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On Solving MCDM Using Ranking Order Of Topsis

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Abstract
In this paper, multi – person – multi criteria decision making in fuzzy environment is discussed using Technique for Order Performance by Similarity to Ideal Solutions (TOPSIS) method.
Keywords: Distances between Two Triangular Fuzzy, Triangular fuzzy number, separation measures, closeness coefficient

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I. INTRODUCTION

The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is one of the method to solve a MCDM problem, which was developed by Hwang and Yoon in 1981[3]and further developments by Yoon in 1987[4], and Hwang, Lai and Liu in 1993[5]. The FPIS is composed of the best performance values for each alternative whereas the FNIS consists of the worst performance values.

Some of the sportsperson or an equally active person would like to lose out on their activities because of lack of nutrients. They have to take care of all the nutrients like proteins, fats, carbohydrates, and omega-3. Being a sportsperson is not an easy one. Apart from being physically active they also have to check the amount and quality of calories they eat. They need more stamina, calories, proteins, fats, carbohydrates than the other regular person but correct amount and quality of calories, proteins, fats, and carbohydrates are more important.In this paper, a distance is used to calculate the distance between two triangular fuzzy ratings. Using this distance, the distance of each alternative is calculated. Then, the ranking order of the alternatives is determined using the closeness coefficient.

This paper is organized as follows: section 2 has preliminaries, section 3 deals with the application; section 4 contains result and discussion of the problem and section 5 has conclusion.

II. PRELIMINARIES

2.1 Distancesbetween Two Triangular Fuzzy[9]

Let $\tilde{G} = (g_1, \ g_m, \ g_2)$and $\tilde{H} = (h_1, \ h_m, \ h_2)$be two triangular fuzzy numbers. Then the distance between $\tilde{A}$ and is $\tilde{B}$defined as

$$d(\tilde{G}, \ \tilde{H}) = 1\backslash 2\{\max(|g_1 - h_1|, (|g_2 - h_2|) + |g_m - h_m|\}$$

2.2 Definition[9]

Let $\tilde{G}$and $\tilde{H}$ be two triangular fuzzy numbers. Then the fuzzy number $\tilde{G}$is closer to fuzzy number $\tilde{H}$ as $d(\tilde{G}, \ \tilde{H})$ approaches 0.

III. SELECTING THE HEALTHY FOOD BY USING RANKING ORDER OF TOPSIS

A sport person needs healthy protein for strength and omega-3 fatty acids – "good" fats that will help the body fight off inflammation. Non-vegetarian foods are rich in protein, especially fish contains healthy protein. We should not take heavy cholesterol contain foods which will affect our heart. While comparing with non-vegetarian, vegetarian is best. But from non-vegetarian sport person will intake protein, heme iron and vitamin B12. Protein will give strength to us. Heme iron can come from only animal foods and sea food. From heme iron we will get the most health benefits of iron. Vitamin B12 is a water soluble vitamin that has a main role in the normal functioning of the brain. Not only for sport person generally men need high protein and women needs iron content in their food to maintain their health. We are having more confusion in choosing healthy non-vegetarian food among chicken,seafood and mutton. In this paper, using ranking order of TOPSIS I have studied which one can sport person prefer to take among chicken, seafood and mutton.

Here, the goal is consider for healthy non-vegetarian food. Alternatives are chicken(F_1), seafood (F_2)and mutton (F_3) and multi-criteria are cost(C_1), protein(C_2), carbohydrates(C_3), omega-3(C_4) and fats(C_5). 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 fuzzy numbers to express the importance priority to five criteria given by

Very Low (VL)	**(0,0,0.1)**
Low (L)	**(0,0.1,0.3)**
Medium Low (ML)	**(0.1,0.3,0.5)**
Medium (M)	**(0.3,0.5,0.7)**
Medium High (MH)	**(0.5,0.7,0.9)**
High (H)	**(0.7,0.9,1.0)**
Very High (VH)	**(0.9,1.0,1.0)**

Linguistic variables of triangular fuzzy number for criteria
Table 1

	D_1	D_2	D_3
C_1	**M**	**MH**	**M**
C_2	**VH**	**H**	**VH**
C_3	**ML**	**M**	**MH**
C_4	**VH**	**VH**	**VH**
C_5	**L**	**VL**	**M**

The importance weight of the criteria
Table 2

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

$\widetilde{W}$	**Fuzzy weight**
$\widetilde{W}_1$	**(0.37,0.57,0.77)**
$\widetilde{W}_2$	**(0.83,0.97,1.0)**
$\widetilde{W}_3$	**(0.3,0.5,0.7)**
$\widetilde{W}_4$	**(0.9,0.1,0.1)**
$\widetilde{W}_5$	**(0.1,0.2,0.37)**

Fuzzy weight of each criterion
Table 3

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

Very Poor (VP)	**(0,0,1)**
Poor (P)	**(0,1,3)**
Medium Poor (MP)	**(1,3,5)**
Fair (F)	**(3,5,7)**
Medium Good (MG)	**(5,7,9)**
Good (G)	**(7,9,10)**
Very Good (VG)	**(9,10,10)**

Linguistic scale of triangular fuzzy number for alternatives
Table 4

The evaluation of the three types of food by the three decision makers under the five criteria are given below

Criteria	Types of food	Decision makers		
		D_1	D_2	D_3
C_1	F_1	4	3	5
	F_2	4	6	5
	F_3	7	8	6
C_2	F_1	G	MG	VG
	F_2	VG	G	VG
	F_3	MG	F	MG
C_3	F_1	G	MG	VG
	F_2	MG	MP	G
	F_3	F	P	MG
C_4	F_1	MG	MP	MG
	F_2	VG	VG	VG
	F_3	MP	P	VP
C_5	F_1	MG	F	P
	F_2	F	MP	VP
	F_3	G	MG	MP

Table 5

Combining the opinion of all the three decision makers for each criterion, the fuzzy decision matrix $\tilde{F} = (\tilde{X}_{ij})$, where i = 1, 2, 3 and j = 1,2,3,4,5 is given by

$$\tilde{D} = \begin{array}{c} \\ F_1 \\ F_2 \\ F_3 \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & C_2 & C_3 & C_4 & C_5 \end{array} \\ \begin{bmatrix} (4.0,4.0,4.0) & (7.0,8.7,9.7) & (7.0,8.7,9.7) & (3.7,5.7,7.7) & (2.7,4.3,6.3) \\ (5.0,5.0,5.0) & (8.3,9.7,10) & (4.3,6.3,8.0) & (9,10,10) & (1.3,2.7,4.3) \\ (7.0,7.0,7.0) & (4.3,6.3,8.3) & (2.7,4.3,6.3) & (0.3,1.3,3.0) & (4.3,6.3,8.0) \end{bmatrix} \end{array}$$

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

	C_1	C_2	C_3	C_4	C_5
F_1	(1,1,1)	(0.7,0.87,0.97)	(0.72,0.89,1.0)	(0.37,0.57,0.77)	(0.34,0.54,0.79)
F_2	(0.8,0.8,0.8)	(0.83,0.97,1.0)	(0.44,0.65,0.82)	(0.9,1.0,1.0)	(0.16,0.34,0.54)
F_3	(0.6,0.6,0.6)	(0.43,0.63,0.83)	(0.28,0.44,0.65)	(0.03,0.13,0.3)	(0.54,0.79,1.0)

The normalized decision matrix

Table 6

Now, calculate the normalized decision matrix $\tilde{V} = (\tilde{v}_{ij})$ for each criterion. We get,

$$\tilde{V} = (\tilde{v}_{ij}) = \begin{array}{c} \\ F_1 \\ F_2 \\ F_3 \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & C_2 & C_3 & C_4 & C_5 \end{array} \\ \begin{bmatrix} (0.37,0.57,0.77) & (0.58,0.84,0.97) & (0.22,0.45,0.7) & (0.33,0.57,0.77) & (0.34,0.11,0.29) \\ (0.29,0.46,0.62) & (0.69,0.94,1.0) & (0.13,0.33,0.57) & (0.81,1.0,1.0) & (0.16,0.07,0.19) \\ (0.22,0.34,0.46) & (0.36,0.61,0.83) & (0.08,0.22,0.46) & (0.03,0.13,0.3) & (0.54,0.16,0.37) \end{bmatrix} \end{array}$$

Then take the FPIS and FNIS to be $P^* = (\tilde{V}_1^*, \tilde{V}_2^*, \tilde{V}_3^*, \tilde{V}_4^*, \tilde{V}_5^*)$ and $\bar{N} = (\bar{\tilde{V}}_1, \bar{\tilde{V}}_2, \bar{\tilde{V}}_3, \bar{\tilde{V}}_4, \bar{\tilde{V}}_5)$ respectively such that $\tilde{V}_j^*$ = (1, 1, 1) and $\bar{\tilde{V}}_j$ = (0, 0, 0).

Now, the distance of each alternative F_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 F_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,

Alternative	d_i^+	d_i^-
F_1	2.85	3.05
F_2	2.86	3.09
F_3	2.745	2.025

Separation measures
Table 7

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

$CC_1 = 0.5169$
$CC_2 = 0.5193$
$CC_3 = 0.4245$

IV. RESULT AND DISCUSSION

According to the CC_i, the ranking order of the three alternatives is seafood > chicken > mutton ($F_2 > F_1 > F_3$). Therefore, the healthy non-vegetarian food is seafood (F_1). It is suggested that we can take fish almost every day, and you can prefer chicken once in week and mutton once in month.

V. CONCLUSION

Here ranking order of TOPSIS with a simple and easiest distance calculation between two triangular fuzzy ratings is used to find the higher priority among non-veg food. In future use we can apply this method in real life problems like choosing a best and suitable business to develop our career.

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