Available online at www.sciencedirect.com

SCIENCE DIRECT®

ELSEVIER Applied Mathematics and Computation 173 (2006) 782–791

APPLIED MATHEMATICS AND COMPUTATION

www.elsevier.com/locate/amc

Exponential membership function in stochastic fuzzy goal programming

Maged George Iskander

Department of Economics, The American University in Cairo, P.O. Box 2511 Cairo, Egypt

Abstract

Considering the stochastic fuzzy goal programming, this paper provides a study of four known fuzzy goal programming models. This study is considered in the case of stochastic fuzzy goal programming. The chance-constrained approach and the exponential membership function are utilized to transform Iskander's structure of stochastic fuzzy goal program [M.G. Iskander, A fuzzy weighted additive approach for stochastic fuzzy goal programming, Applied Mathematics and Computation 154 (2004) 543–553] to its equivalent deterministic-crisp, according to each one of the four models. The exponential membership function is considered with increasing rate of change and with decreasing rate of change. The decision-maker should precisely set his goals relative weights in two models, and his preemptive priority structure in the other two. A numerical example is given for illustration.

Keywords: Stochastic fuzzy goal programming; Exponential membership function; Weighted additive model; Weighted max–min model

E-mail address: magedgi@aucegypt.edu

0096-3003/$ - see front matter
doi:10.1016/j.amc.2005.04.014

1. Introduction

Fuzzy goal programming is one of the extensions of goal programming. Many problems with conflicting goals are considered in a fuzzy environment. Several contributions have been made in the area of fuzzy goal programming. An interesting review of most of the attempts in fuzzy goal programming is given by Chen and Tsai [2]. The early works by Narasimhan [3] and Hannan [4] have been followed by different approaches that handle imprecise goal programming problems. On the other hand, when randomness exists in a fuzzy goal programming problem, then a stochastic fuzzy goal programming problem is defined. Many real life problems have conflicting goals under randomness and fuzziness. These problems can be presented and solved using different models of stochastic fuzzy goal programming. Some attempts have been made in stochastic fuzzy goal programming [1,5–8]. In these articles, the chance-constrained approach is utilized to transform the problem from the stochastic state to its equivalent deterministic. Also, in most of these articles, the linear membership function is used. Some times, the improvement of the achievement degrees of the fuzzy goals needs to be presented exponentially. In this case, the exponential membership function is utilized.

In this paper, Iskander's formulation of stochastic fuzzy goal programming is used [1]. By utilizing the chance-constrained approach and the exponential membership function, whether with increasing or decreasing rate of change, a study of four main models is performed. Those models represent different approaches in fuzzy goal programming. The first model (M1) is based on the weighted additive model given by Tiwari et al. [9]. The second model (M2) is the weighted max–min model given by Lin [10]. The third and the fourth models (M3) and (M4) are the two models with preemptive priority structures, which have been defined by Chen and Tsai [2]. The main concept of the four models is that the decision-maker can precisely set his relative weights in M1 and M2 and his preemptive priority structure in M3 and M4. In the next section, the structure of the stochastic fuzzy goals and their deterministic-crisp equivalents is given. Also, the formulation of the suggested exponential membership function is stated, with increasing and with decreasing rate of change. Section 3 represents the formulation of the four deterministic-crisp models. A study of the four models is presented by a numerical example in Section 4. The last section contains the conclusion.

2. Stochastic fuzzy goal constraints and their equivalent deterministic-crisp

Assume a stochastic fuzzy goal programming problem in the form:
Find $\boldsymbol{x} = (x_1, x_2, \ldots, x_n)$ to achieve