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AN APPLICATION OF TRIANGULAR FUZZY NUMBER MATRICES WITH TRIPLET OPERATOR IN MEDICAL DIAGNOSIS

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Abstract

Fuzzy set theory and fuzzy logic play an essential role in medical field. Fuzzy logic deals a monotony models in complicated structure of medical diagnosis model. Fuzzy logic systems are excellent in handling ambiguous and imprecise information prevalent in medical diagnosis. A new method of medical diagnostic model using triplet operator is presented in this paper.

1. Introduction

Nowadays, an artificial intelligence has been developed by using fuzzy set theory and fuzzy logic to deal many complicated problems. In some medical skills structure, fuzzy set theory has been applied. Professor Zadeh established fuzzy set theory in 1965 and accomplishes a qualitative computational approach which describes uncertainty. Fuzzy matrix theory was developed by Meenakshi who indicating the concepts of fuzzy set and the essential notion of complicated in number of fields. An interval valued fuzzy matrix was developed by Sanchez's study covered medical diagnosis in

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Meenakshi and Kaliraja [2] as well as S. Elizebeth and L. Sujatha [1]. The origins of the arithmetic mean matrix can also be traced back to an interval value.

Sanchez's work for medical diagnostics is represented by a fuzzy matrix is applied.

In this paper, we have given some preliminaries of fuzzy set theory and introduced a triplet-operator on triangular fuzzy number matrix in section 2. Then the procedure is carried out under the fuzzy medical diagnostic model in section 3. In section 4, the exemplification is comprised by giving the proof of proposal. Finally we approach at the end of process, which concludes the paper.

2. Basic Definitions

Definition 2.1 (Triangular Fuzzy Number). A triplet (m_1, m_2, m_3) is known as triangular fuzzy number where "m_1" represents smallest likely value, "m_2" the most probable value, and "m_3" the largest possible value of any fuzzy event.

Definition 2.2 (Triangular Fuzzy Number Matrix). A triangular fuzzy number matrix of order $m \times n$ is defined as $A = (a_{ij})_{m\times n}$, where $a_{ij} = \langle \alpha_{ij}, m_{ij}, \beta_{ij} \rangle$ is the ij^{th} element of A, m_{ij} is the mean value of a_{ij} and α_{ij}, β_{ij} are the left and right spreads of a_{ij} respectively.

Definition 2.3 (Triplet operator on Triangular Fuzzy Number Matrix). A triangular fuzzy number matrix of order $m \times n$ is defined as $A = (a_{ij})_{m\times n}$, where $a_{ij} = \langle \alpha_{ij}, m_{ij}, \beta_{ij} \rangle$ is the ij^{th} element of A, m_{ij} is the mean value of a_{ij} and α_{ij}, β_{ij} are the left and right spreads of a_{ij} respectively and the triplet operator can be defined as

$$A\Delta_T B = (\beta_{ijL} \times \beta_{ijL} - (\alpha_{ijL} + \alpha_{ijL}), \beta_{ijM} \times \beta_{ijM} - (\alpha_{ijM} + \alpha_{ijM}) + \beta_{ijU} \times \beta_{ijU} + \alpha_{ijU})).$$

Here "–" indicates that the minimum value of TFNMA and B.

3. Implementation of Medical Analysis on Triangular Fuzzy Number Matrix

Let the set of patients be P_1, P_2, P_3 and the set of symptoms be S_1, S_2, S_3, S_4 and the set of diseases be D_1, D_2. Suppose that the parameter D_1, D_2 of the family be $(F(D_1), F(D_2))$ over all diseases are included together under this term. The triangular fuzzy number matrix elements are defined as follows $A = (a_{ij})_{m\times n}$, where $a_{ij} = \langle \alpha_{ij}, m_{ij}, \beta_{ij} \rangle$ is the ij^{th} elements of A and $0 \le \alpha_{ij} \le m_{ij} \le \beta_{ij} \le 10$. The implementation involves the following five steps.

3.1. Procedure for fuzzy medical diagnostic model

Step (i). Let us define A_1 be the symptom-disease triangular fuzzy number matrix with mapping $F_1 : D \to F(S)$.

Step (ii). Let us define A_2 be the patient-symptom triangular fuzzy number matrix with mapping $F_2 : S \to F(P)$.

Step (iii). The triangular fuzzy membership matrices A_1 and A_2 are constructed from the matrices which is denoted by $mem(A_1)$ and $mem(A_2)$ using the definition of conversion.

Step (iv). Compute the following relation matrices

(i) $B = mem(A_1) \odot mem(A_2)^c$

(ii) $C = mem(A_1)^c \odot mem(A_2)$

(iii) $B \Delta_T C$

(iv) $MAX\,(B \Delta_T C)$

Step (v). Finally we conclude that the minimum of the corresponding patient P_i has affected strong confirmation of the disease D_i.

4. Example

Purulent, cyanos, hemoptysis, and chest pain are symptoms that three patients are experiencing at the hospital. Bronchiectasis and pneumonia are two probable diseases associated with the above complaints.

Let $P = (P_1, P_2, P_3)$ denote the set of patients.

Let $S = (S_1, S_2, S_3, S_4)$ denote the set of symptoms and $D = (D_1, D_2)$ denote the set of diseases.

Step (i). Let us define A_1 be the symptom-disease triangular fuzzy number matrix with mapping $F_1 : D \to F(S)$. The triangular fuzzy number matrix with imprecise value of medical information of the two diseases and their four symptoms are given by,

$$A_1 = \begin{bmatrix} (3, 4, 5) & (8, 9, 10) \\ (6, 6.5, 7) & (4, 5.5, 7) \\ (2, 3.5, 5) & (5, 6, 7) \\ (7, 8.5, 10) & (6, 7.5, 9) \end{bmatrix}.$$

Step (ii). Let us define A_2 be the patient-symptom triangular fuzzy number matrix with mapping $F_2 : S \to F(P)$. The imprecise value of medical information of our symptoms and the corresponding three patients of relation A_2 is given by,

$$A_2 = \begin{bmatrix} (7, 8.5, 10) & (8, 9, 10) & (4, 5, 6) & (6, 7.5, 9) \\ (4, 5, 6) & (3, 4, 5) & (4, 6, 8) & (3, 4, 5) \\ (3, 4.5, 6) & (6, 7, 8) & (3, 5, 7) & (6, 7, 8) \end{bmatrix}.$$

Step (iii).

$$mem(A_1) = \begin{bmatrix} (0.3, 0.4, 0.5) & (0.8, 0.9, 1) \\ (0.6, 0.65, 0.7) & (0.4, 0.55, 0.7) \\ (0.2, 0.35, 0.5) & (0.5, 0.6, 0.7) \\ (0.7, 0.85, 1) & (0.6, 0.75, 0.9) \end{bmatrix}$$

$mem(A_2)$

$$= \begin{bmatrix} (0.7, 0.85, 1) & (0.8, 0.9, 1) & (0.4, 0.5, 0.6) & (0.6, 0.75, 0.9) \\ (0.4, 0.5, 0.6) & (0.3, 0.4, 0.5) & (0.4, 0.6, 0.8) & (0.3, 0.4, 0.5) \\ (0.3, 0.45, 0.6) & (0.6, 0.7, 0.8) & (0.3, 0.5, 0.7) & (0.6, 0.7, 0.8) \end{bmatrix}$$

$$mem(A_1)^c = \begin{bmatrix} (0.7, 0.6, 0.5) & (0.2, 0.1, 0) \\ (0.4, 0.35, 0.3) & (0.6, 0.45, 0.3) \\ (0.8, 0.65, 0.5) & (0.5, 0.4, 0.3) \\ (0.3, 0.15, 0) & (0.4, 0.25, 0.1) \end{bmatrix}$$

$mem(A_2)^c$

$$= \begin{bmatrix} (0.3, 0.15, 0) & (0.2, 0.1, 0) & (0.6, 0.5, 0.4) & (0.4, 0.25, 0.1) \\ (0.6, 0.5, 0.4) & (0.7, 0.6, 0.5) & (0.6, 0.4, 0.2) & (0.7, 0.6, 0.5) \\ (0.7, 0.55, 0.4) & (0.4, 0.3, 0.2) & (0.7, 0.5, 0.3) & (0.4, 0.3, 0.2) \end{bmatrix}$$

Step (iv).

$B = mem(A_1) \odot mem(A_2)^c$

$$= \begin{bmatrix} (0.4, 0.35, 0.4) & (0.5, 0.5, 0.4) \\ (0.7, 0.6, 0.5) & (0.6, 0.6, 0.5) \\ (0.4, 0.4, 0.4) & (0.7, 0.55, 0.4) \end{bmatrix}$$

$C = mem(A_1)^c \odot mem(A_2)$

$$= \begin{bmatrix} (0.7, 0.6, 0.5) & (0.6, 0.45, 0.3) \\ (0.4, 0.6, 0.5) & (0.4, 0.4, 0.3) \\ (0.4, 0.5, 0.5) & (0.6, 0.45, 0.3) \end{bmatrix}$$

$$B\Delta_T C = \begin{bmatrix} (0.49, 0.36, 0.25) & (0.36, 0.2025, 0.09) \\ (0.16, 0.36, 0.25) & (0.16, 0.16, 0.09) \\ (0.16, 0.25, 0.25) & (0.36, 0.2025, 0.09) \end{bmatrix}$$

Step (v). $MAX\,(B\Delta_T C) = \begin{bmatrix} 0.49 & 0.36 \\ 0.36 & 0.16 \\ 0.25 & 0.36 \end{bmatrix}$.

Thus the minimum values of the ij^{th} row denotes the strong confirmation of disease to the patient.

5. Conclusion

The medical analysis representation on triangular fuzzy number matrix is executed in this paper. We conclude by the implementation on triangular fuzzy number matrix under the medical diagnostic model with fuzzy membership matrix values. And it is simple to determine which individual is suffering from which ailment using triplet operator on triangular fuzzy number matrix.

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