A STUDY ON FUZZY MATRICES IN YOGA ON HYPERTENSION

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Abstract

In this paper, we define fuzzy soft matrices and study their basic properties. Fuzzy set theory plays a vital role in medical fields. There are diversity of models involving fuzzy matrices to deal with different complicated aspects of medical diagnosis. Fuzzy soft matrices representing the medical knowledge between the symptoms and diseases. In this paper the concept applied to hypertension.

Key Words and Phrases: Fuzzy soft set, fuzzy matrices, Max product composition of fuzzy soft matrix, Hypertension.

1 INTRODUCTION

The lot of medicine is one of the most rich and interesting areas applications for fuzzy set theory. They have shown that the quality definition of complement of a fuzzy softest meets all the requirements that complement of a set all the requirements that
complement of a set classical sense really does. In this paper, by using the notation of fuzzy soft matrices we apply fuzzy soft set technology through the well-knowns anchez’s shear for medical diagnosis. Medicine is one of the fields in which fuzzy set theory was recognized fast early in the mid 1970’s. In this field, the uncertainty found in the procedure of diagnosis of disease is focused. Now, a day’s high blood pressure is one among the leading contributors to fright of disease globally. Leading contributors to fright of disease globally. Almost 80 millions US adults are suffering with HBP currently. With less than half of those are having controlled hypertension, 62% of cardiovascular diseases and 49% of ischemic heart diseases are caused due to uncontrolled hypertension.

2 PRILIMINARIES

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

2.1 Fuzzy soft complement set

The complement of fuzzy soft set \((F_\widetilde{A}, E)\) denoted by \((F_\widetilde{A}, E)^c\) is defined by \((F_\widetilde{A}, E)^c = (F_\widetilde{\delta}, E)\) where \(F_\widetilde{\delta} : E \rightarrow I^U\) is a mapping given by \(F_\widetilde{\delta}(e) = [F_\widetilde{\delta}(e)]^c, \forall e \in E\).

2.2 Fuzzy soft matrix

Let \(U = \{u_1, u_2, \ldots, u_m\}\) be the universal set and \(E\) be the set of parameters given by \(E = \{e_1, e_2, \ldots, e_n\}\). Then the fuzzy soft set \((F_\widetilde{A}, E)\) can be expressed in matrix form as \(\widetilde{A} = [a_{ij}]_{m \times n}\) or simply by \([a_{ij}], i = 1, 2, \ldots, m, j = 1, 2, \ldots, n\) and \([a_{ij}] = [(\mu_{ij}, \Upsilon_{ij})]\); where \(\mu_{ij}\) and \(\Upsilon_{ij}\) represent the fuzzy membership function and fuzzy reference function respectively of \(\mu_i\) in the fuzzy set \(\widetilde{F}_A(e_j)\) so that \(\delta_{ij}^A = \mu_{ij}^A - \Upsilon_{ij}^A\) 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 \(\text{FSM} m \times n\). For usual fuzzy sets with fuzzy reference function 0, it is obvious to see that \(a_{ij}^A = [(\mu_{ij}^A, 0)] \forall i, j.\)
2.3 Membership Value Matrix

The membership value matrix corresponding to the matrix $\tilde{A}$ as
$MV(\tilde{A}) = [\delta_{\tilde{A}}]_{m \times n}$, where $\delta_{\tilde{A}}^{ij} = \mu_{\tilde{A}}^{ij} - \Upsilon_{\tilde{A}}^{ij}$ for $i = 1, 2, 3, \ldots, m$ and $j = 1, 2, 3, \ldots, n$, where $\mu_{\tilde{A}}^{ij}$ and $\Upsilon_{\tilde{A}}^{ij}$ represent the fuzzy membership function and fuzzy reference function respectively of $u_i$ in the fuzzy set.

2.4 Complement of fuzzy soft matrices

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

2.5 Max Product of fuzzy soft matrices

Let $\tilde{A} = [a_{\tilde{A}}^{ij}] \in FSM m \times n$, where $a_{\tilde{A}}^{ij} = (\mu_{\tilde{A}}^{ij}, \Upsilon_{\tilde{A}}^{ij})$ represent the fuzzy membership function and fuzzy reference function of $u_i$, so that $\delta_{\tilde{A}}^{ij} = \mu_{\tilde{A}}^{ij} - \Upsilon_{\tilde{A}}^{ij}$ gives the fuzzy membership value of $u_i$. Also let $\tilde{B} = [b_{\tilde{B}}^{jk}] n \times p$, $b_{\tilde{B}}^{jk} = (\mu_{\tilde{B}}^{jk}, \Upsilon_{\tilde{B}}^{jk})$. Where $\mu_{\tilde{B}}^{jk}$ and $\Upsilon_{\tilde{B}}^{jk}$ represent the fuzzy membership function and fuzzy reference function of $u_i$. So that $\delta_{\tilde{B}}^{jk} = (\mu_{\tilde{B}}^{jk} - \Upsilon_{\tilde{B}}^{jk})$ gives the fuzzy membership value of $u_i$. We now define $\tilde{A} \odot \tilde{B}$, the product of $\tilde{A}$ and $\tilde{B}$ as $\tilde{A} \odot \tilde{B} = [d_{\tilde{A}\tilde{B}}^{ik}] m \times p = [\max(\mu_{\tilde{A}}^{ij} \odot \mu_{\tilde{B}}^{jk}), \max(\Upsilon_{\tilde{A}}^{ij} \odot \Upsilon_{\tilde{B}}^{jk})] m \times p$, $1 \leq i \leq m, 1 \leq k \leq p$ for $j = 1, 2, 3, \ldots, n$.

2.6 Hypertension

Hypertension also known as high blood pressure (HBP), is a long term medical condition in which the blood pressure in the arteries is persistently elevated. High blood pressure usually does not cause symptoms in earlier stage. The definition of hypertension is systolic blood pressure (SBP) as 140mmHg or higher or Diastolic blood pressure (DBP) as 90 mmHg or higher or both. Where as <120mm of Hg as SBP and <80 mm of Hg as DBP is considered as normal blood pressure “70”.


3 ALGORITHM

1. Input the fuzzy soft set \((\tilde{F}_A, D)\) and compute \((\tilde{F}_A, D)\circ\). Compute the corresponding matrices \(\tilde{A}\) and \(\tilde{A}^\circ\).

2. Input the fuzzy soft set \((\tilde{F}_B, S)\) and compute \((\tilde{F}_B, S)\circ\). Compute the corresponding matrices \(\tilde{B}\) and \(\tilde{B}^\circ\).

3. Compute \(\tilde{R}_1 = \tilde{B} \circ \tilde{A}\), \(\tilde{R}_2 = \tilde{B} \circ \tilde{A}^\circ\), \(\tilde{R}_3 = \tilde{B}^\circ \circ \tilde{A}\), \(\tilde{R}_4 = \tilde{B}^\circ \circ \tilde{A}^\circ\).

4. Compute the corresponding membership value matrices \(\text{MV}(\tilde{R}_1)\), \(\text{MV}(\tilde{R}_2)\), \(\text{MV}(\tilde{R}_3)\), and \(\text{MV}(\tilde{R}_4)\).

5. Compute the diagnosis score \(S\tilde{R}_1\) and \(S\tilde{R}_2\).

6. Find \(S_k = \max(S\tilde{R}_2(p_i, d_j) - S\tilde{R}_1(p_i, d_j))\). 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.

4 CASE STUDY

Suppose three patient \(P_1, P_2, P_3\) are practiced in yoga with symptoms of HPT include headache \((S_1)\), dizzy spells \((S_2)\) and nose bleeds \((S_3)\). Let the possible diseases relating to the above symptoms be HPT advanced stage. Many symptoms be HPT advanced stage. Many proved studies show that yoga can reduce the blood pressure by effective and non invastive way. It will achieve a balance between mind, body, and soul and also it improves the energy levels of the body. In yoga which includes asana, Pranayama, Meditation are also plays an important role in reducing HBP.

Step 1:
We represent the fuzzy soft sets \((\tilde{F}_A, D)\) and \((\tilde{F}_A, D)\circ\) by the following matrices \(\tilde{A}\) and \(\tilde{A}^\circ\). This is after yoga result for hypertension.

\[
\begin{array}{c|cc}
S_1 & (0.10,0) & (0.11,0) \\
S_2 & (0.12,0) & (0.17,0) \\
S_3 & (0.16,0) & (0.18,0) \\
\end{array}
\]

\[
\begin{array}{c|cc}
S_1 & (1,0.10) & (1,0.11) \\
S_2 & (1,0.12) & (1,0.17) \\
S_3 & (1,0.16) & (1,0.18) \\
\end{array}
\]
This is after yoga result for hypertension.

**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 \( S\{S_1, S_2, S_3\} \) as the set of parameters, where \( S_1, S_2 \) and \( S_3 \) represent the symptoms of side effect diseases.

\[
\tilde{B} = \begin{bmatrix}
P_1 & S_1 & 0.95\,0 & 0.12\,0 & 0.13\,0 \\
P_2 & S_2 & 0.10\,0 & 0.12\,0 & 0.17\,0 \\
P_3 & S_3 & 0.14\,0 & 0.13\,0 & 0.11\,0 \\
\end{bmatrix}
\]

\[
\tilde{B}^o = \begin{bmatrix}
P_1 & S_1 & 1.00\,95 & 1.00\,12 & 1.00\,13 \\
P_2 & S_2 & 1.00\,10 & 1.00\,12 & 1.00\,17 \\
P_3 & S_3 & 1.00\,14 & 1.00\,13 & 1.00\,11 \\
\end{bmatrix}
\]

**Step 3:**
Compute \( \tilde{R}_1 = \tilde{B} \circ \tilde{A} \) and \( \tilde{R}_2 = \tilde{B} \circ \tilde{A}^o \)

\[
\begin{array}{ccc | ccc}
 & d_1 & d_2 & \\
\tilde{R}_1 & S_1 & 0.09\,0 & 0.10\,0 \\
 & S_2 & 0.20\,0 & 0.03\,0 \\
 & S_3 & 0.11\,0 & 0.12\,0 \\
& & & \text{and} \\
\tilde{R}_2 & S_1 & 0.95\,0 & 0.95\,0 \\
 & S_2 & 0.17\,0 & 0.17\,0 \\
 & S_3 & 0.14\,0 & 0.14\,0 \\
\end{array}
\]

Again \( \tilde{R}_3 = \tilde{B}^o \circ \tilde{A} \) and \( \tilde{R}_4 = \tilde{B}^o \circ \tilde{A}^o \)

\[
\begin{array}{ccc | ccc}
 & d_1 & d_2 & \\
\tilde{R}_3 & S_1 & 0.16\,0 & 0.18\,0 \\
 & S_2 & 0.16\,0 & 0.18\,0 \\
 & S_3 & 0.15\,0 & 0.18\,0 \\
& & & \text{and} \\
\tilde{R}_4 & S_1 & 1.00\,09 & 1.00\,09 \\
 & S_2 & 1.00\,02 & 1.00\,03 \\
 & S_3 & 1.00\,1 & 1.00\,02 \\
\end{array}
\]

**Step 4:**

\[
MV(\tilde{R}_1) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.09\,0) & (0.10\,0) \\
 & (0.20\,0) & (0.03\,0) \\
 & (0.01\,0) & (0.02\,0) \\
\end{bmatrix} \quad \text{and} \quad MV(\tilde{R}_2) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.95\,0) & (0.95\,0) \\
 & (0.17\,0) & (0.17\,0) \\
 & (0.14\,0) & (0.14\,0) \\
\end{bmatrix}
\]

\[
MV(\tilde{R}_3) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.16\,0) & (0.18\,0) \\
 & (0.16\,0) & (0.18\,0) \\
 & (0.16\,0) & (0.18\,0) \\
\end{bmatrix} \quad \text{and} \quad MV(\tilde{R}_4) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.91\,0) & (0.90\,0) \\
 & (0.98\,0) & (0.97\,0) \\
 & (0.90\,0) & (0.98\,0) \\
\end{bmatrix}
\]

\[
\text{MV}(\tilde{R}_1) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.09\,0) & (0.10\,0) \\
 & (0.20\,0) & (0.03\,0) \\
 & (0.01\,0) & (0.02\,0) \\
\end{bmatrix} \quad \text{and} \quad \text{MV}(\tilde{R}_2) = \begin{bmatrix}
P_1 & d_1 & d_2 & \\
 & (0.95\,0) & (0.95\,0) \\
 & (0.17\,0) & (0.17\,0) \\
 & (0.14\,0) & (0.14\,0) \\
\end{bmatrix}
\]
Step 5:
Compute the diagnosis score $S\tilde{R}_1 = MV(\tilde{R}_3) - MV(\tilde{R}_1)$ and $S\tilde{R}_2 = MV(\tilde{R}_2) - MV(R_4)$

$$S(\tilde{R}_1) = \begin{pmatrix} P_1 & (0.07) & (0.08) \\ P_2 & (-0.04) & (0.15) \\ P_3 & (0.15) & (0.16) \end{pmatrix}$$

$$S(\tilde{R}_2) = \begin{pmatrix} P_1 & (-0.04) & (-0.05) \\ P_2 & (0.29) & (0.8) \\ P_3 & (0.76) & (0.84) \end{pmatrix}$$

Step 6:
Now we have the difference

$$SR_2 - SR_1 \begin{array}{c|cc} d_1 & d_2 \\ \hline P_1 & -0.11 & -0.13 \\ P_2 & -0.85 & 0.65 \\ P_3 & 0.61 & 0.68 \end{array}$$

It is clear from the above Matrix the patient $P_3$ is suffering from Hypertension. This is advanced stage. This study mean to apply yoga for a longtime with patience and regularity. So that HBP can take more advantage at various level of the personality.

5 CONCLUSION

In this paper, we have applied the fuzzy soft matrices and complement of fuzzy soft sets indecision making problem. Finally we note our beneficitation would help this study on fuzzy soft sets whether the technology put forward in this paper may arise a note good result in this field. Yoga can play an important role in risk modification for cardiovascular disease in mild to moderate hypertension.

References


