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The fuzzy art of decision science

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Abstract

Over the past 20 years there has been massive investment in management information systems, data warehouses, enterprise resource planning systems and analysis technology. However, considering these massive changes, customer decisions are still made using similar techniques.

Many customer decisions are made using sequential rules embedded within campaign management, collections, new business and other customer processing systems.

But customer decisioning is not just an analytical process based on statistics, since it also requires the input of experts and knowledge about other factors that cannot always be based on past experience — for example, the future actions of competitors or changes in business priorities. However, many organisations have found that sequential rules are often difficult to maintain, since they require specialists who change and manage the code and consequently the systems do not always reflect the many different factors that should be considered in making a decision.

This paper addresses the role of customer decision making in organisations and how technology supports this task. It examines whether decisioning technology has moved forward to take advantage of the massive quantities of data and enormous computing power now available, and whether a ‘fuzzy decisioning’ approach would provide better decisions in certain situations. A fuzzy decisioning approach would weight the significant factors in the decisioning process to make a particular outcome more likely. By contrast, a rule-based approach would split groups of customers into different populations based on a logical condition. After reading the paper, readers may also wish to reflect on whether customer decision making is actually a science or an art!

Keywords: customer decisioning, customer relationship management, fuzzy decisioning, decision support, opportunity prioritisation, campaign planning

Background

It was only at the end of the 1970s that the first UK decision support systems were introduced by mail-order companies to make decisions on new customers for account facilities. By the end of the 1980s, most retail banks had taken their first steps in using customer analytics to assist in the automation of operational processes such as pay/no-pay decisions or collections. In the 1990s, many ‘business to consumer’ organisations recruited large teams of analysts to help manage customers more efficiently using statistical models. These models help organisations manage credit risk, retain customers, cross-sell and up-sell new products and services and detect fraudulent behaviours. This enabled banks to

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move customer decisions from the local branch manager's office to a more centralised team at head office: analytical customer relationship management was born.

One would expect that the use of statistical techniques and models has improved the process and quality of decision making within organisations. With the use of better customer and transaction data, it is clear that better decisions can be made. Many organisations have used data-based statistical techniques to reduce costs through automating existing decision processes. While these solutions have been sufficiently sophisticated to cope with the complexity of operational decision making, the rule bases have usually reflected previously employed operational processes.

It is hard to incorporate all dimensions of a decision into rules

The weaknesses of this approach are that the decision processes reflect irrelevant policy and procedures or do not accommodate other relevant factors when managing the wider customer relationship. Even though such systems are highly complex, many still fail to reflect the complexity of the decision process, either based on lack of data or because it is hard to incorporate all dimensions of the decision into rules.

The anatomy of a decision or problem

An economics A-level teacher once said to his class: 'Class, take notes on the two "golden rules" for passing economics exams.' The students all got out their pens, expecting words or insight and wisdom that would propel them to the universities of their choice. Then he said: 'One: read the question. Two: answer it!' Not quite what was expected, but good advice nevertheless! Often in our working lives there is not the luxury of having even the questions provided to us. Frequently the first issue we need to address is 'what is the right question?' or 'do we even need to make a decision?'.

We like yes/no answers

As individuals we like yes/no answers: for example, the advocate is always trying to get a 'yes' or a 'no' out of a witness in court. In business, perhaps we also like to ask ourselves yes/no questions!

For example, a bank may wish to identify which customers should be offered a pension product and use a cross-sell response model to determine which customers are contacted in a direct mail campaign. The bank is trying to identify a population to mail and is left with a population not to mail. But has the bank answered (or even asked) the right question? For example, has it considered the following?

Different questions

- What criteria should be used for selecting customers for the pension?
- Why should we offer this customer a pension rather than another savings product?
- Would we be better doing nothing for this customer?
- Through what channel should we offer the customer a pension?
- Should we offer the pension, but with a different incentive?
- Should we still offer the pension, but in six months' time?
- If we offer this customer a pension do we have the budget to offer the pension to all eligible customers?

- What is the impact on future customer purchases for those who do not want the pension?
- Will the customer buy a pension, but not under a different brand?

All of these questions are quite legitimate, but it is difficult to use sequential business rules to provide the flexibility to answer them. Perhaps the bank is only asking the question that it knows how to answer?

It is relatively easy for an organisation to develop a set of business rules which determine the eligibility for a credit product or what communications should be sent during the process of insurance renewal, since the rules can be determined by a single objective (credit risk and retention rate respectively). For these circumstances the use of sequential business rules within credit scoring and campaign management systems works well.

Multiple objectives

But the complexity in developing business rules is more apparent in business scenarios where there are multiple, often conflicting, objectives, high numbers of products, channel complexity and where capacity constraints limit the number of customers to whom different strategies can be applied. An example would be in an inbound call centre where the organisation's objective is to sell additional products to existing customers. There are many different actions that could be taken, so how could one set of rules determine the best for each customer? And even if one could do that for one scenario, how would the system reflect the different levels of activity within the call centre?

Many actions

Is there an alternate approach to making customer decisions?

It has been seen that where there are multiple outcomes, uncertainty or variation in the operational environment a rule-based approach may be sub-optimal. However, what are the alternatives? Perhaps one does not need to look very far?

Individuals are good at evaluating many options

As individuals, we are very good at evaluating many different options and considering the merits and implications of each. Each day, we are juggling our lives between work and home and we understand the dependencies between the decisions in our everyday lives. We balance all these factors to optimise behaviour within our constraints of money, time and known risks. For example, the choice between a take-away meal on the way home from work compared to cooking your own meal will be based on cost, the time taken in buying/preparing the meal, the nutritional value of the food, your (perceived state of your) waistline, your previous experience of the take-away etc. The actual selection may vary depending on the importance of each of these factors at a point in time. If we are tired or busy, we are more likely to select the take-away; if we have not been paid yet this month, we may eat at home or not at all.

The point is, as individuals, we balance many different factors and ask ourselves different questions, or use different criteria for the same decision in different circumstances for even the simplest of tasks. Our decision making is flexible and intuitive!

While technology has advanced and we may one day be able to

replicate the human thought process, we certainly cannot do so now. However, we may be able to adapt some of these concepts to develop alternate approaches to customer decision making.

Making customer decisions

Some organisations are trying to replicate the ‘corner shop’ — where the proprietor understands each customer’s needs, situation, family and preferences — in their branch, call centre and interactive customer service operations. Data analysis provides the intelligence for the customer decision. The traditional shop proprietor uses his or her knowledge to maximise the long-term value of the customer relationship by balancing many different factors when selling or servicing the customer’s needs. It is this paper’s thesis that the flexible and intuitive ‘shop proprietor balancing approach’ is more appropriate to the management of complex customer relationships.

Shop proprietor balancing approach

Creating a framework for customer decisioning

The two-step process for passing A-level economics is a simple solution to a (relatively) simple problem. When tackling more complex customer decisions such as cross-sell, retention and risk management we need a decision framework which enables us to manage the complexity, fluidity and volatility of the decision and gives the ability to balance different factors within the decision process.

Option analysis

John D. Arnold¹ identifies a seven-stage ‘option analysis’ decision process. Arnold acknowledges the need to apply a rigorous decision process which incorporates the humanistic emotions and feelings which are part of any decision. Arnold’s seven steps are:

- smoke out the issues
- state the purpose
- set criteria
- set priorities
- identify options
- test the options against the criteria
- troubleshoot and refine the choice.

This technique can be used to accommodate the different dimensions of a decision and enables the decision maker to make different decisions, even as the criteria used for the decision process vary over time. The approach also reflects the need for feedback into the decision process, indicating perhaps the difficulty in articulating all the different aspects of a decision. This decision process does not reflect those used within many of today’s available customer decision-support technologies.

Fuzzy decisioning

While not strictly advocating the specific application of the Arnold decision process to all customer decisions, many elements of this framework have considerable merit when defining an appropriate structure for customer decision making.

Fuzzy decisioning

This decision process could be called ‘fuzzy decisioning’. It is ‘fuzzy’ because there are few ‘hard’ rules which determine a particular action. Instead, factors are weighted to indicate the relative importance of each component within a decision process. The weights can be derived statistically based on past behaviour, or can be based on experience and understanding of a specific situation which cannot be modelled using historic data. Another characteristic of fuzzy decisioning is the application of rules to many components of the decision process: to the customer, product, channel, message, objective or a combination of these. This is difficult in a rule base which needs a logical process flow.

Fuzzy decisioning allows a decision process that combines analysis with intuition and control to enable an organisation to manage its customer base more effectively. Its approach recognises that decisions must reflect changes in situations and environments, multiple factors and dimensions, limited information availability and unknown behaviours that characterise most organisations.

Some factors cannot be modelled

To be clear, the paper is not advocating dropping statistical analysis for decision making, but what it is saying is that some factors within our decision making cannot easily be modelled and we need to adapt our decisions based on other factors.

Applicability of fuzzy decisioning to different business scenarios

Where it is difficult to define hard or absolute rules then the decision is probably ‘fuzzy’! The fuzzy decisioning approach is designed for the following types of organisations and decision processes.

Multiple trade-offs

Multiple decision objectives

Multiple and competing business objectives and criteria are used for decision making — examples of these criteria would include sales targets, customer revenues, customer profitability, customer product holding, return on investment etc. Here there are often multiple trade-offs between different objectives which are difficult to define and highly non-linear. For example, individuals are targeted on achieving product sales targets; however, one also must ensure that existing high-value customer relationships are not damaged.

Some rules are never black or white

Grey rules rule

Some decisions rely on an expression of preference rather than strict conditions of certainty. When selling dog food, knowing that the person owns a dog is almost a precondition of the purchase — there is an absolute rule — but when determining which image to use on a customer communication it is likely that the best choice is one of preference rather than an absolute, and it is therefore more suited to a fuzzy approach. Similarly, it may be inappropriate to offer a customer the same product through the same channel within a period of three months (say). However, it may be very relevant to offer a similar product (perhaps with preferential terms) through a more convenient channel following a specific customer event. In these circumstances, while having previously

offered a customer a similar product may mean that he or she is less likely to respond to similar products, the customer event and change in price and channel mean the new offer is still highly pertinent. These types of rules could be called 'grey rules' (as opposed to yes-or-no rules), and they characterise many decisions which express preferences rather than absolutes.

Many options

Large number of communication permutations

The massive growth in new channels has significantly increased the number of communication options available to the marketer. Also, low-cost channels have enabled differently priced business propositions to be made. For example, Web-based insurance or airline tickets booked online may be priced to reflect the cheaper channel. Consider the number of communication permutations faced by a retail bank (Table 1).

Change in options

New products (such as in retail organisations) and new channels mean there are frequent changes to the options that need to be evaluated. A retailer of CDs or fashion items will constantly have to update the range of products and develop new rules based on experience, intuition or human logic rather than statistical tests.

Buried knowledge

Topical relationships between entities

This is a situation where there is known information about products and services which can be applied to different but similar situations. For example, while a retailer may not be able to identify whether an individual would purchase a specific new fashion item, if the retailer could identify that the customer regularly bought newly released items of similar styles this information would be very useful in developing appropriate rule sets. These rules rely on creating relationships between different entities, which need to be built as logical relationships within the data. For example, understanding that a CD is by the same artist, has the same lead guitarist, is in the same style or has the same label as another may be important.

Change in decision criteria or parameters

This applies where there is frequent change in the criteria used for the evaluation or in the competitive environment of the decision. For example, changes in business targets or competitive forces changing

Table 1: Communication permutations for a medium-sized retail bank

	Average number	Example
Products	20	Fixed-rate mortgage
Incentives	5	5% over two years
Packs	7	Variety of message
Channels	6	Statement insert
Customers	7 million	
Permutations	29 billion	

Insufficient time to build and implement models

product sales volumes would require changes in business rules. However, in these situations the external environment moves at such speed that there is insufficient time to secure outcome data on which to build and implement traditional models. Consequently, a ‘fuzzy’ approach is likely to be better than an approach that relies simply on historical behaviour. Indeed, the ability to factor in expected future changes in the competitive environment (say) would perhaps be even more desirable!

Alternate decision-making approaches

These techniques may be viewed as complementary to rule-based or fuzzy decisioning approaches, although there is an element of overlap.

Optimisation

Some organisations have utilised optimisation algorithms and techniques to assist in customer decisioning. Optimisation works well where there are clearly defined customer objectives and business constraints, where there is good and well-understood experience of different customer behaviours which can be modelled and where there is stability in the business environment. However, for many organisations the environment, objectives and constraints are somewhat ‘dynamic’, and consequently other factors need to be considered as part of the decision process. This requires frequent rerunning of the optimisation process (which in itself implies a degree of sub-optimality), or means that it is very difficult to define clearly the optimisation processes’ objective or derive the constraints.

Other factors need to be considered

Collaborative filtering

This technique relies on finding historical customers with similar behaviours and then using this information to identify appropriate ‘next-sell’ actions. Collaborative filtering has a significant role to play within the decision process for organisations with large and stable product ranges and where historical purchasing patterns accurately predict future behaviour, such as retail cross-sell. It is less appropriate where there are multiple objectives, where timing or response to events is important, where other customer actions are important, where there is resource/capacity constraint or where there is a cost (actual or causing damage to the customer relationship) in applying an incorrect action.

The role of fuzzy decisioning in customer relationship management

Customer relationship management (CRM) has many definitions, but a key element of most definitions would include the requirement of organisations to respond to customer needs. However, any customer action must make economic sense to the organisation as well as to the customer. One perspective is that organisations should do ‘what is right for the customer’, implying that benefiting the customer will help create a sustainable relationship that maximises the long-term customer value. Perhaps this approach is appropriate where efforts have been made in developing an exclusive brand, such as Harrods or BMW. As a result, the

Customer actions must make economic sense

CRM — Correct balance between customer and organisation

CRM decisions ideally suited to fuzzy decisioning

business case for sustaining longer-term customer relationships results from a small improvement in customer retention leading to a large improvement in business profitability over the medium term. However, in many other types of business, particularly in lower-margin commodity products such as telephony and financial services, this approach may not be effective, since a customer may not want a 'relationship' or is never going to generate long-term value due to low purchasing capability. In these situations, doing what is right for the customer is not profitable for the organisation

Perhaps a better definition of CRM is to determine the correct balance between doing what is right for the customer and what is best for the organisation. This balance will depend on many changing factors as the goals, capabilities and situation of the organisation also evolve. This balance may also change quickly due to changes in the cost of resources: for example, a change in usage changing the cost base of a customer contact centre. In practice, making profitable business decisions relies on making value judgments about balancing the needs of customers with the ability to create value for the shareholder. CRM managers need to find a balance between customer and organisation in a way that reflects the variation in customer value. This balance is illustrated in Figure 1 through weighing what the customer wants from the organisation with the profitability the organisation needs for its shareholders.

This CRM decision process is ideally suited to a fuzzy decision approach since there are many different options or actions to evaluate, high variances in customer value, many decision factors (such as response rates and product values) that are particular to each customer, and many customer environments are subject to constant change.

Figure 1: Finding the relationship balance between what is best for the customer and the management of the organisation

The role of fuzzy decisioning in customer selection — Balancing campaign and customer objectives

The traditional approach to making proactive customer offers has been to identify customers who are eligible for specific offers. In today's complex multi-product, multi-channel environment this has resulted in many organisations evolving complex rule-based processes to determine which action has priority. While this priority considers the different response rates as components of the profitability of the proposition, it may not reflect the customer's preference in the decision process.

While the automation of selection processes has enabled organisations to run multiple campaigns simultaneously, it has become more difficult to determine if each customer is receiving the offer or communication which is the 'best option' for either customer or organisation.

Fuzzy decisioning enables all potential actions to be evaluated for each individual customer and then prioritised. Each and every (appropriate) action for each customer is sequenced based on all relevant factors. Fuzzy decisioning allows weights to influence this priority. For example, these weights would ensure that a customer's lack of response to a proposition reduces the likelihood that the customer is either offered similar products or communicated with through the same channel in the future. However, this approach can mean that customers with a high likelihood of responding to a specific proposition will still be selected for repeat communications.

Fuzzy decisioning can also enable users to factor multiple issues into the decision process, whether relating to the individual customer (eg needs, circumstance and events), a business process (eg channel cost and capacity) or the entire organisation (eg sales and profitability). This decisioning process enables the organisation to manage its objectives for different customer groups and its own priorities for resource availability, customer service, profitability aspirations and brand management.

A traditional, sequential, rule-based approach to this problem would create very complex solutions. Indeed, it would be almost impossible to determine how to start evaluating a sequential rule set that would be needed if different customers required different criteria for the decision process.

Fuzzy decisioning as component of a customer management framework

Fuzzy decisioning relies on *both* the application of statistical models and the use of intuitive rules based on experience or knowledge. While it stands on its own as a decision technique, it is best used as the decision-making component of a customer management framework.

An ideal customer management strategy has seven steps:

- objective definition
- strategic segmentation
- descriptive profiling
- component modelling
- fuzzy decisioning

**Fuzzy decision
weights**

Multiple factors

**Rule-based solutions
create complexity**

- operational deployment
- review and feedback.

Business goals

Objective definition

The business needs to understand its wider business goals and objectives in order to make better customer decisions. The organisation will be driven by expectations of the shareholder in terms of short- or long-term profitability, rate of growth or control of costs.

Current and potential value

Strategic segmentation

An organisation's customer strategy is best determined by the relationship between current and potential customer value based on the business objectives. Strategic segmentation groups customers using a combination of current and potential value — Figure 2 illustrates an example. The strategic segmentation approach enables the user to identify which customers should be retained, developed, transferred or just serviced.

John Groman has previously advocated a similar segmentation approach in more detail.² Groman advocates an approach based on identifying the value gap in the customer relationship, which could be one of the inputs to the fuzzy decisioning process.

Descriptive profiles

Descriptive profiles are categorisations of customers who exhibit similar behaviours — such as product purchase, channel usage, attitudes, needs

Figure 2: An example of strategic segments

**Understand
customers through
pictures**

and preferences. Descriptive profiles help an organisation understand its customers through pictures and words and help determine the subject, message and method for communicating with these customers.

Descriptive profiles are particularly useful when influencing actions of a group of customers rather than individuals, but are rarely prescriptive since they usually indicate preferences towards particular behaviours. As a result, they are sometimes difficult to factor into a rule-based decision process. However, different marketing messages through different channels can be factored into a fuzzy decisioning process through weighting.

Component modelling

There are two sets of decision components: customer components and organisation components.

Customer components affect customers in the decision process — for example, using propensity models to model known outcomes. In addition, the value of products purchased and the margin contribution can be modelled to reflect the different levels of profitability. Retention models identify the willingness of customers to stay with the organisation and help to derive the value of existing customer relationships. Ideally all of these customer factors are considered within the decision process.

**Not all data are
available**

However, in many organisations not all the data on past decisions are available, or past decisions are not representative of current decisions. This means that alternate approaches should be considered. For example, a propensity model for a product mailing campaign may have been developed but the organisation wants to offer the same product through a telemarketing channel. It needs to blend the product propensity with customers' preferences for transacting through a different channel. Until the organisation has experience of this combination it is impossible to develop a specific propensity model. As a result the decision-making process needs to be very flexible to accommodate this circumstance.

**Inclusion of
customer permission**

Another customer factor is the influence of permission-based marketing within the decision process. Customer permission legitimises customer communication through specific channels or for different products. This information can be factored into the decision-making process at an individual customer level to make a specific communication (based on the customer's stated preferences) more likely. Organisation components are determined by the organisation and include the costs of services or channels and the organisation's business objectives which influence customer decisions. For example, growth in the number of customers or the sale of specific products may be very important for the organisation or individuals within the organisation over and above the pure financial benefit.

Fuzzy decisioning

While it is appropriate to devise a strategic approach to customer groups and to describe customers using descriptive profiles, events occur to customers, not segments! If an organisation is to communicate individually to its customers, then it must recognise the specific

Each action assessed

Customers, organisations, products and channels factored

requirements of each customer. As illustrated in Figure 3, the fuzzy decisioning approach identifies the best next action and priority for each customer through an evaluation of every opportunity and balancing the needs of the customer with the needs of the organisation.

Each action is assessed from a customer perspective using a combination of the strategic segment, the descriptive profile, the product and channel propensity model plus the impact and relevance of customer events. This information is then compared with the organisation's own needs and objectives based on, say, market share, product targets, return on investment, resources capacities and budgets. Fuzzy decisioning weights each of these factors by understanding the impact of the action. For example, a model predicting a high propensity to purchase would be used to weight these customers positively while a low-margin product would be weighted negatively, as would a high-cost channel. However, the need for an organisation to meet its product target would require that this product be weighted positively. Also, the benefit of a highly relevant communication to a high-value customer may be weighted more positively than a highly profitable communication! These examples show how different factors are included within the decision process — not just factors relating to the customer, but also to the organisation, product and channel.

The output from the fuzzy decisioning process is a set of customer-level recommendations of next best actions. These actions will be passed into delivery or deployment systems for implementation.

Operational deployment

The prioritised actions may be used directly within a channel or as part of a further selection process. For example, the prioritised set of communications may be used within a campaign management process whereby the priority determines whether a customer is eligible for a specific selection — not just based on the business objectives but also on the customers' preferences (as determined by the organisation!). Within a call centre or website prioritised actions may be rotated or specific actions

Figure 3: Fuzzy decisioning process

selected based on additional information supplied by the customer or operational circumstances like the workload of the call centre.

Review and feedback

In any decision process, the opportunity for feedback helps improve and refine the decision process. In this context the opportunity to develop statistical models based on actual behaviour will certainly improve an intuitive decision.

Results from fuzzy decisioning

This approach has already been used by organisations to improve their customer decisioning processes. Its initial deployment has been within a multi-product and multi-channel financial services sector where it allows an organisation to move from a traditional campaign process (driven by product targets) to a customer-based planning process which identifies the best action for each customer at each point in time. This approach generates increased returns on investment by enabling the organisation to run many more campaigns simultaneously and only select the best actions for each customer. The project also enables improved response rates and a reduction in the number of irrelevant communications to customers that has a positive impact on customer retention. Through identifying customers with little potential value, the number of communications to these customers was reduced profitably. Fuzzy decisioning also allows the organisation to vary the number and frequency of communications made to their different customer groups.

Fuzzy decisioning has also been used as a business-planning tool that enabled different business scenarios to be evaluated before committing scarce resource. For example, it provided the ability to assess the impact on changing the capacity of a call centre. The business case not only demonstrated the financial benefit of the investment, but also identified the impact on the other channels as the call centre was used more effectively.

Conclusions and challenges for decisioning technologies

- Different business problems require different decisioning processes — as the problem's complexity increases, the type of decision process should reflect the many different factors used as part of the decision to ensure that the business remains effective.
- At the core of the decision process is an understanding of the trade-off between what is right for the customer and what is right for the business — for pricing, risk management, product and channel selection and other aspects of the customer decision.
- Responding effectively to changes in business situations requires the ability to manage change at the appropriate level. For example, an increase in demand for the call centre requires that the customer decisioning system can be adjusted to control and manage the discretionary use of the call centre cross-sell actions to balance the load.

**Move from
traditional campaign
process**

**Improved response
rates and reduction
in irrelevant
communications**

**Business planning
tool**

**Trade-off between
customer and
business**

**Fewer yes/no
decisions**

- Knowledge is complex. It is not just about analysis; it is also about human intuition, understanding and experience, which are as significant in the decision process.
- Decisioning technology should also reflect the many shades of grey and lack of absolutes within the decision process. In today's multi-product and multi-channel world, as in the rest of life there are fewer 'yes/no' decisions.

References

1. Arnold, J. D. (1992) *The Complete Problem Solver*, John Wiley & Sons, NJ.
2. Groman, J. (1999) 'Value gap marketing', *Interactive Marketing*, Vol. 1, No. 2, pp. 149–155.