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MEASURES AND DETERMINATIONS OF SANCHEZ'S METHOD OVER DOUBLE-FRAMED FUZZY SOFT SETS

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Abstract:

In our work, we have defined different types of double-framed fuzzy soft matrix. Operations of addition, multiplication and complement of double-framed fuzzy soft matrix are defined with examples. Some related propositions with proof is also worked out. Finally medical diagnosis problems have been solved using double framed fuzzy soft matrix.

Index Terms: Fuzzy Set. Empty Fuzzy Set, Null Double Framed Fuzzy Soft Set, Absolute Fuzzy Soft Set & Dominance Matrix

Introduction:

Aktas and Cagman [1] studied the basic concepts of soft set theory, and compared soft sets to fuzzy and rough sets, providing examples to clarify their differences. They also discussed the notion of soft groups. Cagman and Enginoglu [3] modified the definitions of soft set operations and gave a decision making method called Uni-int decision method. F. Feng, et.al [4] defined the concept of Soft semi rings. A. R. Hadipour [6] defined applications of double-framed soft ideals in BE-algebra. In 1999, Molodtsov introduced soft set theory [12] as an alternative approach to fuzzy set theory [16] defined by Zadeh in 1965. After Molodtsov's study, many researchers have studied on set theoretical approaches an decision making applications of soft sets. For example Majiet.al [10], [11] defined some new operations of soft sets and gave a decision making method on soft sets. Junet.al [7] [8] introduced the notion of double-framed soft sets (briefly, DFS-sets), and applied it to BCK/BCI- algebras. They discussed double-framed soft algebras (briefly, DFS-algebras) and investigated related properties. A. R. Hadipour [6] defined Double-framed soft BF-algebras and Yongukchoet.al [15] studied on double-framed soft Near-rings. This section, briefly reviews the basic characteristics of Fuzzy set, soft set theory and double-framed fuzzy soft sets that are useful for subsequent sections. Before discussing the essence of the medical applications, tackling with the treatment of gastric and prostate cancer patients, we wish to introduce some basic formulations of fuzzy set theory.

2 Preliminaries:

2.1 Definition: [**Fuzzy Set]** If X is a finite universe set, X = {xi, i = 1, ⋯ , n}, then a fuzzy set A in X is defined as a set of ordered pairs A = {(xi, $\mu_A(x_i)$}, i = 1, ..., n, in which the value of $\mu_A(x_i)$ is called the degree of membership of x_i in fuzzy set A and $\mu_A : X \longrightarrow [0, 1]$ is called the membership function mapping X into the unit interval [0, 1] . The support of the fuzzy set A, S(A) is defined as a non-fuzzy set of these elements, which have the membership degrees greater than zero. There are four types of notations used for presenting a fuzzy set A. 1. A is formed as an ordered set of pairs, A = {(xi, μ_A(xi)}, i = 1, ..., n, where xi denotes the element from the set X and μ_A(xi) denotes the degree of the membership of xi in the fuzzy set A.

Example: Let X = " integers between 1 and 10 " = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, then a fuzzy set A, " integers which are close to 5 " can be defined as A = {(1, 0),(2, 0.3),(3, 0.5),(4, 0.7),(5, 1),(6, 0.9),(7, 0.8),(9, 0.3), (10, 0)}. Now we intend to demonstrate some useful definitions concerning fuzzy sets.

2.2 Definition: (Empty Fuzzy Set) A fuzzy set A is said to be empty if all membership degrees assisting xi, i = 1, ..., n, are equal to zero in X. That is, μ_A(xi)=0, xi ∈ X, i = 1, ..., n =⇒ A is empty.

2.3 Definition; Equal fuzzy sets two fuzzy sets A and B are equal, if and only if the membership degree in A is equal to the membership degree in B for each element xi ∈ X. This property can be expressed as A = B ⇐⇒ μ_A(xi) = μ_B(xi), xi ∈ X, i = 1, . . . , n.

2.4 Definition: Complement of a fuzzy set The complement of a fuzzy set A, denoted by A , is defined by the following formula μ_A(xi)=1 − μ_A(xi), xi ∈ X, i = 1, . . . , n.

2.5 Definition: Fuzzy subset A fuzzy set A is said to be a subset of another fuzzy set B if and only if the membership degree in A is equal or less than the membership degree in B for each element xi ∈ X, which is equivalent to A ⊆ B ⇐⇒ μ_A(xi) ≤ μ_B(xi), xi ∈ X, i = 1, . . . , n.

2.6 Definition: A double-framed pair $\langle(\bar{\alpha}, \bar{\beta}) : G\rangle$ is called a double-framed fuzzy soft set (briefly DFFS-set) over U where $\bar{\alpha}$ and $\bar{\lambda}$ are mapping from A to P(U).

Example: Suppose that U = {s1, s2, s3, s4} is a set of students and E ={e1, e2, e3} is a set of parameters, which stand for result, conduct and sports performances respectively. Consider the mapping from parameters set A is subset of E to the set of all double -framed 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 = {e1, e2} then double-framed fuzzy soft set is

(F,A) = {F(e1) = {(s1, 0.8, 0.1), (s2, 0.3, 0.6), (s3, 0.8, 0.2), (s4, 0.9, 0.0)},
F(e2) = {(s1, 0.8, 0.1), (s2, 0.9, 0.1), (s3, 0.4, 0.5), (s4, 0.3, 0.6)}.

For a DFS-set $\langle(\bar{\alpha}, \bar{\lambda}) : G\rangle$ over U and two subsets γ and δ of U, the γ-inclusive set and the δ-exclusive set of $\langle(\bar{\alpha}, \bar{\lambda}) : G\rangle$, denoted by $i_A(\bar{\alpha}; \gamma)$ and $e_A(\bar{\lambda}, \delta)$ respectively, are defined as follows.

$i_A(\bar{\alpha}; \gamma) = \{ x \in A / \gamma \subseteq \bar{\alpha}(x) \}$ and $e_A(\bar{\lambda}, \delta) = \{ x \in A / \delta \subseteq \bar{\lambda}(x) \}$ respectively.

The set $DF_A(\bar{\alpha}, \bar{\lambda})_{(\gamma,\delta)} = \{ x \in A / \gamma \subseteq \bar{\alpha}(x), \delta \subseteq \bar{\lambda}(x) \}$ is called a double framed including set of $< (\bar{\alpha}, \bar{\lambda}) : G >$. It is clear that $DF_A(\bar{\alpha}, \bar{\lambda})_{(\gamma,\delta)} = i_A(\bar{\alpha}; \gamma) \cap e_A(\bar{\lambda}, \delta)$.

From now on, we will take G, as set of parameters, which is a group unless otherwise specified.

Note: Let $\lambda_S = (\overline{\alpha_S}, \overline{\beta_S}, E)$ be a double framed soft set over U. We will say that $\lambda_S(e) = (\overline{\alpha_S}(e), \overline{\beta_S}(e))$ is image of parameter e ∈ E.

2.7 Definition: Let λ_A and $\lambda_B \in DFFS_E(U)$ then,

i. If $\alpha_A(e) = \emptyset$ and $\beta_A(e) = U$ for all $e \in E$, λ_A is said to be a null double-framed soft set, denoted by $\emptyset_b = (\emptyset, U, E)$.

ii. If $\alpha_A(e) = U$ and $\beta_A(e) = \emptyset$ for all $e \in E$, λ_A is said to be an absolute double-framed soft set, denoted by $\emptyset_b = (U, \emptyset, E)$.

iii. λ_A is double-framed soft subset of λ_B, denoted by $\lambda_A \subseteq \lambda_B$, if $\alpha_A(e) \subseteq \alpha_B(e)$ and $\beta_A(e) \supseteq \beta_B(e)$for all $e \in E$.

iv. Double – framed soft union and intersection of λ_A and λ_B, denoted by $(\alpha_A \cup \alpha_B)$: A∪B → P(U) such that $(\alpha_A \cup \alpha_B)(e) = \alpha_A(e) \cup \alpha_B(e)$ and $(\beta_A \cap \beta_B)(e) = \beta_A(e) \cap \beta_B(e)$ for all e ∈ E.
Also$(\alpha_A \cap \alpha_B)$: A∩B → P(U) such that $(\alpha_A \cap \alpha_B)(e) = \alpha_A(e) \cap \alpha_B(e)$ and $(\beta_A \cup \beta_B)(e) = \beta_A(e) \cup \beta_B(e)$ for all e ∈ E.

v. Double – framed soft complement of λ_A is denoted by $\lambda_A{}^C$ and defined by $\lambda_A{}^C$: E→ P (U) × P(U) such that $\lambda_A{}^C(e) = \{(e, \alpha_A(e), \beta_A(e)): e \in E\}$.

3. Double-Framed Fuzzy Soft Matrix:

In this section, we recall some basic notion of double-framed fuzzy soft set theory and double-framed fuzzy soft matrices.

3.1 Definition: Let U be an initial universal set and let E be set of parameters and A⊆ E. Let P (U) denotes the set of all double-framed fuzzy sets of U. A pair (F, A) is called an double-framed fuzzy soft set over U if F is a mapping given by F: A → P (U).

Example: Suppose that there are four people in the universe given by, U = $\{u_1, u_2, u_3, u_4\}$ and E = $\{e_1, e_2, e_3\}$ where e_1 stands for young , e_2 stands for smart, e_3 stands for middle-aged. Suppose that

$$F(e_1)=\left\{\frac{u_1}{(0.5,0.2)}, \frac{u_2}{(0.9,0.1)}, \frac{u_3}{(0.4,0.1)}, \frac{u_4}{(0.0,0.5)}\right\},$$
$$F(e_2) = \left\{\frac{u_1}{(0.3,0.1)}, \frac{u_2}{(0.8,0.2)}, \frac{u_3}{(0.0,0.4)}, \frac{u_4}{(0.5,0.3)}\right\}$$
$$F(e_3) = \left\{\frac{u_1}{(0.4,0.2)}, \frac{u_2}{(0.7,0.3)}, \frac{u_3}{(0.4,0.3)}, \frac{u_4}{(0.6,0.0)}\right\}$$

Thus double-framed fuzzy soft set is a parameterized family of all double-framed fuzzy set of *U* and gives us a approximate description of the object. We may represent the soft set in the following:

U	e_1	e_2	e_3
u_1	(0.5,0.2)	(0.3,0.1)	(0.4,0.2)
u_2	(0.9,0.1)	(0.8,0.2)	(0.7,0.3)
u_3	(0.4,0.1)	(0.0,0.4)	(0.4,0.3)
u_4	(0.0,0.5)	(0.5,0.3)	(0.6,0.0)

3.2 Definition : Let U = {c1, c2, c3, . . . , cm} be the Universal set and E be the set of parameters given by E = {e1, e2, e3 . . . , en}.Let A _ E and (F,A) be a double-framed fuzzy soft set in the fuzzy soft class (U,E).Then double-framed fuzzy soft set (F,A) in a matrix form as $A_{m\times n} = [a_{ij}]$m×n or A = $[a_{ij}]$ i = 1, 2, . . .m,j = 1, 2, 3, . . . , n where

$$a_{ij} = \begin{cases} \alpha_j(c_i), \beta_j(c_i)) \text{ if } e_j \ \varepsilon\ A \\ (0, 1) \text{ if otherwise} \end{cases}$$

$\alpha_j(c_i)$ represents the membership of c_i in the double-framed fuzzy set F(e_j). $\beta_j(c_i)$ represents the non-membership of c_i in the double-framed fuzzy set F(e_j).

Example: Suppose that U = {s1, s2, s3, s4} is a set of students and E = {e1, e2, e3} 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 double-framed 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 = {e1, e2} then double-framed fuzzy soft set is

(F,A) = {F(e1) = {(s1, 0.8, 0.1), (s2, 0.3, 0.6), (s3, 0.8, 0.2), (s4, 0.9, 0.0)},
F(e2) = {(s1, 0.8, 0.1), (s2, 0.9, 0.1), (s3, 0.4, 0.5), (s4, 0.3, 0.6)}}.

We would represent in matrix form as

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

Results:

3.1 Proposition: Let A, B, C ∈ DFFSM m×n. Then the following results hold.

(i) A + B = B + A

(ii) (A + B) + C = A + (B + C)

(iii) A + [0] = A = [0] + A

Proof: (i) Let $A = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]$, $B = [(\alpha_{j2}(c_i), \beta_{j2}(c_i))]$

Now $A + B = [(\max(\alpha_{j1}(c_i), \beta_{j2}(c_i)),(\min(\alpha_{j1}(c_i), \beta_{j2}(c_i)))]$

$= [(\max(\alpha_{j2}(c_i), \alpha_{j1}(c_i)),(\min(\beta_{j2}(c_i), \beta_{j1}(c)))] = B + A$

(ii) Let $A = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]$, $B = [(\alpha_{j2}(c_i), \beta_{j2}(c_i))]$, $C = [(\alpha_{j3}(c_i), \beta_{j3}(c_i))]$

Now $(A + B) + C = [(\max(\alpha_{j1}(c_i), \beta_{j2}(c_i)),(\min(\alpha_{j1}(c_i), \beta_{j2}(c_i)))] + [(\alpha_{j3}(c_i), \beta_{j3}(c_i))] = [(\max(\alpha_{j1}(c_i),(\alpha_{j2}(c_i), \alpha_{j3}(c_i))),(\min(\beta_{j1}(c_i),(\beta_{j2}(c_i), \beta_{j3}(c_i)))] = A + (B + C)$

(iii) Let $A = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]$,Also $[0] = [(\alpha_j (c_i), \beta_j (c_i))]$ so that $\delta(0)_{ij} = 0$, j Now $A + [0] = [(\max(\alpha_{j1}(c_i), \alpha_j (c_i)),(\min(\beta_{j1}(c_i), \beta_j (c_i)))] = [(\alpha_{j1}(c_i), \alpha_j (c_i))] = A$

3.2 Proposition: Let A, B ∈ DFFSMm×n.Then the following result hold.

(i) $(A^T)^T = A$

(ii) (A + B) T = AT + BT

Proof: (i) Let $A = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]$

Now $A^T = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]^T = [(\alpha_{i1}(c_j), \beta_{i1}(c_j))]$

$(A^T)^T = [(\alpha_{i1}(c_j), \beta_{i1}(c_j))]T = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))] = A$

(ii) Let $A = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]$, $B = [(\alpha_{j2}(c_i), \beta_{j2}(c_i))]$

Now $A + B = [(\max(\alpha_{j1}(c_i), \alpha_{j2}(c_i)), \min(\beta_{j1}(c_i), \beta_{j2}(c_i)))]$

$(A + B)^T = [(\max(\alpha_{j1}(c_i), \alpha_{j2}(c_i)), \min(\beta_{j1}(c_i), \beta_{j2}(c_i)))]^T$

$= [(\max(\alpha_{i1}(c_j), \alpha_{i2}(c_j)), \min(\beta_{i1}(c_j), \beta_{i2}(c_j)))] = [(\alpha_{i1}(c_j), \beta_{i1}(c_j))] + [(\alpha_{i2}(c_j), \beta_{i2}(c_j))] = [(\alpha_{j1}(c_i), \beta_{j1}(c_i))]^T + [(\alpha_{j2}(c_i), \beta_{j2}(c_i))] = A^T + B^T$

3.3 Proposition: Let $\tilde{A},\tilde{B},\tilde{C} \in DFFSM_{m\times n}$. 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 $\tilde{A}= [(\alpha_{ij}{}^{A},\beta_{ij}{}^{A})]$, $\tilde{B}= [(\alpha_{ij}{}^{B},\beta_{ij}{}^{B})]$

Now $\tilde{A}-\tilde{B} = [(\min(\alpha_{ij}{}^{A},\beta_{ij}{}^{B}),\max(\alpha_{ij}{}^{A},\beta_{ij}{}^{B})] =[(\min(\alpha_{ij}{}^{B},\alpha_{ij}{}^{A}),\max(\beta_{ij}{}^{B},\beta_{ij}{}^{A})] = \tilde{B} - \tilde{A}$.

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

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

$= [(\min(\alpha_{ij}{}^{A},(\alpha_{ij}{}^{B}, \alpha_{ij}{}^{C})),\max(\beta_{ij}{}^{A},(\beta_{ij}{}^{B}, \beta_{ij}{}^{C}))] = \tilde{A}- (\tilde{B}- \tilde{C})$

4. Double Framed Fuzzy Dominance Soft Matrices:

Analogous to the Sanchez's notion of medical knowledge we form two matrices M1 and M2 as medical knowledge of an double-framed fuzzy soft set (F1, D) and its complement (F1, D) c respectively over S the set of symptoms of diseases, where D represents the set of diseases. Similarly we form two matrices N1 and N2 as medical knowledge of an double-framed fuzzy soft set (F2, S) and its complement (F2, S) c respectively over P the set of symptoms of patients. Then we obtain two matrices T1 and T2 using our definition of product of two double-framed fuzzy soft matrices as T1 = N1M1 and T2 = N2M2. Now find membership value and non membership value matrices. Then comparing the membership value and non membership value individually, the disease of the patient is diagnosed.

4.1 Algorithm Approach in Medical Diagnosis:

1. Input the double-framed fuzzy soft set (F1, D) and find $(F1, D)^c$ .Also find the corresponding matrices M_1 and M_2.
2. Input the double-framed fuzzy soft set (F2, S) and find $(F2, S)^c$ .Also find the corresponding matrices N_1 and N_2.
3. Find $T_1 = N_1M_1$ and $T_2 = N_2M_2$.
4. Find the membership value and non membership value matrices $T_{\mu}1$ and $T_{\nu}1$ of T_1 and $T_{\mu}2$ and $T_{\nu}2$ of T_2.
5. Compare the membership value and non membership value of T_1 and T_2 individually.

5. Case Study:

Consider three patients p1, p2 and p3 admitted in a hospital with symptoms of headache, heart- attack, abdominal pain and vomiting. Suppose possible diseases with these symptoms be jaundice and typhoid. Let e1, e2, e3 and e4 represents the symptoms headache, heart-attack, abdominal pain and vomiting respectively. Let d1 and d2 represents the diseases jaundice and typhoid respectively. Let S = e1, e2, e3, e4 and D = d1, d2 be the parameter set representing the symptoms and diseases respectively. Also let P = p1, p2, p3 be the set of patient. Let (F1, D) be an double-framed fuzzy soft sets over S, where F1 is a mapping F1 : D → Ff1(S), gives an approximate description of double-framed fuzzy soft medical knowledge of the two diseases and their symptoms.

(F1, D) = {F1(d1) = {(e1, 0.45, 0.50),(e2, 0.20, 0.75),(e3, 0.90, 0.03),(e4, 0.85, 0.05)} F1(d2) = {(e1, 0.65, 0.25),(e2, 0.95, 0.01),(e3, 0.15, 0.85),(e4, 0.03, 0.80)}

Now (F1, D) c = {F c 1 (d1) = {(e1, 0.50, 0.45),(e2, 0.75, 0.20),(e3, 0.03, 0.90),(e4, 0.05, 0.85)} F c 1 (d2) = {(e1, 0.25, 0.65),(e2, 0.01, 0.95),(e3, 0.85, 0.15),(e4, 0.80, 0.03)} (4.4) This set represents the complement of the double-framed fuzzy soft set (F1, D). Now we will represent the double-framed fuzzy soft set (F1, D) and (F1, D) c by the matrices M1 and M2 as follows

$$M1 = \begin{pmatrix} (0.45, 0.50) & (0.65, 0.25) \\ (0.20, 0.75) & (0.95, 0.01) \\ (0.90, 0.03) & (0.15, 0.85) \\ (0.85, 0.05) & (0.03, 0.80) \end{pmatrix} \text{ and}$$

$$M2 = \begin{pmatrix} (0.50,0.45) & (0.25,0.65) \\ (0.75, 0.20) & (0.01, 0.95) \\ (0.03, 0.90) & (0.85, 0.15) \\ (0.05, 0.85) & (0.80, 0.03) \end{pmatrix}$$

Again let us consider another double-framed fuzzy soft set (F2, S) over P, where F2 : S → Ff2(P), gives an approximate description of double-framed fuzzy soft medical knowledge of the symptoms in patients. (F2, S) = {F2(e1) = {(p1, 0.80, 0.15),(p2, 0.20, 0.75),(p3, 0.90, 0.09)} F1(e2) = {(p1, 0.86, 0.10),(p2, 0.05, 0.70),(p3, 0.73, 0.14)} F1(e3) = {(p1, 0.07, 0.67),(p2, 0.86, 0.05),(p3, 0.10, 0.78)} F1(e4) = {(p1, 0.06, 0.75),(p2, 0.50, 0.15),(p3, 0.03, 0.80)})

Now (F2, S) c = {F c 2 (e1) = {(p1, 0.15, 0.80),(p2, 0.75, 0.20),(p3, 0.09, 0.90)} F c 1 (e2) = {(p1, 0.10, 0.86),(p2, 0.70, 0.05),(p3, 0.14, 0.73)} F c 1 (e3) = {(p1, 0.67, 0.07),(p2, 0.05, 0.86),(p3, 0.78, 0.10)} F c 1 (e4) = {(p1, 0.75, 0.06),(p2, 0.15, 0.50),(p3, 0.80, 0.03)} This set represents the complement of the double-framed fuzzy soft set (F2, S). Now we will represent the double-framed fuzzy soft set (F2, S) and (F2, S) c by the matrices N1 and N2 as follows.

$$N1 = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} (0.80, 0.15) & (0.86, 0.10) & (0.07, 0.67) & (0.06, 0.75) \\ (0.20, 0.75) & (0.05, 0.70) & (0.86, 0.05) & (0.50, 0.15) \\ (0.90, 0.09) & (0.73, 0.14) & (0.10, 0.78) & (0.03, 0.80) \end{pmatrix} \quad \text{and}$$

$$N2 = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} (0.15, 0.80) & (0.10, 0.86) & (0.67, 0.07) & (0.75, 0.06) \\ (0.75, 0.20) & (0.70, 0.05) & (0.05, 0.86) & (0.15, 0.50) \\ (0.09, 0.90) & (0.14, 0.73) & (0.78, 0.10) & (0.80, 0.03) \end{pmatrix}.$$

Therefore the product matrices T1 and T2 are

$$T1 = N1M1 \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} (0.45, 0.50) & (0.86, 0.10) \\ (0.86, 0.05) & (0.20,0.70) \\ (0.45, 0.50) & (0.73, 0.14) \end{pmatrix} \quad \text{and}$$

$$T2 = N2M2 \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} (0.30, 0.80) & (0.75, 0.15) \\ (0.70, 0.20) & (0.25, 0.50) \\ (0.30, 0.73) & (0.80, 0.03) \end{pmatrix}$$

Now we find the membership value matrix and non membership value matrix T μ 1 and T ν 1 respectively of the product matrix T1

$$T^{\mu}{}_{1} = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} 0.45 & 0.86 \\ 0.86 & 0.20 \\ 0.45 & 0.73 \end{pmatrix} \text{ and}$$

$$T\nu 1 = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} 0.50 & 0.10 \\ 0.05 & 0.70 \\ 0.50 & 0.14. \end{pmatrix}$$

We observe that T μ 1 (d1) ≤ T μ 1 (d2) for patients p1 and p3 and T μ 1 (d1) ≥ T μ 1 (d2) for patients p2 and T ν 1 (d1) ≥ T ν 1 (d2) for patients p1 and p3 and T ν 1 (d1) ≤ T ν 1 (d2) for patients p2.

The inference that we have drawn is that patients p1 and p3 is more likely to be suffering from disease d1 i.e. jaundice and patient p2 is more likely to be suffering from disease d2 i.e. typhoid. Again we find the membership value matrix and non membership value matrix T μ 2 and T ν 2 respectively of the product matrix T2.

$$T\mu 2 = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} 0.30 & 0.75 \\ 0.70 & 0.25 \\ 0.30 & 0.80 \end{pmatrix} \text{and}$$

$$T\nu 2 = \begin{array}{c} p1 \\ p2 \\ p3 \end{array} \begin{pmatrix} 0.80 & 0.15 \\ 0.20 & 0.50 \\ 0.73 & 0.03 \end{pmatrix}.$$

We observe that T μ 2 (d1) ≤ T μ 2 (d2) for patients p1 and p3 and T μ 2 (d1) ≥ T μ 2 (d2) for patients p2 and T ν 2 (d1) ≥ T ν 2 (d2) for patients p1and p3and T ν 1 (d1) ≤ T ν 1 (d2) for patients p2.

The inference that we have drawn is that patients p1 and p3 is more likely to be suffering from disease d1 i.e. jaundice and patient p2 is more likely to be suffering from disease d2 i.e. typhoid. Thus by using product of matrix representation of double-framed fuzzy soft set and matrix representation of complement of the same double-framed fuzzy soft set we get the same results i.e. patient p1 and p3 is more likely to be suffering from disease jaundice and patient p2 is more likely to be suffering from disease typhoid.

Conclusion:

In our work we have defined different types of double-framed fuzzy soft matrix. Operations of addition, multiplication and complement of double-framed fuzzy soft matrix are defined with examples. Some related propositions with proof is also worked out. Further our work is supported by a decision making problem in medical diagnosis.

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