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An empirical study of dynamic customer relationship management

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Abstract

We apply the Gönül and Shi (1998) approach to the analysis of the optimal messaging and pricing policy mix by studying the past transaction patterns between a local supermarket and its consumers. We develop a dynamic customer relationship management model and investigate the relationship between customer utility and purchasing frequency by modifying the return function of the model discussed in Gönül and Shi (1998). In particular, we extend the analysis to consider a messaging and pricing policy mix, and we use a genetic algorithm in our empirical estimation. When applied to some non-seasonal products in a local supermarket, we find that our model is suitable and far superior to the one-stage model commonly used. Our dynamic model gives the optimal marketing mix strategies in different customer states and the results show that the firm could enjoy a 22% increase in profit.
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Keywords: Dynamic customer relationship management; Customer utility; Customer lifetime value; Markov-perfect equilibrium

1. Introduction

The development of information and communication technology provides many companies with a convenient environment to collect detailed data about their individual customers. These companies can take advantage of customer data to improve their marketing policies to attract more customers and thereby increase their profit. However, while many firms have invested millions in the creation of massive customer information databases, the goal of creating improved marketing policies has often proved elusive (Hoffman, 2001; King, 2001). While the trend continues of firms investing large amounts of money to collect and store customer data (Accenture, 1998), there have recently been a few high-profit firms that have reversed this current and abandoned their customer data collection efforts (Hunt, 1999). Thus, the emphasis is now on the issue of how to effectively utilize the customer databases to manage the customer relationship. It is more important to capture information about your customers than just to build up a database.

However, the potential difficulty of converting data into profits is in how to obtain relevant information from the data and customize the marketing mix policies to satisfy the consumer's wants and needs. As pointed out in Accenture (2004), all customers are not created equal. Customer data are valuable only if it is translated into profitable interactions. Powerful analytical mathematics and statistics models are essential to identify the most profitable customers and predict future profits based on the past history of customers' data. Modeling of customer data has become an increasingly important issue in customer relationship management (CRM). The basic idea of CRM has been embraced and the potential benefits of relationship marketing based upon individual characteristics are generally accepted (Peppers and Rogers, 1993). Over the past 10 years there has been a rapid growth of research topics on modeling the marketing mix as a function of customer relationship

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status, especially taking into consideration both the customer's utility and a firm's profit.

Some important research considers the optimal mailing policy in direct marketing that contributes to an increasingly large share of business sales. Bult and Wansbeek (1995) construct binary choice stochastic models to determine a mailing strategy based on the response behavior of customers. DeSarbo and Ramaswamy (1994) consider latent class models. Neural networks are considered in Levin and Zahavi (1996). Several other papers apply a Markov decision model for direct mailing decisions, see Bitran and Mondschein (1996) and Gönül and Shi (1998), among others. In particular, Gönül and Shi (1998) were the first to propose combining the customer's utility-maximization problem with a firm's profit-maximization problem and thus solve the optimal timing and spacing of direct mailing of catalogs to customers.

Applying the Gönül and Shi (1998) approach, we develop a dynamic customer relationship management (DCRM) model and investigate how the marketing mix policies can be improved by using feedback from customer transaction records. We contribute to the literature in the development, estimation, and testing of an analytical DCRM model that deals with marketing mix policies. Furthermore, we model customers' purchase behavior as a function of current and future marketing decisions in addition to the time elapsed since the last transaction and the number of continuous purchases. We also contribute in the use of a genetic algorithm when estimating the model. By solving the model we arrive at new policies that are both utility-maximizing for the customer and profit-maximizing for the firm over an infinite time horizon.

The Gönül and Shi (1998) approach gave us the initial idea of the DCRM. They present a dynamic structural model that estimates the consumer response to catalog mailings, on the assumption that consumers act as dynamic optimizers. In this context, the assumption implies that a significant part of the motivation for consumers to make purchases is to ensure that they will continue to be solicited. While this paper represents a simple type of customer management, the simple decisions to mail or not to mail are insufficient for most settings. For example, marketing tactics such as pricing and operational characteristics such as messaging are likely to have significant effects on customer retention.

This paper modifies the optimal mailing policy (OMP) model suggested by Gönül and Shi (1998). While the same hypothesis is tested using the model, we propose a dynamic customer relationship management model to illustrate techniques for converting the information contained in customer databases into meaningful knowledge and improved marketing policies. We take a mix of pricing and messaging as the main marketing tactics and measure the sensitivity of the customer's response to these tactics. In the new model, we use the continuous purchase times to replace the accumulative purchase times so as to reduce the customer state spaces and decrease the computational complexity. We modify and verify the relationship between customer utility and continuous purchase time and modify the profit function of the firm by applying the concept of customer lifetime value (CLV) to obtain a better description of the actual CRM situation of the local supermarket under consideration. We estimate the customer discount factor as a parameter rather than taking it as a given constant which was commonly done in the literature. In this way we can take the consumers' heterogeneity into account. Finally, we utilize a genetic algorithm to estimate the model and test the hypothesis by applying the model to some non-seasonal products data from the local supermarket.

The paper is organized as follows. Section 2 presents the model of dynamic customer relationship management and the algorithm to solve the optimal marketing policy. Section 3 describes the data used in this application and the genetic algorithm used for the global optimum solution. Furthermore, the estimation results are presented. Section 4 analyzes the optimal marketing mix policy against the customer database. Finally, in Section 5 we offer our conclusions.

2. Model of dynamic customer relationship management

2.1. Research background and estimation of OMP model

The OMP model, combining a firm's profit-maximizing problem and the customer's utility-maximizing problem, was first presented by Gönül and Shi (1998). The object of their research was the direct mail order industry. In the OMP model, the key factors affecting the optimal mail policy were investigated by maximizing customer utility and the direct-mail company's profit. This model utilized the estimable structural dynamic programming (ESDP) technology to model customer utility and the firm's profit. They considered the exchange between the customer and the firm as a stochastic game process and an equilibrium solution was obtained. The main contribution of the model is that the authors built, estimated, and tested one model that manages the mail policy. The components the model considered were the recency of the last purchase, the accumulative purchase time that describes the customer's purchasing behavior, and the mail policy. Using the model, a firm can get the optimal mail policy to maximize customer utility and its own profit in an infinite time horizon.

The basic assumption in the OMP model is that both the firm and the customers consider not only the current benefit but also the future benefit of a decision. The

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