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A NEW RANKING APPROACH FOR FINDING OPTIMUM SOLUTION FOR IFTP OF TYPE-1

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ABSTRACT. In today's daily life situations TP we frequently face the situation of unreliability in addition to unwillingness due to various unmanageable components. To handle with unreliability and unwillingness multiple researchers have recommended the intuitionistic fuzzy (IF)delineation for material. So, here, we contemplate a fuzzy TP of type - 1 IFN's, i.e., availability and demand are TIFN's and costs are real numbers. We apply IFZPM and IFMODIM to find optimum solution of a IFTP of type-1 make use of proposed ranking function. The same existing method is applied to proposed ranking function is comparatively give the same result. A relevant numerical example is also included.

1. INTRODUCTION

The fuzzy set (FS) theory was initially invented by Zadeh [8] is helpful in many ways in different applications in various fields. The concept fuzzy mathematical programming was invented by Tanaka et al in 1947 framing of fuzzy decision of Bellman et al [2]. Concept of Intuitionistic fuzzy sets (IFS's) suggested by Atanassov [1] are mainly useful to deal with many exceptions, confusion and ambiguities. The IFS's separate the intensity of membership (MF)

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and the intensity of non-membership (NMF) of an element in the set. IFS's help decision maker to agree the intensity of fulfillment, intensity of non-fulfillment and intensity of uncertainty for consignment and also help to make determinant at forth extent of approval and non-approval for transportation cost (TC) in any transportation problem (TP). And undoubtedly coming to decision making problems IFS became a ultimate method which is mostly choosable. Accordingly it's superior to utilize IFS contrasted with FS to cope with problems which our own decision making or unfaithfulness. In Ismail Mohideen et al [5], look over a relative study on TP in fuzzy environment. So, IFS's are used by many authors for different optimal problems. Chakraborty et al. [3], introduced arithmetic operations of IFS's. Multiple researchers are also worked on and with IFS's. An efficient procedure for solving type -1 intuitionistic fuzzy transportation problem (IFTP) was presented by Sujeet Kumar et al [7] which capacity and demands are TIFN's and costs are real numbers and an algorithmic approach for solving IFTP was presented Hussain and Senthil [4] by using these papers in this article we solve numerical example. Pardhasaradhi et al [6] introduced a new ranking function using centroid of centroids of IFN's.

In this article, we are going to introduce a new ranking function which can be obtain using [6] and is used to obtain an optimum solution in an IFTP. For the new ranking function numerical example is solved. Plinth of article is regulated : Section 2 essence resolution, Section 3 provides New Ranking function, Section 4 deals resolution of IFTP of type-1 and computational procedure, province 5 consists Numerical example, finally conjucture is apted in province 6.

2. Basic Definitions

2.1 Intuitionistic Fuzzy Set (IFS)

An IFS $\widetilde{A}^{IFS}$ in X can be defined as follows

$$\widetilde{A}^{IFS} = \{\langle x, \mu_{\widetilde{A}^{IFS}}(x), \nu_{\widetilde{A}^{IFS}}(x)\rangle : x \in X\},$$

where the functions $\mu_{\widetilde{A}^{IFS}} : X \to [0,1]$ *and* $\nu_{\widetilde{A}^{IFS}} : X \to [0,1]$ define the intensity of MF and the NMF of the element $x \in X$, respectively and $0 \leq \mu_{\widetilde{A}^{IFS}}(x),\ \nu_{\widetilde{A}^{IFS}}(x) \leq 1$, for every $x \in X$.

2.2 Intuitionistic Fuzzy Numbers (IFN's)

A subset of IFS, $\widetilde{A}^{IFS} = \{\langle x, \mu_{\widetilde{A}^{IFS}}(x), \nu_{\widetilde{A}^{IFS}}(x)\rangle : x \in X\}$, of the real line $\Re$ is called an IFN if the following holds:

(i) $\exists m \in \Re, \mu_{\widetilde{A}^{IFS}}(m) = 1 and \nu_{\widetilde{A}^{IFS}}(m) = 0$;

(ii) $\mu_{\widetilde{A}^{IFS}} : \Re \to [0,1]$ is sustained and for every $x \in \Re, 0 \leq \mu_{\widetilde{A}^{IFS}}(x)$, $\nu_{\widetilde{A}^{IFS}}(x) \leq 1$ holds.

The MF and NMF of $\widetilde{A}^{IFS}$ is as follows,

$$\mu_{\widetilde{A}^{IFS}}(x) = \begin{cases} f_1(x), x \in [m-\alpha_1, m) \\ 1,\ x = m \\ h_1(x), x \in (m, m+\beta_1] \\ 0.\ otherwise \end{cases}$$

and

$$\nu_{\widetilde{A}^{IFS}}(x) = \begin{cases} 1,\ x \in (-\infty, m-\alpha_2) \\ f_2(x),\ x \in [m-a_2, m) \\ 0, x = m, x \in [m+\beta_2, m) \\ h_2(x),\ x \in (m, m+\beta_2] \end{cases},$$

where $f_i(x)$ and $h_i(x) : i = 1,2$ are strictly inflated and deflated functions in $[m-\alpha_i, m)\ and\ (m, m-\beta_i]$ respectively; α_i and β_i are the left and right spreads of $\mu_{\widetilde{A}^{IFS}}(x) and \nu_{\widetilde{A}^{IFS}}(x)$ respectively.

2.3 Triangular Intuitionistic Fuzzy Number (TIFN):

A TIFN $\widetilde{A}^{IFN}$ is an IFS in $\Re$ with the following $MF \mu_{\widetilde{A}^{IFS}}$ and $NMF \nu_{\widetilde{A}^{IFS}}$ defined by

$$\mu_{\widetilde{A}^{IFS}}(x) = \begin{cases} \frac{x-a_1}{a_2-a_1}, a_1 \leq x \leq a_2 \\ 1,\ x = a_2 \\ \frac{a_3-x}{a_3-a_2}, a_2 \leq x \leq a_3 \\ 0,\ otherwise \end{cases}$$

and

$$\nu_{\widetilde{A}^{IFS}}(x) = \begin{cases} \frac{a_1'-x}{a_2-a_1'}, a_1' \leq x \leq a_2 \\ 0,\ x = a_2 \\ \frac{x-a_2}{a_3'-a_2}, a_2 \leq x \leq a_3' \\ 1,\ otherwise \end{cases},$$

where $a_1 \leq a_1' \leq a_2 \leq a_3 \leq a_3'$. This TIFN is denoted by $\widetilde{A}^{IFN} = (a_1, a_2, a_3; a_1', a_2, a_3')$ in Figure 1.

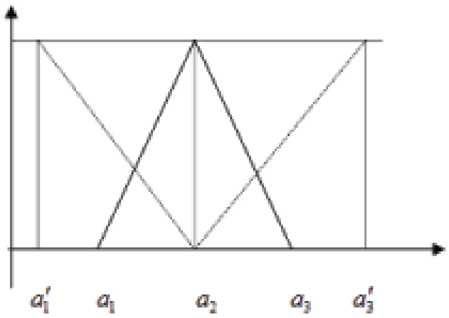

FIGURE 1. MF and NMF of TIFN

Arithmetic operations of TIFN:

For any two TIFN's $\widetilde{A}^{IFN} = (a_1, a_2, a_3; a_1', a_2, a_3')$ and $\widetilde{B}^{IFN} = (b_1, b_2, b_3; b_1', b_2, b_3')$, the arithmetic operations are as follows,

(i) Addition: $\widetilde{A}^{IFN} \oplus \widetilde{B}^{IFN} = (a_1+b_1, a_2+b_2, a_3+b_3; a_1'+b_1', a_2+b_2, a_3'+b_3')$.
(ii) Subtraction:$\widetilde{A}^{IFN} - \widetilde{B}^{IFN} = (a_1-b_3, a_2-b_2, a_3-b_1; a_1'-b_3', a_2-b_2, a_3'-b_1')$.
(iii) Multiplication: $\widetilde{A}^{IFN} \otimes \widetilde{B}^{IFN} = (a_1b_1, a_2b_2, a_3b_3; a_1'b_1', a_2b_2, a_3'b_3')$.
(iv) Scalar Multiplication:

$$k \times \widetilde{A}^{IFN} = \begin{cases} ka_1, ka_2, ka_3; ka_1', ka_2, ka_3', & k \geq 0 \\ \\ ka_3, ka_2, ka_1; ka_3', ka_2, ka_1', & k < 0. \end{cases}$$

3. NEW RANKING FUNCTION

In this section we introduce a new ranking function by using Pardhasaradhi et al [6].

Definition 3.1. *(Attainment and Ranking function of a TIFN's) Enable TIFN be $\widetilde{A}^{IFN} = (a_1, a_2, a_3; a_1', a_2, a_3')$. The ranking function is defined [6] for Trapezoidal and triangular Intuitionistic fuzzy number as*

$$R(\widetilde{A}^{IFN}) = (\frac{a_1 + 2(a_2 + b_3) + a_4 + b_1 + 5(a_3 + b_2) + b_3}{18})(\frac{4w_1 + 5w_2}{18}).$$

Consider $w_1 = w_2 = 1$, we get ranking function is $R(\widetilde{A}^{IFN}) = \frac{a_1+14a_2+a_3+b_1+b_3}{36}$.

Example 1. *Let* $\widetilde{A}^{IFN} = (2,3,4;1.5,3,4.5)$ *and* $\widetilde{B}^{IFN} = (0,1,1.5;-1,1,2)$. *Then* $R(\widetilde{A}^{IFN}) = \frac{(2+7(3)+4)+(1.5+7(3)+4.5)}{36} = \frac{54}{36} = 1.5$ *and*

$$R(\widetilde{B}^{IFN}) = \frac{(0+7(1)+1.5)+(-1+7(1)+2)}{36} = \frac{16.5}{36} = 0.45833.$$

Comparison of TIFN's:

In order to compare TIFN's one and all, ought to ranked them. A function such as $R : F(\Re) \to \Re$, depict each TIFN's commensurate with is called ranking function. At this moment, $F(\Re)$ convey accessible TIFN's.

By using the ranking function "R", TIFN's can be compared.

Let $\widetilde{A}^{IFN} = (a_1, a_2, a_3; a'_1, a_2, a'_3)$ and $\widetilde{B}^{IFN} = (b_1, b_2, b_3; b'_1, b_2, b'_3)$ are two TIFN's then $R(\widetilde{A}^{IFN}) = \frac{a_1+14a_2+a_3+a'_1+a_2+a'_3}{36}$ and $R(\widetilde{B}^{IFN}) = \frac{b_1+14b_2+b_3+b'_1+b_2+b'_3}{36}$.

Subsequently, orders elucidate observes

(i) $\widetilde{A}^{IFN} > \widetilde{B}^{IFN}$ if $R(\widetilde{A}^{IFN}) > R(\widetilde{B}^{IFN})$,
(ii) $\widetilde{A}^{IFN} < \widetilde{B}^{IFN}$ if $R(\widetilde{A}^{IFN}) < R(\widetilde{B}^{IFN})$, and
(iii) $\widetilde{A}^{IFN} = \widetilde{B}^{IFN}$ if $R(\widetilde{A}^{IFN}) = R(\widetilde{B}^{IFN})$.

Ranking function R also confine supporters properties:

(i) $R(\widetilde{A}^{IFN}) + R(\widetilde{B}^{IFN}) = R(\widetilde{A}^{IFN} + \widetilde{B}^{IFN})$,
(ii) $R(k\widetilde{A}^{IFN}) = kR(\widetilde{B}^{IFN}) \forall k \epsilon R$

4. Definition and Computational procedure

4.1 IFTP of type - 1:

There are some draw backs in TP, the decision maker or the adept temporize multitude aspects athwart namely from vendor and insistent. Occasionally, decision maker scarcely clear about some important parameters, for example, if he is not sure about consignment outcome hail repository at peculiar measure, it's enough to get hesitated by supplier side and demand side. Such that, i.e., he has no proper communication with customer or indecisive about considerable amounts of peculiar outcome probably processed by accessible row particulars presuming precise amount. Comparably, he may temporize insistent. Apparently, consequence institute merchandise then customer cannot determine about transportation of the material from one place to other or a particular destination, he is not sure about that. Certainly owing to unconsciousness of customers here of outcome or contrast payment and effectiveness of outcome solitary. Employing IFN's mange with unreliability and unwillingness.

Examine a TP with 'm' vendors and 'n' insistent. c_{ij} is value of transiting one module of outcome from i^{th} vendor to j^{th} insistent.

$\widetilde{a_i}^{IFN} = ({a_1}^i, {a_2}^i, {a_3}^i; {a'_1}^i, {a_2}^i, {a'_3}^i)$ be IF extent at i^{th} vendor.

$\widetilde{B}^{IFN} = ({b_1}^j, {b_2}^j, {b_3}^j; {b'_1}^j, {b_2}^j, {b'_3}^j)$ be IF abundant at j^{th} insistent.

$\widetilde{x}_{ij}^{IFN} = (\{{x_1}^{ij}, {x_2}^{ij}, {x_3}^{ij}; {x'_1}^{i'j'}, {x_2}^{ij}, {x'_3}^{i'j'}\})$ be IF quantity transformed from i^{th} vendor to j^{th} insistent.

Then balanced IFTP of type-1 is given by

$$Min\widetilde{Z}^{IFN} = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} \times {x_{ij}}^{IFN}$$

$$s.t. \sum_{j=1}^{n} = \widetilde{x}_{ij}^{IFN} = \widetilde{a_i}^{IFN}, i = 1, 2, \ldots, m$$

$$\sum_{i=1}^{m} \widetilde{x}_{ij}^{IFN} = \widetilde{b_j}^{IFN}, j = 1, 2, \ldots, n$$

$$\widetilde{x}_{ij}^{IFN} \geq \widetilde{0}\ ; i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$$

The TP is termed as type - 1 IFTP having availability and demands are IFN's and costs are real numbers.

4.2. Computational procedure

The present work enhanced from Hussain and Senthil [4] and Sujeet Kumar et al [7] they used intuitionistic fuzzy modified distribution method(IFMODIM) and intuitionistic fuzzy zero point method (IFZPM) to obtain optimum solution. So, for this two methods we approach a new ranking function. This new ranking function is considered by Pardha saradhi et al [6].

5. Numerical Example

In this province, subsist numerical example [4] is solved by using IFZPM and IFMODIM.

Table 1: Consider IFTP of type-1

	D_1	D_2	D_3	D_4	Supply $(\widetilde{a_i}^{IFN})$
S_1	16	1	8	13	(2, 4, 5; 1, 4, 6)
S_2	11	4	7	10	(4, 6, 8; 3, 6, 9)
S_3	8	15	9	2	(3, 7, 12; 2, 7, 13)
S_4	6	12	5	14	(8, 10, 13; 5, 10, 16)
Dem $(\widetilde{b}_j^{IFN})$	(3, 4, 6; 1, 4, 8)	(2, 5, 7; 1, 5, 8)	(10, 15, 20; 8, 15, 22)	(2, 3, 5; 1, 3, 6)	(17, 27, 38; 11, 27, 44)

Solution:

Method 1 IFMODIM:

Here we have

$$(3,4,6;1,4,8) \oplus (2,5,7;1,5,8) \oplus (10,15,20;8,15,22) \oplus (2,3,5;1,3,6)$$
$$= (2,4,5;1,4,6) \oplus (4,6,8;3,6,9) \oplus (3,7,12;2,7,13) \oplus (8,10,13;5,10,16)$$
$$= (17,27,38;11,27,44).$$

Accordingly, problem is balanced.

Beyond comparison, foregoing IFN's encounter ranking functional values of $\widetilde{a}_i^{IFS}$'s and $\widetilde{b}_j^{IFS}$'s as under:

$$f(\widetilde{a}_1^{IFN}) = \tfrac{70}{36}, f(\widetilde{a}_2^{IFN}) = \tfrac{108}{36}, f(\widetilde{a}_3^{IFN}) = \tfrac{128}{36}, f(\widetilde{a}_4^{IFN}) = \tfrac{182}{36},$$
$$f(\widetilde{b}_1^{IFS}) = \tfrac{74}{36}, f(\widetilde{b}_2^{IFN}) = \tfrac{88}{36}, f(\widetilde{b}_3^{IFN}) = \tfrac{270}{36}, f(\widetilde{b}_4^{IFN}) = \tfrac{56}{36}$$

Now to obtain the Initial basic feasible solution (IBFS)we can apply any one of the methods i.e., IFNWCM, IFLCM or IFVAM.We register IFNWCM to attain IBFS.

IBFS attained is given in Table 2.

Currently, pertain IFMODIM to assess optimality of attained IBFS.

In Table 3 many $z_{ij} - c_{ij} > 0$, so solution is not optimum so we can form a loop as shown above and improve solution.

$z_{34} - c_{34} = 16$ is most +ve, allocating $\widetilde{\theta}^{\ IFN}$ amount there, we get minimal among which $\widetilde{\theta}^{\ IFS}$ subtracted is $(2,3,5;1,3,6)$ because $(2,3,5;1,3,6) < (3,7,12;2,7,13)$.

So, allocating $\widetilde{\theta}^{\ IFN} = (2,3,5;1,3,6)$, we get new enhanced solution (IS)- 1 given Table 4.

In Table 4, $z_{12} - c_{12} = 8$ which is most +ve and $(2,4,5;1,4,6) < (2,5,7;1,5,8)$ so allocate $\widetilde{\theta}^{\ IFN} = (2,4,5;1,4,6)$, we get new IS- 2 given Table 5.

In Table 5, $z_{31} - c_{31} = 5$ which is most +ve and $(-2,4,10;-3,4,11) < (0,4,9;-4,4,13)$, therefore allocate $\widetilde{\theta}^{\ IFN} = (-2,4,10;-3,4,11)$, we get new IS- 3 given Table 6.

In Table 6, $z_{41} - c_{41} = 3$ which is most +ve and $(-10,0,11;-15,0,16)$
$< (-8,10,29;-17,10,38)$.

Therefore, allocate $\widetilde{\theta}^{\ IFN} = (-10,0,11;-15,0,16)$, we get new IS- 4 given Table 7.

In Table 7, all $z_{ij} - c_{ij} \leq 0$ so, attained result is optimum. Optimum solution is
$\widetilde{x}_{12}^{IFN} = (2,4,5;1,4,6)$, $\widetilde{x}_{22}^{IFN} = (-3,1,5;-5,1,7)$, $\widetilde{x}_{23}^{IFN} = (-19,5,29;-30,5,40)$,
$\widetilde{x}_{31}^{IFN} = (-2,4,10;-3,4,11)$, $\widetilde{x}_{34}^{IFN} = (2,3,5;1,3,6)$, $\widetilde{x}_{41}^{IFN} = (-10,0,11;-150,16)$
$\widetilde{x}_{43}^{IFN} = (-19,10,39;-33,10,53)$.

TABLE 2. The IBFS

	D_1	D_2	D_3	D_4
S_1	16 (2, 4, 5; 1, 4, 6)	1	8	13
S_2	11 (-2, 0, 4; -5, 0, 7)	4 (2, 5, 7; 1, 5, 8)	7 (-7, 1, 8; -12, 1, 13)	10
S_3	8	15	9 (3, 7, 12; 2, 7, 13)	2
S_4	6	12	5 (-10, 7, 24; -18, 7, 32)	14 (2, 3, 5; 1, 3, 6)

u_1=5	16 (2,4,5;1,4,6)	1	8	13
u_2=0	11 (-2,0,4;-5,0,7	4 (2,5,7;1,5,8)	7 (-7,1,8;-12,1,13)	10
u_3=2	8	15	9 (3,7,12;2,7,13)	2 $\widetilde{\theta}^{IFN}$
u_4=-2	6	12	5 (-10,7,24;-18,7,32)	14 (2,3,5;1,3,6)
	v_1=11	v_2=4	v_3=7	v_4=16

Table 3 Optimality test of IBFS

u_1=5	16 (2,4,5;1,4,6)	1 $\widetilde{\theta}^{IFN}$	8	13
u_2=0	11 (0,4,9;-4,4,13)	4 (2,5,7;1,5,8)	7 (-7,1,8;-12,1,13)	10
u_3=2	8	15	9 (-2,4,10;-4,4,12)	2 (2,3,5;1,3,6)
u_4=-2	6	12	5 (-8,10,29;-17,10,38)	14
	v_1 = 11	v_2 = 4	v_3 = 7	v_4 = 0

Table 4 IS -1

u_1=-3	16	1 (2,4,5;1,4,6)	8	13
u_2=0	11 (0,4,9; -4,4,13)	4 (-3,1,5; -5,1,7)	7 (-7,1,8; -12,1,13)	10
u_3=2	8 $\widetilde{\theta}^{IFN}$	15	9 (-2,4,10; -3,4,11)	2 (2,3,5; 1,3,6)
u_4=-2	6	12	5 (-8,10,29; -17,10,38)	14
	v_1 = 11	v_2 = 4	v_3 = 7	v_4 = 0

Table 5 IS-2

u_1=-3	16	1 (2,4,5;1,4,6)	8	13
u_2=0	11 (-10,0,11;-15,0,16)	4 (-3,1,5; -5,1,7)	7 (-9,5,18;-15,5,24)	10
u_3 = -3	8 (-2,4,10;-3,4,11)	15	9	2 (2,3,5; 1,3,6)
u_4=-2	6 $\widetilde{\theta}^{IFN}$	12	5 (-8,10,29; -17,10,38)	14
	v_1 = 11	v_2 = 4	v_3 = 7	v_4 = 0

Table 6 IS-3

$$
\begin{aligned}
IFTC\widetilde{Z}^{IFN}_{optimum} &= (2,4,5;1,4,6) \oplus 4(-3,1,5;-5,1,7) \oplus 7(-19,5,29;-30,5,40) \oplus \\
&\quad 8(-2,4,10;-3,4,11), \oplus 2(2,3,5;1,3,6) \oplus 6(-10,0,11;-15,0,16) \\
&\quad \oplus 5(-19,10,39;-33,10,53) = (-310,131,579;-506,131,775).
\end{aligned}
$$

Table 7: IS- 4 (optimal solution)

$u_1 = -3$	16	1 (2, 4, 5; 1, 4, 6)	8	13
$u_2 = 0$	11	4 (-3, 1, 5; -5, 1, 7)	7 (-19, 5, 29; -30, 5, 40)	10
$u_3 = 0$	8 (-2, 4, 10; -3, 4, 11)	15	9	2 (2, 3, 5; 1, 3, 6)
$u_4 = -2$	6 (-10, 0, 11; -15, 0, 16)	12	5 (-19, 10, 39; -33, 10, 53)	14
	$v_1 = 8$	$v_2 = 4$	$v_3 = 7$	$v_4 = 2$

Method 2 IFZPM:

Since $\sum_{i=1}^{m} \widetilde{a}_i^{IFN} = \sum_{j=1}^{n} \widetilde{b}_j^{IFN} = (17, 27, 38; 11, 27, 44)$. So, problem is balanced IFTP of type - 1.

Table:8 Row reduced form

	D_1	D_2	D_3	D_4	Supply ($\widetilde{a}_i^{IFN}$)
S_1	15	0	7	12	(2, 4, 5; 1, 4, 6)
S_2	7	0	3	6	(4, 6, 8; 3, 6, 9)
S_3	6	13	7	0	(3, 7, 12; 2, 7, 13)
S_4	1	7	0	9	(8, 10, 13; 5, 10, 16)
Dem ($\widetilde{b}_j^{IFN}$)	(3, 4, 6; 1, 4, 8)	(2, 5, 7; 1, 5, 8)	(10, 15, 20; 8, 15, 22)	(2, 3, 5; 1, 3, 6)	(17, 27, 38; 11, 27, 44)

Now, using IFZPM we get following allotment table.

Now, using allotment rules of the IFZPM, we have allotment

If optimum solution in terms of TIFN's:

$\widetilde{x}_{12}^{IFN} = (2, 4, 5; 1, 4, 6), \widetilde{x}_{22}^{IFN} = (-3, 1, 5; -5, 1, 7), \widetilde{x}_{23}^{IFN} = (-1, 5, 11; -4, 5, 14)$

$\widetilde{x}_{31}^{IFN} = (-2, 4, 10; -4, 4, 12), \widetilde{x}_{34}^{IFN} = (2, 3, 5; 1, 3, 6), \widetilde{x}_{41}^{IFN} = (-7, 0, 8; -11, 0, 12)$

Table:9 Column reduced form

	D_1	D_2	D_3	D_4	Supply ($\widetilde{a}_i^{IFS}$)
S_1	14	0	7	12	(2, 4, 5; 1, 4, 6)
S_2	6	0	3	6	(4, 6, 8; 3, 6, 9)
S_3	5	13	7	0	(3, 7, 12; 2, 7, 13)
S_4	0	7	0	9	(8, 10, 13; 5, 10, 16)
Dem ($\widetilde{b}_j^{IFS}$)	(3, 4, 6; 1, 4, 8)	(2, 5, 7; 1, 5, 8)	(10, 15, 20; 8, 15, 22)	(2, 3, 5; 1, 3, 6)	(17, 27, 38; 11, 27, 44)

Table:10 Allotment table

	D_1	D_2	D_3	D_4	Supply ($\widetilde{a}_i^{IFS}$)
S_1	11	0	4	14	(2, 4, 5; 1, 4, 6)
S_2	6	0	0	8	(4, 6, 8; 3, 6, 9)
S_3	0	11	2	0	(3, 7, 12; 2, 7, 13)
S_4	0	10	0	14	(8, 10, 13; 5, 10, 16)
Dem ($\widetilde{b}_j^{IFS}$)	(3, 4, 6; 1, 4, 8)	(2, 5, 7; 1, 5, 8)	(10, 15, 20; 8, 15, 22)	(2, 3, 5; 1, 3, 6)	(17, 27, 38; 11, 27, 44)

Table:11 Allotment table

	D_1	D_2	D_3	D_4
S_1	11	0 (2, 4, 5; 1, 4, 6)	4	14
S_2	6	0 (-3, 1, 5; -5, 1, 7)	0 (-1, 5, 11; -4, 5, 14)	8
S_3	0 (-2, 4, 10; -4, 4, 12)	11	2	0 (2, 3, 5; 1, 3, 6)
S_4	0 (-7, 0, 8; -11, 0, 12)	10	0 (-1, 14, 21; -6, 10, 26)	14

$\widetilde{x}_{43}^{IFN} = (-1, 10, 21; -6, 10, 26)$.
Hence, total IFTP optimum cost=$(-76, 131, 345; -173, 131, 442)$.

6. Conclusion

Mathematical Formulation for type - 1 of IFTP and procedure for obtaining an IF optimum solution are discussed with relevant numerical example. The new ranking function is employed to get the optimum solution of IFTP of type - 1by using IFZPM and IFMODIM. The new ranking perform provides same results, as found by Hussain and Senthil[4] and Sujeet Kumar et al [7]. Hence, this may be preferred over the existing methods.

REFERENCES

[1] K.T. ATANASSOV: *Intuitionistic fuzzy sets*, Fuzzy Sets Syst., **20** (1986), 87-96.

[2] R. BELLMAN, L.A. ZADEH: *Decision making in fuzzy environment*, Manag. Sci., **17(B)** (1970), 141-160.

[3] D. CHAKRABORTY, D.K. JANA, T.K. ROY: *arithmetic operations on generalized intuitionistic fuzzy number and its applications to transportation problem*, Opsearch, **52** (2015), 431-471.

[4] R.J. HUSSAIN, P.S. KUMAR: *Algorithmic approach for solving intuitionistic fuzzy transportation problem*, Appl. Math. Sci., **6**(80) (2012), 3981-3989.

[5] S. ISMAIL MOHIDEEN, A. SENTHIL KUMAR: *A Comparative Study on Transportation Problem in fuzzy environment*, International Journal of Mathematics Research. **2**(1) (2010), 151-158.

[6] B. PARDHASARADHI, M.V. MADHURI, N. RAVI SHANKAR: *Ordering of Intuitionistic fuzzy numbers using centroid of centroids of Intuitionistic fuzzy numbers*, International Journal of Mathematics Trends and Technology, **52**(5) (2017), 276-285.

[7] S.K. SINGH, S.P. YADAV: *Efficient approach for solving type - 1 intuitionistic fuzzy transportation problem*, International Journal of System Assurance Engineering and Management, **6**(3) (2015), 259-267.

[8] L.A. ZADEH: *Fuzzy sets*, Inf. Comput., **8** (1965), 338-353.

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