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Application of fuzzy soft matrices in medical diagnosis

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Abstract
In this paper, we define fuzzy soft matrices and investigate some properties by establishing with examples. Also we analyze the application of these matrices in decision making problem.

Keywords: Soft set, Fuzzy soft set (FSS), Fuzzy soft matrices (FSM), Fuzzy soft complement matrices, Null set, fuzzy soft class

1. Introduction

In 1965, Zadeh [14] introduced the notion of fuzzy set theory. In 1999, Molodstov [6] introduced soft set theory as a general mathematical tool dealing with uncertainties which traditional mathematical tools cannot handle. In 2001, Maji *et al.* [4] studied the theory of soft sets initiated by Molodtsov [6] and developed several basic notions of soft set theory. In 2009, Ahmad and tharal [1] developed the result of Maji [4]. In 2010, Cagman *et al.* [2] defined soft matrix which is representation of soft set, to make operations in theoretical studies in soft set more functional. This representation has several advantages. In 2011, Yong *et al.* [13] successfully applied the proposed notion of fuzzy soft matrix in certain decision making problems. In 2011, Neog and sut [11] have defined the "addition operation" for fuzzy soft matrices and anattempt has been made to apply our notion in solving a decision problem. In 2012, Cagman and Enginoglu put forward fs-max min decision method which can be successfully applied to many problems. In 2012, Rajarajeswari and Dhanalakshmi [7] introduced the application of similarity between two fuzzy soft sets based on distance. In 2012, Neog, Bora and sut [12] extend the notion of fuzzy soft matrices. In 2012, Borah *et al.* [5] extended, fuzzy soft matrix decision making method by using fuzzy soft T-product. In 2012, Basu, Mahapatra and Mondal [10] have introduced some operations on fuzzy soft matrices and choice matrices. In 2014, Dr. N. Sarala and Rajkumari [8] introduced intuitionistic fuzzy soft matrices (IFSM) in Agriculture and also issued [9] IFSM in Medical diagnosis. In this paper, we proposed fuzzy soft matrices indecision making problem which will yield fruitful results in this field.

2. Preliminaries

In this we section, we recall some basic essential notion of fuzzy soft set theory.

2.1 Soft Set [7]: Let U be an initial universe set P (U) be the power set of U, E be the set of all parameters and A$\subseteq$ E. A soft set (f_A, E) on the universe U is defined by the set of order pairs (f_A, E) = {(e, f_A (e)): e$\in$ E, f_A (e) $\in$ P (U) where f_A: E $\rightarrow$ P (U) such that f_A (e) = ϕ if e $\notin$ A. Here f_A is called an approximate function of the soft set (f_A, E). The set f_A (e) is called e-approximate value set or e-approximate set which consists of related objects of the parameter e $\in$ E. In the other words, a soft set over *U* is a parameterized family of subsets of the universe *U*.

2.1 Example: Let U= {u_1, u_2, u_3, u_4} be a set of four shoes and E={{ u_1, u_2, u_3, u_4}= { black (e_1), red (e_2),blue (e_3),green(e_4) } be a set of parameters. If A ={e_1, e_2, e_3,e_4} $\subseteq$ E. Let f_A(e_1)= { u_1, u_2, u_3, u_4} and f_A(e_2)= { u_1, u_2, u_3, u_4}, then we write the soft set (f_A,E)= {(e_1,{ u_1, u_2, u_3, u_4}), (e_2,{ u_1, u_4}), (e_3,{ u_1, u_3, u_4}), (e_4,{ u_4})} over U which describe the "colour of the shoes" which Mr. A is going to buy. We may represent the fuzzy soft set in the following form

Table 2.1.1

U	e_1	e_2	e_3	e_4
u_1	1	1	1	0
u_2	1	0	0	0
u_3	1	0	1	0
u_4	1	1	1	1

2.2. Fuzzy soft set [4]: Let U be an initial universe, E be the set of all parameters and A⊆ E. A pair (F, A) is called a fuzzy soft set over U where F: A → *P*(U) is a mapping from A into *P*(U), where *P*(U) denotes the collection of all subsets of U.

2.2 Example: Consider the example 2.1, here we cannot express with only two real numbers 0 and 1, we can characterized it by a membership function instead of crisp number 0 and 1, which associate with each element a real number in the interval [0,1].Then $(F_A, E) =\{ f_A(e_1) =\{(u_1,0.8),(u_2,0.6),(u_3,0.5),(u_4,0.2)\}, f_A(e_2) =\{(u_1,0.5),(u_4,0.2)\}$,
$f_A(e_3) =\{(u_1,0.6),(u_3,0.4)(u_4,0.8)\}, f_A(e_4) =\{(u_4,0.4)\}\}$
is the fuzzy soft set representing the "colour of the shoes" Which Mr. A is going to buy. We may represent the fuzzy soft set in the following form:

Table 2.2.2

U	e_1	e_2	e_3	e_4
u_1	0.8	0.5	0.6	0
u_2	0.6	0	0	0
u_3	0.5	0.0	0.4	0
u_4	0.2	0.2	0.8	0.4

2.3 Fuzzy Soft Class [7]: Let U be an initial universe set and E be the set of attributes. Then the pair (U, E) denotes the collection of all fuzzy soft sets on U with attributes from E and is called a fuzzy soft class.

2.4 Fuzzy Soft Sub Set [7]: For two fuzzy soft sets (F_A,E) and (G_B,E) over a common universe U, we have $(F_A,E) \subseteq (G_B,E)$ if A⊂ B and for all e ∈ A,$F_A(e)$ is a fuzzy soft subset of $G_B(e)$ ie., (F_A,E) is a fuzzy soft subset of (G_B,E).

2.5 Fuzzy soft complement set [11]: The complement of fuzzy soft sets (F_A, E) denoted by $(F_A,E)°$ is defined by $(F_A,E)° =(F_A°, E)$, where $F_A °: E \to I^U$ is a mapping given by $F_A°(e) = [F_A(e)]°$, for all e∈ E.

2.6 Fuzzy Soft Null Set [7]: A fuzzy soft set (F_A,E) over U is said to be null fuzzy soft set with respect to the parameter set E, denoted by $\emptyset$,if $F_A(e)= \emptyset$ for all e∈ E.

2.7 Row- Fuzzy Soft Matrix: A fuzzy soft matrix of order 1×*n* i.e., with a single row is called a row-fuzzy soft matrix.
2.8 Column -Fuzzy Soft Matrix: A fuzzy soft matrix of order *m*×1 i.e., with a single column is called a column-fuzzy soft matrix.

3. Fuzzy Soft Matrices Theory

In this section, we study the concept of soft matrices with fuzzy version.

3.1 Fuzzy Soft Matrices (FSM) [5]: Let $U =\{u_1,u_2,u_3,u_4,\ldots\ldots u_m\}$ be the universal set and E be the set of parameters given by E = $\{\ _1, e_2, e_3,\ldots\ldots e_n\}$. Then the fuzzy soft set (F_A,E) can be expressed in matrix form as $\tilde{A}= [a_{ij}^A]_{m\times n}$ or simply by $[a_{ij}^A]$, i=1,2,3…,m; j=1,2,3,…,n and$[a_{ij}^A] = [(\mu_{ij}^A,\gamma_{ij}^A)]$; where μ_{ij}^A and γ_{ij}^A represent the fuzzy membership function and fuzzy reference function U in the fuzzy set $F_A(e_j)$ so that $\delta_{ij}= \mu_{ij}^A - \gamma_{ij}^A$ gives the fuzzy membership value of U. We shall identify a fuzzy soft set with its fuzzy soft matrix and use these two concepts interchangeable. The set of all m×n fuzzy soft matrices over U will be denoted by FSM m×n. For usual fuzzy sets with fuzzy reference function 0, it is obvious to see that $a_{ij}^A = [(\mu_{ij}^A, 0)]$ for all i,j.

3.1 Example: Let $U = \{u_1, u_2, u_3, u_4\}$ be the universal set and E be the set of parameters given by
$E = \{e_1, e_2, e_3\}$ we consider a fuzzy soft set
$(F_A, E)=\{ F_A(e_1) = \{(u_1,0.5,0),(u_2,0.2,0),(u_3,0.7,0),(u_4,0.8,0\}$,
$F_A(e_2) =\{(u_1,0.9,0),(u_2,0.8,0),(u_3,0.4,0),(u_4,0.7,0\}$,
$F_A(e_3) =\{(u_1,0.1,0),(u_2,0.2,0),(u_3,0.9,0),(u_4,0.6,0\}\}$

We would represent this fuzzy soft set in matrix form as

$$[a_{ij}^A] = \begin{pmatrix} (0.5, 0) & (0.9, 0) & (0.1, 0) & (0.2, 0) \\ (0.8, 0) & (0.2, 0) & (0.7, 0) & (0.4, 0) \\ (0.9, 0) & (0.8, 0) & (0.7, 0) & (0.6, 0) \end{pmatrix}$$

3.2 Membership Value Matrix: The membership value matrix corresponding to the matrix $\tilde{A}$as MV($\tilde{A}$) = $[\delta_{ij}^{A}]_{m\times n}$, where δ_{ij}= μ_{ij}^{A} - γ_{ij}^{A} for all i=1,2,3,..,m, j=1,2,3,..,n where μ_{ij}^{A} and γ_{ij}^{A} represent the fuzzy membership function and fuzzy reference function respectively of U in the fuzzy set $F_A(e_j)$.

3.3 Fuzzy soft Complement Matrix: Let $\tilde{A}$= $[a_{ij}^{A}]_{m\times n}$, then complement of $\tilde{A}$ is denoted by $\tilde{A}^{\circ}$ =[(C_{ij})]; where C_{ij} =1– a_{ij}^{A} for all i andj.

3.4 Addition of fuzzy Soft Matries: Let U = {$u_1, u_2, u_3, u_4,\ldots\ldots u_m$} be the universal set and E be the set of parameters given by E = { e_1, e_2, e_3,……e_n}. Let the set of all m×n fuzzy soft matrices over U be $FSM_{m\times n}$. Let $\tilde{A}$, $\tilde{B}$ ∈ $FSM_{m\times n}$, Where $\tilde{A}$= $[a_{ij}^{A}]_{m\times n}$, $[a_{ij}^{A}]$=[(μ_{ij}^{A},γ_{ij}^{A})]; and $\tilde{B}$= $[b_{ij}^{b}]_{m\times n}$,$[b_{ij}^{B}]$ = [(μ_{ij}^{B},γ_{ij}^{B})]. To avoid degenerate cases we assume that min ((μ_{ij}^{B},μ_{ij}^{B})≥max(([(γ_{ij}^{A},γ_{ij}^{A})) for all i and j. We define the operation 'addition(+)' between$\tilde{A}$ and $\tilde{B}$as $\tilde{A}+\tilde{B}=\tilde{C}$, where $\tilde{C}$= $[C_{ij}^{c}]_{m\times n}$, C_{ij}^{c} = (max(μ_{ij}^{A},μ_{ij}^{B}),min(γ_{ij}^{A},γ_{ij}^{B})), and 'Subraction (-)' between $\tilde{A}$ and $\tilde{B}$as $\tilde{A}$-$\tilde{B}$=$\tilde{C}$, where $\tilde{C}$= $[C_{ij}^{c}]_{m\times n}$, C_{ij}^{c} = (min(μ_{ij}^{B},μ_{ij}^{A}),max(γ_{ij}^{B},γ_{ij}^{A})).

3.5 Proposition: Let $\tilde{A}$,$\tilde{B}$,$\tilde{C}$∈$FSM_{m\times n}$. Then the following results hold.
(i) $\tilde{A}$-$\tilde{B}$ = $\tilde{B}$ - $\tilde{A}$ (ii) ($\tilde{A}$-$\tilde{B}$)- $\tilde{C}$= $\tilde{A}$- $(\tilde{B}$- $\tilde{C})$

Proof

(i) Let $\tilde{A}$= [(μ_{ij}^{A},γ_{ij}^{A})], $\tilde{B}$= [(μ_{ij}^{B},γ_{ij}^{B})]

Now $\tilde{A}$-$\tilde{B}$ = [(min(μ_{ij}^{A},μ_{ij}^{B}),max(γ_{ij}^{A},γ_{ij}^{B})]

\ = [(min(μ_{ij}^{B},μ_{ij}^{A}),max(γ_{ij}^{B},γ_{ij}^{A})]

=$\tilde{B}$ - $\tilde{A}$.

(ii) Let $\tilde{A}$= [(μ_{ij}^{A},γ_{ij}^{A})], $\tilde{B}$= [(μ_{ij}^{B},γ_{ij}^{B})] and $\tilde{C}$= [(μ_{ij}^{C},γ_{ij}^{C})]

Now ($\tilde{A}$-$\tilde{B}$)- $\tilde{C}$= [(min(μ_{ij}^{A},μ_{ij}^{B}),max(γ_{ij}^{A},γ_{ij}^{B})]- [(μ_{ij}^{C},γ_{ij}^{C})]

= [(min(μ_{ij}^{A},$\mu_{ij}^{B,}$ μ_{ij}^{C}),max(γ_{ij}^{A},γ_{ij}^{B}, γ_{ij}^{C})

= [(min(μ_{ij}^{A},($\mu_{ij}^{B,}$ μ_{ij}^{C})),max(γ_{ij}^{A},$(\gamma_{ij}^{B}$, $\gamma_{ij}^{C})$)]

= $\tilde{A}$- $(\tilde{B}$- $\tilde{C})$

3.5 Example

Let $\tilde{A}$ = $\begin{pmatrix} (0.6, 0.0) & (0.5, 0.0) & (0.9, 0.0) & (0.1, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.7, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.7, 0.0) & (0.3, 0.0) & (0.3, 0.0) \end{pmatrix}$

$\tilde{B}$ = $\begin{pmatrix} (0.5, 0.0) & (0.5, 0.0) & (0.8, 0.0) & (0.0, 0.0) \\ (0.3, 0.0) & (0.4, 0.0) & (0.3, 0.0) & (0.6, 0.0) \\ (0.6, 0.0) & (0.5, 0.0) & (03, 0.0) & (0.2, 0.0) \\ (0.7, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \end{pmatrix}$

$\tilde{C}$ = $\begin{pmatrix} (0.9, 0.0) & (0.8, 0.0) & (0.6, 0.0) & (0.7, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.4, 0.0) & (0.3, 0.0) & (0.1, 0.0) & (0.3, 0.0) \\ (0.6, 0.0) & (0.2, 0.0) & (0.5, 0.0) & (0.4, 0.0) \end{pmatrix}$

Then

$\tilde{A}$-$\tilde{B}$ = $\begin{pmatrix} (0.5, 0.0) & (0.5, 0.0) & (0.8, 0.0) & (0.0, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.6, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \end{pmatrix}$

$\tilde{B}$ - $\tilde{A}$ = $\begin{pmatrix} (0.6, 0.0) & (0.5, 0.0) & (0.9, 0.0) & (0.1, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.7, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.7, 0.0) & (0.3, 0.0) & (0.3, 0.0) \end{pmatrix}$

Hence $\tilde{A}$-$\tilde{B}$ = $\tilde{B}$ - $\tilde{A}$

$$(\tilde{A}-\tilde{B})-\tilde{C} = \begin{pmatrix} (0.5, 0.0) & (0.5, 0.0) & (0.8, 0.0) & (0.0, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.6, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \end{pmatrix}$$

$$- \begin{pmatrix} (0.9, 0.0) & (0.8, 0.0) & (0.6, 0.0) & (0.7, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.4, 0.0) & (0.3, 0.0) & (0.1, 0.0) & (0.3, 0.0) \\ (0.6, 0.0) & (0.2, 0.0) & (0.5, 0.0) & (0.4, 0.0) \end{pmatrix}$$

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

$$\tilde{A}-(\tilde{B}-\tilde{C}) = \begin{pmatrix} (0.6, 0.0) & (0.5, 0.0) & (0.9, 0.0) & (0.1, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.7, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.7, 0.0) & (0.3, 0.0) & (0.3, 0.0) \end{pmatrix}$$

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

$$= \begin{pmatrix} (0.5, 0.0) & (0.5, 0.0) & (0.6, 0.0) & (0.0, 0.0) \\ (0.2, 0.0) & (0.3, 0.0) & (0.2, 0.0) & (0.1, 0.0) \\ (0.5, 0.0) & (0.3, 0.0) & (0.1, 0.0) & (0.1, 0.0) \\ (0.6, 0.0) & (0.2, 0.0) & (0.2, 0.0) & (0.1, 0.0) \end{pmatrix}$$

Hence $(\tilde{A}-\tilde{B})-\tilde{C} = \tilde{A}-(\tilde{B}-\tilde{C})$.

3.6 Score Matrix: Let $\tilde{A},\tilde{B} \in FSM_{m\times n}$. Let the corresponding membership value matrices be $MV(\tilde{A}) = [\delta_{ij}^{A}]_{m\times n}$, and $MV((\tilde{B}) = [\delta_{ij}^{B}]_{m\times n}$ i=1,2,3,..,m; j= 1,2,3,..,n. Then the score matrix $S_{(A,B)}$ would be defined as $S_{(A,B)} = [\rho_{ij}]_{mxn}$ where $\rho_{ij} = \delta_{ij}^{A} - \delta_{ij}^{B}$.

3.7 Total Score Matrix: Let $\tilde{A},\tilde{B} \in FSM_{m\times n}$. Let the corresponding membership value matrices be $MV(\tilde{A}) = [\delta_{ij}^{A}]_{m\times n}$, and $MV(\tilde{B}) = [\delta_{ij}^{B}]_{m\times n}$ respectively and the score matrix be

$S_{(A,B)} = \delta_{ij}^{A} - \delta_{ij}^{B}$ i=1,2,3,..,m; j= 1,2,3,..,n. Then the total score for each u_i in U would be calculated by the formula $S_i = \Sigma\, [\delta_{ij}^{A} - \delta_{ij}^{B}] = \Sigma\, [(\mu_{ij}^{A},\gamma_{ij}^{A})-(\mu_{ij}^{B},\gamma_{ij}^{B})]$.

3.8 Methodology

Suppose U is the set of certain number of hospitals. E is a set of parameters related to highest service rendered to patients by the hospitals. We construct a fuzzy soft set (F_A,E) over U representing the best service hospitality and showed by the hospitals. Where F_A is a mapping $F_A:E\rightarrow I^U$, I^U is the set of all fuzzy subset of U. We further construct another fuzzy soft set (G_B,E) over U denoting the best hospitality and need of service focus to the orphans by the organization. The matrices $\tilde{A}$ and $\tilde{B}$ corresponding to the fuzzy soft sets (F_A,E) and (G_B,E) are constructed. We compute the complements $(F_A,E)°$ and $(G_B,E)°$ and write the matrices $\tilde{A}°$ and $\tilde{B}°$ corresponding to $(F_A,E)°$ and $(G_B,E)°$ respectively.Using definition 3.4, we compute $(\tilde{A}-\tilde{B})$which represent s the maximum membership of best service and hospitality rendered to the patients by the hospitals and then compute $\tilde{A}°-\tilde{B}°$, which represented the maximum membership of less service showed to the patients by the hospitals. Using definition 3.2,we compute $MV((\tilde{A}-\tilde{B})$ and $MV(\tilde{A}°-\tilde{B}°)$. The score matrix $S((\tilde{A}-\tilde{B}),(\tilde{A}°-\tilde{B}°))$ is constructed. Using definition 3.6 and the total score S_i for each u_i in U is calculated using definition 3.7. Finally, we would find $S_K = \max(S_i)$, then we conclude that the hospital u_k has the maximum service rendered between the hospitals. If S_K has more than one value the process is repeated by reassessing the parameters for choosing the role model organization.

4. Algorithm

1. Input the fuzzy soft matrices (F_A,E) and (G_B,E). Also write the fuzzy soft matrices $\tilde{A}$ and $\tilde{B}$ commensurate to (F_A,E) and (G_B,E) respectively.
2. Write the fuzzy soft matrices $(F_A,E)°$ and $(G_B,E)°$. Also write the fuzzy soft matrices $\tilde{A}$ and $\tilde{B}$ corresponding to $(F_A,E)°$and $(G_B,E)°$ respectively.
3. Compute $\tilde{A}$-$\tilde{B}$ and MV ($\tilde{A}$-$\tilde{B}$).
4. Compute $\tilde{A}$ °-$\tilde{B}$ ° and MV ($\tilde{A}$ °-$\tilde{B}$°)
5. Compute the score matrix $S_{((\tilde{A} -\tilde{B}),(\tilde{A} °-\tilde{B}°))}$.
6. Compute the total score S_i for each u_i in U.
7. Find $S_k= \max(S_i)$, then we conclude that the multifarious service rendered by hospitals u_k has the maximum score value between the orphanages.
8. If S_k has more than one value, then go to step(1) and repeat the process by reassessing the parameters with regard to the nature of service.

5. Case Study

Let (F_A,E) and (G_B,E) be two fuzzy soft sets representing the hospitals has the maximum score value between the four hospitals U ={ u_1, u_2, u_3, u_4} respectively.
Let us consider E = { e_1,e $_2$, e_3,e_4} as the set ofparameter for choosing the service rendered to patients by the hospitals.
e_1 is the hospitals having only aged patients.
e_2 is the hospitals having only viral-fever patients.
e_3 is the hospitals aving only small box patients.
e_4 is the hospitals having only pregnant patients[mentally disorder patients].
(F_A,E)= { $F_A(e_1)$={(u_1,0.9,0.0),(u_2,0.7,0.0),(u_3,0.8,0.0),(u_4,0.5,0.0)}
$F_A(e_2)$= {(u_1,0.7,0.0),(u_2,0.4,0.0),(u_2,0.5,0.0),(u_2,0.4,0.0)}
$F_A(e_3)$={(u_1,0.5,0.0),(u_2,0.3,0.0),(u_3,0.7,0.0),(u_4,0.5,0.0)}
$F_A(e_4)$={(u_1,0.6,0.0),(u_2,0.3,0.0),(u_3,0.7,0.0),(u_4,0.1,0.0)}}
(G_B,E)= { $G_B(e_1)$={(u_1,0.7,0.0),(u_2,0.7,0.0),(u_3,0.8,0.0),(u_4,0.6,0.0)}
$G_B(e_2)$={(u_1,0.6,0.0),(u_2,0.3,0.0),(u_3,0.7,0.0),(u_4,0.6,0.0)}
$G_B(e_3)$={(u_1,0.4,0.0),(u_2,0.3,0.0),(u_3,0.8,0.0),(u_4,0.6,0.0)}
$G_B(e_4)$={(u_1,0.5,0.0),(u_2,0.4,0.0),(u_3,0.9,0.0),(u_4,0.6,0.0)}}
These two fuzzy soft sets are represented by the following fuzzy matrices respectively.

$$\tilde{A}° = \begin{pmatrix} (1, 0.9) & (1, 0.7) & (1, 0.5) & (1, 0.6) \\ (1, 0.7) & (1, 0.4) & (1, 0.3) & (1, 0.3) \\ (1, 0.8) & (1, 0.5) & (1, 0.7) & (1, 0.7) \\ (1, 0.5) & (1, 0.4) & (1, 0.5) & (1, 0.1 \end{pmatrix}$$

$$\tilde{B}°= \begin{pmatrix} (1, 0.7) & (1, 0.6) & (1, 0.4) & (1, 0.5) \\ (1, 0.7) & (1, 0.3) & (1, 0.3) & (1, 0.4) \\ (1, 0.8) & (1, 0.7) & (1, 0.8) & (1, 0.9) \\ (1, 0.6) & (1, 0.6) & (1, 0.6) & (1, 0.6) \end{pmatrix}$$

$$\tilde{A}\text{-}\tilde{B} = \begin{pmatrix} (0.7, 0.0) & (0.6, 0.0) & (0.4, 0.0) & (0.5, 0.0) \\ (0.7, 0.0) & (0.3, 0.0) & (0.3, 0.0) & (0.3, 0.0) \\ (0.8, 0.0) & (0.5, 0.0) & (0.7, 0.0) & (0.7, 0.0) \\ (0.5, 0.0) & (0.4, 0.0) & (0.5, 0.0) & (0.1, 0.0) \end{pmatrix}$$

$$MV(\tilde{A}\text{-}\tilde{B}) = \begin{pmatrix} 0.7 & 0.6 & 0.4 & 0.5 \\ 0.7 & 0.3 & 0.3 & 0.3 \\ 0.8 & 0.5 & 0.7 & 0.7 \\ 0.5 & 0.4 & 0.5 & 0.1 \end{pmatrix}$$

$$\tilde{A}°\text{-}\tilde{B}° = \begin{pmatrix} (1, 0.9) & (1, 0.7) & (1, 0.5) & (1, 0.6) \\ (1, 0.7) & (1, 0.4) & (1, 0.3) & (1, 0.4) \\ (1, 0.8) & (1, 0.7) & (1, 0.8) & (1, 0.9) \\ (1, 0.6) & (1, 0.6) & (1, 0.6) & (1, 0.6) \end{pmatrix}$$

$$MV(\tilde{A}^{\circ}\text{-}\tilde{B}^{\circ}) = \begin{pmatrix} 0.1 & 0.3 & 0.5 & 0.4 \\ 0.3 & 0.6 & 0.7 & 0.6 \\ 0.2 & 0.3 & 0.2 & 0.1 \\ 0.4 & 0.4 & 0.4 & 0.4 \end{pmatrix}$$

$$S_{((\tilde{A}\text{-}\tilde{B}),(\tilde{A}^{\circ}\text{-}\tilde{B}^{\circ}))} = \begin{pmatrix} 0.6 & 0.3 & -0.1 & 0.1 \\ 0.4 & -0.3 & -0.4 & -0.3 \\ 0.6 & 0.2 & 0.5 & 0.6 \\ 0.1 & 0.0 & 0.1 & -0.3 \end{pmatrix}$$

Step 6: Total score for the best hospitality service:

$$\begin{pmatrix} S_1 & 0.9 \\ S_2 & -0.6 \\ S_3 & 1.9 \\ S_4 & 0.1 \end{pmatrix}$$

We see that S_3, hospital act as a real refuge to the patients with regard to the nature of service and has the maximum value and thus come to a conclusion that the
hospital u_3 has secured the highest total.

6. Conclusion

In this paper, we have applied the motto of fuzzy soft matrices and complement of fuzzy soft sets in decision making problem. Finally, we attribute our contribution would enhance this study on fuzzy soft sets whether the technology put forth in this paper may emerge a note worthy result in this field.

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