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RANKING TECHNIQUE METHOD BY TRIANGULAR FUZZY GAME PROBLEM- A STUDY

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Abstract - A different method for solving Fuzzy game theory problem. In this paper I have to discussed triangular fuzzy number using ranking technique different methods,correlate game value problem and discusses the importance of pointing out the concepts of triangular fuzzy numbers and their formulas for ranking Technique and compare to the various type of formulae .

KEYWORDS :

FuzzyNumber, Triangular fuzzy number , Ranking Technique, Centroid Method. Subinterval Average and addition , Pascal triangular graded mean, magnitude ranking, game theory problem.

I. INTRODUCTION

In 1965 Lotfi. A. Zadeh introduced the concept of Fuzziness. An approximation of analytical functions by Dubois, Prade, and Yager (1978), involves the division of the membership functions of algebraic operations into a left side and a representation of the right side by a simple analytical form. Due to the ascent within the study of Fuzzy sets, we have different types of Fuzzy numbers, namely Triangular, Trapezoidal, Pentagonal, Hexagonal, Heptagonal fuzzy numbers. Well, S.H. Chen was studying operations on fuzzy numbers with real-valued functions in 1985, as well as Klement. In 2004 Michael Hanss introduced the Triangular Fuzzy number. In many applications, fuzzy numbers are used, such as control theory, signal processing, and approximation theory. We also discussed the basic definitions of different Fuzzy numbers and their numerous fuzzy ranking approaches in this survey article. This survey alone would make it easy to consider their review of the effects of the ranking methods and their future development in the future.

Game theory is the study of how and why players make decisions about their circumstances.The intention of game theory is to produce optimal decision-making of independent and competing actors in a strategic setting. Using game theory, real-world scenarios for such situations as pricing competition and product releases (and many more) can be laid out and their outcomes predicted. Scenarios include the prisoner's dilemma and the dictator game among many others.Different types of game theory include cooperative/non-cooperative , zero sum / non- zero sum and simultaneous / sequential.

II. FUZZY NUMBER :

A fuzzy number is a generalization of a regular real number in the sense that it does not refer to one single value but rather to a connected set of possible values,where each possible value has its own weight (w) between 0 and 1. This weight is called the membership function.

A. *Triangular Fuzzy Number:*

Among the various shapes fuzzy number , triangular fuzzy number(TFN) is the most popular.

Definition: 1In other words ,a triangular fuzzy number is a special case of a trapezoidal fuzzy number.

Definition: 2

A triangular fuzzy number or simply triangular number with three point as follows

$\tilde{A} = (\varepsilon_1, \varepsilon_2, \varepsilon_3)$. Its membership function is defined as follows:

$$\mu_{\tilde{A}} = \begin{cases} \dfrac{x-\varepsilon_1}{\varepsilon_2-\varepsilon_1} & , \varepsilon_1 \le x < \varepsilon_2 \\ 1 & , \quad x = \varepsilon_2 \\ \dfrac{\varepsilon_3-x}{\varepsilon_3-\varepsilon_2} & , \varepsilon_2 < x \le \varepsilon_3 \end{cases}$$

B. *Ranking Methods for Triangular Fuzzy Numbers :*

Ranking Methods for Triangular Fuzzy Numbers Many types of ranking procedures have 'Triangular fuzzy numbers.' All the rankings listed here have been discovered over the past few years for

'Triangular fuzzy numbers' and compiled from studying various research papers. Only the most important of them are listed here. They are,

"Sub interval Average" method for Triangular Fuzzy Numbers:

$$R(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \left(\frac{4\,(\varepsilon_1+\varepsilon_2+\varepsilon_3)}{12}\right)$$

"Sub interval Addition" method for Triangular Fuzzy Numbers:

$$R(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \left(\frac{4\,(\varepsilon_1+\varepsilon_2+\varepsilon_3)}{6}\right)$$

"Centroid approach" forTriangular fuzzy Numbers:

$$C(\varepsilon_1, \varepsilon_2, \varepsilon_3; W) = \left(\frac{2\varepsilon_1+14\varepsilon_2+2\varepsilon_3}{6}\right)\left(\frac{7W}{6}\right)$$

"Pascal Triangular Graded Mean" for Triangular Fuzzy Numbers :

$$P(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \left(\frac{\varepsilon_1+2\varepsilon_2+\varepsilon_3}{4}\right)$$

"Magnitude Ranking" for Triangular Fuzzy Numbers :

$$Mag(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \frac{1}{2}\int_0^1 (\varepsilon_3 + 3\varepsilon_1 - \varepsilon_2)\, rdr$$

III. GAMES AND STRATEGY :

Many practical problems require decision- making in a competitive situation where there are two or more opposing parties with conflicting interests and where the action of one depends upon the one taken by the opponent. For example candidates for an election , advertising and marketing campaigns by competing business firms, countries involved in military battles, etc. have their conflicting interests. In a competitive situation the courses of action (alternatives) for each competitor may be either finite or infinite. A competitive situation will be called a "Game", if it has the following properties a) There are a finite number of competitors (participants) called players . b) Each player has a finite number of strategies (alternatives)available to him. c) A play of the game takes place when each player employs his strategy. d) Every game results in an outcome, e.g., loss or gain or a draw usually called payoff ,to some player.

A. Strategy:

A strategy for a player is defined as s set of rules or alternative courses of action available to him in advance, by which player decides the course of action that he should adopt. A strategy may be of two types:

1) Pure strategy:

Pure strategy is a decision making rule in which one particular course of action is selected.If the player select the same strategy each time, then it is referred to an pure- strategy. In this case each player knows exactly what the other player is going to do, the objective of the players is to maximize gains or to minimize losses.

2) Mixed Strategy:

A set of strategies that a player chooses on a particular move of the game with some fixed probability are called mixed strategies.When the players use a combination of strategies and each player always kept guessing as to which course of action is to be selected by the other player at a particular occasion then this is known as mixed strategy. Thus , there is a probabilistic situation and objective of the player is to maximize expected gains or to minimize expected losses.

3) Optimum Strategy:

A course of action or play which puts the player in the most preferred position, irrespective of the strategy of his competitors, is called an optimum strategy .

B. Value of the game:

This is the expected payoff at the end of the game, when each player uses his optimal strategy. It is the expected payoff of play when all the players of the game follow their optimumstrategies .The game is called fair if the value of the game is zero and unfair , if it is non-zero.

C. Pay off matrix :

When the players select their particular strategies, the payoffs (gains or losses) can be represented in the form of a matrix called the payoff matrix. Since the game is zero-sum, therefore gain of one player is equal to the loss of other and vice-versa. In other words. One player's payoff table would contain the same amounts in payoff table of other player with the sign changed. Thus, it is sufficient to construct payoff only for one of the players.

D. Maximin- Minimax Principle:

We shall now explain the so- called Maximin-Minimax Principle for the selection of the optimal strategies by the two players.

For player A, minimum value in each row represents the least gain(payoff) to him if he chooses his particular strategy. These are written in the matrix by row minima . He will then select the strategy that maximizes his minimum gains. This choice of player Ais called the maximin principle, and the corresponding gain is called the maximin value of the game.

For player B, on the other hand , likes to minimize his losses. The maximum value in each column represents the maximum loss to him if he chooses his particular strategy . These are written in the matrix by column maxima . He will then select the strategy that minimizes his maximum losses. This choice of player B is called the minimax principle and the corresponding loss is the minimax value of the game.

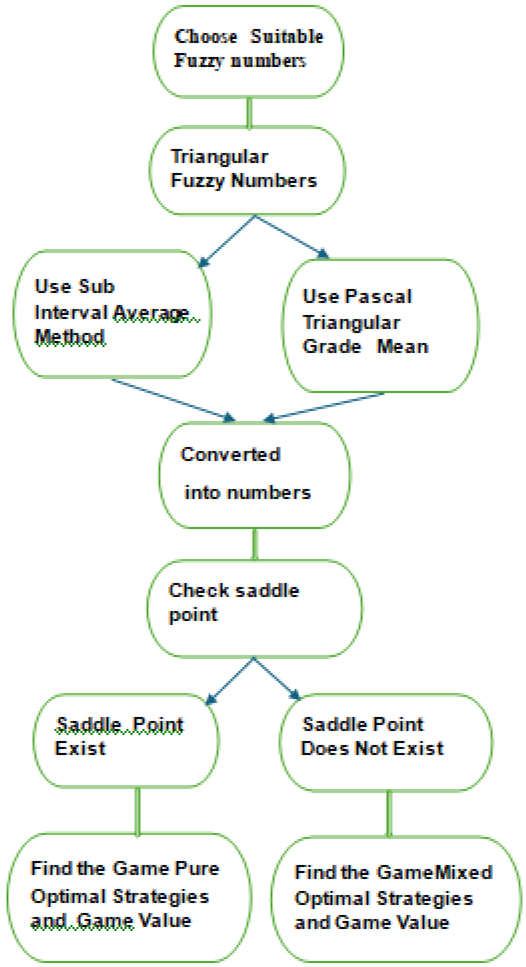
If the maximin value equals the minimax value ,then the game is said to have a saddle(equilibrium) point and the corresponding strategies are called optimum strategies. The amount of payoff at an equilibrium point is known as the value of the game

Saddle point :

Saddle point of a pay-off matrix is that position where the maximum of row minima coincides with the minimum of the column maxima . For a rectangular game,

Maximiumof A is equal to the Minimax of B is the saddle point of the game .The payoff at the saddle point is called the value of the game denoted by v .The saddle point need not be unique.

E. FLOW CHART:



F. NUMERICAL EXAMPLE ;

1) Subinterval Average Method for Triangular fuzzy Number:

$$R(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \left(\frac{4\,(\varepsilon_1+\varepsilon_2+\varepsilon_3)}{12}\right)$$

Problem :Consider the following triangular fuzzy game problem

(3,9,2)	(1.2,3)	1,4,1)	(2,1,5)	(7,6,2)	(5,3,1)	(4,2,1)
(4,2,3)	(2,1,2)	(5,6,1)	(2,4,3)	(9,2,1)	(6,4,2)	(5,9,1)
(5,3,1)	(5,6,4)	(5,3,2)	(3,4,1)	(4,6,3)	(7,3,2)	(4,9,1)
(6,5,4)	(4,3,5)	(7,8,9)	(7,2,1)	(5,4,1)	(3,7,2)	(6,5,2)
(6,4,2)	(4,3,9)	(7,3,2)	(4,3,1)	(7,8,1)	(9,2,3)	(5,6,3)

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Convert the given fuzzy problem

4.67	2	2	2.67	5	3	2.33
3	1.	4	3	4	4	5
3	5	3.33	2.67	4.33	4	4.67
5	4	8	3.33	3.33	4	4.33
4	5.33	4	2.67	5.33	4.67	4.67

Select the Minimum of (4.67 , 2 , 2 , 2.67 , 5 , 3) is 2 , Minimumof (3 , 1.67 , 4 , 3 , 4 , 4 , 5) is 1.67, Minimum of (3 , 5 , 3.33 , 2.67 , 4 , 33 , 4 , 4.67) is 2.67 , Minimum of(5,4,8,3.33,3.33,4,4.33) is 3.33, Minimum of(4,5,33,4,2.67,5,33,4.67,4.67) is 2.67 and select the Maximum of (4.67,3,3,5,4)is 5, Maximum of(2,1.67,5,4,5.33) is 5.33,Maximum of (2,4,3.33,8,4) is 8, Maximum of (2.67,3,2.67,3,33,2.67)is 3.33 , Maximum of (5,4,4.33,3.33,5.33)is 5.33 , Maximum of (3,4,4,4,4.67) is 4.67 , Maximum of (2.33,5,4.67,4.33,4.67) is 5.ThereforeMaximin (2,1.67,2.67,3.33,2.67) is 3.33and Minimax (5,5.33,8,3.33,5.33,4.67,5) is 3.33 . It has saddle point and therefore Strategy for player A isA_4 and Strategy for player B isB_4. Also Value of the game Vis 3.33.Therefore the game is said to be strictly determinable.

2)Centroid approach for triangular fuzzy number:

$$c(\varepsilon_1, \varepsilon_2, \varepsilon_3; w) = \left(\frac{2\varepsilon_1 + 14\varepsilon_2 + 2\varepsilon_3}{6}\right)\left(\frac{7W}{6}\right)$$

Take w = 0.2 ,w ϵ (0,1)

Problem: Consider the following triangular fuzzy game problem

(3,9,2)	(1.2,3)	1,4,1)	(2,1,5)	(7,6,2)	(5,3,1)	(4,2,1)
(4,2,3)	(2,4,3)	(5,6,1)	(2,1,2)	(9,2,1)	(6,4,2)	(5,9,1)
(3,4,1)	(5,6,4)	(5,3,2)	(5,3,1)	(4,6,3)	(7,3,2)	(4,9,1)
(6,5,4)	(4,3,5)	(7,8,9)	(7,2,1)	(5,4,1)	(3,7,2)	(6,5,2)
(6,4,2)	(4,3,9)	(7,3,2)	(4,3,1)	(7,8,1)	(9,2,3)	(5,6,3)

Convert the given triangular fuzzy problem

5.29	1.4	2.33	1.09	3.97	2.1	1.48
1.63	2.57	3.73	0.86	1.87	2.8	5.37
2.49	3.97	2.18	2.1	3.81	2.33	5.29
3.5	2.33	5.6	1.71	2.64	4.2	3.34
2.8	2.64	2.33	2.02	4.98	2.02	3.89

Select the Minimum of (5.29,1.4,2.33,1.09,3.97,2.1,1.48) is 1.09 ,Minimum of (1.63,2.57,3.73,0.86,1.87,2.8,5.37) is 0.86, Minimum of (2.49,3.97,2.18,2.1,3.81,2.33,5.29) is 2.1,Minimumof$(3.5, 2.33, 5.6, 1.71, 2.64, 4.2, 3, 34) is$ 1.71, Minimum of (2.8,2.64,2.33,2.02, 4.98,2.02, 3.89) is 2.02and select the Maximum of (5.29,1.63, 2.49,3.5,2.8) is 5.29 Maximum of (1.4,2.57, 3.97, 2.33,2.64) is3.97 ,Maximum of (2.33,3.73, 2.18, 5.6, 2.33) is5.6 , Maximum of (1.09,0.86, 2.10, 1.71, 2.02) is 2.10 , Maximum of (3.97,1.87, 3.81, 2.64, 4.98) is 4.98 , Maximum of (2.1,2.8, 2.33, 4.2,2.02) is 4.2, Maximum of (1.48, 5.37,5.29,3.34,3.89) is 5.37.Therefore Maximin (1.09,0.86,2.1,1.71,2.02) is 2.10 and Minimax (5.29,3.97,5.6,2.10,4.98,4.2,5.37) is 2.10. It has saddle point and therefore Strategy for player A isA_3 and Strategy for player B isB_4 . Also Value of the game V is2.10.Therefore the game is said to be strictly determinable

3)Pascal Triangular Graded Mean for Triangular Fuzzy Numbers :

$$P(\varepsilon_1, \varepsilon_2, \varepsilon_3) = \left(\frac{\varepsilon_1 + 2\varepsilon_2 + \varepsilon_3}{4}\right)$$

Problem :Consider the following triangular fuzzy game problem

(3,9,2)	(1.2,3)	1,4,1)	(2,1,5)	(7,6,2)	(5,3,1)	(4,2,1)
(4,2,3)	(2,1,2)	(5,6,1)	(3,4,1)	(9,2,1)	(6,4,2)	(5,9,1)
(6,5,4)	(5,6,4)	(5,3,2)	(2,4,3)	(4,6,3)	(7,3,2)	(4,9,1)
(5,3,1)	(4,3,5)	(7,8,9)	(7,2,1)	(5,4,1)	(3,7,2)	(6,5,2)
(6,4,2)	(4,3,9)	(7,3,2)	(4,3,1)	(7,8,1)	(9,2,3)	(5,6,3)

Convert the given triangular fuzzy problem

5.75	3	2.5	2.25	5.25	3	2.25
2.75	1.5	4.5	3	3.5	4	6
5	5.25	3.25	3.25	4.75	3.75	5.75
3	3.75	8	3	3.5	4.75	4.5
4	4.75	3.75	2.75	6	4	5

Select the Minimum of (5.75,3,2.5 ,2.25, 5.25, 3,2.25) is 2.25,Minimum of (2.75,1.5,4.5,3,3.5,4,6) is 1.5, Minimum of (5,5.25,3.25,3.25, 4.75, 3.75, 5.75) is 3.25,Minimum of $(3, 3.75, 8, 3, 3.5, 4.75, 4, 5)$ is3 , Minimum of (4,4.75,3.75,2.75,6,4,5) is 2.75 . Maximum of (5.75,2.75,5,3,4) is 5.75, Maximum of (3,1.5, 5.25,3.75,4.75) is5.25 , Maximum of (2.5, 4.5,3.25,8,3.75) is 8, Maximum of (2.25, 3, 3.25, 3,2.75) is 3.25, Maximum of (5.25,3.5,4.75,3.5,6) is 6 , Maximum of (3,4,3.75,4.75,4) is4.75 , Maximum of (2.25,6,5.75,4.5,5) is 6. Therefore Maximin (2.25,1.5,3.25,3,2.75) is 3.25 and Minimax (5.75, 5.25, 8,3.25,6,4.75,6) is3.25. It has saddle point and therefore Strategy for player A is A_3 and Strategy for player BisB_4Also Value of the game V is 3.25. Therefore the game is said to be strictly determinable

4)COMPARISON:

METHOD	VALUE OF THE GAME
Subinterval Average Method	**3.33**
Centroid Approach	**2.10**
PascalTriangular Grade Mean	**3.25**

IV. CONCLUSION :

This paper I have to compared triangular fuzzy number in ranking technique method for subinterval average ,centroid method and Pascal grade mean for game value.I conclude that two of the methods are nearest approach of game value. This article proposes a simple and concrete method that ranks triangular fuzzy number. We've considered fuzzy numbers throughout this article. We clarified quite well during this survey, and thus, the various types of fuzzy numbers have developed in the previous few years and their different types of fuzzy ranking systems.

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