Available online at www.elixirpublishers.com (Elixir International Journal)

Advanced Mathematics

Elixir Adv. Math. 115 (2018) 49554-49557

ISSN: 2229-712X

Decision of Intuitionistic Fuzzy Soft Matrix in Weighted Harmonic Mean

S.Subramanian[1] and R. Rathika[2]

[1]Professor, Department of Mathematics, PRIST University, Vallam, Thanjavur-613403, Tamil Nadu, India.
[2]Research Scholar, Centre for Research & Development, PRIST University, Vallam, Thanjavur-613403, Tamil Nadu, India.

ARTICLE INFO

Article history:
Received: 26 December 2017;
Received in revised form:
29 January 2018;
Accepted: 5 February 2018;

Keywords
Soft Sets,
Fuzzy Soft sets,
Fuzzy Soft Matrices,
Intuitionistic Fuzzy Soft Matrices.

ABSTRACT
In this study, we explore the fuzzy soft matrix and their operations. In this report, we define intuitionistic fuzzy soft matrices and have entered some new operators with weights. We then prove fuzzy soft algorithm that allows constructing those efficient decision making methods. In the end, we throw an example on the weighted harmonic mean for decision making problems. It indicates that the method can be successfully employed to many problems that contain uncertainties

Introduction

In the fuzzy set theory [14] there were no scopes thinking about the indisposition in the membership degree, which originate in diverse real life places. To master these situations Atanassov introduced theory of intuitionistic fuzzy set in 1986 as a generalization of fuzzy set. Most of the problems in engineering, medical scientific discipline, economics, environments etc. have various doubts. Molodtsov [12] initiated the concept of soft set theory as a mathematical tool for dealing with doubts. Research works on soft set theory are coming along apace. Combining soft sets with fuzzy sets and intuitionistic fuzzy sets, Feng et al., Maji et al. [8,9] defined fuzzy soft sets and intuitionistic fuzzy soft sets which are annoying capabilities for solving resolution making difficulties. Matrices play an important role in the broad arena of science and engineering. The classical matrix theory cannot work the problems touching on various types of uncertainties. In Yang et al, led up a matrix representation of a fuzzy soft seat and presented it in certain decision making problems. The idea of fuzzy soft matrix theory was considered by Borah et al. in . In [5], Chetia et al. And in [13] Rajarajeswari et al. Well-defined intuitionistic fuzzy soft matrix. Once more, it is well recognized that the matrices are important instruments to model/study different mathematical problems specially in linear algebra. And in R. Rathika, S. Subramanian [14] gives an estimate of the weighted geometric mean. Due to huge applications of imprecise information in the above mentioned fields, hence are motivated to take the different matrices containing these data. Soft set is also one of the interesting and popular subject, where different types of decision making problem can be dissolved.

In this broadside, we have presented some operators on intuitionistic fuzzy soft matrix on the basis of weights. We have also deliberated with their examples. In concluding, we have given an elementary application on the decision making, problem on the basis of weighted harmonic mean.

2. Definition and Preliminaries

2.1 Soft set [1]

Let U be a first universe, P (U) be the power set of U , E be the set of all parameters and A⊆E. A soft set (f_A, E) on the universe U is defined by the set of ordered pairs

$$(f_A,E) = \{(e , f_A (e)) : e\in E , f_A (e) \in P(U) \}$$

where f_A: E → P(U) such that f_A (e) = ϕ if e ∉ A.

Here f_A is known as an approximate function of the soft set (f_A,E). The set f_A (e) is known as e-approximate value set or e-approximate set which consists of related objects of the parameter e ∈ E.

2.2. Fuzzy soft set [6] Let U be an primary universe ,E be the set of totally parameters and A⊆ E . A pair (F, A) is known as a fuzzy set over U where F: A → (U) is a mapping from A into (U), where (U) denotes the collection of whole subsets of U. the collection of all subsets of U.

2.3 Fuzzy Soft Matrices (FSM) [5]

Let (f_A , E) be fuzzy soft set over U. And so a subset of U x E is uniquely determined by

R_A = { (u , e) : e∈ A , u ∈ f_A (e) }, which is called relation form of (f_A, E) . The characteristic function of R_A is written by μ_{RA} : U x E → [0 , 1] , where μ_{RA}(u , e) ∈ [0,1] is the membership value of u∈U for each e ∈U. If $\mu ij = \mu RA\ (ui,$ e.g.), we can specify a matrix.

Tele:
E-mail address: rathikarita@gmail.com

$$[\mu_{ij}]_{mxn} = \begin{bmatrix} \mu_{11} & \mu_{12} & \cdots & \mu_{1n} \\ \mu_{21} & \mu_{22} & \cdots & \mu_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \mu_{m1} & \mu_{m2} & \cdots & \mu_{mn} \end{bmatrix}$$

which is so-called an m x n soft matrix of the soft set (f_A,E) done U. Thus we can state that a fuzzy soft set (fA, E) is uniquely characterized by the matrix $[\mu ij]\ m\times n$ and both concepts are interchangeable.

2.4 Row- Fuzzy Soft Matrix

A fuzzy soft matrix of order $1\times n$ i.e., with a only one row is named a row-fuzzy soft Matrix.

2.5 Column -Fuzzy Soft Matrix

A fuzzy soft matrix of order $m\times 1$ i.e., with a single column is termed a column-fuzzy soft matrix.

3. Intuitionistic Fuzzy Soft Matrix Theory

3.1. Intuitionistic Fuzzy Soft Matrix (IFSM) [5]

Let U be an preliminary universe , E be the set of parameters and A⊆ E. Let (f_A,E) be an Intuitionistic fuzzy soft set (IFSS) over U. And so a subset of U x E is uniquely determined by

R_A = { (u , e) : e∈ A , u ∈ f_A(e) },

which is called relation form of (f_A,E) . The membership and non-membership functions are written by μ_{RA}: U x E → [0 , 1] and ν_{RA}: U x E → [0 , 1] where μ_{RA}: (u, e) ∈ [0,1] and μ_{RA}: (u, e) ∈ [0,1] are the membership value and non-membership value of u∈U for each e ∈E.

If (μij, νij) = (RA (ui, ej), νRA (ui, ej)), we can specify a matrixine a matrix

$$[(u_{ij},v_{ij})]_{m\times n}= \begin{bmatrix} (\mu_{11},\nu_{11}) & (\mu_{12},\nu_{12}) & \cdots & (\mu_{1n},\nu_{1n}) \\ (\mu_{21},\nu_{21}) & (\mu_{22},\nu_{22}) & \cdots & (\mu_{2n},\nu_{2n}) \\ \cdots & \cdots & \cdots & \cdots \\ (\mu_{m1},\nu_{m1}) & (\mu_{m2},\nu_{m2}) & \cdots & (\mu_{mn},\nu_{mn}) \end{bmatrix}$$

which is entitled an m x n IFSM of the IFSS(f_A ,E) done U. Thus, we can say that IFSS (fA, E) is uniquely characterized by the matrix [μij, νij] $m\ Xn$ and both concepts are interchangeable. The circle of all m x n IFS matrices will be denoted by IFSM $m \times n$

Example 3.1

Let U ={ u_1 , u_2 , u_3 , u_4, u_5} is a universal set and E = { e_1 , e_2 , e_3 , e_4, e_5},is a set of parameters. If A = { e_1 , e_3 , e_4, e_5} ⊆ E and$f_A(e_1)$= { (u_1,.5,.4) , (u_2,.6,.1) , (u_3,.5 , .5) , (u_4,.5,.4) ,(u_5,.2,.1) },$f_A(e_3)$= {(u_1,.6,.6) ,(u_3,.2 ,.2),(u_4,1,0) , (u_5,.6,.2)}, $f_A(e_4)$= { (u_1,.6 ,.2),(u_2,1,0) ,(u_3,.8 ,.2), (u_4,.6,.3) ,(u_5,.7,.3) },$f_A(e_5)$= { (u_1,.7 ,.8),(u_2,1,0) ,(u_3,.6 ,.5), (u_4,.5,.3) ,(u_5,.8,.2) }

Then the IFS set (F_A,E) is a parameterized family{ $fA\ (e1)$, $fA\ (e3)$, $fA\ (e4)$, $fA\ (e_5)$ } of all IFS sets over U. Hence IFSM [(μij, νij)] can be written every bit

$$[(\mu_{ij}, \nu_{ij})] = \begin{bmatrix} (.5,.4) & (0,0) & (.6,.6) & (.6,.2) & (.7,.8) \\ (.6,.1) & (0,0) & (0,0) & (1,0) & (1\ ,\ 0) \\ (.5,.5) & (0,0) & (.2,.2) & (.8,.2) & (.6,.5) \\ (.5,.4) & (0,0) & (1\ ,0) & (.6,.3) & (.5,.3) \\ (.2,.1) & (0,0) & (.6,.2) & (.7,.3) & (.8,.2\ ) \end{bmatrix}$$

3.2. Complement of Intuitionistic Fuzzy Soft Matrix

Let $\widetilde{A}$ = [($\mu_{ij}^{\tilde{A}}, \nu_{ij}^{\tilde{A}}$)] ∈ IFSM$_{mxn}$. Then Complement of $\widetilde{A}$denoted by $\widetilde{A}^0$ is defined as

$\widetilde{A}^{\,0}$=[($\nu_{ij}^{\tilde{A}}$, $\mu_{ij}^{\tilde{A}}$)] for all i and j .

3.3. Operators of Intuitionistic Fuzzy Soft Matrices

Let $\tilde{A}$= [($\mu_{ij}^{\tilde{A}}$, $\nu_{ij}^{\tilde{A}}$)] , $\tilde{B}$ =[($\mu_{ij}^{\tilde{B}}$, $\nu_{ij}^{\tilde{B}}$)] ∈ IFSM mxn. Then IFSM $\widetilde{C}$=[($\mu_{ij}^{\tilde{c}}$, $\nu_{ij}^{\tilde{c}}$)] is called

a) the "**.**"**(product)** operation of $\widetilde{A}$ and $\widetilde{B}$,denoted by $\tilde{A}\ .\tilde{B}$ if $\mu_{ij}^{\tilde{c}}$=$\mu_{ij}^{\tilde{A}}$. $\mu_{ij}^{\tilde{B}}$ and $\nu_{ij}^{\tilde{c}} = \nu_{ij}^{\tilde{A}} + \nu_{ij}^{\tilde{B}} - \nu_{ij}^{\tilde{A}}.\ \nu_{ij}^{\tilde{B}}$ For all I and j.

b) the "+"**(Probabilistic sum)** operation of $\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ + $\widetilde{B}$ if

$\mu_{ij}^{\tilde{c}} = \mu_{ij}^{\tilde{A}} + \mu_{ij}^{\tilde{B}} - \mu_{ij}^{\tilde{A}}.\mu_{ij}^{\tilde{B}}$ and $\nu_{ij}^{\tilde{c}} = \nu_{ij}^{\tilde{A}}\cdot \nu_{ij}^{\tilde{B}}$ for all i and j.

c) the "@"**(Arithmetic Mean)** operation of $\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ @ $\widetilde{B}$

if $\mu_{ij}^{\tilde{c}} = \frac{(\mu_{ij}^{\tilde{A}} + \mu_{ij}^{\tilde{B}})}{2}$ and $\nu_{ij}^{\tilde{c}} = \frac{(\nu_{ij}^{\tilde{A}} + \nu_{ij}^{\tilde{B}})}{2}$ for all i and j.

d) the "$@^w$" **(Weighted Arithmetic Mean)** operation of $\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ $@^w$ $\widetilde{B}$if $\mu_{ij}^{\tilde{c}} = \frac{(w_1\mu_{ij}^{\tilde{A}} + w_2\,\mu_{ij}^{\tilde{B}})}{w_1 + w_2}$, $\nu_{ij}^{\tilde{c}} = \frac{(w_1\nu_{ij}^{\tilde{A}} + w_2\nu_{ij}^{\tilde{B}})}{w_1 + w_2}$, for all i and j $w_1 > 0, w_2 > \mathbf{0}$

e) the "$" **(Geometric Mean)** operation of $\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ $ $\widetilde{B}$ if

$\mu_{ij}^{\tilde{c}} = \sqrt{\mu_{ij}^{\tilde{A}}.\ \mu_{ij}^{\tilde{B}}}$ and $\nu_{ij}^{\tilde{c}} = \sqrt{\nu_{ij}^{\tilde{A}}.\ \nu_{ij}^{\tilde{B}}}$ for all i and j .

f) the "$\$^w$" **(Weighted Geometric Mean)** operation of$\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ $\$^w$ $\widetilde{B}$ if $\mu_{ij}^{\tilde{c}} = ((\mu_{ij}^{\tilde{A}})^{w_1} .(\mu_{ij}^{\tilde{B}})^{w_2}))^{1/(w_1+w_2)}$ and $\nu_{ij}^{\tilde{c}} = ((\nu_{ij}^{\tilde{A}})^{w_1}.(\nu_{ij}^{\tilde{B}})^{w_2}))^{1/(w_1+w_2)}$ for all i and j $w_1 > 0, w_2 > \mathbf{0}$.

g) the " ⋈"(**Harmonic mean**) operation of$\widetilde{A}$ and $\widetilde{B}$,denoted by $\widetilde{C}$=$\widetilde{A}$ ⋈ $\widetilde{B}$ if $\mu_{ij}^{\tilde{c}} = 2.\frac{(\mu_{ij}^{\tilde{A}}\,.\,\mu_{ij}^{\tilde{B}})}{\mu_{ij}^{\tilde{A}} + \mu_{ij}^{\tilde{B}}}$ and $\nu_{ij}^{\tilde{c}} = \frac{(\nu_{ij}^{\tilde{A}}.\nu_{ij}^{\tilde{B}})}{\nu_{ij}^{\tilde{A}} + \nu_{ij}^{\tilde{B}}}$ for all i and j $w_1 > 0, w_2 > \mathbf{0}$.

h) the " $\bowtie^w$ "(Weighted Harmonic mean) operation of $\widetilde{A}$ and $\widetilde{B}$, denoted by $\widetilde{C}=\widetilde{A} \bowtie^w \widetilde{B}$ if $\mu_{ij}^{\tilde{c}}=\frac{w_1+w_2}{\frac{w_1}{\mu_{ij}^{\tilde{A}}}+\frac{w_2}{\mu_{ij}^{\tilde{B}}}}$, and $\nu_{ij}^{\tilde{c}}=\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{A}}}+\frac{w_2}{\nu_{ij}^{\tilde{B}}}}$ for all i and j $w_1>0, w_2>\mathbf{0}$.

Proposition 1:

Let $\widetilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]$, $\widetilde{B}=[(\mu_{ij}^{\widetilde{B}},\nu_{ij}^{\widetilde{B}})]$ $\in$ IFSM $_{m\,Xn}$. Then (i) $\widetilde{A}^0 @^w \widetilde{B}^0=\widetilde{A} @^w \widetilde{B}$, (ii) $\widetilde{A}^0 \$^w \widetilde{B}^0=\widetilde{A} \$^w \widetilde{B}$, (iii) $\widetilde{A}^0 \bowtie^w \widetilde{B}^0=\widetilde{A} \bowtie^w \widetilde{B}$.

Proof:

Let $\widetilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]$, $\widetilde{B}=[(\mu_{ij}^{\widetilde{B}},\nu_{ij}^{\widetilde{B}})]\in$ IFSM mxn and $w_1>0, w_2>\mathbf{0}$.

(i) $\widetilde{A}^0 @^w \widetilde{B}^0=([\nu_{ij}^{\tilde{A}},\mu_{ij}^{\tilde{A}}] @^w [\nu_{ij}^{\widetilde{B}},\mu_{ij}^{\widetilde{B}}])^0=[(\frac{(w_1\nu_{ij}^{\tilde{A}}+w_2\nu_{ij}^{\widetilde{B}})}{w_1+w_2},\frac{(w_1\mu_{ij}^{\tilde{A}}+w_2\mu_{ij}^{\widetilde{B}})}{w_1+w_2})]^0=[(\frac{(w_1\mu_{ij}^{\tilde{A}}+w_2\mu_{ij}^{\tilde{B}})}{w_1+w_2},\frac{(w_1\nu_{ij}^{\tilde{A}}+w_2\nu_{ij}^{\tilde{B}})}{w_1+w_2})]=\widetilde{A} @^w \widetilde{B}$

(ii) $\widetilde{A}^0 \$^w \widetilde{B}^0=([\nu_{ij}^{\tilde{A}},\mu_{ij}^{\tilde{A}}] \$^w [\nu_{ij}^{\widetilde{B}},\mu_{ij}^{\widetilde{B}}])^0=[((\nu_{ij}^{\tilde{A}})^{w_1}.(\nu_{ij}^{\widetilde{B}})^{w_2})^{1/(w_1+w_2)},((\mu_{ij}^{\tilde{A}})^{w_1}.(\mu_{ij}^{\tilde{B}})^{w_2})^{1/(w_1+w_2)})]^0$

$=[((\mu_{ij}^{\tilde{A}})^{w_1}.(\mu_{ij}^{\tilde{B}})^{w_2})^{1/(w_1+w_2)},((\nu_{ij}^{\tilde{A}})^{w_1}.(\nu_{ij}^{\tilde{B}})^{w_2})^{1/(w_1+w_2)}]=\widetilde{A} \$^w \widetilde{B}$

(iii) $\widetilde{A}^0 \bowtie^w \widetilde{B}^0=([\nu_{ij}^{\tilde{A}},\mu_{ij}^{\tilde{A}}] \bowtie^w [\nu_{ij}^{\widetilde{B}},\mu_{ij}^{\widetilde{B}}])^0=\left[\left(\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{A}}}+\frac{w_2}{\nu_{ij}^{\widetilde{B}}}},\frac{w_1+w_2}{\frac{w_1}{\mu_{ij}^{\tilde{A}}}+\frac{w_2}{\mu_{ij}^{\widetilde{B}}}}\right)\right]^0=\left(\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{A}}}+\frac{w_2}{\nu_{ij}^{\widetilde{B}}}},\frac{w_1+w_2}{\frac{w_1}{\mu_{ij}^{\tilde{A}}}+\frac{w_2}{\mu_{ij}^{\widetilde{B}}}}\right)=\widetilde{A} \bowtie^w \widetilde{B}$.

Proposition 2:

Let $\widetilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]$, $\widetilde{B}=[(\mu_{ij}^{\widetilde{B}},\nu_{ij}^{\widetilde{B}})]\in$ IFSM mxn. Then (i) $\widetilde{A}\cup\widetilde{B}=\widetilde{B}\cup\widetilde{A}$ (ii) $\widetilde{A}\cap\widetilde{B}=\widetilde{B}\cap\widetilde{A}$ (iii) $\widetilde{A}+\widetilde{B}=\widetilde{B}+\widetilde{A}$ (iv) $\widetilde{A}.\widetilde{B}=\widetilde{B}.\widetilde{A}$

Proof:

(i) $\widetilde{A}\cup\widetilde{B}=[(\max\{\mu_{ij}^{\tilde{A}},\mu_{ij}^{\widetilde{B}}\},\min\{\nu_{ij}^{\tilde{A}},\nu_{ij}^{\widetilde{B}}\}]=[(\max(\mu_{ij}^{\widetilde{B}},\mu_{ij}^{\tilde{A}}\},\min\{\nu_{ij}^{\widetilde{B}},\nu_{ij}^{\tilde{A}}\}]=\widetilde{B}\cup\widetilde{A}$

(ii) $\widetilde{A}\cap\widetilde{B}=[(\min\{\mu_{ij}^{\tilde{A}},\mu_{ij}^{\widetilde{B}}\},\max\{\nu_{ij}^{\tilde{A}},\nu_{ij}^{\widetilde{B}}\}]=[(\min(\mu_{ij}^{\widetilde{B}},\mu_{ij}^{\tilde{A}}\},\max\{\nu_{ij}^{\widetilde{B}},\nu_{ij}^{\tilde{A}}\}]=\widetilde{B}\cap\widetilde{A}$

(iii) $\widetilde{A}+\widetilde{B}=[(\max\{\mu_{ij}^{\tilde{A}},\mu_{ij}^{\widetilde{B}}\},\min\{\nu_{ij}^{\tilde{A}},\nu_{ij}^{\widetilde{B}}\}]=[(\max(\mu_{ij}^{\widetilde{B}},\mu_{ij}^{\tilde{A}}\},\min\{\nu_{ij}^{\widetilde{B}},\nu_{ij}^{\tilde{A}}\}]=\widetilde{B}+\widetilde{A}$

Validity: Since $0\le\mu_{ij}^{\tilde{A}},\mu_{ij}^{\widetilde{B}}\le\mathbf{1}$, $0\le\nu_{ij}^{\tilde{A}},\nu_{ij}^{\widetilde{B}}\le\mathbf{1}$, $\min(\mu_{ij}^{\widetilde{B}},\mu_{ij}^{\tilde{A}}\}\le\mathbf{1}$, $\max\{\nu_{ij}^{\tilde{A}},\nu_{ij}^{\widetilde{B}}\}\le\mathbf{1}$

Proposition 3:

Let $\widetilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]$, $\widetilde{B}=[(\mu_{ij}^{\widetilde{B}},\nu_{ij}^{\widetilde{B}})]\in$ IFSM mxn. Then (i) $\widetilde{A} @^w \widetilde{B}=\widetilde{B} @^w \widetilde{A}$ (ii) $\widetilde{A} \$^w \widetilde{B}=\widetilde{B} \$^w \widetilde{A}$ (iii) $\widetilde{A} \bowtie^w \widetilde{B}=\widetilde{B} \bowtie^w \widetilde{A}$.

Proof: For all I and j $w_1>0$, $w_2>0$

(i) $\widetilde{A} @^w \widetilde{B}=[(\frac{(w_1\mu_{ij}^{\tilde{A}}+w_2\mu_{ij}^{\widetilde{B}})}{w_1+w_2}),\frac{(w_1\nu_{ij}^{\tilde{A}}+w_2\nu_{ij}^{\widetilde{B}})}{w_1+w_2})]=[\frac{(w_2\mu_{ij}^{\widetilde{B}}+w_1\mu_{ij}^{\tilde{A}})}{w_2+w_1},\frac{w_2\nu_{ij}^{\widetilde{B}}+w_1\nu_{ij}^{\tilde{A}})}{w_2+w_1}]=\widetilde{B} @^w \widetilde{A}$

(ii) $\widetilde{A} \$^w \widetilde{B}=[((\mu_{ij}^{\tilde{A}})^{w_1}.(\mu_{ij}^{\tilde{B}})^{w_2})^{1/(w_1+w_2)},((\nu_{ij}^{\tilde{A}})^{w_1}.(\nu_{ij}^{\tilde{B}})^{w_2})^{1/(w_1+w_2)}]=[((\mu_{ij}^{\tilde{B}})^{w_2}.(\mu_{ij}^{\tilde{A}})^{w_1}))^{1/(w_1+w_2)},((\nu_{ij}^{\tilde{B}})^{w_1}.(\nu_{ij}^{\tilde{A}})^{w_2}))^{1/(w_1+w_2)}=\widetilde{B} \$^w \widetilde{A}$

(iii) $\tilde{A} \bowtie^w \tilde{B}=\left(\frac{w_1+w_2}{\frac{w_1}{\mu_{ij}^{\tilde{A}}}+\frac{w_2}{\mu_{ij}^{\tilde{B}}}},\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{A}}}+\frac{w_2}{\nu_{ij}^{\tilde{B}}}}\right)=\left(\frac{w_1+w_2}{\frac{w_1}{\mu_{ij}^{\tilde{B}}}+\frac{w_2}{\mu_{ij}^{\tilde{A}}}},\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{B}}}+\frac{w_2}{\nu_{ij}^{\tilde{A}}}}\right)=\tilde{B} \bowtie^w \tilde{A}$.

Proposition 4:

Let $\tilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]\in$ IFSM mxn.Then (i) $\tilde{A} @^w \tilde{A}=\tilde{A}$, (ii) $\tilde{A} \$^w \tilde{A}=\tilde{A}$, (iii) $\tilde{A} \bowtie^w \tilde{A}=\tilde{A}$

Proof: For all I and j $w_1>0$, $w_2>0$

(i) $\tilde{A} @^w \tilde{A}=[(\frac{(w\mu_{ij}^{\tilde{A}}+w\mu_{ij}^{\tilde{A}})}{w+w}),\frac{(w_1\nu_{ij}^{\tilde{A}}+w_2\nu_{ij}^{\tilde{A}})}{w_1+w_2}]=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]=\widetilde{A}$

(ii) $\tilde{A} \$^w \tilde{A}==[((\mu_{ij}^{\tilde{A}})^w.(\mu_{ij}^{\tilde{A}})^{w_2}))^{1/(w+w)},((\nu_{ij}^{\tilde{A}})^w.(\nu_{ij}^{\tilde{B}})^w))^{1/(w+w)}]=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]=\widetilde{A}$

(iii) $\tilde{A} \bowtie^w \tilde{A}=\left(\frac{w+w}{\frac{w}{\mu_{ij}^{\tilde{A}}}+\frac{w}{\mu_{ij}^{\tilde{A}}}},\frac{w+w}{\frac{w}{\nu_{ij}^{\tilde{A}}}+\frac{w}{\nu_{ij}^{\tilde{A}}}}\right)=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]=\widetilde{A}$

4. Presentation of Weighted Harmonic Mean (H_{WHM}) of Intuitionistic Fuzzy Soft Matrix in Decision Making :

In this segment, we express harmonic mean and weighted harmonic mean of intuitionistic fuzzy soft matrix.

4.1. Weighted Harmonic mean of Intuitionistic Fuzzy Soft Matrix:

Let $\widetilde{A}=[(\mu_{ij}^{\tilde{A}},\nu_{ij}^{\tilde{A}})]$ $\in$ IFSM mxn.. Then weighted harmonic Mean (H_{WHM}) of Intuitionistic Fuzzy Soft Matrix $\widetilde{H}$ denoted by $\widetilde{H}_{WHM}=[(\sum_{j=1}^{n}\frac{w_j+w_j}{\frac{w_j}{\mu_{ij}^{\tilde{A}}}+\frac{w_j}{\mu_{ij}^{\tilde{B}}}},\sum_{j=1}^{n}(\frac{w_1+w_2}{\frac{w_1}{\nu_{ij}^{\tilde{A}}}+\frac{w_2}{\nu_{ij}^{\tilde{B}}}})]$, w_j for j = 1, 2, …., n are corresponding weights for membership and non-membership value .

Input: Intuitionistic fuzzy soft sets by m objects , each of which has n parameters.

Output: An optimal solution.

Algorithm

Step- 1: Choose the set of parameters.

Step -2: Make the intuitionistic fuzzy soft matrix for the set of parameters.

Step -3:Compute the harmonic mean for the intuitionistic fuzzy soft matrix for the set of parameters.

Step- 4: Compute the weighted harmonic mean of membership and non-membership value of intuitionistic fuzzy soft matrix as G_{WAM}.

Step-5: Choose the object with highest membership value. In event of tie, i.e. when more than one object with same highest membership value, select the object with highest membership value as well as the lowest non- membership value.

Example:

Let X= {h1, h2, h3, h4, h5} be the set of places under consideration and U = {expensive (e1), nearby city (e1), cheap (e1)} be the set of parameters. Suppose Mr.Z is going to buy a household and an intuitionistic fuzzy soft matrix

$$X = \begin{bmatrix} (\mathbf{0.5}, \mathbf{0.3}) & (\mathbf{0.6}, \mathbf{0.5}) & (\mathbf{0.7}, \mathbf{0.2}) \\ (\mathbf{0.7}, \mathbf{0.2}) & (\mathbf{0.5}, \mathbf{0.3}) & (\mathbf{0.5}, \mathbf{0.3}) \\ (\mathbf{0.6}, \mathbf{0.2}) & (\mathbf{0.7}, \mathbf{0.2}) & (\mathbf{0.7}, \mathbf{0.2}) \\ (\mathbf{0.7}, \mathbf{0.3}) & (\mathbf{0.6}, \mathbf{0.3}) & (\mathbf{0.5}, \mathbf{0.1}) \\ (\mathbf{0.8}, \mathbf{0.1}) & (\mathbf{0.3}, \mathbf{0.2}) & (\mathbf{0.3}, \mathbf{0.1}) \end{bmatrix}$$

$$X_{HM} = \begin{bmatrix} \mathbf{0.350}, & \mathbf{0.0900} \\ \mathbf{0.308}, & \mathbf{0.0675} \\ \mathbf{0.441} & \mathbf{0.0400} \\ \mathbf{0.350} & \mathbf{0.0385} \\ \mathbf{0.154} & \mathbf{0.015} \end{bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

If we choose to ‘near by city’ of the homes and weights. 3,. 5,.2 are given in the parameters expensive, near by city, and cheap respectively then

$$X_{WGM} = \begin{bmatrix} \mathbf{0.5330} & , & \mathbf{0.309} \\ \mathbf{0.625} & , & \mathbf{0.222} \\ \mathbf{0.626} & , & \mathbf{0.200} \\ \mathbf{0.652} & , & \mathbf{0.250} \\ \mathbf{0.533} & , & \mathbf{0.110} \end{bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

From the above results (1) and (2), it is clear that if we give equal preference, we have .441 and .652 is the highest membership value in both (1) and (2). So h3 home is virtually suited for Mr. Z. But if we give more preference on ‘near by city’ than other parameters, then h4 home is the most suitable for Mr.Z.

Conclusion

In this report, we have utilized the properties of intuitionistic fuzzy soft matrix. we have given one simple application for decision making problem on the basis weighted harmonic mean. This method can be applied to other decision making problems with uncertain parameters.

References

[1]B.Ahamad and A.Kharal, On Fuzzy Soft Sets ,Advances in Fuzzy Systems, Volume 2009.

[2]M.I.ALI,F.Feng,X.Y.Liu,W.K.Min,M.Shabir(2009), “On some new operations in soft set theory”,Computers and Mathematics with Applications 57:1547-1553.

[3]H.Aktas and N.Cagman,”Soft sets and soft groups”,Information Sciences,177(2007),2726-2735.

[4]N.Cagman,F.Ctak and S.Enginoglu, Fuzzy parameterized fuzzy softest theory and its application,Turk.J.Fuzzy system, 1(1) 2010 ,21-35

[5]D.Chen,E.C.C.Tsang,D.S.Yeung and X.Wang, The parameterization reduction of soft sets and its application,comput. Math.Appl.,49(2005),757-763.

[6]Z.Kong,L.Gao and L.Wang,comment on fuzzy soft theoretic approach to decision making problems,J.Comput.Appl.Math., 223(2009),540-542.

[7]P.K.Maji,R.Biswas and A.R.Roy,Fuzzy soft sets,J.Fuzzy Math.,9(3)(2001),589-602.

[8] P.K.Maji,R.Biswas and A.R.Roy,An pplication of soft sets in a decision making problem,Comput.Math.Appl.,44(2002),1077-1083.

[9] P.K.Maji,R.Biswas and A.R.Roy,Soft set theory ,Comput.Math.Appl.,45(2003),555-562.

[10]D.A.Molodtsov,soft set theory-first results,Comput.Math.Appl.,37(1999),19-31.

[11] D.A.Molodtsov,The description of dependence with the help of soft sets,J.Comput.Sys.Sc.Int.,40(6)(2001),977-984.

[12] D.A.Molodtsov,”The theory of soft sets(in Russian),URSS Publishers”,Moscow,2004.

[13]P.K.Maji, and A.R.Roy,A fuzzy soft set theoretic approach to decision making problems,J.Comput.Application. Math.203(2007),412-418.

[14]R.Rathika, and S.Subramanian,A case study on intuitionistic fuzzy soft matrix theory in decision making, International Journal of Pure and Applied Mathematics,volume 113 No.6 2017,213-223.

[15]L.A.Zadeh,Fuzzy sets,Information and control,8(1965),338-353.