Fuzzy pricing and marketing planning model: A possibilistic geometric programming approach

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ARTICLE INFO

Keywords:
Optimal pricing
Possibilistic geometric programming
Fuzzy programming
Marketing planning
Fuzzy logic controller

ABSTRACT

During the past few years, many people have been interested in integrated production and marketing planning strategies where demand and cost functions, both, depend on different parameters such as price and marketing expenditure. The primary concern on all previous models is the difficulty on estimating the model parameters such price and marketing elasticity to demand. In this paper, we propose a new possibilistic model which makes it easy to build the overall model based on experts' opinions. The proposed model is formulated in fuzzy geometric programming and the fuzzy decision is made using the recent advances on optimization techniques. We also design a fuzzy logic controller to facilitate the decision making process. The implementation of the proposed model is demonstrated using two numerical examples.

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1. Introduction

The recent advances on pricing and marketing strategies create a good motivation on having more realistic optimal lot-sizing strategies. Lee and Kim (1993) are believed to be the first people who incorporates the pricing and marketing as part of a traditional lot-sizing problem. They assume demand as a function of price and marketing planning where the cost of production is discounted from a demand and the resulted objective is maximized for profitability. The resulted profit function is formulated in a form of geometric programming (GP) and the optimal solution is analyzed. Lee (1993), in other assignment, formulates different form of problem where the cost function depends on the lot-sizing. Sadjadi, Oroujee, and Aryanezhad (2005) consider the Lee and Kim’s method with some additional assumptions. Cheng (1989, 1991) in a different modeling procedure considers the optimal pricing and lot-sizing. Islam (2008) formulates a multi-objective marketing planning inventory model where the space capacity and the shortage are considered. Fathian, Sadjadi, and Sajadi (2008) study the production and marketing for electronic products.

The primary concern on most of the previous production and marketing models is the difficulties occurred for estimating the demand and cost functions. In fact, demand is a log function of price and marketing and traditional econometrics methods such ordinary least square (OLS) can be used. However, the estimated parameters using the statistical models normally suffer from different issues. For instance, one of the basic assumptions on using OLS method is having no correlation between the residuals, i.e. \( \text{cov}(e_i, e_j) = 0 \). Our experience shows that this simple assumption could be easily violated practically. There are also many cases where we face a newly produced product and there is no historical data. Obviously we cannot even use OLS methods to estimate the parameters. The production and marketing planning can be integrated with the concept of fuzzy logic. Roy and Maiti (1997) formulate a single objective lot-sizing model in fuzzy environment and the resulted model was solved using GP technique. Mandal, Roy, and Maiti et al. (2005) propose a multi-item inventory model with multiple objectives in which shortage and storage space are permitted and demand depends on unit cost. Islam and Roy (2006) study a production lot-sizing model with the consideration of flexibility and reliability of production process. Their model involves a storage space constraint and fuzziness is considered in objective and constraint goals, coefficient and indices of the objective function and the constraint. In other study, Islam and Roy (2007) formulate similar model in which the inventory costs, storage spaces and others parameters are considered as fuzzy numbers. Panda, Kar, and Maiti (2008) develop a multi-item production and lot-sizing model in which the cost parameters are of fuzzy/hybrid nature under two types of resources: (a) resources as fuzzy quantities; (b) resources as fuzzy and fuzzy-random quantities. However, the classical fuzzy models used for lot-sizing can be also criticized for a crucial reason. In the aforesaid inventory models, parameters and coefficients of decision variables are considered as fuzzy numbers whereas decision variables are considered to be crisp. This means that, in an uncertain environment, a crisp decision is made to meet some decision criteria. For the first time in the literature, Tanaka and Asai (1984) develop a possibilistic linear programming (PLP) where the coefficients of decision variables are crisp whereas decision

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doi:10.1016/j.eswa.2008.10.009