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A user-friendly marketing decision support system for the product line design using evolutionary algorithms

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Abstract

A marketing decision support system (MDSS) is presented. It has a user-friendly and easy to learn menu driven interface. Its purpose is to assist a marketing manager in designing a line of substitute products. Optimal product line design is a very important marketing decision. The MDSS uses three different optimization criteria. It examines different scenarios using the ''What if analysis''. Also, it finds optimal solutions only for small sized problems using the complete enumeration method and near optimal solutions for real sized problems using evolutionary algorithms. The user is not forced to be familiar with the underlying models.

Keywords: Marketing decision support systems; Product line design; Evolutionary algorithms; Heuristic methods; NP-hard problems

1. Introduction

More and more managers are faced with a rapidly changing and highly competitive marketing environment. Marketing managers are forced to become more competitive through better decision making.

A decision can be considered as the output of a productive activity whose inputs include intellectual efforts of an individual or a group of individuals, computing hardware and software, data, etc. The advances in computer technology and the computer-based techniques for handling information allow the development of decision support systems, than can play a crucial role in the progress of a firm [7].

There is an obvious need for tools, which can improve marketing decision making. Many efforts have been made to develop suitable software tools, that can act as consultants for marketing managers. There are many opportunities for applications of information systems in the marketing area. The modern information technology and information systems can assist a company to manage the increasing information flow and improve its quality. There is a growing interest in the use of marketing decision support systems (MDSSs) designed to be used in complicated marketing decision making problems [38].

An MDSS is defined as ''a coordinated collection of data, models, analytic tools and computing power by which an organization gathers information from the environment and turns it into a basis for action'' [26].

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MDSSs can be classified according to the questions they deal with. An MDSS has a functionality level 1, when it can answer questions of type ''What happened''. These MDSSs can provide information about customers, sales, competitors, etc. An MDSS has a functionality level 2, when it can answer questions of type ''Why did it happen''. These MDSSs can analyze the effects of own and competitors' marketing actions. They analyze causes of changes in the market. An MDSS has a functionality level 3, when it can answer questions of type ''What will happen if''. These MDSSs can forecast the effect of marketing actions by using mathematical models to compute the outcome of different actions. An MDSS has a functionality level 4, when it can answer questions of type ''What should happen''. These MDSSs intend to find the best marketing strategy in a given situation [41].

The product decision is one of the most important decisions in marketing, because it is costly and difficult to change [25]. The rates of failure of new products and their associated losses are very high [9,19,39]. In today's competitive environment the development of appropriate new products is necessary for the survival of a firm. It is obvious, that before the eventual production and introduction of a new product a company should study very carefully its development. New products play a key role in the growth of sales [19]. The question is: What can a company do to ensure the success of its new products?

The optimal product design problem is a significant part of the new product development problem and one of the most crucial decisions for a firm [8,12]. A reason for the failure of many new products is bad design [24]. Many researchers and marketing managers have dealt with optimal product design. However, only the right choice of the attributes of a product can not guarantee the success of a new product [34].

The purpose of the MDSS presented in this paper is to assist and improve the design of a line of substitute products. Because the product line design problem is NP-hard [22], it is impossible to solve real sized problems in realistic time by using methods, which guarantee the optimal solution. The proposed MDSS uses evolutionary algorithms (EAs) to find near optimal solutions in reasonable time. The aim of the MDSS is to help a marketing manager, who is not forced to be familiar with the underlying models, to deal with questions of levels 3 and 4. The MDSS can facilitate the decision making process and improve the quality of the decision.

The paper is organized as follows. Section 2 deals with the presentation of the product line design problem. In Section 3 the proposed MDSS is presented. In particular, Section 3.1 deals with the data used in the MDSS, Section 3.2 deals with the models contained in the model base of the MDSS and in Section 3.3, the user-interface of the MDSS is presented. Finally, in Section 4, the conclusions of the paper are summarized.

2. The product line design problem

''A product is anything that can be offered to a market to satisfy a want or need''. ''A product line is a group of products that are closely related because they perform a similar function, are sold to the same customer groups, are marketed through the same channels, or fall within given ranges'' [24]. When the buyers' preferences are heterogeneous, it is preferable to design a product line than a single product [25]. In this paper by the term ''product line'' a line of substitute products is meant.

Multidimensional scaling (MDS) and the conjoint method are the basic approaches for modelling the single product or product line design problem. Conjoint analysis has superior analytical capabilities and MDS has superior graphics and data display features [18].

According to the MDS approach the buyers' preferences are described in terms of brand and individual ideal point locations in an attribute space. The aim of the MDS method is to identify ''best'' locations for existing or new products. It is assumed that buyers prefer the products, which are closer to their ideal points [18].

The conjoint analysis has had several thousand commercial applications and is one of the most widely accepted methodologies [43]. Many researchers have used the conjoint analysis modelling approach in the product line design problem. Conjoint analysis provides a methodology that links attributes directly to buyers' preferences. Products are described using attributes and attribute levels. The attribute levels denote the values assumed by the attributes. In the