ENTREATY OF INTUITIONISTIC FUZZY SOFT MATRICES

ABSTRACT

Soft set theory is a newly emerging Mathematical tool to deal with uncertain problems. In this work, Intuitionistic fuzzy soft matrices has been introduced and defined different types of Intuitionistic fuzzy soft matrices and some operations. Finally extended the approach in application of these matrices in decision making problems

Keywords: *Algorithm, Case study, Decision making problem Fuzzy soft set, Fuzzy soft Matrix, Intuitionistic fuzzy soft set, Operations of Fuzzy soft matrix.*

Mathematics subject classification*: 03B52, 92C50, 91B06*

Introduction:

In real life situation, most of the problems in economics, social science, environment etc, have various uncertainties. However most of the existing Mathematical tools for formal modeling, reasoning and computing are crisp deterministic and precise in character. There are theories viz, theory of probability, evidence, fuzzy set, Intuitionistic fuzzy set, vague set, interval Mathematics, rough set for dealing with uncertainties. These theories have their own difficulties as pointed out by Molodtsov. In 1999 Molodtsov initiated a novel concept of soft set theory, which is completely new approach for modeling vagueness and uncertainties. Soft set theory has a rich potential for application in solving practical problems in economics , social science, medical science etc. later on Maji et al have studied the theory of fuzzy soft set. Majumdar et al have further generalized the concept of fuzzy soft sets. Maji et al extended soft sets Intuitionistic fuzzy soft sets.

This work, propose Intuitionistic fuzzy soft matrices and defined different types of Intuitionistic fuzzy soft matrices and some operations. Finally extended the Approach in application of these matrices in decision making problems

Fuzzy Soft Matrices

Let $U=\{c_1, c_2, c_3, \ldots . c_m\}$ be the Universal set and E be the set of parameters given by E $=\{e_1 e_2, e_3, \ldots . e_n\}$. let A⊆E and (F,A) be a fuzzy soft set in the fuzzy soft class (U,E). then fuzzy soft set (F,A) in the matrix form as $A_{m\times n} = [a_{ij}]_{m\times n}$ or A=$[a_{ij}]$ i=1,2,…..m, j=1,2,3,….n

Where $a_{ij}=\begin{cases}\mu_j(c_i) & if \quad e_j \in A \\ 0 & if \quad e_j \notin A\end{cases}$, $\mu_j(c_i)$ represents the membership of c_i in the fuzzy set F(e_j).

Intuitionistic Fuzzy Soft Set

Let U be an initial Universe set and E be the set of parameters. Let A⊆E. a pair (F,A) is called Intuitionistic fuzzy soft set over U where F is a mapping given by F:A→I^U where I^U denotes the collection of all Intuitionistic fuzzy subsets of U.

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Example

Consider the example matrix

representation is $\begin{pmatrix} 0.9 & 0.8 & 0 \\ 0.3 & 0.9 & 0 \\ 0.8 & 0.4 & 0 \\ 0.9 & 0.3 & 0 \end{pmatrix}$

Intuitionistic Fuzzy Soft Set

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Example

Suppose that $U=\{s_1, s_2, s_3, s_4\}$ is a set of students and E=$\{e_1, e_2, e_3\}$ is a set of parameters, which stand for result, conduct and sports performances respectively. Consider the mapping from parameters set A⊆E to the set of all Intuitionistic fuzzy subsets of power set U. Then soft set (F,A) describes the character of the students with respect to the given parameters, for finding the best student of an academic year. Consider A=$\{e_1, e_2\}$ then Intuitionistic fuzzy soft set is

(F,A)={F(e_1)={(s_1,0.8,0.1),(s_2,0.3,0.6),

(s_3,0.8,0.2),(s_4,0.9,0.0)},

{F(e_2)={(s_1,0.8,0.1),(s_2,0.9,0.1),(s_3,0.4, 0.5),(s_4,0.3,0.6)}

Intuitionistic Fuzzy Soft Matrix(Ifsm))

Let $U=\{c_1, c_2, c_3, \ldots . c_m\}$ be the iniversal set and E be the set of parameters given by E =$\{e_1 e_2, e_3, \ldots . e_n\}$. let A⊆E and (F,A) be a intuitionsistic fuzzy soft set in the fuzzy soft class (U,E). then Intuitionistic fuzzy soft set (F,A) in the matrix form as $A_{m\times n} = [a_{ij}]_{m\times n}$ or A=$[a_{ij}]$ i=1,2,…..m, j=1,2,3,….n

Where

$$a_{ij}=\begin{cases} (\mu_j(c_i), \nu_j(c_i)) & if\ e_j \in A \\ 0 & if\ e_j \notin A \end{cases},$$

$\mu_j(c_i)$ represents the membership of c_i in the Intuitionistic fuzzy set F(e_j).$\nu_j(c_i)$ represents the non-membership of c_i in the Intuitionistic fuzzy set F(e_j)

Example 5

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(F,A)={F(e_1)={(s_1,0.8,0.1),(s_2,0.3,0.6),(s_3,0.8,0.2),(s_4,0.9,0.0)},

{F(e_2)={(s_1,0.8,0.1),(s_2,0.9,0.1),(s_3,0.4, 0.5),(s_4,0.3,0.6)}

Represent this Intuitionistic fuzzy soft set in matrix form as

$$\begin{pmatrix} (0.8,0.1) & (0.8,0.1) & (0.0,1.0) \\ (0.3,0.6) & (0.9,0.1) & (0.0,1.0) \\ (0.8,0.2) & (0.4,0.5) & (0.0,1.0) \\ (0.9,0.0) & (0.3,0.6) & (0.0,1.0) \end{pmatrix}$$

Intuitionistic Fuzzy Soft Complement Matrix

Let A=$[a_{ij}]$ ∈ $IFSM_{m\times n}$, where $a_{ij}=(\mu_j(c_i), \nu_j(c_i))$. Then A^C is called a Intuitionistic fuzzy soft complement matrix if $A^C=[b_{ij}]_{m\times n}$

$b_{ij}=(\nu_j(c_i), \mu_j(c_i)), \forall\ i, j$

Example

Let A= $\begin{pmatrix}(0.2,0.7) & (0.8,0.3)\\(0.9,0.4) & (0.5,0.5)\end{pmatrix}_{2\times2}$ be Intuitionistic fuzzy soft matrix then the complement of this matrix is

A^C= $\begin{pmatrix}(0.7,0.2) & (0.3,0.8)\\(0.4,0.9) & (0.5,0.5)\end{pmatrix}_{2\times2}$

Scalar Multiple Of Intuitionistic Fuzzy Soft Matrix

Let A=$[a_{ij}]$ $\in IFSM_{m\times n}$, where a_{ij}=$(\mu_j(c_i),\nu_j(c_i))$. Then scalar multiple of Intuitionistic fuzzy soft matrix A by a scalar k is defined by kA=$[ka_{ij}]_{m\times n}$ where $0\leq k\leq 1$

Example

Let A= $\begin{pmatrix}(0.2,0.7) & (0.8,0.3)\\(0.9,0.4) & (0.5,0.5)\end{pmatrix}_{2\times2}$ be Intuitionistic fuzzy soft matrix , then the scalar multiple of this matrix by k=0.4 is

kA= $\begin{pmatrix}(0.08,0.28) & (0.32,0.12)\\(0.36,0.16) & (0.20,0.20)\end{pmatrix}_{2\times2}$

Trace Of Intuitionistic Fuzzy Soft Matrix

Example

Let A= $\begin{pmatrix}(0.9,0.7) & (0.8,0.3)\\(0.9,0.4) & (0.5,0.5)\end{pmatrix}_{2\times2}$ be Intuitionistic fuzzy soft matrix, then trace of this matrix is trA=0.9-0.7+0.5-0.5=0.2

Intuitionistic Fuzzy Soft Matrix Theory In Decision Making Value Matrix

Let A=$[a_{ij}]$ $\in IFSM_{m\times n}$, where a_{ij}=$(\mu_j(c_i),\nu_j(c_i))$. Then define the value matrix of Intuitionistic fuzzy soft matrix A is V(A)= $[a_{ij}]$ =$[\mu_j(c_i)-\nu_j(c_i)]$. I=1,2,….m ,j=1,2,….n

Score Matrix

Let A=$[a_{ij}]$ $\in IFSM_{m\times n}$, B=$[b_{ij}]$ $\in IFSM_{m\times n}$,then define score matrix of A and B as $S_{(A,B)}=[d_{ij}]_{m\times n}$ where $[d_{ij}]$=V(A)-V(B)

Total Score

Let A=$[a_{ij}]$ $\in IFSM_{m\times n}$, B=$[b_{ij}]$ $\in IFSM_{m\times n}$. Let the corresponding value matrices be V(A),V(B) and their score matrix is $S_{(A,B)}=[d_{ij}]_{m\times n}$then define total score for each c_i in U is $S_i=\sum_{j=1}^{n} d_{ij}$

Methodology

Suppose U is a set of candidates appearing in an interview for appointment of photography job in a company. Let E is a set of parameters related to photography level of candidates. Then construct IFSS (F,E) over U represent the selection of candidate by field expert X, where F is a mapping F:E→IF^U, IF^U is the collection of all Intuitionistic fuzzy subsets of U. Further construct another IFSS (G,E) over U represent the selection candidate by field expert Y, where G is a mapping G:E→IF^U, IF^U is the fuzzy soft sets (F,E) and (G,E) are constructed, compute the complements $(F,E)^c$ and $(G,E)^c$ respectively. Compute A+B which is the maximum membership of selection of candidates by the judges. Compute A^c+B^c which is the maximum membership of non selection of candidates by the judges. Using definition of value matrix, compute V(A+B),V(A^c+B^c) , $S_{((A+B),(A^c+B^c))}$ and the total score S_i for each candidate in U. Finally find S_j= max(S_i),then conclude that the candidate c_j has selected by the judges. If S_j has more than one value the process is repeated by reassessing the parameters.

Algorithm

STEP 1: Input the Intuitionistic fuzzy soft set (F,E) , (G,E) and obtain the

Intuitionistic fuzzy soft matrices A,B corresponding to (F,E) and (G,E) respectively.

STEP 2: Write the Intuitionistic fuzzy soft complement set $(F,E)^c$, $(G,E)^c$ and obtain the Intuitionistic fuzzy soft matrices A^c, B^c corresponding to $(F,E)^c$ and $(G,E)^c$ respectively.

STEP 3: Compute (A+B), $(A^c + B^c)$,V(A+B),V$(A^c + B^c)$ and $S_{((A+B),(A^c+B^c))}$

STEP 4: Compute the total score S_i for each c_i in U.

STEP 5: Find c for which max(S_i).

Then conclude that the candidate c_i is selected for photography job.

In case max S_i occurs for more than one value, then repeat the process by reassessing the parameters.

Application Of Intuitionistic Fuzzy Soft Matrix On Selecting Suitable Candidate For The Photography Job

Let (F,E) and (G,E) be two Intuitionistic fuzzy soft set representing the selection of four candidates from the universal set U ={c_1, c_2, c_3, c_4} by the experts X and Y . Let E={e_1, e_2, e_3} be the set of parameters which stand for uniqueness of concept, clarity and creativity.

(F,E) = {F(e_1) = {(c_1, 0.8,0.2),(c_2, 0.6,0.3),(c_3, 0.8,0.3),(c_4, 0.7,0.5)}
F(e_2)= {(c_1, 0.7,0.4) , (c_2, 0.9,0.5),(c_3, 0.5,0.5),(c_4,0.1, 0.8)}
F(e_3) = {(c_1, 0.6,0.5),(c_2, 0.8,0.1),(c_3, 0.4, 0.6),(c_4, 0.5,0.4)}}

(G,E) = {G(e_1) = {(c_1,0.7,0.3),(c_2, 0.6,0.4),(c_3, 0.5,0.4),(c_4, 0.3,0.7)}
G(e_2)= {(c_1, 0.7,0.4) , (c_2, 0.1,0.8),(c_3, 0.5,0.5),(c_4,0.4,0.2)}
G(e_3) = {(c_1, 0.6,0.6),(c_2, 0.7,0.3),(c_3, 0.3, 0.6),(c_4, 0.1,0.4)}}

These two Intuitionistic fuzzy soft sets are represented by the following Intuitionistic fuzzy soft matrices respectively.

A= $\begin{matrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.8,0.2) & (0.7,0.4) & (0.6,0.5) \\ (0.6,0.3) & (0.9,0.5) & (0.8,0.1) \\ (0.8,0.3) & (0.5,0.5) & (0.4,0.6) \\ (0.7,0.5) & (0.1,0.8) & (0.5,0.4) \end{pmatrix}$

B = $\begin{matrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.7,0.3) & (0.7,0.4) & (0.6,0.6) \\ (0.6,0.4) & (0.1,0.8) & (0.7,0.3) \\ (0.5,0.4) & (0.5,0.5) & (0.3,0.6) \\ (0.3,0.7) & (0.4,0.2) & (0.1,0.4) \end{pmatrix}$

A^c=

$\begin{matrix} & e_1 & e_2 & e_3 \\ c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.2,0.8) & (0.4,0.7) & (0.5,0.6) \\ (0.3,0.6) & (0.5,0.9) & (0.1,0.8) \\ (0.3,0.8) & (0.5,0.5) & (0.6,0.4) \\ (0.5,0.7) & (0.8,0.1) & (0.4,0.5) \end{pmatrix}$

B^c = $\begin{matrix} & e_1 & e_2 & e_3 \\ c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.3,0.7) & (0.4,0.7) & (0.6,0.6) \\ (0.4,0.6) & (0.8,0.1) & (0.3,0.7) \\ (0.4,0.5) & (0.5,0.5) & (0.6,0.3) \\ (0.7,0.3) & (0.2,0.4) & (0.4,0.1) \end{pmatrix}$

Then the addition matrices are

A+B= $\begin{matrix} & e_1 & e_2 & e_3 \\ c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.8,0.2) & (0.7,0.4) & (0.6,0.5) \\ (0.6,0.3) & (0.9,0.5) & (0.8,0.1) \\ (0.8,0.3) & (0.5,0.5) & (0.4,0.6) \\ (0.7,0.5) & (0.4,0.2) & (0.5,0.4) \end{pmatrix}$

$A^c + B^c$ =

$\begin{matrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{matrix}\begin{pmatrix} (0.3,0.7) & (0.4,0.7) & (0.6,0.6) \\ (0.4,0.6) & (0.8,0.1) & (0.3,0.7) \\ (0.4,0.5) & (0.5,0.5) & (0.6,0.3) \\ (0.7,0.3) & (0.8,0.1) & (0.4,0.1) \end{pmatrix}$

$$V(A+B)=\begin{matrix}c_1\\c_2\\c_3\\c_4\end{matrix}\begin{pmatrix}0.6 & 0.3 & 0.1\\0.3 & 0.4 & 0.7\\0.5 & 0.0 & -0.2\\0.2 & 0.2 & 0.1\end{pmatrix}$$

$$V(A^c+B^c)=\begin{matrix}c_1\\c_2\\c_3\\c_4\end{matrix}\begin{pmatrix}-0.4 & -0.3 & 0.0\\-0.2 & 0.7 & -0.4\\-0.1 & 0.0 & 0.3\\0.4 & 0.7 & 0.3\end{pmatrix}$$

Calculate the score matrix and the total score for selection

$$S_{((A+B),(A^c+B^c))}=\begin{matrix}c_1\\c_2\\c_3\\c_4\end{matrix}\begin{pmatrix}1.0 & 0.6 & 0.1\\0.5 & -0.3 & 1.1\\0.6 & 0.0 & -0.5\\-0.2 & -0.5 & -0.2\end{pmatrix}$$

$$\text{Total score}=\begin{matrix}c_1\\c_2\\c_3\\c_4\end{matrix}\begin{bmatrix}1.7\\1.3\\0.1\\0.9\end{bmatrix}$$

Thus the first candidate has the maximum value and thus conclude that from both the expert's opinion, candidate c_1 is selected for the photography job.

Conclusion

In this work, Intuitionistic fuzzy soft matrices has been proposed and defined different types of Intuitionistic fuzzy soft matrices and some operations. Finally extended the approach in application of these matrices in decision making problems.

The work is in fact an attempt to extend the notion of Intuitionistic fuzzy sot matrix. Future work in this regard would be required to study whether the notions put forward in this work yield a fruitful result.

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