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Research Article

USING FUZZY GAME THEORY TO DETERMINE THE OPTIMAL STRATEGY FOR DECISION MAKING

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ABSTRACT

The purpose of the present article is to consider fuzzy game theory for the analysis of the best optimal strategy of industrial decision making process under the uncertain choice of action. We use max- min approximation for establishing minimax- maximin criterion for obtaining best optimal strategy.

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INTRODUCTION

The fuzzy set theory and decision making was first considered in 1970 by bellman and Zadeh. Fuzzy Game theory is one of the types of decision theory in which players' action is imprecise after taking into account all possible actions available to an opponent player playing the same game. The problem of industrial decision making is considered as an applicable of fuzzy game theory. The mathematical analysis of competitive problems is based upon miniaxi-maximin criterion of J. Von Neumann. The simplest type of competitive situation is two person zero sum game. These games involve only two players they are called Zero sum game because one player wins whatever the other player loses. We use max-min approximation for establishing the minimax- maximin criterion.

Preliminaries: In preliminaries, we discuss basic notions which are used in the subsequent part of this paper.

One of the basic problems in the game theory is two player zero sum game. A two players' zero sum game is a game with only two players which a player wins what the other player loses. Let A be a matrix whose entries represent the win of player I. Let us suppose that the player I adopts strategies 'I'and player II strategies j. Then player I wins amount a_{ij} corresponding to the $(I, j)^{th}$ increase in matrix A. The matrix A is thus called the game matrix or the payoff matrix.

Fuzzy minimax-maximin Criterion: Let P be the payoff matrix for the two person were p: x→ [0, 1]. We define payoff matrix corresponding to the rules:

1. Determination of Diagonal elements: $P_{ii} = B_i - A_i$ i= 1, 2, 3
2. Determination of non-diagonal elemnts: $P_{ij} = A_i \times B_j$ $i \neq j$ where A and

B are two players. The problem that we are aiming to solve is a two player zero sum fuzzy game in which the entries in the payoff matrix is as follows:

$$\begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{a}_{m1} & \tilde{a}_{m2} & \cdots & \tilde{a}_{mn} \end{bmatrix} \qquad m \times n$$

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The cell entries in player B's in fuzzy payoff matrix is exactly negative of as A's fuzzy payoff matrix as sum of payoff matrices of player A and B is zero. If $\vee_i(\wedge_j \tilde{a}_{iJ}) = \underline{r}$and $\wedge_j(\vee_i \tilde{a}_{iJ}) = \bar{r}$ then$\bar{r} \geq \underline{r}$

Saddle point: If maximin value equals the minimax value, then the game is said to have a saddle point (equilibrium point) and the corresponding strategies which give the saddle point are called optimal strategies i. e. $\wedge_j(\vee_i \tilde{a}_{iJ}) = \vee_i(\wedge_j \tilde{a}_{iJ})$

Fuzzy Optimal strategies: If fuzzy payoff $\tilde{a}_{iJ}$ is a saddle point, the players have fuzzy optimal strategies in pure strategies. Player I have i^{th} and player II have J^{th} fuzzy optimal strategies respectively.

Value of Fuzzy game: The fuzzy payoff $\tilde{a}_{iJ}$at saddle point (i, j)th is called value of Fuzzy game.

Fair Fuzzy Game: A fuzzy game is said to be fair game if saddle point $\tilde{a}_{iJ}$ = 0.

Problem in Consideration: The largest economic activity providing direct and indirect opportunities in agriculture sector in developing country. In this paper, application of fuzzy game to sugar industry is discussed in problem in consideration. The primary data obtained from the decision maker is intutionistic. So it must proceed this in deterministic data by fuzzy set theory. Sugar industry needs to attract more sugarcane producers in order to optimize the benefit against various constraints such as near distance, maximum rate, more reliability, more recovery, less deduction etc. Here we develop payoff matrix y considering constraints.

Let A and B be the two different sugar factories. We consider near distance, max^{m} rate, more reliability and less deduction as constraints for obtaining optimal strategy.

Table 1 Intutionistic Primary Data

Factory	Distance	Reliability	Rate	Deduction
A	6 km	0.7	Rs.3150	Rs. 259
B	17 km	0.8	Rs. 3280	Rs. 230

Table 2 Fuzzy normalization of Data

Factory	Distance	Reliability	Rate	Deduction
A	0.26	0.46	0.49	0.53
B	0.74	0.54	0.51	0.47

(We define Fuzzy normalization considering the rule: A/ (A + B))

Table 3 Payoff matrix

	Factory *B*			
	Near distance	**More Reliability**	**Maximum Rate**	**Less Deduction**
Near Distance	0.47	0.14	0.13	0.12
More Reliability	0.34	−0.08	−0.23	−0.32
Maximum Rate	0.36	−0.26	−0.02	−0.23
Less Deduction	0.39	0.28	0.27	−0.06

Factory *A*

Calculations

$P_{11} = B_1 - A_1 = 0.74 - 0.26 = 0.47$
$P_{22} = B_2 - A_2 = 0.54 - 0.46 = 0.08$
$P_{33} = B_3 - A_3 = 0.51 - 0.49 = 0.02$
$P_{44} = B_4 - A_4 = 0.47 - 0.53 = 0.06$

$P_{ij} = A_i \times B_j$
$P_{12} = A_1 \times B_2 = 0.26 \times 0.54 = 0.14$
$P_{13} = A_1 \times B_3 = 0.26 \times 0.51 = 0.13$
$P_{14} = A_1 \times B_4 = 0.26 \times 0.47 = 0.12$
$P_{21} = A_2 \times B_1 = 0.46 \times 0.74 = 0.34$
$P_{23} = A_2 \times B3 = 0.46 \times 0.51 = 0.23$
$P_{24} = A_2 \times B_4 = 0.46 \times 0.47 = 0.31$
$P_{31} = A_3 \times B_1 = 0.49 \times 0.74 = 0.36$
$P_{32} = A_3 \times B_2 = 0.49 \times 0.54 = 0.26$
$P_{34} = A_3 \times B_4 = 0.49 \times 0.47 = 0.23$
$P_{41} = A_4 \times B_1 = 0.53 \times 0.74 = 0.39$
$P_{42} = A_4 \times B_2 = 0.53 \times 0.54 = 0.28$
$P_{43} = A_4 \times B_3 = 0.53 \times 0.51 = 0.27$

MAX MIN Approximation: *Row Minimum*

Row I: $0.47 \vee 0.14 \vee 0.13 \vee 0.12 = 0.12$
Row II: $0.34 \vee -0.08 \vee -0.23 \vee -0.32 = -0.32$
Row III: $0.36 \vee -0.26 \vee -0.02 \vee -0.23 = -0.26$
Row IV: $0.39 \vee 0.28 \vee 0.27 \vee -0.06 = -0.06$

Fuzzy Maximin
$0.12 \wedge -0.32 \wedge -0.26 \wedge -0.06 = 0.12$

Column Maximum
Column I: $0.47 \wedge 0.34 \wedge 0.36 \wedge 0.39 = 0.47$
Column II: $0.14 \wedge -0.08 \wedge 0.26 \wedge 0.28 = 0.28$
Column III: $0.13 \wedge -0.23 \wedge -0.02 \wedge 0.27 = 0.27$
Column IV: $0.12 \wedge -0.32 \wedge -0.23 \wedge -0.06 = 0.12$

Fuzzy Minimax

$0.47 \vee 0.28 \vee 0.27 \vee 0.12 = 0.12$

Hence,
$\wedge_j(\vee_i \tilde{a}_{iJ}) = 0.12 = \vee_i(\wedge_j \tilde{a}_{iJ})$
Fuzzy Minimax-Maximin criterion is used for obtaining best optimal strategy A and B.

CONCLUSION

We come to a conclusion from this article that we can develop the application of Fuzzy Game Theory to industrial decision making. The fuzzy optimal strategy for Factory A is Row I (near distance) and the fuzzy optimal strategy for Factory B is column IV (less deduction).

References

1. Thomas S. Ferguson, Online Lecture notes on Game theory.
2. L, A, Zadeh, Fuzzy Sets as a basis for a theory of possibility, Fuzzy Sets and system, no. 1 (1978)
3. MasotoshiSakowa & Ichiro Nischizaki, Max-min Solution for fuzzy multi-objective matrix Game s, Fuzzy Sets and Systems 67 (1994)
4. Kumar S., Chopra R., Saxena R., Method to Solve Fuzzy Game Matrix *IJPAM* volume 89
5. Yadav S. N., Kehedekar M.D., Bapat M. S. and Aher S. J. (2016). Two-person Zero sum game using max-min Approximation. *IJRITCC*. ISSN: 2321- 8169(4)