SOLVING FUZZY LPP FOR PENTAGONAL FUZZY NUMBER USING RANKING APPROACH

SOMESHWAR SIDDI[1]
[1]Associate Professor in Mathematics, St. Martin's Engineering College, India
someshsiddi@gmail.com

Y RAGHUNATHA REDDY[2]
[2]Assistant Professor, Department of OR & SQC, Rayalaseema University, India
drraghy@gmail.com

ABSTRACT

A method is proposed for solving Fuzzy LPP with pentagonal fuzzy number by using a ranking function and compared the solutions with fully fuzzy LPP. It is observed that the Optimum solutions were obtained using fully fuzzy LPP.

Keywords: Fuzzy LPP, Fully Fuzzy LPP, membership function, pentagonal fuzzy number, ranking function

1. INTRODUCTION

Problems involved decision making in the real time scenario are very often uncertain or vague in general. Fuzzy numbers are used in various fields such as fuzzy process methods, decision control theory, problems involving decision making, system reasoning. Fuzzy systems, including fuzzy set theory and fuzzy logic, have a variety of successful applications. Due to the presence of uncertainty in many mathematical formulations in different branches of science and technology, the concept of fuzzy linear programming was proposed by Tanaka et al[3]. Pandian and Jayalakshmi[6] have proposed a decomposition method for solving fuzzy Integer LPP with fuzzy variables by using classical integer LPP.

Bellman and Zadeh[7] proposed the concept of decision making in fuzzy environment. Nasseri[10] has proposed a raking new method for solving fuzzy LPP in which he has converted the fuzzy objective function into crisp objective function.

In this paper, we use the notion of pentagonal fuzzy number by generalizing some other types of fuzzy numbers and studied properties and formulation required for the pentagonal fuzzy number. Also presented several preliminaries regarding the fuzzy number.

2 PRELIMINARIES

For the LPP's in the crisp problems, we need to maximize or minimize a linear objective function under linear constraints. But in many practical situations, the decision maker may not be in a position to specify the objective and or constraint functions precisely rather than can specify them in a fuzzy sense. In such type of problems, it is required to use Fuzzy Programming type of modelling so as to provide more flexibility to the decision maker.

Membership function for the trapezoidal fuzzy number A=(a, b, c, d) is given by

$$\mu_A(x) = \begin{cases} 0, & x \le a \\ \frac{x-a}{b-a}, & a < x < b \\ 1, & b \le x \le c \\ \frac{d-x}{d-c}, & c < x < e \\ 0, & d > a \end{cases}$$

Membership function for the pentagonal fuzzy number A=(a, b, c, d e) is given by

$$\mu_A(x) = \begin{cases} 0, & x \le a \\ \frac{x-a}{b-a}, & a < x \le b \\ \frac{x-b}{c-b}, & b < x < c \\ 1, & x = c \\ \frac{d-x}{d-c}, & c < x < d \\ \frac{e-x}{e-d}, & d \le x < e \\ 0, & x \ge e \end{cases}$$

3. ARITHMETIC OPERATIONS OF PENTAGONAL FUZZY NUMBER (PFN)

(i) **Addition:** Let A= (a_1,a_2,a_3,a_4,a_5) and B=(b_1,b_2,b_3,b_4,b_5) be two pentagonal fuzzy numbers then A+B = $(a_1+b_1, a_2+b_2,a_3+b_3,a_4+b_4,a_5+b_5)$

(ii) **Subtraction:** Let A= (a_1,a_2,a_3,a_4,a_5) and B=(b_1,b_2,b_3,b_4,b_5) be two pentagonal fuzzy numbers then A-B = $(a_1-b_1, a_2-b_2,a_3-b_3, a_4-b_4, a_5-b_5)$

(iii) **Scalar Multiplication:** Let A= (a_1,a_2,a_3,a_4,a_5) be a pentagonal fuzzy number and k ∈ R be any scalar then kA= $(ka_1, ka_2, ka_3, ka_4, ka_5)$

(iv) **Positive PFN:** A pentagon fuzzy number is said to be positive if all its entries are positive.

(v) **Null PFN**: A PFN is called a Null PFN if all of its entries are zero.

4 PROPOSED ALGORITHM FOR PENTAGONAL FUZZY NUMBER

STEP I : Formulate the chosen problem in to the fuzzy LPP as

Maximize(or Minimize) z = cx

s. to Ax ≤ = ≥b and x ≥ 0

STEP II : **Derivation of Ranking function**

Let Ã = (a, b, c, d, e) be any pentagonal fuzzy number then,

$$R(\tilde{A}) = \frac{1}{2}\int_0^1 (a + (b-a)\lambda + b + (c-b)\lambda + d - (d-c)\lambda + e - (e-d)\lambda)d\lambda$$

$$= \frac{1}{4}(a + 2b + 2c + 2d + e)$$

Using the above proposed ranking function, the Fuzzy LPP transformed into LPP.

STEP III: The LPP is solved by using Simplex method to obtain the optimal solution.

5 ILLUSTRATION OF PROPOSED METHOD (FUZZY LPP) FOR PENTAGONAL FUZZY NUMBER

Consider the following fuzzy linear programming problem

Max Z = (0.1, 0.3, 0.4, 0.5, 0.7) x_1 + (0.2, 0.3, 0.5, 0.7, 0.8) x_2

s. to (0.1, 0.2, 0.3, 0.4, 0.6) x_1 + (0.1, 0.2, 0.3, 0.5, 0.6) $x_2 \leq$ (0.1, 0.3, 0.4, 0.7, 0.9)

(0.2, 0.4, 0.6, 0.7, 0.8) x_1 + (0.3, 0.4, 0.5, 0.6, 0.9) $x_2 \leq$ (0.1, 0.2, 0.3, 0.5, 0.7)

(0.1, 0.3, 0.4, 0.7, 0.8) x_1 + (0.3, 0.4, 0.7, 0.8, 0.9) $x_2 \leq$ (0.2, 0.3, 0.5, 0.6, 0.8) and $x_1, x_2 \geq 0$.

The fuzzy Linear programming problem can be reformulated to the LPP by using the proposed ranking function (applying to Objective function)

Max z={(0.1+2(0.3)+2(0.4)+2(0.5)+0.7)/4}x_1+{(0.2+2(0.3)+2(0.5)+2(0.7)+0.8)/4} x_2

i.e., Max z= $0.8x_1 + x_2$

s. to $0.1x_1+0.1x_2 \leq 0.1$, $0.2x_1+0.2x_2 \leq 0.3$, $0.3x_1+0.3x_2 \leq 0.4$, $0.4x_1+0.5x_2 \leq 0.7$

$0.6x_1+0.6x_2 \leq 0.9$, $0.2x_1+0.3x_2 \leq 0.1$, $0.4x_1+0.4x_2 \leq 0.2$, $0.6x_1+0.5x_2 \leq 0.3$, $0.7x_1+0.6x_2 \leq 0.5$, $0.8x_1+0.9x_2 \leq 0.7$, $0.1x_1+0.3x_2 \leq 0.2$, $0.3x_1+0.4x_2 \leq 0.3$

$0.4x_1+0.7x_2 \leq 0.5$, $0.7x_1+0.8x_2 \leq 0.6$, $0.8x_1+0.9x_2 \leq 0.8$ and $x_1, x_2 \geq 0$.

The optimal solution of the above Fuzzy LPP is x_1 =0.5 , x_2 =0 and Max Z = 0.4

PENTOGONAL FUZZY LPP Solution	X1	X2		RHS
Maximize	.8	1		
Constraint 1	.1	.1	<=	.1
Constraint 2	.2	.2	<=	.3
Constraint 3	.3	.3	<=	.4
Constraint 4	.4	.5	<=	.7
Constraint 5	.6	.6	<=	.9
Constraint 6	.2	.3	<=	.1
Constraint 7	.4	.4	<=	.2
Constraint 8	.6	.5	<=	.3
Constraint 9	.7	.6	<=	.5
Constraint 10	.8	.9	<=	.7
Constraint 11	.1	.3	<=	.2
Constraint 12	.3	.4	<=	.3
Constraint 13	.4	.7	<=	.5
Constraint 14	.7	.8	<=	.6
Constraint 15	.8	.9	<=	.8
Solution	.5	0		.4

Table 5.1: Fuzzy LPP Solution of pentagonal problem using QM for windows

6 ILLUSTRATION OF PROPOSED METHOD (FULLY FUZZY LPP) FOR PENTAGONAL FUZZY NUMBER

Consider the following fuzzy linear programming problem

$\text{Max } Z = (0.1, 0.3, 0.4, 0.5, 0.7)\, x_1 + (0.2, 0.3, 0.5, 0.7, 0.8)\, x_2$

s. to $(0.1, 0.2, 0.3, 0.4, 0.6)\, x_1 + (0.1, 0.2, 0.3, 0.5, 0.6)\, x_2 \leq (0.1, 0.3, 0.4, 0.7, 0.9)$

$(0.2, 0.4, 0.6, 0.7, 0.8)\, x_1 + (0.3, 0.4, 0.5, 0.6, 0.9)\, x_2 \leq (0.1, 0.2, 0.3, 0.5, 0.7)$

$(0.1, 0.3, 0.4, 0.7, 0.8)\, x_1 + (0.3, 0.4, 0.7, 0.8, 0.9)\, x_2 \leq (0.2, 0.3, 0.5, 0.6, 0.8)$

$x_1, x_2 \geq 0.$

The fully fuzzy Linear programming problem can be reformulated to the LPP by using the proposed ranking function

$\text{Max } z=\{(0.1+2(0.3)+2(0.4)+2(0.5)+0.7)/4\}x_1+\{(0.2+2(0.3)+2(0.5)+2(0.7)+0.8)/4\}x_2$

s. to

$\{(0.1+0.4+0.6+0.8+0.6)/4\}x_1+\{(0.1+0.4+0.6+1+0.6)/4\}x_2\leq\{(0.1+0.6+0.8+1.4+.9)/4\}$

$\{(0.2+0.8+1.2+1.4+0.8)/4\}x_1+\{(0.3+0.8+1+1.2+0.9)/4\}x_2\leq\{(0.1+0.4+.6+1+0.7)/4\}$

$\{(0.1+0.6+0.8+1.4+0.8)/4\}x_1+\{(0.3+0.8+1.4+1.6+.9)/4\}x_2\leq\{(0.2+0.6+1+1.2+0.8)/4\}$

$x_1,x_2 \geq 0.$

i.e., $\text{Max } z= 0.8x_1+ x_2$

s. to 0.625 x_1 +0.675 $x_2 \leq 0.95$, 1.1 x_1+ 1.05 $x_2 \leq 0.7$

0.925 x_1+ 1.25 $x_2 \leq 0.95$ and $x_1, x_2 \geq 0$.

The optimal solution of the above fully fuzzy LPP is

$x_1 = 0$, $x_2 = 0.67$ and Max Z = 0.67

PENTOGONAL PROBLEM FOR FULLY FUZZY LPP Solution				
	X1	X2		RHS
Maximize	.8	1		
Constraint 1	.63	.68	<=	.95
Constraint 2	1.1	1.05	<=	.7
Constraint 3	.93	1.25	<=	.95
Solution	0	.67		.67

Table 6.1: Fully Fuzzy LPP Solution of pentagonal problem using QM for windows

7 COMPARISON STUDY FOR PENTAGONAL FUZZY NUMBER

RANKING METHOD	x_1	x_2	Z
(MI)Fuzzy LPP	0.5	0	0.4
(MII)Fully Fuzzy LPP	0	0.67	0.67

Table 7.1: Result comparison between Fuzzy LPP and Fully fuzzy LPP for pentagonal fuzzy number

Using Fuzzy LPP ranking method, solution set is x_1=0.5, x_2=0 and Max Z=0.4

Using Fully Fuzzy LPP ranking method, solution set is x_1=0, x_2=0.67 and Max Z=0.67

We have obtained the OPTIMAL SOLUTION by using Fully Fuzzy LPP method. Hence, Fully Fuzzy LPP ranking method is reasonable and effective in finding the maximum value of the objective function of a fuzzy LPP problem.

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