



Data Mining: A Competitive tool in Retail Industries

MAHENDRA TIWARI

Dept. of MCA, United Institute of Management,
Allahabad, India

tiwarimahendra29@gmail.com

ABSTRACT

The data mining process used to be a highly technical process requiring mathematicians to build the analysis for companies. Today's data mining technology offers retailers the tools they need to make sense of their customer data & apply it to business. Data mining is the process of extracting previously unknown information, typically in the form of patterns and associations, from large databases. Today's organizations are realizing the numerous advantages that come with data mining. It is a valuable tool-by identifying potentially useful information from the large amounts of data collected, an organizations can gain a clear advantage over its competitors. Data mining can help companies in better understanding of the vast volume of data collected by the CRM systems. In the past, many organizations have recognized the vital importance of the information they have on their customers.

KEYWORD

Data Mining

Tool

CRM System

Retail

Marketing

Risk Management

Preface

Data Mining:

Data mining involves the use of sophisticated data analysis tools to discover previously unknown, valid patterns and relationships in large data sets. These tools can include statistical models, mathematical algorithms, and machine learning methods (algorithms that improve their performance automatically through experience, such as neural networks or decision trees). Consequently, data mining consists of more than collecting and managing data, it also includes analysis and prediction.

Data mining can be performed on data represented in quantitative, textual, or multimedia forms. Data mining applications can use a variety of parameters to examine the data. They include association (patterns where one event is connected to another event, such as purchasing a pen and purchasing paper), sequence or path analysis (patterns where one event leads to another event, such as the birth of a child and purchasing diapers), classification (identification of new patterns, such as coincidences between duct tape purchases and plastic sheeting purchases), clustering (finding and visually documenting groups of previously unknown facts, such as geographic location and brand preferences), and forecasting (discovering patterns from which one can make reasonable predictions regarding future activities).

Tasks can be Performed with Data Mining:

Many problems of intellectual, economic, and business interest can be phrased in terms of the following six tasks:

■ Classification
■ Estimation
■ Prediction
■ Affinity grouping
■ Clustering
■ Description and profiling

Examples of classification tasks that have been addressed using the techniques include:

■ Classifying credit applicants as low, medium, or high risk.
■ Choosing content to be displayed on a Web page.
■ Determining which phone numbers correspond to fax machines.
■ Spotting fraudulent insurance claims.
■ Assigning industry codes and job designations on the basis of free-text job

Examples of estimation tasks include:

■ Estimating the number of children in a family.
■ Estimating a family's total household income.
■ Estimating the lifetime value of a customer.
■ Estimating the probability that someone will respond to a balance transfer solicitation.

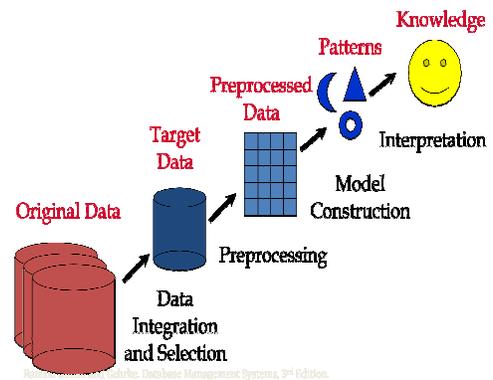
Examples of prediction tasks addressed by the data mining techniques discussed include:

- Predicting the size of the balance that

will be transferred if a credit card prospect accepts a balance transfer offer.

- Predicting which customers will leave within the next 6 months.
 - Predicting which telephone subscribers will order a value-added service such as three-way calling or voice mail
- Affinity grouping can also be used to identify cross-selling opportunities and to design attractive packages or groupings of product and services.
- People who buy cat food also buy kitty litter with probability.
 - People who buy kitty litter also buy cat food with probability.

- At on what it has learned to make customers more profitable



Data mining in Retail Industry:

In the narrow sense, data mining is a collection of tools and techniques. It is one of several technologies required to support a customer-centric enterprise. In a broader sense, data mining is an attitude that business actions should be based on learning, that informed decisions are better than uninformed decisions, and that measuring results is beneficial to the business. Data mining is also a process and a methodology for applying the tools and techniques. For data mining to be effective, the other requirements for analytic CRM must also be in place. In order to form a learning relationship with its customers, a firm must be able to:

- *Notice* what its customers are doing
- *Remember* what it and its customers have done over time
- *Learn* from what it has remembered

The retail industry is realizing that it is possible to gain a competitive advantage utilizing data mining. Retailers have been collecting enormous amounts of data throughout the years, just like the banking industry, and now have the tool needed to sort through this data and find useful pieces of information. For retailers, data mining can be used to provide information on product sales trends, customer buying habits and preferences, supplier lead times and delivery performance, seasonal variations, customer peak traffic periods, and similar predictive data for making proactive decisions. Here are some examples of how the retail industry has been utilizing data mining effectively.

Marketing:

Areas of data mining for the retail industry, as in the banking industry, is marketing. 'Market basket analysis' is a marketing method used by many retailers to determine optimal locations to promote products. Simply stated, it is the study of retail stock movement data recorded at a Point of Sale (PoS)—to support decisions on shelf-space allocation, store layout, product location and promotion effectiveness. In fact, it uses information about products already purchased by customers to predict which products they would be likely to buy if given special offers or even if they are just made aware of the products. Knowing where to locate products and promote them effectively can increase store sales. Another marketing tactic employed by many retail stores is the use of 'loyalty' cards. Rewarding customers who are frequent buyers encourages them to do even more of their shopping at that store, and make them less likely to buy from competing stores. Coupon printers at checkout stands of supermarkets provide an additional way to target customers. These printers are beneficial to brand managers who may not know which customers to target for their brand of products. The coupon printer at the checkout stand can be programmed to print out a coupon for their particular brand when certain products are purchased.

Risk Management:

It is another area where data mining is used in the retail industry. However, not as much research has been done in this area as in other areas. Retail

organizations use data mining to understand which products may be vulnerable to competitive offers or changing customer-purchasing patterns. Previous purchasing patterns of customers are analyzed to identify those customers with low product or brand.

A majority of banks in developing countries (particularly in the public sector) are not usually known to exploit their information 'asset' for deriving business value through data mining and gain competitive advantage. But with progressive liberalization of rules on entry for private and foreign multinational banks, under the GATS framework of WTO, competitive pressure on domestic banks is increasing.

Loyalty, Data mining enables retailers to remain competitive and reduce risks by helping them understand what their customers are really doing. Retailers can then target those customers who are more likely to buy a certain brand or product and also be able to promote products in stores where and when they are needed.

Fraud Detection:

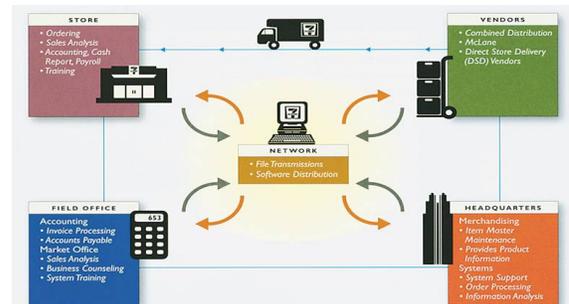
Retail industries must also be aware that fraud detection is absolutely necessary. Fraud occurring at POS terminals is a concern for retailers but this can be reduced by using data mining. It is estimated that 38% of retail shrink occurs because of dishonest employees. And with about 25 paise of every shrink Rupee traceable to PoS fraud, It is no wonder that retails continue to look for ways to reduce the number of dishonest cashiers.

Some supermarkets have begun to use digitized closed circuit television (CCTV) systems, along with PoS data mining, to enable retail loss prevention managers to expose cashier stealing and sweet hearting assemble convincing evidence, and deal with these situations as a matter or routine. The managers decide what constitutes suspicious behavior and sends software to detect it. This is called 'exception based reporting. The system flags PoS transactions that are the most susceptible to fraud refunds, credits, discounts, no sale rings, and the like and compiles them in a report that identifies the date, time, and checkout lanes where they took place. Managers can then look at the videotape to see exactly what happened; they do not even have to be anywhere nears the store.

Customer Acquisition and Retention:

Data mining can also help in acquiring and retaining customers in the retail industry. The retail industry deals with high levels of completion, and can use data mining to better understand customers' needs. Retailer can study customers' past purchasing historical and know with what kinds of promotions and incentives to target customers. Also, if a store has seen a number of people leave and go to some petitions, data mining can be used to study their past purchasing histories, and use this information to keep other customers from doing likewise. Retailers collect terabytes upon terabytes of information every day - anything from transactional data, to demographics, to product sales based on seasons. But what do they do with it all once it is neatly organized into a database? The concept of

data mining is just as it sounds. Companies drill holes through 0s and 1s to come up with relationships and patterns in customer habits. To a retailer this information can be more valuable than mining for gold, because the results are almost a guarantee. The data mining process used to be a highly technical process requiring mathematicians to build the analysis for companies. But today's data mining technology offers retailers the tools they need to make sense of their customer data and apply it to business. Mark Smith, president of Quadstone, a predictive marketing software company, and Peter Urban, senior research analyst at AMR Research, discuss the advantages of analyzing data from all sources and customer channels - including the Web.

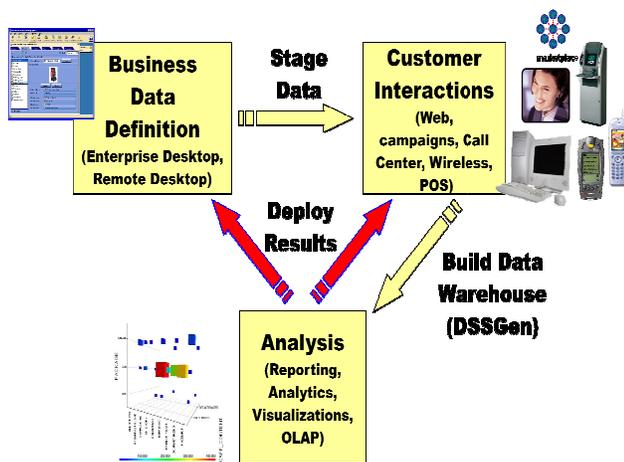


The best sources of customer information for retailers:

The best source is turning POS (point of sale) transaction data into measurements of customer behavior. The problem for many retailers is that they lack any information on specific customers, and hence are trapped analyzing data at the product and basket level. The rise of loyalty programs, mail

order, and the Internet has provided retailers with real access to customers for the first time. This allows retailers to study the purchase behavior of customers in detail, tracking changes in purchases as affected by their marketing and CRM (customer relationship management) programs. Thus, retailers understand how they can grow the value of individual customers to their businesses.

making a diaper run after work and while they were there, picked up some beer. Seeing this pattern, the supermarkets placed the expensive beer right next to the diapers. This technique can be very useful for such product- focused wins, but can add even more value when such linked purchases are tied to the customer details.



Data mining for every retailer:

Almost any retailer could gain some value from analyzing their data. The main driver for whether or not to do so will be the scale potential benefits and return on investment (ROI) compared to the cost of collecting, storing, and analyzing the data. Thus a specialist retailer, with very few products and customers, may gain little insight from data mining over and above their own knowledge of their business.

Different levels of data mining:

Directed data mining allows users to specify what they are interested in discovering, such as finding good targets for a product. Undirected data mining uses a clustering approach that looks for pure statistical patterns that show why customers are like each other in any way, but often not in a business-focused way. A third set of techniques uses association of "basket" analysis to discover links between different products. This approach is not customer focused at all. The most famous example of this is when a super market spotted customers buying beer and diapers on certain days of the week. It was thought this was because men were

Category management in the retail market:

The retail market is an especially dynamic one. This is traditionally due to the similarity in the offered products since all retailers have access to more or less the same range of products via their distributors. In the last years the internet allowed new business concepts and further intensified internationalization and increased competitive pressure. For the application of a typical data mining process many, mostly anonymous data of the customer behavior is

available, which can be used for the optimization of the offers.

The problems arising in category management can be separated into four **different** areas:

- campaign optimization (i. e., selection of target groups and customers).
- cross- and up-selling (i. e., additional sales to customers).
- assortment optimization (i. e., product assortment and categories).
- price optimization (i. e., optimization of product prices and promotions).

A few years ago retailers started to apply mathematical approaches for the analysis of customer behaviour, but its use is sporadic and differs according to the line of business and the marketing activity. While the e-business shows a remarkable adoption of, arguably often too simple, algorithms, the mail order business uses mathematics to a large degree only for the optimization of mailing activities, that is the selection of customers with a high response probability to special offers. Last is the stationary retail market, but exactly here the current technological revolution of interactive digital shopping devices opens up new interesting possibilities for the development and application of new mathematical methods for the category management.

The high degree of customer interaction in retail is beneficial for the use of mathematical approaches since a large amount of customer data is available. At first the use of mathematics proved useful in some classical data mining fields. Here, it is very common

to use classification algorithms for the optimization of mailings. Clustering methods for the segmentation of customers into thematic groups are increasingly successful. Other areas like real-time analysis and offers only apply the simplest methods. In the strategic field of management of commodity groups, that is the optimization of the range of products and their prices, the use of modern mathematical instruments is still the exception. But exactly here is, in combination with real-time approaches of optimal control, an important upcoming application area for the interdisciplinary cooperation of business, computer science and mathematics. Further information on data mining approaches in retail, marketing and customer relationship management can for example be found in [2]. In the following, we focus on the first two problems, i. e., campaign optimization and cross- and up-selling, and existing success stories of the use mathematical approaches in these fields.

Optimization of campaigns :

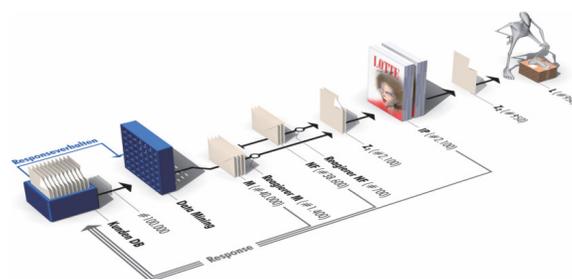
With regard to the use of mathematics the optimization of campaigns is the most advanced. The goal is to apply marketing campaigns with a clear focus on the target customers. This concerns both, the definition of the aims and procedure of the campaign, as well as the analysis of the results. One distinguishes here between target group (segmentation) and target customer (individualization). While target groups are strictly defined according to one or several attributes (for example female), target customers are selected

based on an individual assessment in form of a numerical value, the score. An example for segmentation is the mailing of a catalogue of sporting goods only to customers interested in sports, i. e., those who bought sporting goods before. For the individualization on the other hand each customer is checked for affinity to this specific catalogue of sporting goods, independent of being part of the segment of sport affine customers. For segmentation mostly clustering algorithms are used, while for the individualization mainly classification and regression algorithms are applied. In the following we will discuss the case of mailing optimization in more detail.

For simplification the revenue is considered profit. To select only the customers with the highest response probability by means of data mining can increase the overall profit. The historical mailings for a catalogue are analysed based on the existing customer data. Models for the response probability are machine-learned based on the customer profile and then are evaluated on the 100.000 prospective recipients. This results in a list of scores out of which the 40.000 with the highest score (that is with the estimated largest response probability) are selected and sent the catalogue. If done correctly such a data mining approach can achieve more than twice the conventional response rate, here we assume 950 responders (ca. 2.4 %). The calculation of profit shows that, in comparison to the classical mailing campaign, in the end a higher profit of ca. 297.000 EUR instead of ca. 140.000 EUR is generated with less income. As an additional benefit customers overall receive less catalogues. Such personalized mailing campaigns

are successfully used by several mail order companies. The optimization of a mailing campaign is based on the classification of customers using a model which is learned from existing customer data. An example for such a classification method is described in Fig..

Figure : The phases of an optimized mailing campaign



it is based on an approximate reconstruction and evaluation of functions over a high dimensional state space of customer attributes. Here, the method of sparse grids [5, 11] can be used for the approximation of such high dimensional functions. Alternatives are for example kernel based approaches with radial basis functions or neural networks.

Cross- and up-selling :

As a second example for category management in the retail market we consider cross- and up-selling. Every salesperson knows that it is easier to sell additional products to an existing customer than to gain new customers. Cross- and up- selling addresses this core topic of increasing the customer value. The goal is to offer additional products (cross-selling) or higher valued products (up-selling) to existing

customers based on their preferences which are indicated by their interests or former purchases. Besides the increase of revenue for the merchant good cross- and up-selling also leads to higher satisfaction of the customer. Since the customer is receiving offers he is actually interested in he can save time and can avoid searching on his own.

Cross-selling starts with the disposition of the products into the market. This is traditionally the role of the category manager, although mathematical approaches are being used for several years as well. In particular, clustering approaches are used for basket analysis. These methods work transaction based and analyse for example cashier data with regard to cooperative sales. Products which are frequently bought together can therefore easily be placed near to each other in the store. Alternatively content based methods are used to analyze products and categories according to their attributes (colour, description, sound,...) and appropriate product clusters are formed. In addition to the disposition of products the e-business brought new forms of interactive and automated cross-selling: recommendation engines and avatars lead the customer to related products and services. Well known and at the fore-front is the online shop Amazon.com. While they are shopping customers are presented with overviews of related products based on their current shopping basket and product searches ("customers who bought this product also bought..."). Although the early algorithms of Amazon.com were based on simple co-relation analysis, they led the way for modern recommendation engines and adaptive analysis systems. Recommendation engines are nowadays

established in e-business and are used in generalized forms for a wide range of applications like searches, matching, personalized pages, and dynamic navigation. At the same time it became the topic of academic research and meanwhile a large amount of publications exists. Current methods range from clustering and text mining, Bayesian nets and neural nets up to complex hybrid solutions. Although the mathematical foundation of many approaches is still lacking, there is no doubt that currently an exciting research topic for applied mathematics is built here. In the following we discuss this example of dynamic programming for product recommendations in more detail.

Success story - Product recommendations:

Recommendation engines nowadays play an important role for automated customer interaction. A recommendation engine offers, based on click and purchase behaviour of a customer, automatically related product recommendations. The recommendation engine learns online directly from the customer interaction. Recommendation engines increase the sales up to 20 % and lead to enlarged customer satisfaction. But their application is not limited to this, modern recommendation engines vary design, product assortment and prices dependent on the user and allow totally new possibilities of personalization.

In stationary retail the use of automatic recommendation engines appeared until now technically infeasible, although interest exists since

most buying decisions take place in the store. But change is on the horizon. In the first shopping malls electronic tools like the personal shopping assistant are available, a device which is placed on the shopping cart. Customers can access detailed information for a product from the shelf by using the scanner of the personal shopping assistant, the display then shows the corresponding information and addition- ally related product recommendations. Such systems allow for the first time fully automatic interaction with the customer in the store, for example in form of real time couponing on the receipt depending on the purchases or in form of dynamic price changes using electronic displays. This results in an interest.

Discussion:

Data mining is a tool used to extract important information from existing data and enable better decision-making throughout the banking and retail industries. They use data warehousing to combine various data from databases into an acceptable format so that the data can be mined. The data is then analyzed and the information that is captured is used throughout the organization to support decision-making.

It is universally accepted that many industries (including banking, retail and telecom are using data mining effectively. Undoubtedly, data mining has many used in industries. Its practical applications in such areas as analyzing medical outcomes, detecting credit card fraud, predicting customer purchase behavior, predicting the personal interests of Web users, optimizing manufacturing processes

etc. have been very successful. It has also led to a set of fascinating scientific questions about how computers might automatically learn from past experience. The retail industry is also realizing that data mining could give them a competitive advantage.

A majority of the banks in developing countries (particularly in the public sector) are not usually known to exploit their information.

Data mining typically involves the use of predictive modeling, forecasting and descriptive modeling techniques. By using these techniques, an organization can proactively manage customer retention, identify cross-sell and up-sell opportunities, profile and segment customers, set optimal pricing policies, and objectively measure and rank which suppliers are best suited for their needs.

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