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Prognostication of Customer Behaviour using Web Data

Samiah Jan Nasti[1]
Department of Computer Sciences
BGSB University
Rajouri, J&K – India

M. Asger[2]
School of Mathematical Sciences and Engineering
BGSB University
Rajouri, J&K – India

Muheet Ahmad Butt[3]
Department of Computer Sciences
University of Kashmir
Hazratbal Srinagar, J&K – India

Abstract: ***From the past two years, we are generating tremendous amount of data on daily basis. But the data on web is unstructured and unorganized and do not carry a valuable information. To get knowledge out of the web data, descriptive and predictive data mining techniques are being used. Predictive models are trained to learn from the past and predict the future more accurately and precisely. Such models have wide range of applications such as fraud detection, disease prevention and winner prediction in reality shows. In this paper we propose a predictive model for prognostication of customer behaviour in an e-commerce system.***

Keywords: Fraud Detection; Customer Behavior; Predictive Model; Web Data.

I. INTRODUCTION

As we know data is our future. Data on the Web can help us to predict the future and improve the future. According to IBM, 90% of the data that is available on the web is created and generated in the past two years. Fortunately search engines have access to the web. These search engines crawls and indexes the web in order to satisfy the user's information need and so it has access to almost terabytes of data, which is just waiting there in order to be processed, understood and modelled the right way. Many data mining techniques such as Nearest Neighbour, Support Vector Machines, Decision Trees, Linear and Logistic Regression, Clustering and Association Rules exist that help us to get the valuable information from the web. The categorization of data mining task as Predictive and Descriptive with their own techniques is shown in Figure1.

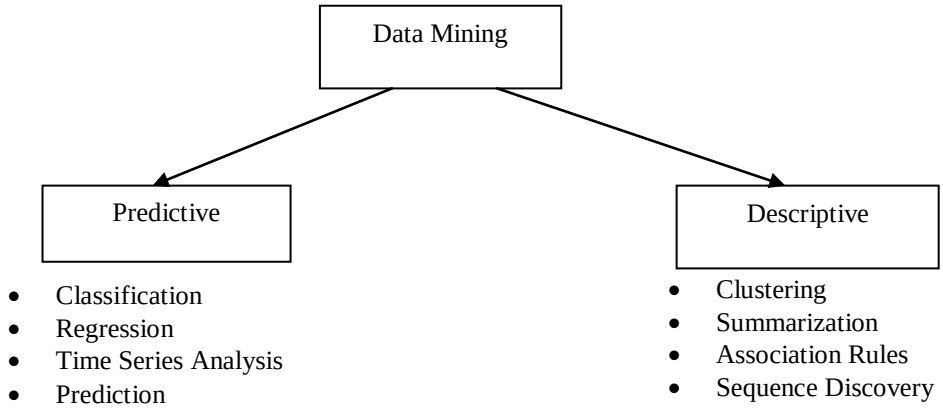

Figure 1

The main aim of predictive data mining is to generate a model that can be used to perform tasks such as classification, prediction or estimation, while as the main aim of descriptive data mining is to generate a model that can be used to perform tasks such as Clustering, Summarization or Sequence discovery. A predictive model is the result of combing data and predictive

modelling technique as shown in Fig 2.The predictive modelling technique converts the data into valuable information by learning patterns hidden in the data. After learning is done, outcome is the predictive model. Once the model is verified, it is believed that the knowledge it learnt will be applied to new scenario's.

Figure 2

II. Related Work

Poel and Buckinx[1] investigated the contribution of different types of predictors to the purchasing behaviour at an online store. They use logit modelling to predict whether or not a purchase is made during the next visit to the website using both forward and backward variable-selection techniques.

Lian Yan et al. [2] extracted calling links, i.e., who called whom, from the CDR data, and propose several distance measures based on calling links. They demonstrate that, by using information derived from the calling links alone as inputs to a neural network model, an acceptable accuracy for predicting churn (customer switching from one service provider to another) can be achieved.

Mansour et al.[5] provide a way in finding sequences of the customers' shopping, which in comparison with the previous methods, it works better and they demonstrate that it could obtain sequences of the customers' shopping in shorter time than the previous methods. They provide a method of finding two-member and higher sequences by distributed learning automata; its costs is lower than the other methods and examined it on online basket data of costumer shopping.

Jason Choi et al. [6]focuses on identifying features of customers who have moved for the purpose of predicting customer address changes. The data consisted of transactional and event data from the customer databases of a large financial services company. The analysis involved supervised learning techniques that used information about whether a customer had changed their address in the system as a response variable. The information gained about the features that explain customer address changes was extrapolated to all customers under the assumption that customers that have moved undergo similar spending patterns regardless of whether they changed their address in the database or not.

III. Predictive Modelling Techniques

As we Know the enormous amount of data available of Web is unstructured and unorganised and don't carry a valuable information. Organizations need to take their data which is unstructured and unorganised, get aggregated information out of it to get knowledge. Once they understand the value of data (what data means), they can build predictive models that best suits their requirements. These predictive models can then be used to exploit patterns to identify potential risks and opportunities before they actually occur e.g. these models can tell us who are our best customers, what makes our customer leave, what makes our customer stay, what mix of items they buy and what action can we take to prevent them from leaving .So, nearly every Organization in this competitive market will eventually need to do predictive modelling in order to remain ahead of the curve. The two main predictive modelling techniques are:

Classification: Classification consists of examining the properties of a newly presented observation and assigning it to a predefined class such as assigning customers to predefined customer segments (good vs. bad) or classifying credit applicants as low, medium, or high risk. Classification means that based on the properties of existing data, we have to made classification. The concept can be well understood by a very simple example of student grouping. A student can be grouped either as good or bad depending on his previous record. Similarly an employee can be grouped as excellent, good, fair etc. based on his track record in the organization. The classification of students or employees is based on the historical data. We can say history is the best

predictor of the future. When an organization conducts test and interviews from candidate employees, their performance is compared with those of the existing employees. This knowledge can be used to predict how good you can perform if employed. This is known as absolute or binary classification i.e. either good or bad. Thus each entity is assigned to one of the groups or classes. An example where classification can prove to be beneficial is in customer segmentation. The businesses can classify their customers as either good or bad; the knowledge thus can be utilized for executing targeted marketing plans.

Prediction: Prediction means that what's the probability of an item/event/customer to go in a specific class. This means that prediction tells that in which class this specific item would lie in future or to which class this specific event can be assigned in any time in future, say after six years. First of all a model is built using existing data and the existing data set is divided into two subsets, one is called the training set and the other is called test set. The training set is used to form model and the associated rules. Once model is built and rules are defined, the test set is used for grouping. Prediction can be well understood by considering a simple example. Suppose a business wants to know about their customers their propensity to buy/spend/purchase or how much the customer will spend in next 6 months. Similarly a mobile phone company can install a new tower based on the knowledge spending habits of its customers in the surroundings. It is not the case that companies install facilities or invest money because of their gut feelings. Companies bother about their customers because if they know their customers, their interests, their like and dislikes, their buying patterns then only it is possible to run targeted marketing campaigns and thus increase profit.

IV. Our Proposed Model

Our proposed model is based on Attitude-Behavior correlation given by Glasman and Albarracin[3]. According to their Attitude-Behavior model, following relations can be formulated:

$$AA_3 = \alpha_{31} RE_1 + \alpha_{32} DBE_2 + \varepsilon_3 \quad (1)$$

$$C_5 = \alpha_{51} RE_1 + \alpha_{57} OS_7 + \varepsilon_7 \quad (2)$$

$$BR_6 = \alpha_{61} RE_1 + \alpha_{64} M_4 + \varepsilon_6 \quad (3)$$

$$AS_8 = \alpha_{81} RE_1 + \alpha_{85} C_5 + \alpha_{86} BR_6 + \alpha_{87} OS_7 + \varepsilon_8 \quad (4)$$

$$AS_8 = \alpha_{91} RE_1 + \alpha_{92} DBE_2 + \alpha_{93} AA_3 + \alpha_{94} M_4 + \alpha_{97} OS_7 + \alpha_{98} AS_8 + \varepsilon_9 \quad (5)$$

Where RE means repeated expression and is defined as the number of times participants expressed their attitudes towards an object. DBE means direct behavioral experience and is defined as whether the participants had previous experience with the object. C means confidence and is defined as how confidently participants held the attitude towards the object. BR means behavioral relevance of attitudes and is defined as the co-relation between the attitudes that participants held and the behavior's they engaged later on. OS means one sidedness of information and refers to received information is biased. AA means attitude accessibility and refers to how easily the attitude can be accessed. AS means Attitude stability and refers to the degree to change the attitude.

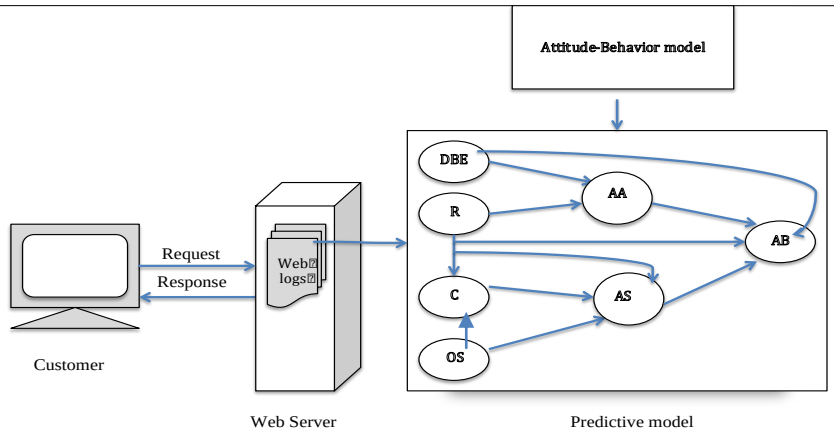

Figure 3 Predictive Model for Customer Behavior

Taking into consideration the above factors, we build our predictive model for customer behavior as shown in Figure 3. Let us take a scenario of customer behavior both in a general store and in an online store. In a general store, data about the customer can be collected only at one point known as checkout counter or 'point-of-sale'. No other information about the customer behavior can be predicted throughout his/her shopping process. But in case of an online store, the complete behavior of customer can be recorded with the help of web log files (web logs are maintained by web servers and contain information about the user accessing the site). Applying Attitude- Behavior model we can say, when a customer browses a product page that means the customer has motivation to buy it. If he views the product, that shows his attitude towards the product. If he views the product more than once, that shows his attitude towards the product repeatedly (R).If he views the product page for the long time, it shows his confidence (C). If the customer has bought the product before, it is considered as direct behavioral experience (DBE). Ratio of number of times buying the product with the number of times viewing the product means one-sided information (OS). Finally if a customer buys the product in that very session, we consider the customer as having behavior. According to our predictive model, following relations can be formulated:

$$AB_0 = \beta_{01}AA_1 + \beta_{02}DBE_2 + \beta_{03}R_3 + \beta_{05}AS_5 + \delta_0 \quad (6)$$

$$AA_1 = \beta_{12}DBE_2 + \beta_{13}R_3 + \delta_1 \quad (7)$$

$$C_4 = \beta_{43}R_3 + \beta_{46}OS_6 + \delta_4 \quad (8)$$

$$AS_5 = \beta_{53}R_3 + \beta_{54}C_4 + \beta_{56}OS_6 + \delta_5 \quad (9)$$

We use equation (10) to obtain the membership of coefficients [4]

$$\mu(x) = \begin{cases} x/a & 0 < x \le a \\ 1 & a < x < b \\ (c-a)/(c-b) & b \le x \le c \end{cases} \quad (10)$$

Then we use the coefficients in order to obtain the values of eq.(6) to eq. (9) on data sets to classify the customers. The customers can be classified into two categories. First category (Category 1) includes customers who will buy the product and second (Category 2) those customers who will not buy the product. The results are shown below in Table 1:

Table 1

Our Predictive method	Category 1 (Precision)	Category 2(Precision)	Average (precision)
Data set 1	0.5321	0.6145	0.5733
Data set 2	0.4989	0.6260	0.5625

V. CONCLUSION

In this paper, we propose a model for predicting customer behaviour using Attitude-Behavior co-relationship. Our method is comparatively good at predicting the precision for buying behaviour. The proposed model can predict the behaviour of customers who buy and also of those who don't buy and accordingly we can take measures. By predicting customer behaviour, we can understand who are our best customers, so that we can connect with them in a good way.

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