

Data Mining For Marketing

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Abstract:- This paper gives a brief insight about data mining, its process and the various techniques used for it in the field of marketing. Data mining is the process of extracting hidden valuable information from the data in given data sets. In this paper cross industry standard procedure for data mining is explained along with the various techniques used for it. With growing volume of data every day, the need for data mining in marketing is also increasing day by day. It is a powerful technology to help companies focus on the most important information in their data warehouses. Data mining is actually the process of collecting data from different sources and then interpreting it and finally converting it into useful information which helps in increasing the revenue, curtailing costs thereby providing a competitive edge to the organisation.

1. Introduction to Data Mining For Marketing

Marketing as a discipline involves researching and developing a product and facilitating its sale and distribution to the general public. The concept of marketing has existed since long and is changing as per the needs and purchasing behaviours of consumers. Thus, today's marketing is very different from what it used to be a few decades ago, mainly due to a rapidly changing world economy and the advancement in the technology, which together led to free and speedy knowledge distribution and exchange. With this, local markets were exposed to MNC's as the cost and complexity of operating overseas was reduced by globalisation thereby contributing to a wider competition. As markets have become more deregulated, there has been a major change in the way in which and the speed with which knowledge is disseminated. Almost everything we do, like taking a long walk in the woods, leaves little bits of electronic data behind. Every time the Internet or mobile phone is used, data is punched and there's a giant industry right behind sucking up all that data and using it to figure out how to sell you something. From selling toothpaste down to life insurance policies, every activity generates some amount of data, courtesy globalisation and technical advancements, which if analysed properly can provide a competitive edge in the international market by discovering hidden patterns and explicit relationships among large data sets. One such technique that can be employed to analyse such large amount of data is known as data mining.

Data mining is the process of finding correlations or patterns among dozens of fields in large databases. The overall goal of data mining is to extract knowledge from an existing data set and transform it into a human-understandable structure for further use.

Data mining is the non-trivial process of identifying valid, novel, potentially useful and ultimately understandable

patterns in data and data mining as the extraction of patterns or models from observed data. (Berzal, et al., 2001)

Data mining can be characterized as the technology which incorporates the statistical techniques and mathematical equations that are used in an attempt to identify the significant relationships between variables in the historical data, to forecast or perform analysis on the data; or determine any significant relationship within the data captured (Becker, 2002).

Data mining is an essential process where intelligent methods are applied in order to extract data pattern. (Han & Kamber, 2007)

Data mining is the exploration and analysis of large quantities of data in order to discover meaningful patterns and rules. (Berry & Linoff, 2008)

Nowadays, large quantities of data are being accumulated. The amount of data collected is said to be almost doubled every 9 months. Seeking knowledge from massive data is one of the most desired attributes of Data Mining. Usually there is a huge gap between the stored data and the knowledge that can be constructed from it. This transition does not occur automatically, that's where Data Mining comes into picture. This technology is popular with many marketers because it allows them to learn more about their customers and make smart marketing decisions. The data mining business, as it is known, grows 10 percent a year as the amount of data produced is booming. The information thus produced from using data mining can help to increase return on investment (ROI), improve customer's relationships management (CRM) and market analysis, reduce marketing campaign costs, and facilitate fraud detection and customer retention.

Marketing is defined as putting the right product in the right place, at the right price, at the right time. It is a process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organisational objectives (Kotler & Armstrong, 2006). A lot of hard work needs to go into finding out what customers want, and identifying where they do their shopping. Then it is to be figured out how to produce the item at a price that represents value to them, and get it all to come together at the critical time.

But one wrong element can lead to a disaster e.g. promoting a car with amazing fuel-economy in a country where fuel is very cheap or publishing a textbook after the start of the new school year, or selling an item at a price that's too high or too low to attract the people you're targeting. A good place to start off is the marketing mix where plans for a product or service can be thought over so as to avoid any mistakes. It is a general phrase used to describe the different kinds of choices organizations have to make in the whole process of bringing a product or service to market. The 4 Ps is one way of the best way of defining the marketing mix, and was first expressed in 1960 by E J McCarthy.

The 4Ps are:

- Product (or Service)
- Price
- Place
- Promotion

There are a number of applications of data mining in the field of marketing. One of them is called market segmentation, with which common customer behaviours are identified Patterns among customers that seem to purchase the same products at the same time are looked for. Another application of data mining is called customer churn, which helps estimating such customers who are likely to stop purchasing products or services and go to on competitors. In addition, a company can use data mining to find out which purchases are most likely to be fraudulent. For example, by using data mining, a retail store may be able to determine which products are stolen the most so that protective measures are taken accordingly.

Further, while direct mail marketing is an old technique, the companies can, however, combine it with data mining for fantastic results. For example, data mining can be used to find out which customers will respond favourably to a direct mail marketing strategy. It also determines the effectiveness of interactive marketing. Some of the customers are more likely to purchase products online than offline, and, as such, there is a need to identify such customers.

While many marketers use data mining to help increase their profits, it can also be used to create new businesses and industries, and every such data-mining based industry is based on the automatic prediction of both behaviours and trends. For example, automatic prediction is used in data mining to look at past marketing strategies. Which one worked the best? Why did it work the best? Who were the customers that responded most favourably to it? Data mining answers these questions and thus helps avoid making any mistakes that were made in previous marketing campaign. Thus data mining for marketing helps organisations to gain competitive advantage over others and sustain in the international market.

2. Process

Data mining process analyses large amount of data stored in databases so as to discover hidden valuable information or knowledge. This process helps marketers make better decisions that ultimately lead to the required objective such as increase in revenue or process efficiency. To get a competitive edge over others various industries in the field of marketing is making use of data mining process. The process used must be reliable and repeatable by business people with little or no knowledge about data mining.

One such data mining process developed in 1990 is the cross industry standard procedure for data mining (CRISP-DM). It is an iterative process which consists of the following six phases:

- Defining Project Objectives
- Data Exploration
- Data Preparation
- Model Building
- Assessment of Models
- Implementation

2.1 Defining Project Objectives

This phase focuses on understanding and defining the project objectives from the perspective of the business. The knowledge about these objectives is then converted into data mining problem and a plan is designed so as to fulfil these objectives. The steps involved in this phase are:

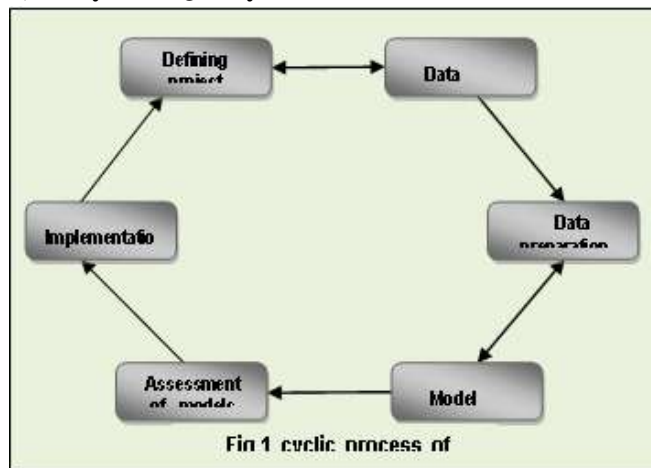
- a) Determining Business Objectives
- b) Assess Situation
- c) Determining Data Mining Goals
- d) Project Plan

2.2 Data Exploration

This phase involves the collection of required data and proceeds through activities for getting familiar with the data. Assessment of sources, quality and characteristics of the data are accomplished in this phase along with understanding the meaning of metadata to form hypotheses

for the hidden information. The various steps involved in this phase are:

- a) Collecting Initial Data
- b) Describe Data
- c) Explore Data
- d) Verify Data Quality



2.3 Data Preparation

This phase covers all the activities required to construct the final data set that is to be fed into the modeling tools from the initial raw data. The tasks such as table, record and attribute selection as well as the transformation and cleaning of data for modeling tools in the data preparation phase are tweaked multiple times in no prescribed order. The various steps involved in this phase are:

- a) Data Selection
- b) Clean Data
- c) Construct Data
- d) Data Integration
- e) Data Formatting

2.4 Model Building

This phase involves selecting and applying various modeling techniques as well as calibrating the parameters to optimal values. Several techniques can address same data mining problem. Some of these techniques require a specific form of data. Therefore interaction with the data preparation phase is often required. The various steps involved in this phase are:

- a) Selecting Modeling Technique
- b) Generate Test Design
- c) Building Model
- d) Assess Model

2.5 Assessment of Models

This phase involves the thorough evaluation of model before implementation. It assesses the degree up to which the developed model meets the business objectives and requirements and also seeks to determine if there is any reason that the chosen model is deficient.

2.6 Implementation

This phase involves incorporating the data mining results into the day-to-day decision making process. Depending on the requirement this phase can be as simple as giving a report or as complex as implementing a repeatable data mining process. Implementation is followed by review of project to assess what went right and what went wrong, what has been done well and what needs to be improved.

3. Techniques

The various techniques employed in data mining are as follows:

3.1 Classification

It is a classic data mining technique and is based on machine learning. It can be defined as the process of predicting the class label of the various data present in the data set, and is used to map the data item into one of the several predefined classes. In classification approach we normally use a training set where all objects are already associated with known class labels. The classification algorithm learns from the training set and then builds a model which is used to classify the objects. For example, a typical classification problem is to divide a database of companies into groups that are as homogeneous as possible with respect to a creditworthiness variable with values "Good" and "Bad." Other examples of classification technique may include predicting tumor cells as benign or malignant, classifying credit card transactions as legitimate or fraudulent, classifying secondary structures of protein as alpha-helix, beta-sheet, or random coil, categorizing news stories as finance, weather, entertainment, sports, etc.

Classification is learning function that maps (classifies) a data item into one of several predefined classes (Weiss, Brusica, & Zeleznikow, 1991)

The classifier-training algorithm uses pre-classified examples to determine the set of parameters required for proper discrimination. The algorithm then encodes these parameters into a model called a classifier.

The commonly used methods for data mining classification tasks can be classified into the following groups:

- a) Logistic regression (LOG)
- b) K-Nearest Neighbors
- c) Naïve Bayes
- d) Tree Augmented Naïve (TAN)
- e) Decision Trees
- f) Artificial neural networks (ANN)
- g) Associative Classification
- h) Support Vector Machines
- i) Genetic Algorithms (GAs)/Evolutionary Programming (EP)
- j) Fuzzy Sets
- k) Rough Sets

Application of classification in marketing:

Classification method can help the marketers in the following four dimensions:

(1) Customer Identification; Elements for customer identification include target customer analysis and customer segmentation. Target customer analysis involves seeking the profitable segments of customers through analysis of customers' underlying characteristics, whereas customer segmentation involves the subdivision of an entire customer base into smaller customer groups or segments, consisting of customers who are relatively similar within each specific segment (Woo, Bae, & Park, 2005)

(2) Customer Attraction

After identifying the segments of potential customers, organizations can direct effort and resources into attracting the target customer segments. An element of customer attraction is direct marketing. Direct marketing is a promotion process which motivates customers to place orders through various channels. (Cheung, Kwok, Law, & Tsui, 2003) (He, X, & J, 2004) (Liao & Chen, 2004) (Prinzie & Poel, 2005) For instance, direct mail or coupon distributions are typical examples of direct marketing.

(3) Customer Retention

Elements of customer retention include one-to-one marketing, loyalty programs and complaints management. One-to-one marketing refers to personalized marketing campaigns which are supported by analysing, detecting and predicting changes in customer behaviours (Chen, Chiu, & Chang, 2005) (Jiang & Tuzhilin, 2006)

(Kim & Moon, 2006)

(4) Customer Development.

Elements of customer development include customer lifetime value analysis, up/cross selling and market basket analysis. Customer lifetime value analysis is defined as the prediction of the total net income a company can expect from a customer (Drew, Mani, Betz, & Datta, 2001) (Etzion, Fisher, & Wasserkrug, 2005) (Rosset, Neumann, Eick, & Vatnik, 2003) Up/Cross selling refers to promotion activities which aim at augmenting the number of associated or closely related services that a customer uses within a firm. (Prizie & Poel, 2006) Market basket analysis aims at maximizing the customer transaction intensity and value by revealing regularities in the purchase behaviour of customers

These four dimensions can be seen as a closed cycle of a customer management system that share the common goal of creating a deeper understanding of customers to maximize customer value to the organization in the long term. Classification techniques, therefore, can help to accomplish such a goal by extracting customer characteristics and behaviours from large databases and then grouping them classifying them based on their characteristics such as the buying pattern, buying frequency, etc.

Beside the above mentioned points the Classification technique can help us in identifying frequency of purchases, size of purchases, regency of purchases and in identifying typical customer groups. The characteristics of each group can be obtained by class identification or concept description. For example, a profile indicating that the customer has purchased a new house may lead to the marketer offering a special deal for home furnishings. Knowing the customer and targeting the right deal gets a far better response rate than a general message

3.2 Sequencing

Sequencing or time series analysis methods relate events in time, based on a series of preceding events. It consists of sequences of events obtained over repeated measurements of time. The items are typically measured at equal time intervals (e.g. Hourly, daily, weekly) through this analysis various hidden trends, often highly predictive of future events, can be discovered. Data is mined to anticipate behaviour patterns and trends. Sequences are often analysed as they relate to a specific customer or group of customers. Using this information a catalogue containing specific product types can be target mailed to a customer associated with a known sequence of purchases. E.g. an outdoor equipment retailer could predict the likelihood of a backpack being purchased based on a consumer's purchase of sleeping bags and hiking shoes. Also a known buying sequence can be that parents tend to buy promotional toys associated with a particular movie within two weeks after renting the movie.

3.3 Clustering

The process of grouping a set of physical objects into classes of similar objects is called clustering. A cluster is a collection of data objects that are similar to one another within the same cluster and are dissimilar to the objects in other clusters. A cluster of data objects can be treated collectively as one group. We first partition the set of data into groups based on data similarity (example using clustering) and then assign labels to the relatively small number of groups. E.g. business clustering can help marketers discover distinct groups in their customer bases and characterise customer groups based on purchasing patterns. The customer of a given geographic location and of a particular job profile demand a particular set of services, like in banking sector the customers from the service class always demand for the policy which ensures more security as they are not intended to take risks, likewise the same set of service class people in rural areas have the preference for some particular brands which may differ from their counterparts in urban areas. This information will help the organization in cross-selling their products, This technique will help the management in finding the solution

of 80/20 principle of marketing, which says: Twenty per cent of your customers will provide you with 80 per cent of your profits, then problem is to identify those 20 % and the techniques of clustering will help in achieving the same.

Clustering is the task of segmenting a heterogeneous population into a number of more homogeneous sub groups or clusters. (Berry & Linoff, 2008)

3.3.1 Approaches to Clustering

- a) Hierarchical Clustering
- b) Partitioning Clustering
- c) Density-Based Clustering
- d) Grid-Based Clustering
- e) Model-Based Clustering
- f) Categorical Data Clustering

Application in marketing

Clustering may typically be used in marketing for advertisements when the customers are yet to be segmented. After running a cluster analysis, the clusters may be examined for characteristics based on which advertisement campaigns may be directed at the customer base. After segmentation, based on the characteristics of the clusters, product positioning, product repositioning and product development may be done, to improve its fit with the targeted customers. Cluster analysis may also be done to selecting test markets. Also clustering may be used in customer relationship management (CRM). Customer clustering would use customer-purchase transaction data to track buying behaviour and create strategic business initiatives. Companies want to keep high-profit, high-value, and low-risk customers. This cluster typically represents the 10 to 20 per cent of customers who create 50 to 80 per cent of a company's profits. A company would not want to lose these customers, and the strategic initiative for the segment is obviously retention. A low-profit, high-value, and low-risk customer segment is also an attractive one, and the obvious goal here would be to increase profitability for this segment. Cross-selling (selling new products) and up-selling (selling more of what customers currently buy) to this segment are the marketing initiatives of choice.

3.4 Association

Association rule mining also known as affinity analysis is the study of "what goes with what". The task of affinity grouping is to determine which things go together. Association rule mining finds interesting associations and/or correlation relationships among large sets of such data items. Association rules show attributes value conditions that occur frequently together in a given data sets. Association rules show strong associations between items that occur frequently in a given data set. These rules are commonly used to analyse the purchasing patterns of customers in a store, such analysis is useful in many decision making processes such as product placement and

catalogue design. This technique helps the marketers in finding patterns which help in guiding the organization to make decisions regarding pricing, selling and to design the strategies for marketing. The association may be direct or indirect. Direct such as purchasing a pen and paper, That means when the customer buys paper then he/she will buy the pen also, this association will help the organization in designing the layout of store, by placing these two products adjacent to each other, which will lead to convenience to the customer and organization can use these results for designing the pricing decision and can give offers based on this study. The organization can find that which customer buys which product most of the times together and hence can provide discounts based on the results

Application in marketing:

Pattern association may be extensively used to predict customer preferences when very little data about the customer is available to the marketer. Tools for pattern association would help a marketer to predict which product or advertisement the customer may be interested in solely by the current buying behaviour of the customer and matching it with the buying behaviour of similar customers (who bought similar products) even when no information is available for the customer.

4. Future Trends

The diversity of data, data mining tasks and data mining approaches poses many challenging research issues in data mining .the development of efficient and effective data mining methods and systems, the construction of interactive and integrated data mining environments, the design of data mining language and the application of data mining techniques to solve large application problems are important tasks for data mining researchers and data mining system and application developers. Some of the trends in data mining that reflect the pursuit of these challenges are: application exploration, scalable and interactive data mining methods, integration of data mining with database systems, data warehouse systems and web data base systems, standardisation of data mining language, visual data mining, new methods for mining complex types of data, biological data mining, data mining and software engineering, web mining, distributed data mining, real-time data mining etc. (Han & Kamber, 2007)

5. Conclusion

This paper gives us a brief insight about data mining and the various techniques used to mine the data in the field of marketing and how this will help the marketers to fulfil their organisational goals. With growing volume of data every day, the need for data mining is also increasing day by day. It is a powerful technology to help companies focus on the most important information in their data warehouses. In this

paper the concept of marketing mix i.e. 4 P's (product, place, promotion and price) have been deliberated upon which help the organisations to describe the different kinds of choices they can make in the process of bringing the product or service to market. This helps the marketers to increase return on investment (ROI), improve customer relationship management (CRM), helps in market analysis, reduces marketing campaign costs, facilitates fraud detection and also helps in customer retention thereby giving them a competitive edge over others.

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