Catalog Segmentation by Implementing Fuzzy Clustering and Mathematical Programming Model

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Abstract. This work is concerned with the fuzzy clustering problem of different products in j variant catalogs, each of size i products that maximize customer satisfaction level in customer relationship management. The satisfaction degree of each customer is defined as a function of his/her needed product number that exists in catalog and also his/her priority. To determine the priority level of each customer, firstly customers are divided to three clusters with high, medium and low importance based on his/her needed products list. Then, all customers have been ranked based on their membership level in each of the above three clusters. In this paper in order to cluster customers, fuzzy c-means algorithm is applied. The proposed problem is firstly modeled as a bi-objective mathematical programming model. The objective functions of the model are to maximize the number of covered customers and overall satisfaction level results of delivering service. Then, this model is changed to a single integer linear programming model by applying fuzzy theory concepts. Finally, the efficiency of the proposed solution procedure is verified by using a numerical example.

Keywords: Catalog Segmentation, Customer Clustering, Fuzzy C-means Algorithm.

1 Introduction

Nowadays, one of the business and marketing organizations goals is customer attraction. Catalog design has known as the most common way in customer attraction,

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satisfaction, and retention cycle of customer relationship management [9]. Meanwhile one of the challenges that companies using catalogs face is the optimization problem of available products; this means by the catalog which products are covered and for which cluster of customers is designed. The catalog optimization has an effective role in satisfying customers' requirements and company profitability. With the fast growing number of products suggested by retailers and electronic retailers alike, the design of one catalog that can include all products is not possible. In many cases, some customers are attracted by only a small portion of the products the company carries. Nowadays, the catalog design has changed as one of the competitive tools for marketing among companies. The latest Benchmark Survey on important Issues and Trends conducted by Catalog Age magazine in 2003 indicates that catalog companies that participated in the survey spent a mean 26% of their profits on marketing expenses and that print and postage costs account for nearly half of those expenses [1]. The number of catalogs that companies send to customers and potential buyers is also growing up at a fast pace [4].

Efficiency and profitability of one catalog is evaluated by the number of available products of interest to customers that companies send to them. The companies seek optimum decision making on the customers clusters, not optimal decision making as individual [11]. In this problem, the need of a customer is satisfied if at least the specified minimum number of products of interest to him/her is included in one of the catalogs.

The classical catalog segmentation problem was introduced by Kleinberg et al. [7]. This problem consists of designing j catalogs, each of size i products that maximize the number of covered customers. This paper in different from previous studies in the way of defining the problem and also the solution method. Xu et. al. [12] tried to develop j catalogs with i products in order to maximize the overall number of catalog purchased. In his Model, the interest constraint is minimized and the profit constraint is maximized so that the profit of products purchased by customers who have at least t interesting products in receiving catalogs is maximized. Amiri [1] presented a mathematical model that consists of designing j catalogs, each of size i products and the target is finding the maximum proportion of costumers covered by catalogs and maximizes the number of covered customers. But it is unrealistic to assign a crisp value for a subjective issue, especially when the information is vague or imprecise [5]. This is a main motivation of this study. In this paper, the authors modeled the catalog design problem as a fuzzy mathematical programming model and this is the main contribution of this research. Other contribution of this research is considering of priority degree of customers. Efficiency of the proposed model has been verified through a numerical example. This method is quite novel in the area of catalog segmentation problems. In this model, we assume that customers and their product interests are identified. The key input data in order to implement catalog segmentation is the customer interest database that consists of the set of products which each customer is attracted in. The product interests of a customer can be gained either by aggregating all purchase transactions of the customer or by obtaining his/her explicit preferences from a set of products.

The remainder of the paper is organized as follows. In Section 2, we give the definition and formulation of the problem. Then, circumstance of the priority