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A New Two-Phase Method for Solving the Fuzzy Primal Simplex Algorithm

S.A. Edalatpanah & S. Shahabi

Abstract: Recently, Nasseri et al., [1, 2] proposed fuzzy two-phase method involving fuzzy artificial variables and fuzzy big-M method to obtain an initial fuzzy basic feasible solution to solve the linear programming with fuzzy variables (FVLP) problems. In this paper, we propose a new two-phase method for solving fuzzy linear programming. Our method needs not any artificial variables and has an advantage of the simple implementation. Furthermore this method is more effective and faster than above methods.

Keywords: Linear programming with fuzzy variables, Fuzzy primal simplex method, Fuzzy dual simplex method, Fuzzy big-M method, Fuzzy two-phase method, Fuzzy basic feasible solution, Ranking function, Trapezoidal fuzzy number.

1. Introduction

Fuzzy set theory has been applied to many disciplines such as control theory and operations research, mathematical modeling and industrial applications. The concept of fuzzy mathematical programming on general level was first proposed by Tanaka et al., [3] in the framework of the fuzzy decision of Bellman and Zadeh [4]. Afterwards, many authors considered various types of fuzzy linear programming problems and proposed several approaches for solving them; see [5-14]. Fuzzy programming approach is useful and efficient to treat a programming problem under uncertainty. While classical and stochastic programming approach may require a lot of cost to obtain the exact coefficient value or distribution, fuzzy programming approach does not (see [15]). From this fact, fuzzy programming approach will be very advantageous when the coefficients are not known exactly but vaguely specified by human expertise. Linear programming problems with trapezoidal fuzzy variables (FVLP) have recently attracted some interest. Some methods have been developed for solving these problems. Fuzzy primal and dual simplex algorithms have been recently proposed to solve these problems.

These methods have been developed with the assumption that an initial Basic Feasible Solution (BFS) is at hand. In many cases, finding such a BFS is not straightforward and some works may be needed to get the simplex algorithm started. Furthermore, there exists a shortcoming in the fuzzy dual simplex algorithm when the dual feasibility or equivalently the primal optimality is not at hand and in this
Take \( x_1, x_2, x_3 \) to be basic variables. Then \( x = [(5, 7, 2, 6), (6, 10, 3, 7), (-5, -3, 1, 2), 0, 0] \) is a regular solution. Now, construct the FVLP(4.3):

\[
\begin{align*}
\text{Min} \quad & \tilde{z} = \tilde{x}_4 + \tilde{x}_5 \\
\text{s.t.} \quad & \tilde{x}_1 + \tilde{x}_4 - 2\tilde{x}_5 = (5, 7, 2, 6) \\
& \tilde{x}_2 - 3\tilde{x}_1 + \tilde{x}_5 = (6, 10, 3, 7) \\
& \tilde{x}_3 - \tilde{x}_1 - \tilde{x}_4 = (-5, -3, 1, 5) \\
& \tilde{x}_1, \tilde{x}_2, \ldots, \tilde{x}_5 \geq 0.
\end{align*}
\]

Solve the above programming by fuzzy dual simplex [17] obtained, whose iteration process gives: \([(5, 7, 2, 6), (6, 10, 3, 7), (-5, -3, 1, 2), 0, 0] \Rightarrow [(0, 4, 3, 11), (1, 22, 110, 7), 0, (3, 5, 5, 1), 0] \)

Then an optimal solution of FVLP(4.3) is obtained, i.e., a basic feasible solution is obtained. Now make the fuzzy simplex iteration from \([(0, 4, 3, 11), (1, 22, 110, 7), 0, (3, 5, 5, 1), 0] \) and an optimal solution of FVLP (3.1) is obtained, which is \([(0, 4, 3, 11), (1, 22, 110, 7), 0, (3, 5, 5, 1), 0] \) and \( z = (1, 7, 11, 7) \). Obviously, the classic methods such as two-phase method and the big-M method have more computational requirements, see [1, 2]. Therefore, the efficiency of our algorithm is better than classical methods.

6. Conclusions

In this paper, we have proposed a new method for solving linear programming with fuzzy variables (FVLP) without any artificial variables. The result of this method shows that our algorithm is more effective and faster than classical methods for FVLP. Furthermore, numerical example is given to illustrate the efficiency of our method.

REFERENCES


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