



White Paper

Data Mining for Business

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1. Introduction

This white paper provides an overview of the principles of data mining and their application in a business context. It addresses theoretical and practical considerations and so will be of interest to both analysts and business managers with an interest in the output of data mining.

Data mining is the process of discovering information from data, with the emphasis on discovery. To put this another way, conventional analysis starts with an assumption and looks at the data to see if it is true. Data mining looks at the data and discovers what is true.

Data mining techniques underpin modern approaches to market segmentation, targeting and prioritisation. These topics are covered in Wright Associates' white papers *Customer Segments for Marketing* and *Market Targeting and Prioritisation*.

2. Why is Data Mining Important?

Fundamentals

The philosophy behind data mining is that, given enough data about customers, it is possible to predict with a reasonable degree of accuracy what they are going to do next. This is entirely different from conventional analysis which looks at what has happened in the past.

As a consequence, data mining has applications in virtually every area of business. The following two examples illustrate the point.

Example 1

A telephone service provider found by conventional analysis that 60% of its customers are men aged between 25 and 45. It would have seemed natural to for them to target their marketing at this group. However, by looking at all the other data they held they discovered that three quarters of the sales made to this target group were as a result of a telephone call from a woman.

Action based on the conventional analysis would have focused sales and marketing resource on the wrong audience at the wrong stage of the sales cycle.

Example 2

An oil company was looking to identify market segments for their oil amongst motorcycle owners in South America. Their marketing to date had assumed the market divided into three segments:

- people who were passionate about the brand of oil they used;
- people who were passionate about their motorcycles and who trusted their service agent to choose a premium brand of oil;
- people who didn't care what oil they used.

The original aim was to confirm whether this view, centred on attitude towards brand, was valid. Conventional analysis did indeed show that the market could be broken down in this way, but using data mining to discover market segments revealed that the key differentiators were:

- the price of the oil;
- the age of the motorcycle;
- the importance to the owner of keeping the motorcycle in good working order.

That is to say, the brand of oil in itself was completely unimportant in the purchase decision. This insight allowed the company to adjust its marketing strategy to take account of the real, rather than assumed, differentiators.

In essence, data mining starts with the premise that there are no known patterns of customer behaviour. Rather than asking "Is this the pattern?", data mining asks "Is there a pattern, and if so what?".

3. Operational Considerations

Organisational Commitment

Data mining is a powerful tool that can be used to modify the business proposition to meet the needs of customers. It requires data to be accessed from every part of the organisation, all of which may be impacted by the results of the exercise. A company should only consider embarking on a data mining exercise if it is able to manage the process cross-functionally and is able and willing to make changes based on the output.

Backing for such a project must come at a director level, and the key people at this level are probably the Marketing/Sales Director, and the Finance Director.

Accessing Data

Every contact with the customer is a moment of truth for them. These moments of truth are spread across time and have different degrees of importance for the customer: over time these moments of truth build the customer's perception of the company's brand.

Critically, every point of contact with a customer can generate data potentially useful in a mining exercise.

These data are of different types and are collected in different ways - the following are just a few examples.

- Customers have different needs according to their life-stage, life-style, social characteristics, income.
- Customers operate in different modes according to the time of day/week/year, location, activity.
- Customers only experience the service provided by the business at discrete times. For example:

- a customer of a satellite TV broadcaster only receives the service when they press the buttons on the control;
- a customer of an insurance company only receives the service when they make a claim or receive a renewal notice.

In most organisations such data are held in different and non-communicating databases. To link all the data in such a way that it can be used for data mining is a challenge for the IT department.

The growth of e-commerce has driven advances in linking data and has demonstrated how more traditional businesses can benefit from using the techniques of data mining applied to a unified database.

Full consideration must also be given to the ethical and legal framework for the operation from the outset of planning. Data protection legislation is in force in most developed countries and should be observed in spirit as well as in the letter.

4. Business Benefits of Data Mining

Amongst the needs of the business are:

- To reduce the costs of
 - acquiring customers
 - marketing
 - sales campaigns
- To increase revenues by
 - increased response to sales campaigns
 - increased usage of product/service content
- To decrease customer churn
- To increase the quality of the service by
 - more accurate personalisation
 - better targeted product development

While data mining is not a magic wand that can be waved to cure all business problems, it has a key role in addressing all of the above needs.

Reducing Costs

Acquiring customers

Acquiring customers is an on-going activity. Database marketing enables the business to target the best prospects. By building a profile for each person in the database, the database can be broken down into potential customers who are more likely to be attracted by each service or product.

To do this in consumer markets the business needs a database of the population with life-stage and life-style information. In recent years

the availability and quality of such databases (such as the Claritas database in the UK) has improved markedly.

Marketing

Data mining can provide validated customer segments that are aligned with the marketing channels that have been identified within marketing. It is possible to describe the characteristics of each segment, not only in terms of their demographics, but in terms of their life-stage, their life-style, their interests, and their behaviour.

For example, the business will want to keep customers who are high value and low risk. This segment typically represents the 10 to 20 percent of customers who create 80 percent of the profits. Equally, the business will want to convert customers who are low value and low risk into high value customers. Knowing the characteristics of this segment will tell us how it can be done.

By aligning the marketing strategy with the characteristics of each target audience, the success rate can be increased and the business can reduce its costs.

Data mining can also provide the marketing function with a strategic model based on the attitudinal and behavioural characteristics of the marketplace. This allows 'what-if' questions to be investigated and predictions made. For example, predicting the effect of an increase in the base price of a service on usage and loyalty.

Sales Campaigns

Sales campaigns use a mix of marketing channels which can be supported as described above. Data mining techniques can support all of these, but are particularly effective when used in automated campaigns such as those managed through a website. Amazon.com is an example of a leading company in this area.

Data mining can enhance such automated campaigns in several ways. Firstly, the campaign can be implemented with an inbuilt automated data mining engine to identify likely targets. Moving forward, it can be linked to the individual customer profiles built by the business data mining operation. These profiles are the repository of all the information deduced about customers, relevant to maximising their value to the business.

This allows the business to target its offers efficiently and lower its costs.

Increasing Revenue

Increased Response to Sales Campaigns

The individual customer profiles that are created through data mining can contain buying propensity for each of the company's products or services. By targeting sales campaigns at those most likely to respond, the business will increase the response rate.

The customer profiles can also contain affinities to market segments. This will allow the business to align its sales campaigns to the characteristics of each target audience, thus increasing the response rate.

This can also be extended to new customers or prospects having no history with the company. By picking up indicative data from external databases or sales prospecting, their likely purchase propensities can be linked to those available from data mining. In this way they can be included in targeted sales campaigns, so increasing revenues.

This is in contrast to Customer Relationship Management (CRM) systems. These target customers according to their current behaviour, and are not generally able to target potential customers, or to target customers according to their needs and life-stage.

For example, an elderly man who purchases a Westlife CD for his grand daughter is likely to be identified by a CRM system as having an interest in teenage fashion and pop concerts. Data mining should identify him according to his actual characteristics and behaviour.

Increased Usage of Product/Service Content

Once a customer has been acquired, their financial value depends upon the extent to which they use (and pay for) the product or service. The better the company can tailor the product or service to each customer's needs the greater the likelihood of increased use and repeat purchase.

To do this the business has to provide personalisation that is independent of sales campaigns. Achieving personalisation and increasing effectiveness can be done by data mining. Customer attributes and preferences held in the customer profile can be derived and matched to each product feature or service element.

By matching product or service content to the needs and interests of customers, greater usage can be stimulated, which will mean increased revenue.

As an illustration, there are now devices which monitor television programmes watched. These build up a profile of viewer interests. By matching this profile against the attributes of future programmes, the service provider is able to suggest those which the viewer is likely to enjoy. In this way usage of the service is increased.

Decreasing Churn

Data mining can provide for individual customers an estimate, referred to as a 'retention index', of how likely they are to be retained. This will allow the business to take action that is appropriate to particular circumstances. The effect will be to decrease the rate of churn, which can greatly increase revenues.

For example, if the retention index for a customer falls below a critical value, the business can take action to remedy the situation.

Greater revenue can also be generated when, for example, the retention index is high and the customer is in a more receptive state to accept an offer of further services.

Increasing Service Quality

More Accurate Personalisation

By calculating the characteristics and interests of each customer, data mining will enable the business to provide more accurate personalisation. This means that the content delivery system, the user interface, and the contact centre will be able to behave in ways that match the individual needs of each customer. By doing this, the business will provide customers with information that is timely, relevant, and adds value. The effects of this will be seen in increased revenue from existing customers, greater retention of customers, and an enhanced ability to attract new customers.

More Accurate Service/Product Development

For each product and service data mining will establish what drives satisfaction and what drives revenue and profit. This will give each product and service the opportunity to assess their current offering. As they define new offerings, data mining will be able to give an estimate of the likely take-up.

The effect will be that the business is able to identify and develop new products and services at greater speed and with greater accuracy.

5. Overview of Data Mining Techniques

It is important for anyone commissioning a data mining exercise to have some understanding of what can be involved. Data mining requires far more than running a data set through an off-the-shelf clustering package.

Essentially, data mining involves using a combination of database management and statistical techniques to uncover useful patterns hidden in (usually) large, complex data sets. This section provides a very brief overview of these statistical techniques.

The statistical techniques used can include:

- Factor analysis
- Discriminant analysis
- Conjoint analysis
- Decision trees
- Genetic algorithms
- Fuzzy logic
- Neural networks
- Cluster analysis

This is by no means an exhaustive list, but looking at each of these in turn will give some feel for what can be involved in a thorough data mining exercise.

Factor Analysis

Factor analysis is typically used as a data reduction method. In particular it allows structure in the relationships between variables to be detected, so allowing the number of variables in a data set to be reduced.

It is likely to be used at the beginning of a data mining exercise to identify groups of variables likely to be significant.

Discriminant Analysis

Discriminant analysis allows a set of predictors to be used to predict membership in two or more mutually exclusive groups, when there is no natural ordering on the groups. So for example researchers looking at future university attendance might examine a wide range of factors in childrens' backgrounds (eg parental education, SATs results, class...). Discriminant analysis can then be used to identify those factors significant enough to be reliable predictors of entry into higher education.

Conjoint Analysis

Conjoint analysis is a variety of multi-variate analysis, typically used to assess the weighting of different factors, individually and in combination, in decision making.

It is one of the most widely used statistical techniques in marketing applications. It is commonly used in new product design (eg to test trade-offs between different feature sets and price) and research into purchase behaviour.

Decision Trees

A decision tree is a top-down predictive model used to classify items in a dataset. It arranges variables as sequentially nodes, branching out from a root. At each node the value attributed to the item determine its path.

They are very useful when there are clear hierarchies of data. However, they can also be limited in application because they do not allow for any interaction between branches.

Genetic Algorithms

Genetic algorithms were first developed during the 1960s. They are sometimes referred to as part of evolutionary computing, a growing area of artificial intelligence.

Essentially statistical problems are solved by an evolutionary process resulting in a best (fittest) solution (survivor). This involves eliminating less fit solutions in a way akin to Darwinian natural selection, hence the terms used.

Fuzzy Logic

Most statistical methods rely upon discrete variables. Fuzzy logic is a problem-solving methodology that allows conclusions to be drawn from vague or imprecise data sets. It can be useful in situations where only approximate or ambiguous data are available.

Neural Networks

Neural networks are sophisticated techniques capable of modeling complex, non-linear functions. As the name suggests, they originated in attempts to mimic biological thought processes as part of research into artificial intelligence. They work by using training algorithms to automatically 'learn' the structure of representative data.

Neural networks can be applied in any situation where a relationship exists between predictor variables (independents, inputs) and predicted variables (dependents, outputs). They can be used even when the relationships are very complex and not easy to articulate in the usual terms of correlation or differences between groups.

Cluster Analysis

Cluster analysis is widely used in marketing in the development of customer segments. It actually encompasses a number of different classification algorithms, the most common of which is *k-nearest neighbour*.

The purpose of cluster analysis is to divide a population into discrete groups which, ideally, are very similar internally (ie they have a high degree of internal homogeneity) but distinctly different to each other (externally heterogenous).

6. About Wright Associates

Founded in 1994 Wright Associates is a management consultancy firm offering support to senior executives lacking the time or resource to deal with critical issues as fast as they would like. Our clients range from corporates to SMEs and start-ups. We work across business sectors with a particularly strong track record in technology, media and services. Our services are grouped into focus areas:

- Go to market
- Decision support and planning
- Sales performance
- Africa solutions
- Organisational support

7. Further Information

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