be out of stock and must be arranged closely together.
- 2) Products that did not appear in the pruned rules must be promoted.



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