Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Multi Criteria Decision Making Under Intuitionistic Fuzzy Environment Using Ranking Order of Soft TOPSIS

K. Rajaraman*[1], R. Sophia Porchelvi[2], J. Irine[3] and B. Snekaa[4]

[1*]Department of Mathematics, A.V.C.College of Engineering, Mayiladuthurai, Tamilnadu.
[2,3,4]Research Scholar, A.D.M. College for Women (Autonomous), Nagapattinam, Tamilnadu.,India.
Email: krajaleo@gmail.com

ABSTRACT

The aim of this paper is to provide the model for group decision making under intuitionistic fuzzy number. Owing to equivocal concept of frequently represented in decision data, the crisp value are insufficient to real life problems. In this paper, the assessment of each alternative and the encumbrance of each criterion are described by phonological terms which can be articulated in intuitionistic fuzzy numbers, then ranking order of soft TOPSIS is used to determine the various order of all alternatives by calculating the distance between the intuitionistic fuzzy positive ideal solution and intuitionistic fuzzy negative ideal solution. This paper provides the alternative method for decision maker in ambiguous concept.

KEYWORDS: Linguistic variable, triangular intuitionistic fuzzy number, Distances between Two Triangular intuitionistic Fuzzynumbers, MCDM, Similarity to Ideal Solutions (TOPSIS) method.

***Corresponding author**

K. Rajaraman

Research Scholar,

Manonmaniam Sundaranar University,

Triuneveli, Tamilnadu

Email :krajaleo@gmail.com

1. INTRODUCTION

Multiple criteria decision-making (MCDM) is considered as a complex decision-making (DM) tool involving both qualitativeand quantitative factors. In recent years, several MCDM techniques and approaches have been suggested for choosing the best probable options. De et al.[1] studied the Sanchez's approach for medical diagnosis and also they extended this concept which is a generalization of fuzzy set theorywith the notion of intuitionistic fuzzy set theory. The Boran[2]combined TOPSIS method with intuitionistic fuzzy set. They proposed a method to select best supplier in group decision making environment.

Liu and Wang[3]presented new methods in an intuitionistic fuzzy environment for solving multi-criteria decision-making problem. Firstly, they defined an evaluation function for the decision-making problem and then introduced operators which will reduce the degree of uncertainty of the elements corresponding to an intuitionistic fuzzy set. Tan and Chen[4] developed the procedure and algorithm of multi-criteria decision making based on intuitionistic fuzzy Choquet integral operator is given under uncertain environment. They also shown that the intuitionistic fuzzy Choquet integral operator is represented by few special t-norms and t-conorms, and it is a generalization of the intuitionistic fuzzy OWA operator and intuitionistic fuzzy weighted averaging operator.

Lin et al.[5]presented and proposed a new method for handling multi-criteria fuzzy decision-making problems based on intuitionistic fuzzy sets. This method allows the decision-maker to assign the degrees of membership and non-membership of the criteria to the fuzzy concept "importance." Atanassovet al.[6] discussed intuitionistic fuzzy interpretations of multi-criteria multi-person and multi-measurement tool decision making. Kelemenis and Askounis[7] considered a real life application on the selection of a top management team member shows the practical implications using TOPSIS.

In this study, TOPSIS method merged with triangularintuitionistic fuzzy set is used to select best candidate for a company in group decision making environment. Here, Intuitionistic fuzzy operator is utilized to aggregate individual opinions of decision makers for rating the importance of criteria and alternatives. Finally, a numerical example for selection is given to illustrate application of triangular intuitionistic fuzzy TOPSIS method.

2. ALGORITHM OF RANKING ORDER OF TOPSIS

- Form a committee of decision makers and then identify the evaluation criteria.
- Choose the appropriate linguistic variables for the importance weight of the criteria and the linguistic ratings for alternativeswith respect to criteria.
- For the criterionC_j , aggregate the weight of criteria to get the aggregated fuzzy weight $W_j$and pool the decision maker's opinions to get the aggregated fuzzy rating $\tilde{X}_{ij}$of the alternative Ai under criterionC_j.

- Construct the fuzzy decision matrix and the normalized fuzzy decision matrix.
- Construct the weighted normalized fuzzy decision matrix.
- Construct the FPIS and FNIS.
- Calculate the distance of each alternative from FPIS and FNIS respectively.
- According to the closeness coefficient, the ranking order of all alternatives can be determined.

3. APPLICATION OF RANKING ORDER OF SOFT TOPSIS- MULTI CRITERIA DECISION MAKING USING TRIANGULAR INTUITIONISTIC FUZZY NUMBERS

Here, the goal is to find the best candidate for the company. Alternatives are three candidates(C_1),$(C_2)$and(C_3) and multi-criteria are Emotional steadiness(Q_1), Oral communication skill(Q_2), Personality(Q_3), and Self-confidence(C_4). By these multi criteria, decision makers (D_1, D_2, D_3) will choose the best alternative.

The three decision makers use the seven points scale linguistic variables whose values are given as triangular intuitionistic fuzzy numbers to express the importance priority to four criteria given by

Table 1:Linguistic variables of triangular intuitionistic fuzzy number for criteria

Very Good (VG)	(8,10,12;7.5,10,12.5)
Good (G)	(7,9,11;6.5,9,11.5)
Medium Good (MG)	(6,8,10;5.5,8,10.5)
Fair (F)	(5,7,9;4.5,7,9.5)
Poor (P)	(4,6,8;3.5,6,8.5)
Medium Poor (MP)	(3,5,7;2.5,5,7.5)
Very Poor (VP)	(2,4,6;1.5,4,6.5)

Table 2: The importance weight of the criteria

	D_1	D_2	D_3
Q_1	**VG**	**P**	**MG**
Q_2	**MG**	**G**	**P**
Q_3	**G**	**G**	**F**
Q_4	**VG**	**G**	**VG**

Based on table 1 and table 2, the fuzzy weight of each criterion is found as

Table 3: Fuzzy weight of each criterion

$\widetilde{W}$	**Fuzzy weight**
$\widetilde{W}_1$	**(6,8,10;5.5,8,10.5)**
$\widetilde{W}_2$	**(5.7,7.7,9.7;5.2,7.7,10.2)**
$\widetilde{W}_3$	**(6.3,8.3,10.3;5.8,8.3,10.8)**
$\widetilde{W}_4$	**(7.7,9.7,11.7;7.2,9.7,12.2)**

The three candidates are assessed by the three decision makers on a seven point linguistic scale whose values are given as

Table 4: Linguistic scale of triangular intuitionistic fuzzy number for alternatives

Very Poor (VP)	**(0.2,0.4,0.6;0.15,0.4,0.65)**
Poor (P)	**(0.4,0.6,0.8;0.35,0.6,0.85)**
Medium Poor (MP)	**(0.3,0.5,0.7;0.25,0.5,0.75)**
Fair (F)	**(0.5,0.7,0.9;0.45,0.7,0.95)**
Medium Good (MG)	**(0.6,0.8,0.10;0.55,0.8,1.05)**
Good (G)	**(0.7,0.9,0.11;0.65,0.9,1.15)**
Very Good (VG)	**(0.8,0.10,0.12;0.75,0.10,1.25)**

By the evaluation of the three candidates by the three decision makers under the four criteria and combining the opinion of all the three decision makers for each criterion, the fuzzy decision matrix $\tilde{F} = \left(\tilde{X}_{ij}\right)$, where i = 1, 2, 3 and j = 1, 2, 3, 4 is given by

$\widetilde{D} =$

Table 5: Fuzzy decision matrix

	Q_1	Q_2	Q_3	Q_4
C_1	(4,4,4; 4,4,4)	(0.7,0.9,1.1; 0.65,0.9,1.15)	(0.7,0.9,1.1; 0.65,0.9,1.15)	(0.5,0.7,0.9; 0.45,0.7,0.95)
C_2	(5,5,5;5,5,5)	(0.77,0.97,0.17; 0.72,0.97,1.22)	(0.53,0.73,0.93: 0.48,0.73,0.98)	(0.33,0.53,0.73; 0.28,0.53,0.78)
C_3	(7,7,7;7,7,7)	(0.57,0.77,0.97; 0.52,0.77,1.02)	(0.5,0.7,0.9; 0.45,0.7,0.95)	(0.53,0.73,0.93; 0.48,0.73,0.98)

Then calculate the normalized decision matrix $\tilde{R} = \left(\tilde{r}_{ij}\right)$ for each criterion.

Table 6: The normalized decision matrix

	Q_1	Q_2	Q_3	Q_4
C_1	**(1,1,1;1,1,1)**	**(0.57,0.74,0.90; 0.53,0.74,0.94)**	**(0.61,0.78,0.96; 0.57,0.78,1)**	**(0.51,0.71,0.92; 0.46,0.71,0.97)**
C_2	**(0.8,0.8,0.8; 0.8,0.8,0.8)**	**(0.63,0.79,0.14; 0.59,0.79,1)**	**(0.46,0.63,0.81; 0.42,0.63,0.85)**	**(0.34,0.54,0.74; 0.29,0.54,0.79)**
C_3	**(0.6,0.6,0.6; 0.6,0.6,0.6)**	**(0.47,0.63,0.79; 0.43,0.63,0.84)**	**(0.43,0.61,0.78; 0.39,0.61,0.83)**	**(0.54,0.74,0.95; 0.49,0.74,1)**

Now, calculate the normalized decision matrix $\tilde{V} = \left(\tilde{v}_{ij}\right)$ for each criterion and reducing to three terms. We get,

$\tilde{V} = \left(\tilde{v}_{ij}\right) =$

$$\begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \end{array} \begin{array}{cccc} Q_1 & Q_2 & Q_3 & Q_4 \\ \end{array}$$

$$\begin{matrix} C_1 \\ C_2 \\ C_3 \end{matrix} \begin{bmatrix} (5.75,8,10.25) & (3,5.69,9.16) & (3.58,6.47,10.35) & (3.62,6.89,11.29) \\ (4.6,6.4,8.2) & (3.33,6.08,5.78) & (2.67,5.23,8.76) & (2.36,5.24,9.15) \\ (3.45,4.8,6.15) & (2.46,4.85,8.12) & (2.49,5.06,8.49) & (3.85,7.18,11.66) \end{bmatrix}$$

Then take the FPIS and FNIS to be $P^* = (\tilde{V}_1^*,\ \tilde{V}_2^*,\ \tilde{V}_3^*,\ \tilde{V}_4^*)$ and $\overline{N} = \left(\bar{\bar{V}}_1,\ \bar{\bar{V}}_2,\ \bar{\bar{V}}_3,\ \bar{\bar{V}}_4\right)$ respectively such that $\tilde{V}_j^*$ = (1, 1, 1) and $\bar{\bar{V}}_j$ = (0, 0, 0).

Now, the distance of each alternative C_i from the positive solution is $d_i^+ = \sum_{j=1}^{n} d \quad (\tilde{V}_{ij}, \quad \tilde{V}_j^*)$ where i = 1, 2, 3 and the distance of each alternative C_i from the negative solution is $d_i^- = \sum_{j=1}^{n} d \quad (\tilde{V}_{ij}, \quad \bar{\tilde{V}}_j)$ where i = 1, 2, 3.

Therefore, the separation measures from the positive and negative solution are calculated and we get,

Table 7: Separation measures

Alternative	d_i^+	d_i^-
C_1	31.05	34.04
C_2	22.92	27.42
C_3	24.16	28.17

The closeness coefficient $CC_i = \frac{d_i^-}{d_i^+ \; + \; d_i^-}$

$$CC_1 = 0.523,\ CC_2 = 0.545,\ CC_3 = 0.538$$

4. RESULT

According to the CC_i, the ranking order of the three alternatives is candidate 2> candidate 3>candidate 1 ($C_2 > C_3 > C_1$). Therefore, the best candidate isC_2.

5. CONCLUSION

In multi criteria decision making problems follow to uncertain and vague data, and intuitionistic fuzzy set theory is suitable to deal with it. In this paper, a linguistic decision process is offered to solve the multiple criteria decision-making problem under intuitionistic fuzzy environment.

In decision-making process, very often, the assessment of alternatives with respect to criteria and the importance weight are suitable to use the linguistic variables instead of numerical values. Here, under group decision-making process, it is not difficult to use other aggregation function to pool the intuitionistic fuzzy assignment of decision makers in the proposed method. Although the method presented in this section is illustrated by a personal selection problem, however, it can also be applied to problems such as material section, project selection, area selection and many other areas of decision making problems.

CONFLICT OF INTERESTS:The author declared no conflict of interests.

REFERENCES

1. De SK, Biswas R, and Roy AR. An application of intuitionistic fuzzy sets in medical diagnosis. Fuzzy sets and Systems.2001;117(2):209-213.
2. Boran FE,Genç S,KurtM et al. A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method. Expert Systems with Applications.2009; 36(8): 11363-11368.

3. Liu HW and Wang GJ. Multi-criteria decision-making methods based on intuitionistic fuzzy sets. European Journal of Operational Research.2007; 179(1): 220-233.
4. Tan C and ChenX. Intuitionistic fuzzy Choquet integral operator for multi-criteria decision making. Expert Systems with Applications.2010; 37(1): 149-157.
5. Lin L,Yuan XH and Xia ZQ. Multicriteria fuzzy decision-making methods based on intuitionistic fuzzy sets. Journal of computer and System Sciences.2007; 73(1): 84-88.
6. Atanassov, PasiG,Yager R. Intuitionistic fuzzy interpretations of multi-criteria multi-person and multi-measurement tool decision making. International Journal of Systems Science.2005; 36(14): 859-868.
7. Kelemenis A and Askounis D. A new TOPSIS-based multi-criteria approach to personnel selection. Expert systems with applications.2010; 37(7):4999-5008.
8. Jianqiang W and ZhongZ. Aggregation operators on intuitionistic trapezoidal fuzzy number and its application to multi-criteria decision making problems. Journal of Systems Engineering and Electronics.2009; 20(2): 321-326.
9. NayagamVL,MuralikrishnanS and Sivaraman, G.Multi-criteria decision-making method based on interval-valued intuitionistic fuzzy sets. Expert Systems with Applications.2011; 38(3): 1464-1467.
10. Tan C. A multi-criteria interval-valued intuitionistic fuzzy group decision making with Choquet integral-based TOPSIS. Expert Systems with Applications.2011; 38(4):3023-3033.
11. Wei GW. GRA method for multiple attribute decision making with incomplete weight information in intuitionistic fuzzy setting. Knowledge-Based Systems.2010; 23(3): 243-247.
12. Xu ZS. And Jian CH EN. Approach to group decision making based on interval-valued intuitionistic judgment matrices. Systems Engineering-Theory & Practice.2007; 27(4): 126-133.
13. Ye J. Multicriteria fuzzy decision-making method using entropy weights-based correlation coefficients of interval-valued intuitionistic fuzzy sets. Applied Mathematical Modelling.2010; 34(12): 3864-3870.
14. Zhang SF and Liu SY. A GRA-based intuitionistic fuzzy multi-criteria group decision making method for personnel selection. Expert Systems with Applications.2011; 38(9): 11401-11405.