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Application of Bipolar Intuitionistic Fuzzy Matrices for Disease Diagnosis

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Abstract

Abstract—In this paper, define bipolar intuitionistic fuzzy matrices and somedefinitions of BIFM. The BIFM for disease diagnoses inpatients who suffer fromdifferent diseases such as stomach ulcers and typhoid by usingHypotheticaldata. consider three patients who are suffering from a disease Stomachulceror typhoid whose symptoms are fever, flu, the digestive problem. Finally, byusing bipolar intuitionistic fuzzy matrix concludesuffering from disease typhoid.

Keywords— Bipolar intuitionistic fuzzy matrices, Application of BipolarIntuitionistic Fuzzy Matrices for Disease Diagnosis.

I. INTRODUCTION

Zadeh [12] introduced fuzzy set theory and Atanassov [1, 2, 3, 4] generalizedit as IFS. Kim et al. [5] studied determinants of fuzzy square matrices.Shyamal et al. [10] defined two new binary fuzzyoperators for fuzzy matrices.Khan et al. [6] developed the concept of IFM. Rajarajeswari et al. [9]

developed the concept of IFSM theory and applied it in DM problem. Theconcept of bipolar fuzzy set was first introduced by Zhang [11]. Pal et al. [8]defined the concept of BFM. Zulqarnian et al. [13] introduced the comparisonfuzzy soft matrix and interval valued fuzzy soft matrix in decision

making.

Motivated by these theories, bipolar intuitionistic fuzzy matrices, operationsof BIFM and decision making problem on BIFM has been developed.Comparison technique between the +ve-membership,-ve membership and +venon-membership, -ve non- membership entries of BIFMs is introdced. An algorithms for solving decision making problems are designed and suitableexamples are given to establish the working of these algorithms. BIFM fordisease diagnoses inpatients who suffer from different diseases such as stomachulcers and typhoid by using hypothetical data. consider three patients who aresuffering from a disease stomach ulcer or typhoid whose symptoms are fever,flu, the digestive problem. Finally, by using bipolar intuitionistic fuzzy matrixconclude that patient p3 suffering stomach ulcer p1 and p2 patients sufferingfrom disease typhoid.

II. BIFMS FOR DISEASE DIAGNOSIS

Definition 1: The entire data set can be represented in the form of a m × k bipolar intuitionistic fuzzy matrix whose entries are pairs of elements from [-1, 1] denoted by M_{ij}. BIFM = $[((\mu^p_{ij}, \mu^n_{ij}), (\nu^p_{ij}, \nu^n_{ij}))]_{m\times k}$ is constructed,

$$M_{ij=}\begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_m \end{array}\begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \dots & C_k \end{array} \\ \begin{pmatrix} (\mu^n_{11},\mu^p_{11})(\nu^n_{11},\nu^p_{11}) & (\mu^n_{12},\mu^p_{12})(\nu^n_{12},\nu^p_{12}) & \cdots & (\mu^n_{1k},\mu^p_{1k})(\nu^n_{1k},\nu^p_{1k}) \\ (\mu^n_{21},\mu^p_{21})(\nu^n_{21},\nu^p_{21}) & (\mu^n_{22},\mu^p_{22})(\nu^n_{22},\nu^p_{22}) & \cdots & (\mu^n_{2k},\mu^p_{2k})(\nu^n_{2k},\nu^p_{2k}) \\ \cdots & \cdots & \cdots & \cdots \\ (\mu^n_{m1},\mu^p_{m1})(\nu^n_{m1},\nu^p_{m1}) & (\mu^n_{m2},\mu^p_{m2})(\nu^n_{m2},\nu^p_{m2}) & \cdots & (\mu^n_{mk},\mu^p_{mk})(\nu^n_{mk},\nu^p_{mk}) \end{pmatrix} \end{array}$$

IIIEffectof Stomach Ulcer and Typhoid in BIFMMedical Analysis

In this section, the different climates and environmental features causing several diseases. For the diagnosis of these diseases, several antibiotics and drugs are available. The stomach ulcer is caused by food poisoning and affects the different organs of our body such as the digestive system. The stomach plays a vital role in the second phase of the digestive system, it performs a chemical breakdown in humans and other animals due to enzymes and hydrochloric acid. Typhoid is a bacterial infection and caused by Salmonella typhi bacteria it is very dangerous for children especially in developing countries and affects almost 26 million peoples every year.

Bipolar intuitionistic fuzzy matrices for diagnosis of those people who are suffering from stomach ulcers and typhoid. BIFM in Medical Analysis, assume S be a set of symptoms of stomach ulcer and typhoid, D is the side effects of diseases associatedto these signs, and P be a set of patients characterized the set of signs presenting in the set S. Two new relation matrices BIFM1 = BIFM(B).BIFM(A) and BIFM2 = BIFM(B).BIFM(A^c) known as symptoms patient disease and patient symptoms nondisease matrix appropriately. In the same way, the relation matrix BIFM3=BIFM(B^c).BIFM(A)and BIFM4=BIFM(B).BIFM(A^c)

Knownthe patient non-symptoms disease matrix and patient non-symptoms nondisease matrix respectively.

Now BIFM1=BIFM(B).BIFM(A),

BIFM2=BIFM(B).BIFM(A^c)

BIFM3 = BIFM(B^c).BIFM(A),

BIFM4 = BIFM(B^c).BIFM(A^c),

andusingDefinition of bipolar membership valueBIFM1,BIFM2,BIFM3,BIFM4. Compute the diagnosis score S_{BIFM1} and S_{BIFM2} for and against the diseases appropriately like

$S_{BIFM1} = [\rho(BIFM_1)]p \times q$, where $\rho(BIFM_1)$ =BIFM1 -BIFM3.

$S_{BIFM2} = [\rho(BIFM_2)]p \times q$, where $\rho(BIFM_2)$ =BIFM2 -BIFM4.

Then if $\max(S_{(BIFM1)}(p_i,q_j) - S_{(BIFM2)}(p_i,q_k))$ appear for exactly (p_i, q_k) only. To accept that diagnosis hypothesis for patient p_i is the diseases d_k Then in this way, there is a connection in which the hypothesis is repeated for patient pi by assuming the symptoms.

IV Algorithm

Step 1: Input BIFM(A, D) and BIFM(A^c, D) two disease of the matrix form.
Step 2: BIFM(S) and BIFM(S^c) represents the symptoms and patient matrix.
Step3: Calculate the symptoms and non-symptoms patient matrix.
Step 4: Compute the +ve,-ve membership and non-membership value.
Step5: Compute the diagnosis

score.

Step 6: Ranking the value of Patients with disease.

V. Application of BIFM in Medical Diagnoses

Example 5.1. Consider P = {p1, p2, p3} are three patients who are suffering from a disease whose symptoms are fever, flu, the digestive problem represented as S = {s1, s2, s3} and the possible diseases related to the above symptoms may be stomach ulcer and typhoid represented by D = {d1, d2} gives an approximation result of two disease and their symptoms. Consider the BIFM(A,D) and its complement BIFM(A^c,D) in matrix form can be written as follows;

Step 1: The BIF M(A,D) and BIF M(A^c, D) is defined

$$\text{BIFM(A)} = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{pmatrix} (-0.15,0.75)(-0.18,0.12) & (-0.16,0.45)(-0.25,0.14) \\ (-0.15,0.68)(-0.42,0.1) & (-0.35,0.25)(-0.15,0.2) \\ (-0.14,0.35)(-0.25,0.08) & (-0.5,0.6)(-0.4,0.3) \end{pmatrix} \end{array} \text{ and}$$

$$\text{BIFM}(A^c) = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{pmatrix} (-0.18,0.12)(-0.15,0.75) & (-0.25,0.14)(-0.16,0.45) \\ (-0.42,0.1)(-0.15,0.8) & (-0.15,0.2)(-0.35,0.25) \\ (-0.25,0.08)(-0.14,0.35) & (-0.4,0.3)(-0.5,0.6) \end{pmatrix} \end{array}$$

Step 2: BIFM(S) and BIFM(S^c) represents the symptoms and patient matrix.

BIFM(B)=

$$\begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{ccc} S_1 & S_2 & S_3 \end{array} \\ \begin{pmatrix} (-0.2,0.9)(-0.3,0.1) & (-0.15,0.75)(-0.85,0.25) & (-0.25,0.5)(-0.65,0.3) \\ (-0.25,0.4)(-0.6,0.5) & (-0.15,0.68)(-0.85,0.32) & (-0.15,0.6)(-0.7,0.2) \\ (-0.11,0.7)(-0.3,0.08) & (-0.75,0.6)(-0.25,0.4) & (-0.4,0.5)(-0.3,0.25) \end{pmatrix} \end{array}$$

BIFM(B^c)=

$$\begin{array}{ccc} S_1 & S_2 & S_3 \end{array}$$

$$\begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-0.3,0.1)(-0.2,0.9) & (-0.85,0.25)(-0.15,0.75)(-0.65,0.3)(-0.25,0.5) \\ (-0.6,0.5)(-0.25,0.4) & (-0.85,0.32)(-0.15,0.68) \quad (-0.7,0.2)(-0.15,0.\,) \\ (-0.3,0.08)(-0.11,0.7) & (-0.25,0.4)(-0.75,0.6) \quad (-0.3,0.25)(-0.4,0.5) \end{pmatrix}$$

Step 3: The symptoms and non-symptoms patient matrix.

$BIFM_1$ =BIFM(B)·BIFM(A)

d_1d_2

$$\begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-0.85,0.25)(-0.15,0.75) & (-0.85,0.25)(-0.15,0.75) \\ (-0.85,0.2)(-0.15,0.68) & (-0.85,0.2)(-0.15,0.6) \\ (-0.75,0.35)(-0.18,0.4) & (-0.75,0.25)(-0.15,0.4) \end{pmatrix}$$

$BIFM_2$ =BIFM(B)·BIFM(A^c)

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-0.85,0.08)(-0.14,0.75) & (-0.85,0.14)(-0.15,0.75) \\ (-0.85,0.08)(-0.14,0.75) & (-0.85,0.14)(-0.15,0.68) \\ (-0.75,0.08)(-0.15,0.75) & (-0.75,0.14)(-0.16,0.6) \end{pmatrix}$$

$BIFM_3$ =BIFM(B^c)·BIFM(A)

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-0.3,0.1)(-0.18,0.9) & (-0.5,0.1)(-0.15,0.9) \\ (-0.25,0.35)(-0.18,0.5) & (-0.5,0.25)(-0.15,0.5) \\ (-0.3,0.08)(-0.11,0.7) & (-0.5,0.08)(-0.11,0.7) \end{pmatrix}$$

$BIFM_4$ =BIFM(B^c)·BIFM(A^c)

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-0.42,0.08)(-0.14,0.9) & (-0.4,0.1)(-0.16,0.9) \\ (-0.42,0.08)(-0.14,0.75) & (-0.25,0.4)(-0.16,0.6) \\ (-0.42,0.08)(-0.11,0.75) & (-0.4,0.8)(-0.11,0.7) \end{pmatrix}$$

Step 4: The +ve,-ve membership and non-membership value of $BIFM_1$, $BIFM_2$, $BIFM_3$ and $BIFM_4$, respectively.

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\begin{matrix} p_1 \\ BIFM_1=p_2 \\ p_3 \end{matrix}\begin{pmatrix} (-1,-0.5) & (-1,-0.5) \\ (-1,-0.48) & (-1,-0.48) \\ (-0.93,-0.05) & (-0.9,-0.15) \end{pmatrix}$$

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\text{BIFM}_2 = \begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} (-0.99,-0.67) & (-1,-0.61) \\ (-0.99,-0.67) & (-1,-0.54) \\ (-0.9,-0.67) & (-0.91,-0.46) \end{pmatrix}$$

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\text{BIFM}_3 = \begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} (-0.48,-0.8) & (-0.65,-0.8) \\ (-0.43,-0.15) & (-0.65,-0.25) \\ (-0.41,-0.62) & (-0.61,-0.62) \end{pmatrix}$$

$$\begin{matrix} & d_1 & d_2 \end{matrix}$$

$$\text{BIFM}_4 = \begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} (-0.56,-0.82) & (-0.56,-0.8) \\ (-0.56,-0.67) & (-0.41,-0.46) \\ (-0.53,-0.67) & (-0.51,-0.62) \end{pmatrix}$$

Step 5: Compute the diagnosis score.

$$S_{BIFM1} = BIFM1 - BIFM3 = \left(BIFM_{\mu 1} - BIFM_{\mu 3}\right) + \left(BIFM_{\nu 1} + BIFM_{\nu 3}\right)$$

$$S_{BIFM1} = \begin{matrix} & d_1 & d_2 \\ p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} -1.82 & -1.65 \\ -1.2 & -1.08 \\ -1.19 & -1.06 \end{pmatrix}$$

$$S_{BIFM2} = BIFM2 - BIFM4 = \left(BIFM_{\mu 2} - BIFM_{\mu 4}\right) + \left(BIFM_{\nu 2} + BIFM_{\nu 4}\right)$$

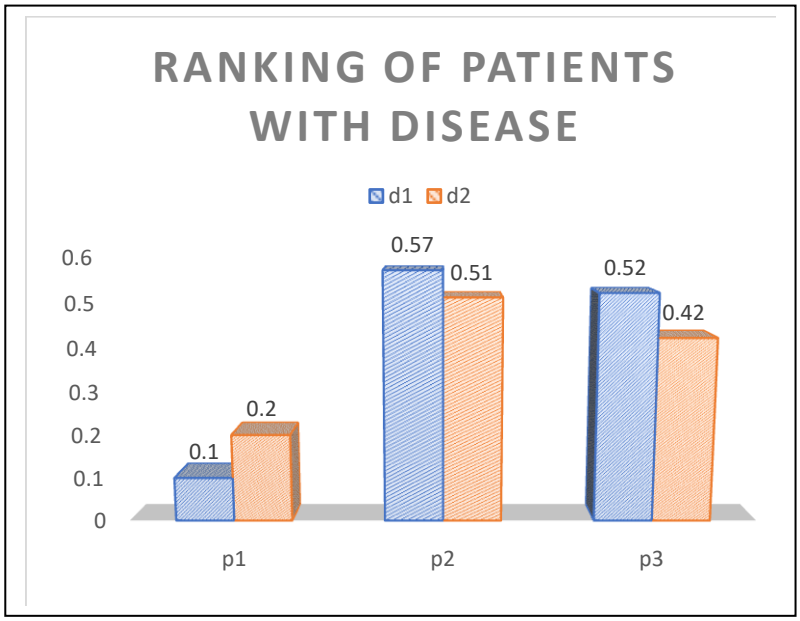
$$S_{BIFM2} = \begin{matrix} & d_1 & d_2 \\ p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} -1.92 & -1.85 \\ -1.77 & -1.59 \\ -0.71 & -1.48 \end{pmatrix}$$

$$S_{BIFM} = S_{BIFM1} = S_{BIFM2} = \begin{matrix} & d_1 & d_2 \\ p_1 \\ p_2 \\ p_3 \end{matrix} \begin{pmatrix} 0.1 & 0.2 \\ 0.57 & 0.51 \\ 0.52 & 0.42 \end{pmatrix}$$

Step 6: Ranking the value of Patients with disease.

Table 6.1: Ranking of Patients with disease

S_{BIFM}	d_1	d_2
p_1	0.1	0.2
p_2	0.57	0.51
p_3	0.52	0.42



6.5.1 Conclusion

The BIFM for disease diagnoses inpatients who suffer from different diseases such as stomach ulcers and typhoid by using hypothetical data. consider three patients who are suffering from a disease stomach ulcer or typhoid whose symptoms are fever, flu, the digestive problem. Finally, by using bipolar intuitionistic fuzzy matrix conclude that patient p3 suffering stomach ulcer p1 and p2 patients suffering from disease typhoid.

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