International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 6, September-October 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Icosagonal Fuzzy Number in Decision Making Problem

V. Raju[1], S. Ramachandran[2]

[1]Department of Mathematics, School of Basic Sciences,
Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, Tamil Nadu, India
[2]Department of Mathematics, St. Thomas College of Arts and Science, Chennai, Tamil Nadu, India

ABSTRACT
This article introduces Icosagonal fuzzy number in the fuzzy decision making problem by. The value of Payoff matrix is specified by Icosagonal fuzzy number. We adapt the fuzzy decision making problem into crisp valued decision making problem by way of ranking to pay off. The crisp valued decision making problem can be efficiently gave out with Savage mini max regret criterion.

KEYWORDS: *Icosagonal fuzzy number, fuzzy decision making, fuzzy ranking and Savage mini max*

How to cite this paper: V. Raju | S. Ramachandran "Icosagonal Fuzzy Number in Decision Making Problem" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-6, October 2021, pp.1194-1199, URL: www.ijtsrd.com/papers/ijtsrd47553.pdf

IJTSRD47553

1. INTRODUCTION

Fuzzy set theory was initiated by Zadeh [1].The concept of fuzzy set theory gives out ambiguity and indistinctness. This is the reason of uncertainty in decision making problem. Uncertainty arises for having the lack of understanding about insertion or omission. We get a lot information from our environment day by day is fuzzy. We are unable to have our daily life without crossing fuzzy connected circumstances. Fuzzy set is resourceful in many existent world condition .Jain [2] was the first to propose method of ranking fuzzy numbers for decision making in fuzzy related condition. Raju and Jayagopal [3] was the first to introduce the Icosagonal fuzzy number. Some decisions are being in use based on the compilation of data. Decision makers are applying Icosagonal fuzzy numbers rather than real numbers to express their judgments. Solving problems and making decisions are necessary skills for business and life. Problem solving shows the importance of decision making. Decision making is very significant and essential for management and leadership and individual. In today's situation there are many process and techniques to get better the decision making and the quality of decision making

In this paper, we have taken decision making problem in which imprecise values are Icosagonal fuzzy numbers. We have completed it with converting to crisp valued decision making problem using ranking technique. We have described fuzzy decision making problem using Icosagonal fuzzy number with illustrations. The crisp valued decision making problem can be efficiently explained with Savage mini max regret criterion

2. PRELIMINARIES

In this section, we give the preliminaries that are required for this study.

Definition 2.1. *A fuzzy set* A *is defined by* $A = \{(x, \mu_A(x)) : x \in A, \mu_A(x) \in [0,1]\}$. *Here* x *is crisp set* A *and* $\mu_A(x)$ *is membership function in the interval* $[0,1]$.

Definition 2.2.
The fuzzy number A is a fuzzy set whose membership function must satisfy the following conditions.

1. A fuzzy set A of the universe of discourse X is convex

2. A fuzzy set A of the universe of discourse X is a normal fuzzy set if $x_i \in X$ exists
3. $\mu_A(x)$ is piecewise continuous

Definition 2.3.
A fuzzy number $A = (a, b, c)$, where $a \le b \le c$, is triangular fuzzy number and its membership function is given by

$$\mu_A(x) = \begin{cases} \frac{x-a}{b-a}, for a \le x \le b \\ \frac{c-x}{c-b}, for b \le x \le c \\ 0, x > c \end{cases}$$

Definition 2.4
A fuzzy number $A = (a, b, c, d)$, where $a \le b \le c \le d$, is trapezoidal fuzzy number and its membership function is given by

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

Definition 2.5
An α-cut of fuzzy set A is classical set defined as $^{\alpha}A = \{x \in X | \mu_A(x) \ge \alpha\}$

Definition 2.6
A fuzzy set A is a convex fuzzy set iff each of its α-cut $^{\alpha}A$ is a convex set.

Definition 2.7
Decision theory concerns about decisions.Decisions are taken based on the available datas.If available datas are false datas that decisions awill be false. We will have the loss. So we search for good datas, itit is received the decisions will be good.

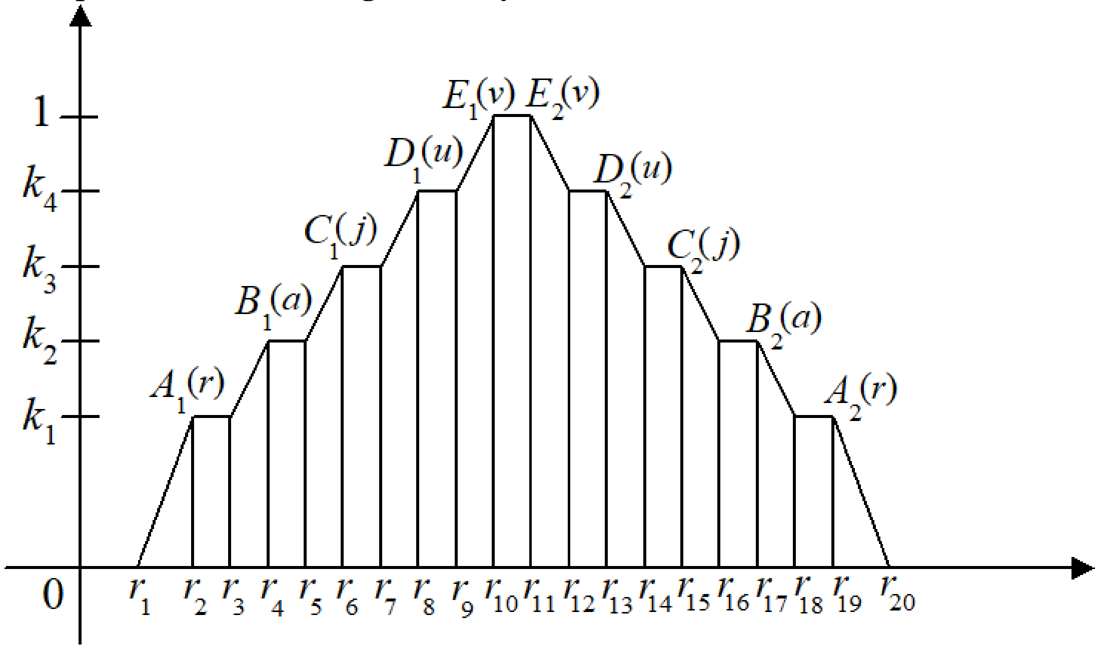
Definition 2.8 [3] A fuzzy number is called as Icosagonal fuzzy number and is denoted by

A = $(r_1, r_2, r_3, r_4, r_5, r_6, r_7, r_8, r_9, r_{10}, ...r_{20})$ and its membership function is given by

$$\mu_A(x) = \begin{cases} 0, \ for \ x \prec r_1 \\ k_1\left(\frac{x-r_1}{r_2-r_1}\right), for \ r_1 \le x \le r_2 \\ k_1, for \ r_2 \le x \le r_3 \\ k_1 + (k_2 - k_1)\left(\frac{x-r_3}{r_4-r_3}\right), for \ r_3 \le x \le r_4 \\ k_2, for \ r_4 \le x \le r_5 \\ k_2 + (k_3 - k_2)\left(\frac{x-r_5}{r_6-r_5}\right), for \ r_5 \le x \le r_6 \\ k_3, \ r_6 \le x \le r_7 \\ k_3 + (k_4 - k_3)\left(\frac{x-r_7}{r_8-r_7}\right), for \ r_7 \le x \le r_8 \\ k_4, for \ r_8 \le x \le r_9 \\ k_4 + (1 - k_4)\left(\frac{x-r_9}{r_{10}-r_9}\right), for \ r_9 \le x \le r_{10} \\ 1, for \ r_{10} \le x \le r_{11} \\ k_4 + (1 - k_4)\left(\frac{r_{12}-x}{r_{12}-r_{11}}\right), for \ r_{11} \le x \le r_{12} \\ k_4, for \quad r_{12} \le x \le r_{13} \\ k_3 + (k_4 - k_3)\left(\frac{r_{14}-x}{r_{14}-r_{13}}\right), for \ r_{13} \le x \le r_{14} \\ k_3, for \ r_{14} \le x \le r_{15} \\ k_2 + (k_3 - k_2)\left(\frac{r_{16}-x}{r_{16}-r_{15}}\right), for \ r_{15} \le x \le r_{16} \\ k_2, for \ r_{16} \le x \le r_{17} \\ k_1 + (k_2 - k_1)\left(\frac{r_{18}-x}{r_{18}-r_{17}}\right), for \ r_{17} \le x \le r_{18} \\ k_1, for \ r_{18} \le x \le r_{19} \\ k_1\left(\frac{r_{20}-x}{r_{20}-r_{19}}\right), for \ r_{19} \le x \le r_{20} \\ 0, \ for \ x > r_{20} \end{cases}$$

$$where \ 0 \le k_1 \le k_2 \le k_3 \le k_4 \le 1$$

2.9 Graphical representation of Icosagonal fuzzy number:



3. Mathematical formulation of Fuzzy Decision making problem:

Consider a fuzzy decision making problem in which all the entries of the payoff matrix are Icosagonal fuzzy numbers. Let us take the problem P has m strategies and problem Q has n strategies. Then the payoff matrix m x n is

$$A=\begin{pmatrix} p_{11} & p_{12} & . & p_{1n} \\ p_{21} & p_{22} & . & p_{2n} \\ . & . & . & . \\ p_{m1} & p_{m2} & . & p_{mn} \end{pmatrix}$$

3.1. Procedures for solving Savage Minimax regret criterion:

Step 1: Construct a regret (opportunity loss) table of each alternative for every state of nature from the given pay off matrix

Step 2: Pick out the maximum pay off in each column and subtract all the elements in that column from this maximum value

Step 3: For each decision alternative (row) , pick out the maximum row value and enter this in the last decision column

Step 4: Choose the decision alternative with the smallest value in the decision column

3.2. Numerical Examples:

Consider the fuzzy decision making problem with payoff matrix as Icosikaioctagonal fuzzy numbers. This problem is worked out by taking the values k_1=0.2, k_2=0.4, k_3=0.6, k_4=0.8

We get the values of $\mu_{Icos}(a_{ij})$

a_{11}	10,-9,-8,-7,-6,-4,-3,-2,-1,0,1,2,4,6,8,10,12,14,16,18,20	$\mu_{Icos}(a_{11}) = 3$
a_{12}	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20	$\mu_{Icos}(a_{12}) = 10.5$
a_{21}	-3,-7,-6,-5,-4,-3,-2,-1,0,3,5,6,7,8,10,12,14,15,16,18	$\mu_{Icos}(a_{21}) = 3.9$
a_{22}	0,1,2,3,4,5,6,7,8,9,10,11,13,15,17,19,21,23,25,27	$\mu_{Icos}(a_{22}) = 11.3$
a_{31}	2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34,36,38,40	$\mu_{Icos}(a_{31}) = 21$
a_{32}	1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39	$\mu_{Icos}(a_{32}) = 20$

Step 1: Fuzzy decision making problem is reduced to the following payoff profit matrix

Alternatives	Expected level of sale (Rupees)	
	I	II
A	3	10.5
B	3.9	11.3
C	21	20

Step 2: The opportunity loss table for each alternative with the states of nature is depicted below

Alternatives	Expected level of sale (Rupees)	
	I	II
A	18	9.5
B	17.1	8.7
C	0	0
Column Maximum	21	20

Step 3: The opportunity loss table and the maximum loss in each row is entered and shown in the below table

Alternatives	Expected level of sale (Rupees)		Decision Column (Maximum Loss)
	I	II	
A	18	9.5	18
B	17.1	8.7	17.1
C	0	0	0

Result: Since the minimum of maximum loss is in alternative C = 0 rupee, this alternative should be selected.

3.3. Ranking of Icosagonal fuzzy number :

Let I be a normal Icosagonal fuzzy number. The value $M\ (I)$, called as measure of I is calculated as

$$M(I)=\frac{1}{2}\int_{1}^{k_1}(A_1(r)+A_2(r))dr+\frac{1}{2}\int_{k_1}^{k_2}(B_1(a)+B_2(a))ds+\int_{k_2}^{k_3}(C_1(j)+C_2(j))dt+\int_{k3}^{k_4}(D_1(u)+D_2(u))du+\int_{k4}^{k_1}(E_1(v)+E_2(v))dv$$

$$where\ \ 0\le k_1\le k_2\le k_3\le k_4\le 1$$

$$M(I)=\frac{1}{4}\left[\begin{matrix}(r_1+r_2+r_{19}+r_{20})k_1+(r_3+r_4+r_{17}+r_{18})(k_2-k_1)+(r_5+r_6+r_{15}+r_{16})(k_3-k_2)+\\(r_7+r_8+r_{14}+r_{13})(k_4-k_3)+(r_9+r_{10}+r_{11}+r_{12})(1-k_4)\end{matrix}\right]$$

$$where\ \ 0\le k_1\le k_2\le k_3\le k_4\le 1$$

3.4. Numerical Example:

Let us consider the matrix

$$\begin{pmatrix}
\begin{pmatrix}-7,-6,-5,-4,-3,-2,-1,0,1,\\2,3,4,5,6,7,8,9,10,11,12\end{pmatrix} & \begin{pmatrix}4,5,6,7,8,9,10,11,12,13,14,\\15,16,17,18,19,20,21,22,23\end{pmatrix} & \begin{pmatrix}-5,-4,-3,-2,-1,0,1,2,3,4,\\5,6,7,8,9,10,11,12,13,14\end{pmatrix}\\
\begin{pmatrix}-4,-3,-2,-1,0,1,2,3,4,6,7,9,\\10,11,13,14,16,17,19,20\end{pmatrix} & \begin{pmatrix}1,2,3,5,6,8,9,10,11,13,15,\\16,17,1819,21,23,24,25,26\end{pmatrix} & \begin{pmatrix}-4,-3,-2,-1,0,2,3,5,6,7,9,\\10,12,13,15,16,18,19,20,22\end{pmatrix}\\
\begin{pmatrix}0,1,3,4,5,6,7,8,9,10,11,13,\\14,15,16,18,20,22,23,25\end{pmatrix} & \begin{pmatrix}2,3,6,8,9,10,12,13,14,16,17,\\19,20,21,22,23,25,27,28,30\end{pmatrix} & \begin{pmatrix}-5,-4,-3,-2,-1,0,1,2,3,4,5,\\6,8,9,10,11,12,13,14,16\end{pmatrix}
\end{pmatrix}$$

Step 1:

We obtain the values of $\mu_{Icskoct}(\ a_{ij})$ of the given fuzzy decision making problem and convert the fuzzy decision making problem into crisp valued decision making problem which is shown in the given table.

a_{11}	-7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12	$\mu_{Icos}(\ a_{11}) = 2.5$
a_{12}	4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23	$\mu_{Icos}(\ a_{12}) = 13.5$
a_{13}	-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14	$\mu_{Icos}(\ a_{13}) = 4.5$
a_{21}	-4,-3,-2,-1,0,1,2,3,4,6,7,9,10,11,13,14,16,17,19,20	$\mu_{Icos}(\ a_{21}) = 7.1$
a_{22}	1,2,3,5,6,8,9,10,11,13,15,16,17,1819,21,23,24,25,26	$\mu_{Icos}(\ a_{22}) = 13.6$
a_{23}	-4,-3,-2,-1,0,2,3,5,6,7,9,10,12,13,15,16,18,19,20,22	$\mu_{Icos}(\ a_{23}) = 8.35$
a_{31}	0,1,3,4,5,6,7,8,9,10,11,13,14,15,16,18,20,22,23,25	$\mu_{Icos}(\ a_{31}) = 11.5$
a_{32}	2,3,6,8,9,10,12,13,14,16,17,19,20,21,22,23,25,27,28,30	$\mu_{Icos}(\ a_{32}) = 16.25$
a_{33}	-5,-4,-3,-2,-1,0,1,2,3,4,5,6,8,9,10,11,12,13,14,16	$\mu_{Icos}(\ a_{33}) = 4.95$

Step 2: The given fuzzy decision making problem is reduced to the following payoff profit matrix

Alternatives	Expected level of Sale (in Rupees)		
	I	II	III
A	2.5	13.5	4.5
B	7.1	13.6	8.35
C	11.5	16.25	4.95

Step 3: The opportunity loss table for each alternative with the states of nature is depicted below

Alternatives	Expected level of Sale (in Rupees)		
	I	II	III
A	9	2.75	3.85
B	4.4	2.65	0
C	0	0	3.4
Column Maximum	11.5	16.25	8.35

Step 4: The opportunity loss table and the maximum loss in each row is entered and shown in the below table

Alternatives	Expected level of Sale (in Rupees)			Decision Column (Maximum Loss)
	I	II	III	
A	9	2.75	3.85	9
B	4.4	2.65	0	4.4
C	0	0	3.4	3.4

Result: Since the minimum of maximum loss is in alternative C =3.4 rupees, this alternative should be selected.

Conclusion: In this paper we have explained and solved fuzzy decision making problem and its pay off matrix whose elements are Icosagonal fuzzy number. We have illustrated the alternative selection of the fuzzy valued decision making problem converting to crisp valued decision making problem using ranking techniques. The Crisp valued decision making problem is worked out by savage minimax regret criterion.

References:

[1] L. A. Zadeh, , Fuzzy sets, Information and Control, 8(3) , 1965, 338-353.

[2] R. E. Bellman and L. A. Zadeh, Decision making in fuzzy environment, Management Science, 17, 1970, 141- 164.

[3] V. Raju and R. Jayagopal "An Arithmetic Operations of Icosagonal fuzzy number using Alpha cut" International Journal of Pure and Applied Mathematics. Volume 120, No. 8, 2018, 137-145

[4] S. Sasikumar and V. Raju '' Study on Fuzzy game problem in Icosikaitetragonal Fuzzy number'' Annals of Romanian Society for Cell biology , Volume 25, Issue 6, 2021, Page No : 10500-10508

[5] V. Raju and R. Jayagopal, ''A new operation on Icosikaitetragonal fuzzy number'', Journal of Combinatorial Mathematics and Combinatorial Computing, Volume 112(2020), Page no : 127- 136

[6] V. Raju and S. Maria Jesu Raja ''An Approach on Fuzzy game problem in Icosikaioctagonal Fuzzy number'' Journal of Xidian University, Volume 14, Issue 4, 2020, Page no: 1009-1016

[7] V. Raju and S. Arul Amirtha Raja " Study on fuzzy sequencing problem in Icosikaioctagonal Fuzzy Numbers'' Journal of Xidian University, Volume 14, Issue 4, 2020, Page no: 3829-3837

[8] V. Raju and S. Maria Jesu Raja '' Fuzzy decision making problem in Icosikaioctagonal Fuzzy number'' Journal of Xidian University, Volume 14, Issue 5, 2020, Page no: 3240-3248

[9] R. Deepa and V. Raju ''Solving Fuzzy Transportation Problem using Icosikaioctagonal Fuzzy Numbers'' Journal of Shanghai Jiaotong University, Volume 16, Issue 7, 2020 Page No: 162-173

[10] S. Maria Jesu Raja and V. Raju '' Elucidating Fuzzy Assignment problem Employing Icosikaioctagonal Fuzzy Number '' Journal of Xi'an University of Architecture and Technology , Volume 12, Issue 6, 2020 , Page no : 1681-1688

[11] V. Ashok Kumar and V. Raju '' An Approach on Fuzzy Assignment problem in Icosagonal Fuzzy Number '' Journal of Xi'an University of

Architecture and Technology, Volume 12, Issue 5, 2020 , Page no : 3487-3493

[12] V. Raju , Ranking Function on Icosagonal Fuzzy Number for Solving Fuzzy Transportation Problem, ''Journal of Applied Science and Computations '' Volume VI, Issue IV, 2019, Page No: 3631-3640

[13] V. Raju and M. ParuvathaVathana "An Icosagonal Fuzzy Number for solving Fuzzy Sequence Problem'' International journal of Research in Engineering, IT and Social Sciences'' Volume 9, Issue 5, 2019. Page no: 37-40

[14] V. Raju and M. ParuvathaVathana " Fuzzy Critical path method with Icosagonal Fuzzy Numbers using Ranking Method'' A Journal of Composition Theory, Volume 12, Issue 9, 2019, Page no: 62-69

[15] V. Raju and R. Jayagopal "An Approach on Icosikaioctagonal Fuzzy number- Traditional Operations on Icosikaioctagonal fuzzy number" A Journal of composition theory, Vol. XII, Issue X, 2019, Page No: 727-734

[16] V. Raju and R. Jayagopal "An Arithmetic Operations of Icosagonal fuzzy number Using Alpha cut "International Journal of Pure and Applied Mathematics. Volume 120, No. 8, 2018, 137-145

[17] V. Raju and R. Jayagopal'' A Rudimentary Operations on Octagonal Fuzzy Numbers '' International Journal of Research in Advent Technology Vol. 6, No. 6, June 2018, Page No: 1320-1323

[18] V. Raju and M. Paruvatha Vathana '' Graceful labeling for some complete bi partite garaph'' Journal of computer and Mathematical sciences , Volume 9, Issue 12 , 2018, Page no : 2147-2152

[19] R. Jayagopal and V. Raju ''Domination Parameters in shadow graph and Path connected graph'' International Journal of mathematics and its Applications , volume 6, Issue 2B, 2018 , Page no : 167-172