Chapter 8
Fuzzy Dynamic Programming Problem for Single Additive Constraint with Additively Separable Return by Means of Trapezoidal Membership Functions

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ABSTRACT

Dynamic Programming Problem (DPP) is a multivariable optimization problem is decomposed into a series of stages, optimization being done at each stage with respect to one variable only. DP stands a suitable quantitative study procedure that can be used to explain various optimization problems. It deals through reasonably large as well as complex problems; in addition, it involves creating a sequence of interconnected decisions. The technique offers an efficient procedure for defining optimal arrangement of decisions. Throughout this chapter, solving procedure completely deliberate about as Fuzzy Dynamic Programming Problem for single additive constraint with additively separable return with the support of trapezoidal membership functions and its arithmetic operations. Solving procedure has been applied from the approach of Fuzzy Dynamic Programming Problem (FDPP). The fuzzified version of the problem has been stated with the support of a numerical example for both linear and nonlinear fuzzy optimal solutions and it is associated to showing that the proposed procedure offers an efficient tool for handling the dynamic programming problem instead of classical procedures. As a final point the optimal solution with in the form of fuzzy numbers and justified its solution with in the description of trapezoidal fuzzy membership functions.

DOI: 10.4018/978-1-5225-1008-6.ch008

1. INTRODUCTION

Dynamic programming is different from linear programming on two counts. First, there does not be present a typical mathematical formulation of DPP. Accordingly, there is no procedure, similar to the simplex algorithm, that they can be preset to solve all the problems. DP is, proposed, a procedure that permits us to separate difficult into a sequence of sub problems, which are then evaluated by stages. This offers a generalized methodology to problem solving. Moreover, while linear programming problem is a method which gives single stage, that is one time – period solutions, DP has the power to determine the optimal solutions over, say, a one year time horizon by breaking the problem into twelve smaller one month time horizon problems and to solve each of these optimally. Thus, it uses a multistage approach to problem solving. There is a wide variety of problems which can be handled using dynamic programming. Dynamic programming problem was first developed in 1950, through the effect of Richard Bellman and his principle of optimality states that an optimality policy has the property that whatever the initial stages and decisions are, the remaining decisions must constitute an optimal policy with regards to the state resulting from the first decision. This implies that a wrong decision taken at one stage does not prevent from taking optimum decisions for the remaining stages. In dynamic programming problem, there do not exist any mathematical formulation. Particular equations must be developed to adequate for each distinct situation (Lushu, Li & Lai, 2001). DPP can be classifying different types such as single additive constraint with additively separable return or multiplicatively separable return and single multiplicative constraint with additively separable return. The problem of fuzzy dynamic problem has been dealt with many researcher (Baldwin & Pilsworth, 1982; Esogbue, 1983; Schweickardt & Miranda, 2007) in recent days with crisp state transformation function in terms of fuzzified dynamic programming (Zimmerman, 1991). Bellman and Zadeh (1970) suggested for the first time a fuzzy approach to the dynamic programming problem. Here also make an effort to fuzzifiy a dynamic programming problem and solve it to find a fuzzy optimal solution for single additive constraint with additively separable return with the support of trapezoidal membership functions and its arithmetic operations (Dinagar & Palanivel, 2009, 2016). The fuzzified version of the problem has been stated with the support of a numerical example for both linear and nonlinear fuzzy optimal solutions.

2. PRELIMINARIES

L.A. Zadeh advanced the fuzzy theory in 1965. The theory proposes a mathematical technique for dealing with imprecise concepts and issues that have several potential solutions. The conception of fuzzy mathematical programming on a general level was initially projected by (Tanaka et al., 1974) within the frame work of fuzzy decision of Bellmann and Zadeh (1970). Now it tends to present some necessary definitions are:

2.1 Basic Definitions

Definition

A real fuzzy number A is a fuzzy subset of the real number R with membership function μ_A satisfying the subsequent conditions.