International Journal for Modern Trends in Science and Technology
Volume: 03, Issue No: 09, September 2017
ISSN: 2455-3778
http://www.ijmtst.com

To Solve Fuzzy Game Problem Using Pentagonal Fuzzy Numbers

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To Cite this Article
P.Monisha and K.Sangeetha, "To Solve Fuzzy Game Problem Using Pentagonal Fuzzy Numbers", *International Journal for Modern Trends in Science and Technology*, Vol. 03, Issue 09, September 2017, pp.-152-154.

ABSTRACT

In this paper, a new concept of Fuzzy game problem using Pentagonal fuzzy numbers with some operation is introduced. By using ranking to the payoffs, we convert the fuzzy valued game problem to crisp valued game problem, which can be solved using the row minima-column maxima. The solution of such fuzzy games with saddle point, by minimax-maximin principle is discussed.

Keywords: *Fuzzy Number, Fuzzy Transportation Problem, Membership Function, Pentagonal Fuzzy Number, Ranking of Fuzzy Number.*

I. INTRODUCTION

Game theory is a mathematical theory that deals with the general features of competitive situations like some operations of pentagonal fuzzy numbers in a formal abstract way. The focus in this paper is on the minimax principle which states that each competitor will act so as to minimize one player's maximum loss (or maximize one player's minimum gain), then the opponent still can take advantage for this knowledge to reduce the expected payoff to the first player. We have analyzed the solution of such fuzzy games with saddle point, by minimax – maximin principle.

II. PRELIMINARIES

2.1.Fuzzy Set:

A fuzzy set is characterized by a membership function mapping elements of a domain, space, or universe of discourse X to the unit interval [0,1].(i.e.) A={x, μ_A (x);x∈X} here μ_A :X→[0,1] is a mapping called the degree of **membership function** of the fuzzy set A and μ_A(x) is called the membership value of x in the fuzzy set A.These membership grades are often represented by real numbers ranging from [0,1].

2.2. Fuzzy Numbers:

A fuzzy set A defined on the set of real numbers R is said to be a fuzzy number if its membershipfunction μ_A : R → [0, 1] has the following characteristics.

(i) A is normal. It means that there exists an x∈R such that μ_A(x) = 1.

(ii) A is convex. It means that for every x_1,x_2 ∈R,

$\mu_A(\lambda x_1 + (1-\lambda)x_2) \geq \text{Min}\{\mu_A(x_1),\mu_A(x_2)\}$, $\lambda \in [0,1]$

(iii) μ_A is upper semi-continuous.

(iv) Supp (A) is bounded in R.

III. Pentagonal Fuzzy Number

The Fuzzy Number P is a Pentagonal Fuzzy. A_P is a Pentagonal Fuzzy number denoted AP (a, b, c, d, e; 1) and its membership function □$_{AP}$(x) is given below:

$$\mu\, A_P(X) = \begin{cases} \frac{(x-a)}{b-a}, & a \le x \le b \\ \frac{(x-b)}{c-b}, & b \le x \le c \\ 1, & x = c \\ \frac{(d-x)}{d-c}, & c \le x \le d \\ \frac{(e-x)}{e-d}, & d \le x \le e \\ 0, & otherwise \end{cases}$$

IV. SADDLE POINT

A saddle point of a payoff matrix is that position in the payoff matrix. Where maximum of row minima, co-inside with the minimum of the column maxima. The pay off at the saddle point is called the value of the game denoted by gamma. The saddle point need not be unique. We denote the maximin value of the game by gamma($\underline{\gamma}$) and the minimax value of the game by$\bar{\Upsilon}$.

The game is said to be fair. If$\underline{\gamma}$ = 0 = $\bar{\Upsilon}$

The game is said to be strictly determinable. If $\underline{\gamma}$ = γ= $\bar{\Upsilon}$

V. MATHEMATICAL FORMULATION OF A FUZZY GAME PROBLEM

Let Player A have m strategies A_1, A_2 ...Am and Player B have n strategies B_1, B2,...,Bn. Here, it isassumed that each player has his choices from amongst the pure strategies. Also it is assumed that player A is always the gainer and player B is always the loser. That is, all payoff are assumed in terms of player A. Let a_{ij} be the payoff which player A gains from player B if player A chooses strategy A_i and player B chooses strategy B_j . Then the payoff matrix to player A

VI. PROCEDURE FOR SOLVING FUZZY GAME PROBLEM

We shall present a solution to fuzzy game problem involving strategies of the players using triangular fuzzy numbers.

Step 1: Check whether a saddle point exists in the problem. If it exists, the solution can be obtained directly. If the saddle point does not exist, go to the next step.

Step 2: Comparison of column strategies.
(a). If elements of Column A ≤ elements of Column B, Column A strategy dominates over column B strategy. Hence delete column B strategy from the pay off matrix.
(b). Compare each column strategy with all possible column strategies and delete inferior strategies as for as possible.

Step 3: Comparison of row strategies.
(a). If elements of Row A ≥ elements of Row B, Row A strategy dominates over Row B strategy. Hence delete Row B strategy from the pay off matrix.
(b). Compare each row strategy with all possible row strategies and delete inferior strategies as for as possible.
(c). The Game may reduce to a single cell giving information about the value of the game and optimal strategies of players. If not go to step 4.

Step 4: Dominance need not to be based on the superiority of pure strategies only. A given strategy can be dominated if it is inferior to an average of two or more other pure strategies.

6.1. Numerical Example

Consider the following fuzzy game problem

	B_1	B_2	B_3	B_4	B_5
A_1	(7,8,9,10,11)	(1,2,3,4,5)	(1,0,1,2,3)	(4,6,8,10,12)	(-4,-2,0,4,8)
A_2	(4,5,6,7,8)	(1,3,5,7,9)	(0,2,4,6,8)	(4,5,6,7,8)	(5,6,7,8,9)
A_3	(0,1,2,3,4)	(0,2,3,4,5)	(1,2,3,4,5)	(1,2,3,4,5)	(4,6,8,10,12)
A_4	(4,6,8,10,12)	(4,5,6,7,8)	(2,0,2,4,6)	(0,1,2,3,4)	(-1,0,1,2,3)

Solution

Using ranking function

$$R(\tilde{A}) = \frac{P_1+P_2+P_3+P_4+P_5}{5}$$

$$R(7, 8, 9, 10, 11) = \frac{7+8+9+10+11}{5} = \frac{45}{5}$$

R (7, 8, 9, 10, 11) = 9

Similarly

R(1,2,3,4,5) =3 R(-1,0,1,2,3) =1 R(4,6,8,10,12) = 8
R(-4,-2,0,4,8) = 0
R(4,5,6,7,8) =6 R(1,3,5,7,9) =5 R(0,2,4,6,8) =4
R(4,5,6,7,8) =6 R(5,6,7,8,9) = 7
R(0,1,2,3,4) =2 R(0,2,3,4,5) =4 R(1,2,3,4,5) =3
R(1,2,3,4,5) =3 R(4,6,8,10,12) = 8
R(4,6,8,10,12) = 5, R(4,5,6,7,8) = 6, R(-2,0,2,4,6) = 2, R(0,1,2,3,4) = 2, R(-1,0,1,2,3) = 1

B_1 B_2 B_3 B_4 B_5 Row min Minimax

$$\begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \end{matrix} \begin{pmatrix} 9 & 3 & 1 & 8 & 0 \\ 6 & 5 & 4 & 6 & 7 \\ 2 & 4 & 3 & 3 & 8 \\ 5 & 6 & 2 & 2 & 1 \end{pmatrix} \quad \begin{matrix} 0 \\ 4 \\ 2 \\ 1 \end{matrix} \qquad 4$$

Column max 9 6 4 8 8

Maximin 4

Minimum = maximum = 4

Saddle point is (4, 4)

Saddle point at the position

($A_2 \rightarrow B_3$) ($A_3 \rightarrow B_2$)

Value of the game γ **= 4**

VII. CONCLUSION

In this paper, we consider some operations of pentagonal fuzzy numbers and a solution of Fuzzy Game Problem with pentagonal fuzzy numbers. The Solution of such Fuzzy games with saddle point by minimax - maximin principle is discussed.This can be solved using the row minimum-column maximum.

ACKNOWLEDGMENT

I would like to thank K.Sangeetha for his guidance and support for preparing this paper.

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