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A NEW METHOD FOR SOLVING FUZZY OCTAGONAL NUMBER USING ROBUST RANKING METHOD

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Abstract:

In this paper, a new concept for solving fuzzy transportation problem using octagon fuzzy numbers using Robust's ranking technique are introduced.

Key Words: Octagonal Fuzzy Number & Row Minima

1. Introduction:

Fuzzy set theory has been studied extensively over the past 30 years most of the early interest in fuzzy set theory pertained to representing uncertainly in human cognitive process. Fuzzy set theory is now applied to problems in Engineering, Business, Medical and related health sciences. In an effort to gain a better understanding of the use of fuzzy set theory in operation research over the years there have been successful applications and implementations of fuzzy set theory in operation research. Fuzzy set theory has been used to model system that is hard to precisely .the activity "Operation Research" has become increasing complexities in business and industry. No science has ever been born on a specific day operations research is no exception. Its roots are as old as science and society. During the last four decads, a large number of mathematical tools have been developed in and for operation research. They are primarily devices to find the optimal solutions after a problem has been modelled formally. The idea of fuzzy set was introduced dy zadeh in [1]. Bellman and Zadeh proposed the concept of decision making in fuzzy environment in [2].Ranking fuzzy numbers was first proposed by Jain [3] for decision making in fuzzy situations by representing the well-defined quantity as a fuzzy set. Jain in [4]. Proposed the concept of ranking function for comparing normal fuzzy number. Ranking fuzzy number is an important component of the decision process in many application. More than 30 fuzzy ranking indices have been proposed since 1976.In [5] Jain proposed a method using the concept of maximizing set to order the fuzzy numbers. Jain's method is that the decision maker considers only the right-sides membership function. The basic transportation problem was originally developed by Hitchcock in [6].The concept of fuzzy mathematical programming on a general was first proposed by Tanaka at [7].In [8] T.C.Koopmans presented an independent study called optimum unitization of the transportation methods which involve in a number of shipping sources and a number of destinations. The idea of fuzzy set was introduced by Zadeh in [1]. Bellmann and Zadeh proposed the concept of decision making in fuzzy environment in [9].After this many authors have studied fuzzy linear programming problem techniques such as S.C.Fang in 1999.

Definition 1.1: The characteristic function of a crisp set assigns a value either 1 or 0 each individual in the universal set their by discriminating between member and nonmembers of the crisp set under consideration the value assigns to the element of the universal set of all in a specified range and indicated membership such a function is called a membership function it the set defined by it to be a fuzzy set.

Definition 1.2: Let denote a universal set then the membership function μ_A by which a fuzzy set a usually defined in the form μ_A:x→[0,1] where [0,1] denote the interval of real number from 0 to 1 inclusive.

Definition 1.3: A fuzzy number Ã is a normal octagonal fuzzy number denoted by $(a_1,a_2,a_3,a_4,a_5,a_6,a_7,a_8)$ where $a_1,a_2,a_3,a_4,a_5,a_6,a_7,a_8$ are real number and its membership function $\mu_{\tilde{A}}(x)$ is given by

$$\mu_{\tilde{A}}(x)=\begin{cases} 0 & x<a_1 \\ k\left(\frac{x-a_1}{a_2-a_1}\right) & a_1 \le x \le a_2 \\ k & a_2 \le x \le a_3 \\ k+(1-k)\left(\frac{x-a_3}{a_4-a_3}\right) & a_3 \le x \le a_4 \\ 1 & a_4 \le x \le a_5 \\ K+(1-k)\left(\frac{a_6-x}{a_6-a_5}\right) & a_5 \le x \le a_6 \\ K & a_6 \le x \le a_7 \\ k\left(\frac{a_8-x}{a_8-a_7}\right) & a_7 \le x \le a_8 \\ 0 & x \ge a_8 \end{cases}$$

Where 0 < k < 1

2. Ranking of Octagonal Fuzzy Numbers:

Let $\bar{A}_{oc}=(a_1,a_2,a_3,a_4,a_5,a_6,a_7,a_8)$ and $\tilde{N}_{oc}=(n_1,n_2,n_3,n_4,n_5,n_6,n_7,n_8)$ be two octagonal fuzzy numbers the

$$\bar{A}_{oc} \Leftrightarrow \tilde{N}_{oc} \Leftrightarrow R(\bar{A}_{oc})=R(\tilde{N}_{oc})$$
$$\bar{A}_{oc} \ge \tilde{N}_{oc} \Leftrightarrow R(\bar{A}_{oc})\ge R(\tilde{N}_{oc})$$
$$\bar{A}_{oc} \le \tilde{N}_{oc} \Leftrightarrow R(\bar{A}_{oc})\le R(\tilde{N}_{oc})$$

Definition 2.1: Robust ranking technique which satisfies the following properties,

- ✓ Compensation

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- ✓ Linearity
- ✓ Additive

It provides results which are consistent with human intuition. If $\tilde{a}$ is a convex fuzzy number, the Robust ranking index is defined by

$$R(\tilde{a})= \int_0^1 0.5\left(a_{\alpha,}^L a_\alpha^U\right) d\alpha$$

Where $\left(a_{\alpha,}^L a_\alpha^U\right)$=[{(b-a)$\alpha$+a,d-(d-c) α},{(f-e) α+e,h-(h-g) α}]

is a α-level cut of a fuzzy number $\tilde{a}$.In this paper we use this method for ranking the objective values.The Robust ranking index R($\tilde{a}$) gives the representative value of fuzzy number $\tilde{a}$.

3. Row Minima Method Using Robust'S Ranking Technique:

3.1 Numerical Example:

Let us consider a fuzzy assignment problem with the rows representing 4 workers A,B,C,D and columns representing the jobs job1, job2, job3 and job4 the cost matrix R(C_{ij}) is given whose element are octagon fuzzynumbers.

The problem is to find the optimal assignment so that the total cost of job assignment becomes minimum

$[c_{ij}]_{4\times4}$=(0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8) (0.2,0.5,0.8,0.9,0.11,0.7,0.1,0.3)
(0.22,0.24,0.26,0.28,0.23,0.9,0.11,0.25)(0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08)
(0.17,0.21,0.14,0.18,0.24,0.7,0.11,0.15) (,0.1,0.2,0.04,0.01,0.020.08,0.03,0.05)
(0.11,0.12,0.23,0.24,0.4,0.5,0.17,0.28) (0.31,0.32,0.25,0.34,0.22,0.28,0.29,0.41)
(0.1,0.2,0.11,0.12,0.15,0.16,0.13,0.14) (0.8,0.9,0.11,0.15,0.16,0.17,0.11,0.14)
(0.22,0.24,0.26,0.28,0.30,0.32,0.34,0.36)(0.23,0.25,0.27,0.23,0.26,0.28,0.12,0.22)
(0.21,0,31,0.33,0.35,0.12,0.25,0.11,0.15)(0.8,0.9,0.23,0.5,0.24,0.27,0.22,0.29)
(0.13,0.15,0.12,0.22,0.1,0.2,0.11,0.18)(0.1,0.3,0.5,0.7,0.11,0.9,0.13,0.15)

Solution:

R(0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8)x_{11} + R(0.2,0.5,0.8,0.9,0.11,0.7,0.1,0.3)x_{12}
+R(0.22,0.24,0.26,0.28,0.23,0.9,0.11,0.25)x_{13}
+R(0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08)x_{14}
+R(0.17,0.21,0.14,0.18,0.24,0.7,0.11,0.15)x_{21}
+R(, 0.1,0.2,0.04,0.01,0.020.08,0.03,0.05)x_{22}
+R(0.11,0.12,0.23,0.24,0.4,0.5,0.17,0.28)x_{23}
+R (0.31,0.32,0.25,0.34,0.22,0.28,0.29,0.41)x_{24}
+R(0.1,0.2,0.11,0.12,0.15,0.16,0.13,0.14)x_{31}
+ R(0.8,0.9,0.11,0.15,0.16,0.17,0.11,0.14)x_{32}
+R(0.22,0.24,0.26,0.28,0.30,0.32,0.34,0.36)$_{x33}$
+R(0.23,0.25,0.27,0.23,0.26,0.28,0.12,0.22)$_{x34}$
+R(0.21,0,31,0.33,0.35,0.12,0.25,0.11,0.15)x_{41}
+R(0.8,0.9,0.23,0.5,0.24,0.27,0.22,0.29)x_{42}
+R(0.13,0.15,0.12,0.22,0.1,0.2,0.11,0.18)$_{x43}$+ R(0.1,0.3,0.5,0.7,0.11,0.9,0.13,0.15)x_{44}

Subject to:

$$x_{11} + x_{12} + x_{13} + x_{14} = 1$$
$$x_{21} + x_{22} + x_{23} + x_{24} = 1$$
$$x_{31} + x_{32} + x_{33} + x_{34} = 1$$
$$x_{41} + x_{42} + x_{43} + x_{44} = 1$$

Now calculate R(0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8) by applying Roubust's ranking method. The membership function of octagonal fuzzy number.

R($\tilde{a}$)= $\int_0^1 0.5\left(a_{\alpha,}^L a_\alpha^U\right) d\alpha$ Where $\left(a_{\alpha,}^L a_\alpha^U\right)$=[{(b-a)$\alpha$+a,d-(d-c) α},{(f-e) α+e,h-(h-g) α}]

R($\tilde{a}_{11}$) $= \int_0^1 0.5\{(0.2 - 0.1)(0.5) + 0.1 + 0.4 - (0.4 - 0.3)(0.5) + (0.6 - 0.5)(0.5) + 0.8 - (0.8 - 0.7)(0.5)\} d\alpha$

$=\int_0^1 0.5(0.05 + 0.1 + 0.4 - 0.05 + 0.05 + 0.5 + 0.8 - 0.05)\, d\alpha = \int_0^1 0.5(1.8)\, d\alpha$ =0.9

Similarly;

$$R(\tilde{a}_{12}) = 0.903 R(\tilde{a}_{13}) = 0.573 R(\tilde{a}_{14}) = 0.090$$
$$R(\tilde{a}_{21}) = 0.475 R(\tilde{a}_{22}) = 0.133 R(\tilde{a}_{23}) = 0.513$$
$$R(\tilde{a}_{24}) = 0.605 R(\tilde{a}_{31}) = 0.278 \quad R(\tilde{a}_{32}) = 0.635$$
$$R(\tilde{a}_{33}) = 0.58 \quad R(\tilde{a}_{34}) = 0.49 \quad R(\tilde{a}_{41}) = 0.458$$
$$R(\tilde{a}_{42}) = 0.863 \quad R(\tilde{a}_{43}) = 0.268 R(\tilde{a}_{44}) = 0.723$$

	J_1	J_2	J_3	J_4
A	0.9	0.903	0.573	0.090
B	0.475	0.133	0.513	0.605
C	0.278	0.635	0.58	0.49
D	0.458	0.863	0.268	0.723

Number of rows=4
Number of columns=4
This is balanced transportation problem

Step 1:

	J_1	J_2	J_3	J_4
A	0.9	0.903	0.573	0.090
B	0.475	0.133	0.513	0.605
C	0.278	0.635	0.58	0.49
D	0.458	0.863	0.268	0.723

Step 2:

	J_1	J_2	J_3	J_4
A	0.810	0.813	0.483	0
B	0.342	0	0.380	0.472
C	0	0.357	0.302	0.212
D	0.190	0.595	0	0.455

Step 3:

	J_1	J_2	J_3	J_4
A	0.810	0.813	0.483	0
B	0.342	0	0.380	0.472
C	0	0.357	0.302	0.212
D	0.190	0.595	0	0.455

The optimal solution is

A $\rightarrow J_4$ B$\rightarrow J_2$ C$\rightarrow J_1$ D$\rightarrow J_3$

$$Z = R(\tilde{a}_{14}) + R(\tilde{a}_{22}) + R(\tilde{a}_{31}) + R(\tilde{a}_{43})$$

$$= 0.090+0.133+0.278+0.268 = 0.769$$

4. Conclusion:

In this paper, the row minima methods are considered as imprecise numbers described by fuzzy numbers which are more realistic and general in nature. This method is easy to apply in real value problem.

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