

An Analysis of Diabetes Using Fuzzy Soft Matrix

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ABSTRACT: In this paper, Diabetic related diseases and its symptoms are discussed and the different kinds of affected patients are analysed using fuzzy soft matrices based on reference function.

KEYWORDS: Soft Set, Fuzzy Soft Set (FSS), Fuzzy Soft Matrices (FSM), Complement, Product of Fuzzy Soft Matrices.

I. INTRODUCTION

The concept of fuzzy set theory was introduced (Zadeh 1965). Fuzzy soft set theory was explained (Molodtsov) 1999 as a general Mathematical tool for dealing with uncertainties and so fuzzy not clearly defined the objects. Then the theory of soft sets initiated by Molodtsov was studied by (Maji et al), 2001 and developed into several basis notions Soft Matrices (Cagman et al 2010) which were a Matrix representation of the soft sets and constructed a soft Max-Min decision making method. 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.

Diabetes overview

Diabetes is a set of related diseases in which the body cannot regulate the amount of sugar (glucose) in the blood. Insulin is produced by the pancreas, a small organ near the stomach that also secretes important enzymes that help in the digestion of food. People cannot use insulin properly (type 1 diabetes) or People with diabetes either don't produce enough insulin (type 2 diabetes).

Type 1 Diabetes :

The pancreas secretes insulin, but the body is partially (or) completely unable to use the insulin. This is sometimes referred to as insulin resistance. The body tries to overcome this resistance by secreting more and more insulin. People with insulin resistance develop type 2 diabetes when they do not continue to secrete enough insulin to cope with the higher demands. At least 90% of patients with diabetes have type 2 diabetes. Type 2 diabetes is typically recognized in adulthood, usually after age 45 years. It used to be called adult-onset diabetes mellitus, or non insulin dependent diabetes mellitus. These names are no longer used because type 2 diabetes does occur in younger people and some people with type 2 diabetes need to use insulin. type 2 diabetes is usually controlled with diet, weight loss, exercise and oral medications more than half of all people with type 2 diabetes require insulin to control their blood

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sugar at some point in the course of their illness. Beside this there are other forms of diabetes like Gestational diabetes, pre-diabetes etc.

Type 2 Diabetes :

The body stops producing insulin (or) produces too little insuling to regulate blood glucose level. Type 1 diabetes is typically recognized in childhood or adolescence. It is used to be known as Juvenile onset diabetes or insulin dependent mellitus. Type 1 diabetes can occur in an older individual due to destruction of pancrease by alcohol, disease (or) removal by surgery or progressive failure of pancreatic beta cells, which produce insulin. People with type 1 diabetes generally require daily insulin treatment to sustain life.

II. PRELIMINARIES

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

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 $e \notin A$. 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 otherwords, 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 dresses and $E = \{ \text{High Quality } (e_1), \text{Medium Quality } (e_2), \text{Low Quality } (e_3) \}$ 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 dresses” 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	1	0
u_2	1	1	0
u_3	1	1	0
u_4	1	0	0

B. FUZZY SOFT SET

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

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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

$(\tilde{F}_A, E) = \left\{ \begin{array}{l} \tilde{F}_A(e_1) = \{(u_1, 0.4), (u_2, 0.6), (u_3, 0.7), (u_4, 0.8)\} \\ \tilde{F}_A(e_2) = \{(u_1, 0.5), (u_2, 0.3), (u_3, 0.2)\} \end{array} \right\}$ is the fuzzy soft set representing the “Quality of dresses” which Mr.X is going to buy. We mar represent the fuzzy soft set in the following form :

Table 2.2.2

U	HighQuality (e_1)	Medium Quality(e_2)	LowQuality (e_3)
u_1	0.4	0.5	0.0
u_2	0.6	0.3	0.0
u_3	0.7	0.2	0.0
u_4	0.8	0.0	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 SUBSET

For two fuzzy soft sets (\tilde{F}_A, E) and (\tilde{G}_B, E) over a common universal U , We have $(\tilde{F}_A, E) \subseteq (\tilde{G}_B, E)$ if $A \subset B$ and $\forall e \in A, \tilde{F}_A(e)$ 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 set (\tilde{F}_A, E) denoted by $(\tilde{F}_A, E)^0$ is defined by $(\tilde{F}_A, E)^0 = (\tilde{F}_A^0, E)$ where $\tilde{F}_A^0: E \rightarrow I^U$ is a mapping given by $\tilde{F}_A^0(e) = [\tilde{F}_A(e)]^0, \forall e \in E$.

F. FUZZY SOFT NULL SET

A Fuzzy soft set (\tilde{F}_A, E) over U is said to be null fuzzy soft set with respect to the parameter set E , denoted by $\tilde{\phi}$, if $\tilde{F}_A(e) = \tilde{\phi}, \forall e \in E$.

III. FUZZY SOFT MATRICES RELIED UPON 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 $U = \{u_1, u_2, u_3, \dots, u_m\}$ be the universal set and E be the set of parameters given by $E = \{e_1, e_2, e_3, \dots, e_n\}$. Then the fuzzy soft set (\tilde{F}_A, E) can be expressed in matrix form as $\tilde{A} = [a_{ij}^A]_{m \times n}$ or simply by $[a_{ij}^A], i =$

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$1, 2, \dots, m; j = 1, 2, \dots, n$ and $[a_{ij}^{\tilde{A}}] = [(\mu_{ij}^{\tilde{A}}, \gamma_{ij}^{\tilde{A}})]$; where $\mu_{ij}^{\tilde{A}}$ and $\gamma_{ij}^{\tilde{A}}$ represent the fuzzy membership function and fuzzy reference function respectively of u_i in the fuzzy set $\tilde{F}_A(e_j)$ so that $\delta_{ij}^{\tilde{A}} = \mu_{ij}^{\tilde{A}} - \gamma_{ij}^{\tilde{A}}$ gives the fuzzy membership value of u_i . We shall identify a fuzzy soft set with its fuzzy soft matrix and use these two concepts interchangeable. The set of all $m \times n$ 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

$$(\tilde{F}_A, E) = \left\{ \begin{array}{l} \tilde{F}_A(e_1) = \{(u_1, 0.6, 0), (u_2, 0.4, 0), (u_3, 0.5, 0)\} \\ \tilde{F}_A(e_2) = \{(u_1, 0.7, 0), (u_2, 0.2, 0), (u_3, 0.8, 0)\} \\ \tilde{F}_A(e_3) = \{(u_1, 0.9, 0), (u_2, 0.1, 0), (u_3, 0.5, 0)\} \end{array} \right\}$$

we would represent this fuzzy soft set in matrix form

$$[a_{ij}^{\tilde{A}}]_{3 \times 3} = \begin{bmatrix} (0.6, 0) & (0.7, 0) & (0.9, 0) \\ (0.4, 0) & (0.2, 0) & (0.1, 0) \\ (0.5, 0) & (0.8, 0) & (0.5, 0) \end{bmatrix}_{3 \times 3}$$

B. MEMBERSHIP VALUE MATRIX

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

C. ZERO FUZZY SOFT MATRICES

Let $\tilde{A} = [a_{ij}^{\tilde{A}}]_{m \times n} \in FSM_{m \times n}$, where $a_{ij}^{\tilde{A}} = (\mu_{ij}^{\tilde{A}}, \gamma_{ij}^{\tilde{A}})$. Then \tilde{A} is called a fuzzy soft zero (or null) matrix denoted by $[\tilde{0}]_{m \times n}$, or simply by $[\tilde{0}]$, if $\delta_{ij}^{\tilde{A}} = \tilde{0}$ for all i and j for usual fuzzy sets, $\delta_{ij}^{\tilde{A}} = \mu_{ij}^{\tilde{A}} \forall i, j$.

D. IDENTIFY FUZZY SOFT MATRICES

Let $\tilde{A} = [a_{ij}^{\tilde{A}}]_{m \times n} \in FSM_{m \times n}$, where $a_{ij}^{\tilde{A}} = (\mu_{ij}^{\tilde{A}}, \gamma_{ij}^{\tilde{A}})$. Then \tilde{A} is called a fuzzy soft unit or identify matrix denoted by $[\tilde{1}]$, if $m = n$, $a_{ij}^{\tilde{A}} = (\mu_{ij}^{\tilde{A}}, \gamma_{ij}^{\tilde{A}})$ for all $i \neq j$ and $a_{ij}^{\tilde{A}} = (0, 1)$ i.e., $a_{ij}^{\tilde{A}} = 1 \forall i, j$.

E. COMPLEMENT OF FUZZY SOFT MATRICES

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

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F. PRODUCT OF FUZZY SOFT MATRICES

Let $\tilde{A} = [a_{ij}^{\tilde{A}}]_{m \times n}$ 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 function and fuzzy reference function of u_i , so that $\delta_{ij}^{\tilde{A}} = \mu_{ij}^{\tilde{A}} - \gamma_{ij}^{\tilde{A}}$ gives the fuzzy membership value of u_i . Also let $\tilde{B} = [b_{jk}^{\tilde{B}}]_{n \times p}$ where $b_{jk}^{\tilde{B}} = (\mu_{jk}^{\tilde{B}}, \gamma_{jk}^{\tilde{B}})$, where $\mu_{jk}^{\tilde{B}}$ and $\gamma_{jk}^{\tilde{B}}$ represent the fuzzy membership function and fuzzy reference function of u_i . We now define $\tilde{A} \cdot \tilde{B}$, the product of \tilde{A} and \tilde{B} as

$$\tilde{A} \cdot \tilde{B} = [d_{ik}^{\tilde{A}\tilde{B}}]_{m \times p} = \left[\begin{array}{c} \max \min (\mu_{ij}^{\tilde{A}}, \mu_{jk}^{\tilde{B}}) \\ \min \max (\gamma_{jj}^{\tilde{A}}, \gamma_{jj}^{\tilde{B}}) \end{array} \right]_{m \times p}$$

$$1 \leq i \leq m, 1 \leq k \leq p \text{ for } j = 1, 2, \dots, n.$$

IV. APPLICATION OF FSM IN MEDICAL DIAGNOSIS

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

A. FUZZY SOFT MATRICES IN MEDICAL DIAGNOSIS

Let us assume S is the set of symptoms of some effects of diabetes D is the side effects related to these symptoms and P is the set of Patients showing the symptoms present in the set S . We construct a fuzzy soft set (\tilde{F}_A, D) over S . A relation matrix \tilde{A} is obtained from the fuzzy soft set (\tilde{F}_A, D) . We would name the matrix as symptom – disease matrix. Similarly its complement $(\tilde{F}_A, D)^0$ gives another relation matrix \tilde{A}^0 called non symptom disease matrix we call the matrices \tilde{A} and \tilde{A}^0 as medical knowledge of fuzzy soft set further we construct another fuzzy soft set (\tilde{F}_B, S) over P . This fuzzy soft set gives the relation matrix \tilde{B} called patient symptom matrix and its complement $(\tilde{F}_B, S)^0$ gives the relation matrix \tilde{B}^0 called patient non-symptom 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 symptom non disease matrix respectively. In a similar manner, we obtain the relation matrices $\tilde{T}_3 = \tilde{B}^0\tilde{A}$ and $\tilde{T}_4 = \tilde{B}^0\tilde{A}^0$ called the patient non symptom non disease matrix respectively.

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

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 score $S\tilde{T}_1$ and $S\tilde{T}_2$ for and against the disease respectively as

$$S\tilde{T}_1 = [Y(\tilde{T}_1)_{ij}]_{m \times n} \quad (4.2.2)$$

$$\text{where } Y(\tilde{T}_1)_{ij} = \delta(\tilde{T}_1)_{ij} - \delta(\tilde{T}_3)_{ij}$$

$$S\tilde{T}_2 = [Y(\tilde{T}_2)_{ij}]_{m \times n} \quad (4.2.3)$$

$$\text{where } Y(\tilde{T}_2)_{ij} = \delta(\tilde{T}_2)_{ij} - \delta(\tilde{T}_4)_{ij}$$

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Now if $\max [S\tilde{T}_1(P_i d_j) - S\tilde{T}_2(P_i d_j)]$ 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 disease d_k . In case there is a tie, the process is repeated for patient p_i by reassessing the symptoms.

V. ALGORITHM

1. Input the fuzzy soft set (\tilde{F}_A, D) and compute $(\tilde{F}_A, D)^0$, compute the corresponding matrices \tilde{A} and \tilde{A}^0
2. Input the fuzzy soft set (\tilde{F}_B, S) and compute $(\tilde{F}_B, S)^0$, compute the corresponding matrices \tilde{B} and \tilde{B}^0
3. Compute $\tilde{T}_1 = \tilde{B}\tilde{A}, \tilde{T}_2 = \tilde{B}\tilde{A}^0, \tilde{T}_3 = \tilde{B}^0\tilde{A}, \tilde{T}_4 = \tilde{B}^0\tilde{A}^0$
4. Compute $MV(\tilde{T}_1), MV(\tilde{T}_2), MV(\tilde{T}_3)$ and $MV(\tilde{T}_4)$.
5. Compute the diagnosis score $S\tilde{T}_1$ and $S\tilde{T}_2$.
6. Find $S_k = \max [S\tilde{T}_1(P_i d_j) - S\tilde{T}_2(P_i d_j)]$. We conclude that the patient P_i is suffering from the disease d_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 $P_1 P_2 P_3$ are admitted in a hospital who affect the diabetic 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 Fatigue, Weightloss, Polydipsia, Polyuria, altered mental status, Polyhpagic respectively and the set $D = \{d_1, d_2\}$, where d_1 and d_2 represent the parameters of side effect in the humanbody of diabetic type 1 and diabetic type 2.

Step 1

Let the fuzzy soft set (\tilde{F}_A, D) over S , where \tilde{F}_A is a mapping $\tilde{F}_A: D \rightarrow \tilde{F}(S)$ gives an appropriate description of fuzzy soft Medical knowledge of the side effect diseases and their symptoms appeared due to diabetic. Let $(\tilde{F}_A, D) = \left\{ \begin{array}{l} \tilde{F}_A(d_1) = \{(e_1, 0.2, 0), (e_2, 0.5, 0), (e_3, 0.4, 0)\} \\ \tilde{F}_A(d_2) = \{(e_1, 0.8, 0), (e_2, 0.6, 0), (e_3, 0.7, 0)\} \end{array} \right\}$ Complement of (\tilde{F}_A, D) i.e, $(\tilde{F}_A, D)^0$ is given by

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

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

$$\tilde{A} = \begin{matrix} & \begin{matrix} d_1 & d_2 \end{matrix} \\ \begin{matrix} e_1 \\ e_2 \\ e_3 \end{matrix} & \left(\begin{array}{cc} (0.2, 0) & (0.8, 0) \\ (0.5, 0) & (0.6, 0) \\ (0.4, 0) & (0.7, 0) \end{array} \right) \end{matrix}$$

and

$$\tilde{A}^0 = \begin{matrix} & \begin{matrix} d_1 & d_2 \end{matrix} \\ \begin{matrix} e_1 \\ e_2 \\ e_3 \end{matrix} & \left(\begin{array}{cc} (1, 0.2) & (1, 0.8) \\ (1, 0.2) & (1, 0.6) \\ (1, 0.4) & (1, 0.7) \end{array} \right) \end{matrix}$$

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Step 2

Again we take $P = (P_1 P_2 P_3)$ 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 (\tilde{F}_B, S) fuzzy soft set, where \tilde{F}_B is a mapping $\tilde{F}_B: S \rightarrow \tilde{F}(P)$ gives a collection of an appropriate description of the patient side effect symptoms in the hospital. Let

$$(\tilde{F}_B, S) = \begin{cases} \tilde{F}_B(e_1) = \{(P_1, 0.6, 0), (P_2, 0.7, 0), (P_3, 0.1, 0)\} \\ \tilde{F}_B(e_2) = \{(P_1, 0.8, 0), (P_2, 0.4, 0), (P_3, 0.5, 0)\} \\ \tilde{F}_B(e_3) = \{(P_1, 0.2, 0), (P_2, 0.5, 0), (P_3, 0.6, 0)\} \end{cases}$$

we note the fuzzy soft set (\tilde{F}_B, S) by the following matrix \tilde{B} called patient symptom matrix.

$$\tilde{B} = \begin{matrix} & e_1 & e_2 & e_3 \\ \begin{matrix} P_1 \\ P_2 \\ P_3 \end{matrix} & \begin{pmatrix} (0.6, 0) & (0.8, 0) & (0.2, 0) \\ (0.7, 0) & (0.4, 0) & (0.5, 0) \\ (0.1, 0) & (0.5, 0) & (0.6, 0) \end{pmatrix} \end{matrix}$$

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

$$(\tilde{F}_B, S)^0 = \begin{cases} \tilde{F}_B(e_1) = \{(P_1, 1, 0.6), (P_2, 1, 0.7), (P_3, 1, 0.1)\} \\ \tilde{F}_B(e_2) = \{(P_1, 1, 0.8), (P_2, 1, 0.4), (P_3, 1, 0.5)\} \\ \tilde{F}_B(e_3) = \{(P_1, 1, 0.2), (P_2, 1, 0.5), (P_3, 1, 0.6)\} \end{cases}$$

$$\tilde{B}^0 = \begin{matrix} & e_1 & e_2 & e_3 \\ \begin{matrix} P_1 \\ P_2 \\ P_3 \end{matrix} & \begin{pmatrix} (1, 0.6) & (1, 0.8) & (1, 0.2) \\ (1, 0.7) & (1, 0.4) & (1, 0.5) \\ (1, 0.1) & (1, 0.5) & (1, 0.6) \end{pmatrix} \end{matrix}$$

Step 3 and Step 4

Thus we have

$$\tilde{T}_1 = \tilde{B} \cdot \tilde{A} = \begin{matrix} & d_1 & d_2 \\ \begin{matrix} e_1 \\ e_2 \\ e_3 \end{matrix} & \begin{pmatrix} (0.5, 0) & (0.6, 0) \\ (0.4, 0) & (0.7, 0) \\ (0.5, 0) & (0.6, 0) \end{pmatrix} \end{matrix}$$

$$\tilde{T}_2 = \tilde{B} \cdot \tilde{A}^0 = \begin{matrix} & d_1 & d_2 \\ \begin{matrix} e_1 \\ e_2 \\ e_3 \end{matrix} & \begin{pmatrix} (0.8, 0.2) & (0.8, 0.6) \\ (0.7, 0.2) & (0.7, 0.6) \\ (0.6, 0.2) & (0.6, 0.6) \end{pmatrix} \end{matrix}$$

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

$$MV(\tilde{T}_1) = \begin{matrix} & d_1 & d_2 \\ \begin{matrix} P_1 \\ P_2 \\ P_3 \end{matrix} & \begin{pmatrix} 0.5 & 0.6 \\ 0.4 & 0.7 \\ 0.5 & 0.6 \end{pmatrix} \end{matrix}$$

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and

$$MV(\tilde{T}_2) = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.6 & 0.2 \\ 0.2 & 0.1 \\ 0.4 & 0.0 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

$$\tilde{T}_3 = \tilde{B}^0 \cdot \tilde{A} = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.5,0.2 & 0.8,0.2 \\ 0.5,0.4 & 0.8,0.4 \\ 0.5,0.1 & 0.8,0.1 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

$$\tilde{T}_4 = \tilde{B}^0 \cdot \tilde{A}^0 = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 1,0.4 & 1,0.7 \\ 1,0.5 & 1,0.6 \\ 1,0.2 & 1,0.6 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

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

$$MV(\tilde{T}_3) = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.3 & 0.6 \\ 0.1 & 0.4 \\ 0.4 & 0.7 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

and

$$MV(\tilde{T}_4) = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.6 & 0.3 \\ 0.5 & 0.4 \\ 0.8 & 0.4 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

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

$$S_{\tilde{T}_1} = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.2 & 0.0 \\ 0.3 & 0.3 \\ 0.1 & -0.1 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

and

$$S_{\tilde{T}_2} = \begin{matrix} & d_1 & d_2 \\ P_1 & \begin{pmatrix} 0.0 & -0.1 \\ 0.0 & -0.3 \\ -0.4 & -0.4 \end{pmatrix} \\ P_2 & \\ P_3 & \end{matrix}$$

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Step 5

Now, we have the difference for and against the diseases

$S_{\bar{T}_1} - S_{\bar{T}_2}$	d_1	d_2	Maximum Value
P_1	0.2	0.1	0.2
P_2	0.3	0.6	0.6
P_3	0.5	0.3	0.5

$P_1 P_3$ is suffering diabetic type 1 and P_2 is suffering diabetic type 2

VII. CONCLUSION

In this paper we elucidate the theory fuzzy soft matrices in the field 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. 40 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 type 1 diabetes. Making lifestyle changes will help the diabetic patients to prevent serious complications of diabetes.

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