Chapter 6.15
Innovative Hybrid Genetic Algorithms and Line Search Method for Industrial Production Management

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ABSTRACT

Many engineering, science, information technology and management optimization problems can be considered as non linear programming real world problems where the all or some of the parameters and variables involved are uncertain in nature. These can only be quantified using intelligent computational techniques such as evolutionary computation and fuzzy logic. The main objective of this research chapter is to solve non linear fuzzy optimization problem where the technological coefficient in the constraints involved are fuzzy numbers which was represented by logistic membership functions by using hybrid evolutionary optimization approach. To explore the applicability of the present study a numerical example is considered to determine the production planning for the decision variables and profit of the company.

INTRODUCTION

It is well known that optimization problems arise in a variety of situations. Particularly interesting are those concerning management problems as decision makers usually state their data in a vague way: "high benefits", "as low as possible", "important savings", etc. Because of this vagueness, managers prefer to have not just one solution but a s of them, so that the most suitable solution can be applied according to the state of existing decision of the production process at a given time and without increasing delay. In these situations fuzzy optimization is an ideal methodology, since it allows us to represent the underlying uncertainty of the optimization problem, while finding optimal

DOI: 10.4018/978-1-61350-456-7.ch6.15

solutions that reflect such uncertainty and then applying them to possible instances, once the uncertainty has been solved. This allows us to obtain a model of the behavior of the solutions based on the uncertainty of the optimization problem.

Fuzzy constrained optimization problems have been extensively studied since the seventies. In the linear case, the first approaches to solve the so-called fuzzy linear programming problem appeared in Bellman & Zadeh (1970), Tanaka, Okuda & Asai (1974), Zimmermann (1976), Sengupta, Vasant & Andreeski (2008). Since then, important contributions solving different linear models have been made and these models have been the subject of a substantial amount of work. In the nonlinear case (Ali, 1998; Ekel, Pedrycz & Schinzinger, 1998; Ramik & Vlach, 2002; Vasant & Barsoum, 2008; Vasant, Barsoum, Khatun & Abbas, 2008; Jimenez, Sanchez & Vasant, 2008) the situation is quite different, as there is a wide variety of specific and both practically and theoretically relevant nonlinear problems, with each having a different solution method.

In this chapter, the new methodology of modified s-curve membership function using fuzzy linear programming in production planning and their applications to decision making are carried out. Especially, fuzzy linear programming based on vagueness in the fuzzy parameters such as objective coefficients, technical coefficients and resource variables given by a decision maker is analyzed.

Various types of membership functions were used in fuzzy linear programming problem and its application such as a linear membership function (Zimmermann, 1976; 1978; Elamvazuthi, Sinnadurai, Khan & Vasant, 2009), a tangent type of a membership function (Leberling, 1981), an interval linear membership function (Hannan, 1981), an exponential membership function (Carlsson and Korhonen, 1986), inverse tangent membership function (Sakawa, 1983), logistic type of membership function (Watada, 1997), concave piecewise linear membership function (Inuiguchi, Ichihachi and Kume, 1990) and piecewise linear membership function (Hu and Fang, 1999). As a tangent type, of a membership function, an exponential membership function, and hyperbolic membership function are non-linear function; a fuzzy mathematical programming defined with a non-linear membership function results in a non-linear programming. Usually a linear membership function is employed in order to avoid non-linearity. Nevertheless, there are some difficulties in selecting the solution of a problem written in a linear membership function. Therefore, in this chapter a modified s-curve membership function is employed to overcome such deficits, which a linear membership function has. Furthermore, S-curve membership function is more flexible enough to describe the vagueness in the fuzzy parameters for the production planning problems (Vasant, 2003; 2006; 2008). Moreover, the application of modified s-curve membership functions in production management and industrial manufacturing problems are widely available in Vasant, Bhattacharya & Abraham (2008), Peidro & Vasant (2009), Tsoulos & Vasant (2009) and Vasant & Nader (2009).

Due to limitations in resources for manufacturing a product and the need to satisfy certain conditions in manufacturing and demand, a problem of fuzziness occurs in industrial production planning systems. This problem occurs also in chocolate manufacturing when deciding a mixed selection of raw materials to produce varieties of products. This is referred here to as the Product-mix Selection Problem (Tabucanon, 1996). The objective of the company is to maximize its profit, which is, alternatively, equivalent to maximizing the gross contribution to the company in terms of US$. That is to find the optimal product mix under uncertain constraints in the technical, raw material and market consideration. Furthermore, it is possible to show the relationship between the optimal profits and the corresponding membership values (Zimmermann, 1978; Bhattacharya, Abraham & Vasant, 2008). According to this

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