Marketing Bulletin,1990, 1, 46-49, Research Note 2

Pricing Decision Rules for an Expert System

Alan Tse and Peter Alexander

The object of this study was to identify a set of pricing decision rules that could be added to the knowledge-base of the expert system developed by Tse (1989), to improve the performance of that system. As a huge body of price decision making knowledge has already been consolidated in standard marketing textbooks, these texts were chosen as the source of these rules. This paper demonstrates a typical system-user dialogue.

Keywords: expert systems, pricing, decision rules, artificial intelligence

Introduction

In the past few years, research in artificial intelligence has led to the development of "expert systems". An expert system is a high performance special-purpose system which is produced by "capturing" and codifying the skill and knowledge of an expert using a computer language. The idea is that the resulting computer system can then provide the same level of service to a user as the original expert.

The most important component of an expert system is the knowledge-base (K-base), which contains all the "knowledge" in the domain used for making inferences. Waterman (1986) has pointed out that knowledge for an expert system can be acquired in several ways. One way is to adopt an observational approach, and analyse sources such as textbooks, examples and case studies. A second approach is to adopt an intuitive perspective, and have human experts analyse their own cognitive processes and derive a set of rules of thumb (or heuristics) for making decisions.

There are problems in the implementation of each of these two approaches. The problem with the intuitive approach is its dependence on the expert to describe his or her knowledge in an easily understood manner. In practice, many experts make decisions based on intuition, and most of them find it difficult, or impossible, to explain the decisions they make in a problem solving situation.

On the other hand, adopting an observational approach means that only a limited proportion of the problem space receives attention. This essentially means that other potential sources of expert knowledge are ignored. Even so, this approach does provide an accessible and easily codified source of decision rules that can form the basis from which more industry-specific expert systems can be developed. Industry-specific knowledge, usually in the form of heuristics, can be added to the K-base of the general expert system so that the expert system constructed can be used to solve specific problems in the industry.

The object of this study was to identify a set of pricing decision rules that could be added to the knowledge-base of the expert system developed by Tse (1989), to improve the performance of that system. As a huge body of price decision making knowledge has already been consolidated in standard marketing textbooks, these texts were chosen as the source of these rules.

Method

Three popular textbooks were consulted to identify pricing decision rules: "Marketing Decision Making" by Cravens, Hill and Woodruff, 1980; "Marketing Management" by Kotler, 1988; and "Basic Marketing" by McCarthy, 1981.
The first task when developing the decision rules was to identify a number of conditions, or problem situations, that a marketing manager would be likely to encounter. The next step was to identify and extract from each text in turn, the actions that would be available to the manager given the respective condition. Overlapping rules were then combined, redundancies were eliminated and ambiguous terms were replaced by their certainty equivalents. The rules extracted as a result are independent of each other and therefore capable of being represented by a single module in the expert system.

Results

Table 1 shows five of the 27 decision rules extracted from the three texts. These rules will be represented in the knowledge base of the system using a formal language. When the program is executed, the user will be required to answer a number of questions. The answers to these questions enable the system to select the appropriate decision rules from the knowledge base and make a recommendation.

Table 1. Extracted pricing decision rules

Rule	Condition - if . . .	Action - then . . .
1	Manager's objective is to stabilise the market OR product has no differential features OR demand is elastic	Price the product the same as competitors
2	Manager is cost conscious AND the gross margin required is x%	Price = cost * (1 + x/100)
3	Manager wants to gain market share AND potential buyers think the product is worth $P	Price = VC + (P - VC) * 0.618
4	Manager's objective is to maximise current profit and the firm has knowledge of its demand function	Price = P that maximises the current profit function
5	Firm has high customer loyalty	Maintain the present price

The following example shows a typical system-user dialogue:

system > "What is your marketing objective?"
(Please key in the appropriate number)

1. Stabilise the market.
2. Gain market share.
3. Cost-plus pricing.
4. Maximise current profit.
5. Speed up the product's entry into the market.

user > 3

(Since the user's response to the first question is "3", the system will select rule 2 from Table 1 and the following question will be asked to get the required profit margin.)

system > "What is the profit margin required?"
user > 25 %

(In order to determine the best price for the product, the system will search through the accounting subsystem for the cost of the product. However, this search and the subsequent calculation to get the recommended price using the formula "price = cost * (1 + x/100)" as specified by the action part of rule 2 are transparent to the user. Assume that the cost of production is $100; the recommendation of the system will be as shown below.)

system > Your product should be priced at $125.

Thanks for using this system.

The above is a very simplified picture of how the rules are used in the system. The actual operation is much more complicated because of the potentially large number of decision rules. Although the rules are made as independent as possible, the order of the rules in the knowledge base and any uncovered interaction between the rules might cause unexpected results.

In addition, a number of interfaces need to be established between the various subsystems and the main module of the system. For instance, as accounting data is frequently required, a proper interface must be established between the main system and the accounting subsystem for easy retrieval of accounting data. Another complication is that the system must be able to answer "how" type and "why" type questions so that the system will be transparent to the users. All these demand a heavy amount of programming effort and thinking in the construction of the system.

Discussion

The three textbooks provided easily accessible sources from which to extract decision rules, since each included a chapter that focused specifically on pricing decisions or strategies, or both.
The rules suggested in the texts are intended for general price situations. However, a country's economic system is made up of a number of industries, each of which has set of problems or decisions peculiar to its functioning.

It would therefore be undesirable for an organisation in a specific industry to simply adopt such general strategies directly in an attempt to resolve its own unique pricing problems.
This point illustrates a serious limitation of textbooks as a source for decision rules. A general pricing decision rule drawn from a text may not be appropriate for a firm whose management is concerned with solving specific pricing problems exclusive to the industry in which it operates.

A second limitation of using textbook-based decision rules is that in many real-life marketing decision situations, intuition is often the prevailing determinant of a particular course of action rather than carefully followed academic strategies found in textbooks. However, there has been little study of the role played by intuition in experts' decision making process.

A third limitation is that many of the rules mentioned in the textbooks do not have the support of empirical evidence. For example, rule 5, which suggests that firms having high consumer loyalty should maintain the present price, is put forward without any research support. In fact, many of the rules described in the textbooks are founded on intuitive judgement only.

Moreover, many of the rules are ambiguous. For example, the word "loyalty" used in rule 5 is characterized by a high degree of fuzziness. Ambiguous decision rules must be converted to their certainty equivalents, but the derivation of these equivalents is both subjective and contentious.

A fourth limitation is that the rules extracted are dependent on the person doing the extraction. Different persons may come up with different sets of rules from the same source.
In spite of these limitations, rules drawn from textbooks still provide a foundation upon which more industry specific rules can be added for solving industry specific problems. The next task is to test and refine these rules, and to supplement them with rules of thumb based on the decision processes of experts.

References

Cravens DW; Hills GE & Woodruff RB (1980). *Marketing Decision Making: Concepts and Strategy*. Homewood, Ill.:Richard D. Irwin.

Kotler P (1988). Marketing Management (6th ed.). New Jersey: Prentice-Hall International, Inc.

McCarthy EJ (1981). *Basic Marketing* (7th ed.). Illinois: Richard D. Irwin.

Tse A (1989). A Prolog-based expert system for price decision making under incompleteknowledge. In L. F. Pau, J. Motiwalla, Y. H. Pao & H. H. Teh (Eds.), *Expert Systems in Economics, Banking and Management*, Amsterdam: North Holland, 299-308.

Waterman DA (1986). *A Guide to Expert Systems*. Reading, MA: Addison Wesley.

Alan Tse is a Lecturer, and Peter Alexander is a third year BBS marketing student, in the Department of Marketing, Massey University.