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An Application of Fuzzy Soft Matrix in Medical Diagnosis

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Abstract:*In this paper, tuberculosis related diseases and its symptoms are discussed and the different kinds of affected patients are analyzed using fuzzy soft matrices based on reference function.*

Keywords:*Soft Set, Fuzzy Soft Set (FSS), Fuzzy Soft Matrices (FSM), Complement, Product of Fuzzy SoftMatrices.*

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I. Introduction

FuzzySoft set theory is a generalization of soft set theory that was proposed by Molodtsov in 1999 to deal with uncertainty in a parametric manner. The most important steps for the new theory of soft sets was to define mapping on soft sets, which was achieved in 2009 by AtharKharal and Bashir Ahmed, soft sets have also applied to the problem of medical diagnosis for use in medical expert systems. Fuzzy soft sets have also been introduced by Kharal and Ahmed. The matrix representation of a fuzzy soft set (Yong Yang and chen liji,2011) was successfully applied to the proposed notion of fuzzy soft matrix in certain decision making problems.

In this paper we proposed fuzzy soft matrix theory and also extended our approach with regard to fuzzy soft matrices based on reference function in medical diagnosis.

Tuberculosis is an infectious disease that usually affects the lungs. Compared with other diseases caused by a single infectious agent, tuberculosis is the second biggest killer, globally. The world health organization estimates that 9 million people a year get sick with TB. It is among top 3 causes of death for women aged 5 to 44.It is an airborne pathogen

Latent TB :

Latent TB occurs when a person has being TB Bacteria within their body, but the bacteria are presenting very small numbers. They are kept control by the body's immune system and do not cause any symptoms and are not contagious, but they can become active.

Active TB :

The bacteria do cause symptoms and can be transmitted to others. This condition makes you sick and can spread to others. It can occur in the first few weeks after infection with the TB bacteria or it might occur years later.

II. Preliminaries

In this section, we recall some basic essential notion of fuzzy soft set and defined different types of fuzzy softset.

A. Soft Set

Let U be an initial universal set and E be a set of parameters. Let P(U) denotes the power set of U. Let $A \subseteq E$. A pair (F_A, E) is called a soft set over U, where $F_A$is a mapping given by $F_A: E \rightarrow P(U)$ there exists $F_A(e) = \phi$ is $e \notin$Here $F_A$is called approximate function of the soft set (F_A, E). The set $F_A(e)$ is called e-approximate value set which consists of related objects of the parameter $e \in E$. In other words, a soft set over U is a parameterized family of subsets of the universe U.

Example 2.1

Let U = $\{u_1,u_2,u_3,u_4\}$ be a set of four varieties of woods and E={High Quality (e_1),Medium Quality(e_2), Low Quality (e_3)}be the set of parameters ,if A = $\{e_1,e_2\}\subseteq E$. Let $F_a(e_1)=\{u_1,u_2,u_3,u_4\}$ and $F_a(e_2)=\{u_1,u_2,u_3\}$.Then we write the soft set (F_a, E) = $\{(e_1,\{u_1,u_2,u_3,u_4\}),(e_2,\{u_1,u_2,u_3\})\}$ over U which describes "the Quality of woods" which Mr .X is going to buy.
We may represent the soft set in the following form.

Table 2.1.1

U	HighQuality(e_1)	Medium Quality(e_2)	LowQuality(e_3)
u_1	1	0	0
u_2	1	1	0
u_3	1	1	0
u_4	1	1	0

B. Fuzzy Soft Set

Let U be an initial universal set and E be a set of parameters. Let A⊆E. A Pair ($\tilde{F}_A$, E) is called a fuzzy soft set (FSS) over U, where $\tilde{F}_A$ is a mapping given by $\tilde{F}_A$:E→ I^U, where I^U denotes the collection of all fuzzy subsets of U.

Example 2.2

Consider the example 2.1, here we cannot express with only two real numbers 0 and 1, we can characterized it be a membership function instead on crisp number 0 and 1, which associate with each element a real number in the interval [0,1]. Then

$$(F_A, E) = \begin{Bmatrix} \widetilde{F}_A(e_1) = \{(u_1, 0.6), (u_2, 0.4), (u_3, 0.3). (u_4, 0.2)\} \\ \widetilde{F}_A(e_1) = \{(u_2, 0.5), (u_3, 0.2), (u_4, 0.1)\} \end{Bmatrix}$$

isthe fuzzy soft set representing the "Quality of woods" which Mr.X is going to buy. We may represent the fuzzy soft set in the following form.

Table 2.2.2

U	HighQuality (e_1)	MediumQuality (e_2)	LowQuality (e_3)
u_1	0.6	0.0	0.0
u_2	0.4	0.5	0.0
u_3	0.3	0.2	0.0
u_4	0.2	0.1	0.0

C. Fuzzy Soft Class

Let U be an initial universal set and E be a 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.

D. Fuzzy Soft Sub Set

For two fuzzy soft sets ($\tilde{F}_A$, E) and ($\tilde{G}_B$, E) over a common universal U, We have ($\tilde{F}_A$,E)⊆($\tilde{G}_B$, E) if A ⊂Band ∀e ∈A, $\tilde{F}_A$(e) is a fuzzy subset of $\tilde{G}_B$(e),i.e.,($\tilde{F}_A$, E) is a fuzzy soft subset of ($\tilde{G}_B$, E).

E. Fuzzy Soft Complement Set

The complement of fuzzy soft sets ($\tilde{F}_A$, E) denoted by $(\widetilde{F}_A, E)^0$ is defined by $(\widetilde{F}_A, E)^0 = (\tilde{F}_A^0, E)$where $\tilde{F}_A^0: E \rightarrow I^0$ is a mapping given by $\tilde{F}_A^0(e) = [\widetilde{F}_A(e)]^0$, ∀e ∈ E.

F. Fuzzy Soft Null Set

A fuzzy soft sets ($\tilde{F}_A$, E) over U is set to be null fuzzy soft set with respect to the parameters set E, denoted by ϕ, if $\widetilde{F}_A(e) = \phi$,∀e ∈E.

III. Fuzzy Soft Matrices Based On Reference Function

In this section, we introduce the notion of fuzzy soft matrices with difficult types based on reference function.

A. Fuzzy Soft Matrices

Let U={u_1,u_2,u_3,…,u_m}be the universal set and E be the set of parameters given by E={e_1,e_2,e_3,…,e_n}.Then the fuzzy soft set $(\widetilde{F}_A, E)$can be expressed in matrix form as $\tilde{A} = \left[a_{ij}{}^{\tilde{A}}\right]_{mXn}$ or simply by $\left[a_{ij}{}^{\tilde{A}}\right]$, i = 1,2,3,….m;j = 1,2,3,…n and $\left[a_{ij}{}^{\tilde{A}}\right] = \left[\left(\mu_{ij}{}^{\tilde{A}}, \gamma_{ij}{}^{\tilde{A}}\right)\right]$ where $\mu_{ij}{}^{\tilde{A}}$ and $\gamma_{ij}{}^{\tilde{A}}$ represent the fuzzy membership function and fuzzy reference function respectively of value of u_i in the fuzzy set $\widetilde{F}_A(e_j)$ so that $\phi_{ij}{}^{\tilde{A}} = \mu_{ij}{}^{\tilde{A}} - \gamma_{ij}{}^{\tilde{A}}$giives the fuzzy membership values of u_i. We shall identify a fuzzy soft set with its fuzzy soft matrix and use these two concepts inter changeable. The set of all m×n fuzzy soft matrices over U will be denoted by $FSM_{m\times n}$.For usual fuzzy sets with fuzzy reference function 0, it is obvious to see that $a_{ij}{}^{\tilde{A}} = [(\mu_{ij}{}^{\tilde{A}},0)], \forall i, j$.

Example 3.1

Let U = {u_1,u_2,u_3} 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 $(\widetilde{F}_{A,}E) = \begin{Bmatrix} \widetilde{F}_A(e_1) = \{(u_1, 0.8,0), (u_2, 0.6,0), (u_3, 0.3.0)\} \\ \widetilde{F}_A(e_2) = \{(u_1, 0.6,0), (u_2, 0.4,0), (u_3, 0.2,0)\} \\ \widetilde{F}_A(e_3) = \{(u_1, 0.5,0), (u_2, 0.3,0), (u_3, 0.2,0)\} \end{Bmatrix}$

We would represent this fuzzy soft set in matrix form

$$\left[a_{ij}{}^{\tilde{A}}\right] = \begin{vmatrix} (0.8,0) & (0.6,0) & (0.3.0) \\ (0.6,0) & (0.4,0) & (0.2,0) \\ (0.5,0) & (0.3,0) & (0.2,0) \end{vmatrix}_{3X3}$$

B. Mebership Valuematrix

The membership value matrix corresponding to the matrix $\tilde{A}$ as MV $(\tilde{A}) = \left[a_{ij}{}^{\lambda}\right]_{mXn}$ where $\delta_{ij}{}^{\lambda} = \mu_{ij}{}^{\tilde{A}} - \gamma_{ij}{}^{\tilde{A}}$,∀ i = 1,2,3,….m;j = 1,2,3,…n, where $\mu_{ij}{}^{\tilde{A}}$ and $\gamma_{ij}{}^{\tilde{A}}$ represent the fuzzy membership function and the fuzzy reference function respectively of u_i in the fuzzy set $\widetilde{F}_A(e_j)$.

C. Zero Fuzzy Soft Matrix

Let $\widetilde{\mathbf{A}} = \left[\mathbf{a_{ij}}^{\widetilde{\mathbf{A}}}\right]_{\mathbf{mXn}} \in FSM_{mxn}$, where $a_{ij}{}^{\widetilde{A}} = (\boldsymbol{\mu_{ij}}^{\widetilde{\mathbf{A}}}, \boldsymbol{\gamma_{ij}}^{\widetilde{\mathbf{A}}})$;Then $\widetilde{\mathbf{A}}$ is called a fuzzy soft zero matrix denotedby$(\tilde{1})$, if $\delta_{\mathbf{ij}}{}^{\widetilde{\mathbf{A}}} = 0$ be all i and j for usual fuzzy sets , $\delta_{ij}{}^{\widetilde{A}} = \gamma_{ij}{}^{\widetilde{A}}$¥ i,j.

D. Identity Fuzzy Soft Matrix

Let $\widetilde{\mathbf{A}} = \left[a_{ij}{}^{\widetilde{A}}\right]_{mXn} \in FSM_{mXn}$, where $a_{ij}{}^{\widetilde{A}} = (\boldsymbol{\mu_{ij}}^{\widetilde{\mathbf{A}}}, \boldsymbol{\gamma_{ij}}^{\widetilde{\mathbf{A}}})$;Then $\widetilde{\mathbf{A}}$ is called a fuzzy soft identity matrix denoted by $(\tilde{1})$, if $\mathbf{m} = \mathbf{n}$,$a_{ij}{}^{\widetilde{A}} = (\boldsymbol{\mu_{ij}}^{\widetilde{\mathbf{A}}}, \boldsymbol{\gamma_{ij}}^{\widetilde{\mathbf{A}}}$ for all i ≠ j and $a_{ij}{}^{\widetilde{A}}$ = (0, 1) i.e., $a_{ij}{}^{\widetilde{A}}$ = 1¥ i,j.

E. Compliment of Fuzzy Soft Matrices

Let $\widetilde{A} = \left[(a_{ij}{}^{\widetilde{A}}, 0)\right]_{mXn} \in FSM_{m\,x\,n}$, where $a_{ij}{}^{\widetilde{A}} = (\mu_{ij}{}^{\widetilde{A}}, \gamma_{ij}{}^{\widetilde{A}})$, the representation of the complement of the fuzzy matrix Then $\widetilde{A}$which is denoted by$\widetilde{A}^0$ and then $\widetilde{A}^0$ is called fuzzy soft complement matrix if $\widetilde{A}^0 = \left[1, a_{ij}{}^{\widetilde{A}}\right]_{mXn}$ $forall\, a_{ij}{}^{\widetilde{A}} \in$ [0,1]. Then the matrix obtained from so called membership value would be the following $\widetilde{A}^0 = \left[a_{ij}{}^{\widetilde{A}}\right] = \left[\left(1 - a_{ij}{}^{\widetilde{A}}\right)\right]$ for i and j.

F. Product Of Fuzzy Softmatrices

Let $\tilde{A} = \left[a_{ij}{}^{\tilde{A}}\right]_{mXn} \in FSM_{mxn}$, where $a_{ij}{}^{\tilde{A}} = (\mu_{ij}{}^{\tilde{A}}, \gamma_{ij}{}^{\tilde{A}})$; where $\mu_{ij}{}^{\tilde{A}}$and $\gamma_{ij}{}^{\tilde{A}}$ represent the fuzzy membership functionand fuzzy reference function respectively of $u_{i,}$ so that $\delta_{ij}{}^{\lambda} = \mu_{ij}{}^{\tilde{A}} - \gamma_{ij}{}^{\tilde{A}}$gives the fuzzymembership value of $u_{i.}$. Also let $\tilde{B} = \left[b_{ij}{}^{\tilde{B}}\right]_{nXp}$ where $b_{ij}{}^{\tilde{B}} = (\mu_{jk}{}^{\tilde{B}}, \gamma_{jk}{}^{\tilde{B}})$, where $\mu_{jk}{}^{\tilde{B}} and \gamma_{jk}{}^{\tilde{B}}$ represents fuzzy member function and fuzzy reference function of ui. We now define $\tilde{A}$ and $\tilde{B}$ as

$$\tilde{A}.\tilde{B} = \left[d_{ik}{}^{\tilde{A}\tilde{B}}\right]_{mxp} = \begin{bmatrix} \max\min(\mu_{jk}{}^{\tilde{A}}, \gamma_{jk}{}^{\tilde{B}}), \\ \min max\,(\mu_{jk}{}^{\tilde{A}}, \gamma_{jk}{}^{\tilde{B}}) \end{bmatrix}, 1 \le i \le m,\ 1 \le k \le p \text{ for } j = 1,2,\ldots,n$$

IV. Application of Fsm In Medicaldiagnosis

In this section, we are put forwarding the problem which is based upon FSM in Medical diagnosis.

A. Fuzzy Soft Matrices in Medicaldiagnosis

Let us assume S is the set of types of some effects of tuberculosis D is the side effects related to these types and P is the set of Patients havingthe types of TB present in these set S. We construct a fuzzy soft set $(\widetilde{F}_A, D)$ over S. A relation matrix$\tilde{\tilde{A}}$is obtained from the fuzzy soft set $(\widetilde{F}_A, ,D)$. We would name the matrix as symptom disease matrix. Similarly its complement $(\widetilde{F}_A, D)^0$ gives another relation matrix $\tilde{A}^0$ called symptom disease matrix we call the matrices $\tilde{A}$and $\tilde{A}^0$ as medical knowledge of fuzzy soft testfurther we construct another fuzzy soft set $(\widetilde{F}_A, ,S)$over P. This fuzzy soft set gives the relation matrix $\tilde{B}$ called patient symptom disease matrix and its complement $(\widetilde{F}_A, S)^0$ gives the relation matrix $\tilde{B}^0$ called patient non- symptom disease matrix. Then using definition 3.6 above, we obtain two new relation matrices $\tilde{T}_1 = \tilde{B}\tilde{A} and \tilde{T}_2 = \tilde{B}\tilde{A}^0$ called Patient symptom disease matrix and patient non symptom disease matrixrespectively. In a similar manner, we obtain the relation matrices $\tilde{T}_3 = \tilde{B}^0\,\tilde{\tilde{A}}and\tilde{T}_4 = \tilde{B}^0\,\tilde{A}^0$ called the patient symptom non disease matrix and patient non symptom non disease matrix respectively.

$$\text{Now} \quad \left.\begin{aligned} \tilde{T}_1 &= \tilde{B}\tilde{A},\ \tilde{T}_2 = \tilde{B}\tilde{A}^0 \\ \tilde{T}_3 &= \tilde{B}^0\,\tilde{\tilde{A}},\ \tilde{T}_4 = \tilde{B}^0\,\tilde{A}^0 \end{aligned}\right\}$$

Using definition 3.1 we may obtain the corresponding membership value matrices $MV(\tilde{T}_1)$, $MV(\tilde{T}_2)$, $MV(\tilde{T}_3)$ and $MV(\tilde{T}_4)$. We calculate the diagnosis scores $S\tilde{T}_1$and $S\tilde{T}_2$for and against the disease respectively

$$S\tilde{T}_1 = \left[Y(\tilde{T}_1)_{IJ}\right]_{mXn}$$

$$\text{Where} \quad Y(\tilde{T}_1)_{IJ} = \delta(\tilde{T}_1)_{IJ} - \delta(\tilde{T}_3)_{IJ}$$

$$S\tilde{T}_2 = \left[Y(\tilde{T}_2)_{IJ}\right]_{mXn}$$

$$\text{Where} \quad Y(\tilde{T}_2)_{IJ} = \delta(\tilde{T}_2)_{IJ} - \delta(\tilde{T}_4)_{IJ}$$

Now if max $\left[S\tilde{T}_1(p_i d_j) - S\tilde{T}_2(p_i d_j)\right]$occurs for exactly $(p_{i,} d_k)$ only, then we would be in a position to accept that diagnosis hypothesis for patient p_i is the diseased_k. In case there is a tie, the process is repeated for patient $p_i$by reassessing the symptom.

V. Algorithm

1. Input the fuzzy soft set$(\widetilde{F}_A, ,D)$and compute $(\widetilde{F}_A, D)^0$ compute the corresponding matrices $\tilde{A}$and $\tilde{A}^0$
2. Input the fuzzy softest$(\widetilde{F}_B, ,S)$and compute $(\widetilde{F}_B, S)^0$,compute the corresponding matrices $\tilde{B}$and $\tilde{B}^0$
3. Compute $\tilde{T}_1, \tilde{T}_2, \tilde{T}_3, \tilde{T}_4$
4. Compute $MV(\tilde{T}_1)$, $MV(\tilde{T}_2)$, $MV(\tilde{T}_3)$and $MV(\tilde{T}_4)$.
5. Compute $S\tilde{T}_1$and $S\tilde{T}_2$
6. Find S_k = max $\left[S\tilde{T}_1(p_i d_j) - S\tilde{T}_2(p_i d_j)\right]$. We conclude that patientp_i is suffering from the diseased_k.
7. If $S_k$has more than one value, then go to step (1) and repeat the process by reassessing the symptoms for the patient.

VI. Case Study

Suppose that there are the three patients $p_{1,}p_2, p_3$admitted in a hospital who affect the tuberculosis disease. We consider the set S = {e_1,e_2,e_3} as a universal set where e_1, e_2 and e_3 represent the symptoms of Coughing up blood, unintentional weight loss, fatigue, loss of appetite respectively and the set D = {d_1,d_2}, where d_1 and d_2 represent the parameters of side effect in the human body of Latent TB and Active TB

Step 1

Let the fuzzy soft set $(\widetilde{F}_A, ,D)$over S, where $\widetilde{F}_A$is a mapping $\widetilde{F}_A$:D→$\widetilde{F}$(S) gives an appropriated ascription of fuzzy soft Medical knowledge of the side effect diseases and their symptoms appeared due to tuberculosis.

$$\text{Let } (\widetilde{F}_A, ,D) = \left\{\begin{matrix} \widetilde{F}_A(d_1) = \{(e_1, 0.4,0), (e_2, 0.5,0), (e_3, 0.2,0)\} \\ \widetilde{F}_A(d_2) = \{(e_1, 0.7,0), (e_2, 0.6,0), (e_3, 0.8,0)\} \end{matrix}\right\}$$

Compliment of $(\widetilde{F}_A, ,D)$ i.e.,$(\widetilde{F}_A, D)^0$ is given by

$$(\widetilde{F}_A, D)^0 = \left\{\begin{matrix} \widetilde{F}_A(d_1) = \{(e_1, 1,0.4), (e_2, 1, 0.5), (e_3, 1, 0.2)\} \\ \widetilde{F}_A(d_2) = \{(e_1, 1,0.7), (e_2, 1,0.6), (e_3, 1, 0.8)\} \end{matrix}\right\}$$

Werepresent the fuzzy soft sets $(\widetilde{F}_A, ,D)$ and $(\widetilde{F}_A, D)^0$by the following matrices $\tilde{A}$and $\tilde{A}^0$ respectively

$$d_1 \quad d_2$$

$$\tilde{A} = \begin{array}{cc} \begin{array}{c} e_1 \\ e_2 \\ e_3 \end{array} & \begin{bmatrix} 0.4,0 & 0.7,0 \\ 0.5,0 & 0.6,0 \\ 0.2,0 & 0.8,0 \end{bmatrix} \\ & \begin{array}{cc} d_1 & d_2 \end{array} \end{array}$$

and $\tilde{A}^0 = \begin{array}{cc} \begin{array}{c} e_1 \\ e_2 \\ e_3 \end{array} & \begin{bmatrix} 1,0.4 & 1,0.7 \\ 1,0.5 & 1,0.6 \\ 1,0.2 & 1,0.8 \end{bmatrix} \end{array}$

Step 2

Again we take P = ($P_1P_2P_3$) as the universal set where P_1, P_2 and P_3 represent three Patients respectively and S = {e_1, e_2, e_3} as the set of parameters where e_1, e_2 and e_3 represent the symptoms of side effect diseases.

Let $(\widetilde{F}_B, ,S)$ fuzzy soft set, where $\widetilde{F}_B$ is a mapping $\widetilde{F}_B : S \rightarrow \widetilde{F}(P)$ gives a collection of an appropriate description of the patient side effect symptoms in the hospital.

$$\text{Let } (\widetilde{F}_B, ,S) = \begin{Bmatrix} \widetilde{F}_B(e_1) = \{(p_1, 0.1,0), (p_2, 0.7,0), (p_3, 0.6,0)\} \\ \widetilde{F}_B(e_2) = \{(p_1, 0.5,0), (p_2, 0.4,0), (p_3, 0.8,0)\} \\ \widetilde{F}_B(e_3) = \{(p_1, ,0.6,0), (p_2, 0.5,0), (p_3, 0.2,0)\} \end{Bmatrix}$$

We note the fuzzy soft set $(\widetilde{F}_B, ,S)$ by the following matrix $\tilde{B}$ patient symptom matrix

$$\tilde{B} = \begin{array}{cc} & \begin{array}{ccc} e_1 & e_2 & e_3 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 0.1,0 & 0.5,0 & 0.6,0 \\ 0.7,0 & 0.4,0 & 0.5,0 \\ 0.6,0 & 0.8,0 & 0.2,0 \end{bmatrix} \end{array}$$

Compliment of $(\widetilde{F}_B, ,S)$ i.e., $(\widetilde{F}_B, S)^0$ is given by

$$(\widetilde{F}_B, S)^0 = \begin{Bmatrix} \widetilde{F}_B(e_1) = \{(p_1, 1, 0.1), (p_2, 1, 0.7), (p_3, 1, 0.6)\} \\ \widetilde{F}_B(e_2) = \{(p_1, 1, 0.5), (p_2, 1, 0.4), (p_3, 1, 0.8)\} \\ \widetilde{F}_B(e_3) = \{(p_1, 1, 0.6), (p_2, 1, 0.5), (p_3, 1, 0.2)\} \end{Bmatrix}$$

and $\tilde{B}^0 = \begin{array}{cc} & \begin{array}{ccc} e_1 & e_2 & e_3 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 1, 0.1 & 1, 0.5 & 1, 0.6 \\ 1, 0.7 & 1, 0.4 & 1, 0.5 \\ 1, 0.6 & 1, 0.8 & 1, 0.2 \end{bmatrix} \end{array}$

Step 3 and step 4

Thus we have

$$\tilde{T}_1 = \tilde{B}.\tilde{A} = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} e_1 \\ e_2 \\ e_3 \end{array} & \begin{bmatrix} 0.5,0 & 0.8,0 \\ 0.5,0 & 0.7,0 \\ 0.5,0 & 0.8,0 \end{bmatrix} \end{array}$$

$$\tilde{T}_2 = \tilde{B}.\tilde{A}^0 = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} e_1 \\ e_2 \\ e_3 \end{array} & \begin{bmatrix} 0.5,0.2 & 0.6,0.6 \\ 0.7,0.2 & 0.6,0.6 \\ 0.2,0.2 & 0.8,0.6 \end{bmatrix} \end{array}$$

We have the following membership value matrices MV ($\tilde{T}_1$) and MV ($\tilde{T}_2$)

$$\text{MV}(\tilde{T}_1) = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 0.5 & 0.8 \\ 0.5 & 0.7 \\ 0.5 & 0.8 \end{bmatrix} \end{array}$$

$$\text{MV}(\tilde{T}_2) = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 0.3 & 0.0 \\ 0.5 & 0.0 \\ 0.0 & 0.2 \end{bmatrix} \end{array}$$

$$\tilde{T}_3 = \tilde{B}^0 .\tilde{A} = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 0.5,0.1 & 0.8,0.1 \\ 0.5,0.4 & 0.8,0.4 \\ 0.5,0.2 & 0.8,0.2 \end{bmatrix} \end{array}$$

$$\tilde{T}_4 = \tilde{B}^0 .\tilde{A}^0 = \begin{array}{cc} & \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{array}{c} p_1 \\ p_2 \\ p_3 \end{array} & \begin{bmatrix} 1,0.2 & 1,0.6 \\ 1,0.4 & 1,0.6 \\ 1,0.2 & 1,0.6 \end{bmatrix} \end{array}$$

We have the following membership value matrices MV ($\tilde{T}_3$) and MV ($\tilde{T}_4$)

$$\text{MV}(\tilde{T}_3) = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} 0.4 & 0.7 \\ 0.1 & 0.4 \\ 0.3 & 0.6 \end{bmatrix} \end{array}$$

$$\text{MV}(\tilde{T}_4) = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} 0.8 & 0.4 \\ 0.6 & 0.4 \\ 0.8 & 0.4 \end{bmatrix} \end{array}$$

We conclude the diagnosis score $S_{\tilde{T}_1}$ and $S_{\tilde{T}_2}$ for and against the diseases as below

$$S_{\tilde{T}_1} = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} 0.0 & 0.1 \\ 0.0 & 0.3 \\ 0.0 & 0.2 \end{bmatrix} \end{array}$$

And

$$S_{\tilde{T}_2} = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} -0.5 & -0.4 \\ -0.1 & -0.4 \\ -0.8 & -0.2 \end{bmatrix} \end{array}$$

Now, we have the difference for and against the diseases

$S_{\tilde{T}_1}$ - $S_{\tilde{T}_2}$	d_1	d_2	Maximum Value
P_1	0.5	0.5	0.5
P_2	0.1	0.7	0.7
P_3	0.8	0.4	0.8

P_1,$P_3$is suffering Latent TB and P_2 suffering Active TB

VII. Conclusion

In this paper we elucidate the theory fuzzy soft matrices in the field of medical diagnosis. We enhance some new concepts such as complement of fuzzy soft matrix based on reference function. The TB affected patients should be given awareness of how it has affected the body. Awareness programs should be set up to prevent the spread of this disease. 50 patients data has been collected and the above relation is formed with that. But for the purpose of understanding it is explained with 3 patients data which can be done the same way for hundreds of data also. In the above result most of the people affected Latent TB.

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