Using Fuzzy Goal Programming Technique to Solve Multiobjective Chance Constrained Programming Problems in a Fuzzy Environment

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ABSTRACT

In this paper a fuzzy goal programming technique is presented to solve multiobjective decision making problems in a probabilistic decision making environment where the right sided parameters associated with the system constraints are exponentially distributed fuzzy random variables. In model formulation of the problem, the fuzzy chance constrained programming problem is converted into a fuzzy programming problem by using general chance constrained methodology. Then by realizing the fuzzy nature of the parameters associated with the system constraints, the problem is decomposed by considering the tolerance ranges of the parameters. The tolerance membership functions of each of the individual objectives are defined in isolation to measure the degree of achievements of the goal levels of the objectives. Then a fuzzy goal programming model is developed to achieve the highest degree of each of the defined membership functions to the extent possible. In the solution process the minsum fuzzy goal programming technique is used to find the most satisfactory decision in the decision making environment. An example is solved to illustrate the proposed methodology and the achieved solution is compared with the solution of another existing technique.

Keywords: Chance Constrained Programming, Exponential Distribution, Fuzzy Goal Programming, Fuzzy Numbers, Fuzzy Programming, Fuzzy Random Variables, Membership Function

INTRODUCTION

To resolve infeasible linear programming problems, the concept of goal programming (GP) was first introduced by Charnes and Cooper (1961). Afterwards the remarkable methodological up gradation of GP was made by Ijiri (1965), Ignizio (1976) and other pioneer researchers. As a promising tool for solving problems having multiplicity of objectives with conflicting
behaviors, GP has been studied extensively and widely circulated in the literature (Kornbluth & Steuer, 1981; Romero, 1986).

The main advantage of GP method is that it leads to arrive at an acceptable compromise solution directly. However the main weakness of classical GP is that the aspiration levels of the goals need to be specified precisely in making a decision. Also the classical GP technique cannot capture directly the uncertainty arises due to the presence of chance constraints associated with the multiobjective decision making problems. To overcome such uncertainties due to probabilistic nature, Charnes and Cooper (1959) first introduced chance constrained programming (CCP) technique. Thereafter different methodological aspects of CCP was discussed by Kataoka (1963), Miller and Wagner (1965), Panne and Popp (1963), Prékopa (1973) and other researchers. Contini (1978) developed an algorithm for stochastic GP problems when the random variables are normally distributed with known means and variances. Stancu-Minasian and Wets (1976) and Maarten and Van Der (2003) discussed research bibliographical surveys in the field of stochastic programming.

Stochastic programming deals with the theory and methods of incorporating stochastic variables into a mathematical programming problem. In most of the stochastic programming approaches, the basic concept is to convert the probabilistic nature of the parameters into an equivalent deterministic model according to the specified confidence levels and the nature of the distribution followed by the random variables. Stancu-Minasian and Wets (1976) and Maarten and Van Der (2003) discussed research bibliographical surveys in the field of stochastic programming.

In the proposed methodology, FGP technique is used to solve fuzzy multiobjective CCP (FMOCCP) problem consisting of exponentially distributed fuzzy random variables associated with the right hand side of the system constraints with the view point that exponential distribution has only one parameter and it is more robust to small sample sizes and uncertainties in parameter fitting than other distributions with two or more parameters. Also the coefficients of the system constraints considered as fuzzy numbers. The general CCP technique is used to remove the probabilistic nature of the problem and to convert it into an equivalent FP model in the model formulation process. Now considering the fuzzy aspects of the parameters associated with the system constraints of the problem, the problem is decomposed on the basis of tolerance ranges of the parameters in the decision making situation. Then the individual optimal solution of each objective are found to construct
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