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Solving Fuzzy Game Theory Problem by Using Ranking Technique

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Abstract

In this paper we study on solving fuzzy Game problems by using Ranking Technique.

Keywords: *Fuzzy numbers, Triangular fuzzy number, Ranking of triangular fuzzy number*

1. INTRODUCTION

The history of game theory dates back to the early twentieth century but a new turn for its wider applicability took only in 1944, when john von Newman and Oscar Morgenstern published the famous article 'theory of games and economic behaviour'. A game is a model of a situation where two or more groups are in dispute over some issues. The participants in a game are called the players. Using the notion of fuzzy sets, each component in a game (set of players, set of strategies, set of payoffs, etc) can be fuzzified. Fuzzy set theory was formally introduced by lotfi.a.zadeh in his classic paper "fuzzy sets" in the year 1965. Fuzzy set is defined with the help of grades of membership of elements in the set which is described in the interval [0,1]. Among various types of fuzzy sets, there is a special significance for the fuzzy sets that are defined on the set r of real numbers. Membership functions of these sets, which have the form a:r→[0,1]can be viewed as fuzzy numbers or fuzzy intervals under certain conditions. Fuzzy numbers plays an important role in many applications, including decision making, approximate reasoning, optimization etc.

2. PRELIMINARIES:

2.1 Fuzzy set:

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A fuzzy set is characterized by a membership function mapping element of a domain, space, or the universe of discourse x to the unit interval [0, 1] i.e. A= . Here is mapping called the degree of membership function of the fuzzy set A and is called the membership value of x∈ X in the fuzzy set A. These membership grades are often represented by real numbers ranking from [0, 1]

2.2. Fuzzy numbers:

A fuzzy set A defined on the set of real numbers R is said to be fuzzy number if its membership function $\mu_A : R \to [0,1]$ has the following characteristics

i. A is normal. It means that there exists an x ϵ R such that $\mu_A(x) = 1$

ii. $A$is convex. It means that for every $x_1, x_2 \in R$,

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

iii. μ_A *is*upper semi-continuous.

iv. Supp(A) is bounded in R

2.3. Normal fuzzy set:

A fuzzy set A of universe of discourse X is called a normal fuzzy set implying that there exists at least one x ϵ X such that μ_A(x)=1

2.4 Triangular fuzzy number

A fuzzy number ã = (a, b, c) is said to be a triangular fuzzy number if it is member ship function is given by, where a<=b<=c are real numbers

$$\mu_{\tilde{A}}(x) = \begin{cases} 0, & x < a \\ \frac{x-a}{b-a}, & a \leq x \leq b \\ \frac{c-x}{c-b}, & b \leq x \leq c \\ 0, & x > c \end{cases}$$

3. RANKING OF TRIANGULAR FUZZY NUMBER

Let, a= (a(r), Ā(r)) 0≤r≤1 be a fuzzy number. The value of m (ã) is called the measure of as calculated as follows.

M (ã) =1\2$\int_0^1 (A(r) + \bar{A}(r))dr$,where 0≤r≤1.

=1\4 [2b+a+c]

If

$a \equiv (A(r), \bar{A}(r)) = a + \frac{b-a}{\omega}r, c + \frac{b-c}{\omega}r$ be an arbitr ary triangular fuzzy number at decision level higher than “a” and a,$\omega \in [0,1]$.

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4. EXAMPLE:

Consider the following game problem with payoff as triangular fuzzy number. We want to solve it by traditional method.

Player B

$$\textbf{Player A}\begin{bmatrix}(-4,-1,2) & (-2,1,8) & (-2,1,4)\\ (-2,1,4) & (-8,-2,4) & (-4,2,8)\\ (2,3,4) & (3,4,5) & (-6,-5,4)\end{bmatrix}$$

Let ã=((a(r),Ā(r)),(0≤r≤1)be a fuzzy number, and then the value m(Ā) is assigned to ã is calculated as follows:

$$m_0^{tra}(\tilde{a})=\frac{1}{2}\int_0^1(\underline{A}(r),\bar{A}(r))\,dr$$

$$=\frac{1}{4}[2b+a+c+]$$

Step:1 we obtain the values $m(\widetilde{aij})$ for each $\widetilde{aij}$for the fuzzy game which is given in tablel-1

Step: 2 The reduced fuzzy game problem is

Player B

$$\textbf{Player A}\begin{bmatrix}-1 & 2 & 1\\ 1 & -2 & 2\\ 3 & 4 & -3\end{bmatrix}$$

It has no saddle point. So, we can apply matrix oddment method.

Step: 3 we compute the matrices c and r by subtracting the successive columns (rows) from the proceeding column(row).

Table 1 Rank values of the triangular fuzzy numbers in the fuzzy game problem of Numerical

$\widetilde{a_{11}}$=(-4,-2,1)

$M_0^{tri}(\widetilde{a_{11}})=\frac{1}{4}$[-2-4+2]=-1

$\widetilde{a_{12}}$=(-2,1,8)

$M_0^{tri}(\widetilde{a_{12}})=\frac{1}{4}$[2-2+8]=2

$\widetilde{a_{13}}$=(-2,1,4)

$M_0^{tri}(\widetilde{a_{13}})=\frac{1}{4}$[-2+2+4]=1

$\widetilde{a_{21}}$=(-2,1,4)

$M_0^{tri}(\widetilde{a_{21}})=\frac{1}{4}$[-2+2+2]=1

$\widetilde{a_{22}}$=(-8,-2,4)

$M_0^{tri}(\widetilde{a_{22}})=\frac{1}{4}$[-4-8+4]=-2

$\widetilde{a_{23}}$=(-4,2,8)

$M_0^{tri}(\widetilde{a_{23}})=\frac{1}{4}$[4-4+8]=2

$\widetilde{a_{31}}$=(2,3,4)

$M_0^{tri}(\widetilde{a_{31}})=\frac{1}{4}$[6+2+4]=3

$\widetilde{a_{32}}$=(3,4,5)

$M_0^{tri}(\widetilde{a_{32}})=\frac{1}{4}$[8+3+5]=4

$\widetilde{a_{33}}$=(-6,-5,4)

$M_0^{tri}(\widetilde{a_{33}})=\frac{1}{4}$[-10-6+4]=-3

By using matrix oddment method, we have

,

$|r_1|=17$ $|r_2|=-20$ $|r_3|=9$

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$|c_1|=14$ $|c_2|=-12$ $|c_3|=20$

The augmented pay off matrix is

row oddments

-1 2 1 17

1 -2 2 20

3 4 -3 9

Column oddments 14 12 2046

The optimum strategies are

Player

A:$(\frac{17}{46}, \frac{20}{46}, \frac{9}{46})$; Player B: $(\frac{14}{46}, \frac{12}{46}, \frac{20}{46})$

Value of the game $=\frac{17}{46}(-1)+\frac{20}{46}(1)+\frac{9}{46}(3)=\frac{15}{23}$

CONCLUSION

In this paper, A Method of Solving fuzzy game problem using ranking of fuzzy numbers has been consider. This method can be used solve any m x n two person game with its value as triangular or trapezoidal fuzzy numbers, these imprecise values are converted into crisp values and the reduced crisp value game is then solved by any of the available traditional method like dominance rule, graphical method etc.

graphical method etc.

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