Triangular Valued Fuzzy Matrix in Eczema

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Abstract: The field of medicine is the most fruitful and interesting area of applications of Fuzzy Matrix. In real world deals, the representation of the uncertain and in accurate knowledge of medical documentation, parameters of disease diagnosis. In this work Weight Loss or Weight Gain, Excessive Thirst, Frequent Urination, Blurry Visionary, Skin Erosion. We have used the Triangular valued fuzzy number matrices to speak to the medicinal information between the side effects/infections and Patients/Symptoms.

Keywords: Triangular valued fuzzy Matrices, Membership Function, Max – Min Composition on Membership Function of Triangular Valued Fuzzy Number.

1. Introduction

In 1965, Zadeh introduced in notion of fuzzy set theory. In recent years, the Fuzzy Set Theory and Fuzzy Logic have been highly suited and applicable to the development of knowledge-based medical systems for medical findings tasks. Various models involving fuzzy matrices are available for dealing with various complicated aspects of medical diagnosis. Esogbue and Elder used fuzzy cluster analysis to model medical diagnosis. Meenakshi and Kaliraja have extended Sanchez's approach for medical diagnosis using representation of a interval valued fuzzy matrix. They have also introduced the arithmetic mean matrix of an interval valued fuzzy matrix and directly applied Sanchez's method of medical diagnosis on it.

Fuzzy set theory also plays a crucial role in decision making. Decision Making is most important scientific, social and economic Endeavour. Decisions are made under conditions of certainty in classical crisp decision-making theories but in real-life situations this is not possible which gives rise to fuzzy theories of decision-making .One may refer to Bellman and Zadeh for decision making in a fuzzy environment. Most likely the fuzzy decision model, in which the overall ranking or ordering of different fuzzy sets is, determined using Shimura's matrix of comparison, introduced and developed.

This paper is organized as follows: In section 2, basic definition of fuzzy set thepry has been reviewed. In section 3, a novel approach is presented for medical diagnosis which is also an extension of Sanchez's approach which modified procedure using triangular fuzzy matrices and its membership function. A method for fuzzy decision model is proposed in section 4, using new relativity function and matrix comparison. In both the section illustrative example in included demonstrating approach. Section 5, Concludes the paper.

2. Preliminaries:

Definition (2.1):

Triangular Fuzzy Matrix:

Triangular fuzzy number is denoted as,

$$A = (a_1, a_2, a_3), a_1, a_2, a_3 \in R,\ \ a_1 < a_2 < a_3$$

Definition (2.2):

Triangular Fuzzy Number Matrix:

Fuzzy triangular number matrix of order $m \times n$ is known as $A = (a_{ij})_{m\times n}$ where $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijU})$ is the ij^{th} element of A. a_{ijL}, a_{ijU} are respectively $a_{ij}{}'s$ left and right spreads and a_{ijM} is the mean value.

Definition (2.2):

Addition and Subtraction Operation on triangular fuzzy number matrix:

Let $A = (a_{ij})_{n\times n}$ and $B = (b_{ij})_{n\times n}$ be two triangular fuzzy number matrices of same order. Then

(i) Addition Operation:

$A + B = (a_{ij} + b_{ij})_{n\times n}$ Where $(a_{ij} + b_{ij}) = (a_{ijL} + b_{ijL}, a_{ijM} + b_{ijM}, a_{ijU} + b_{ijU})$ is the ij^{th} element of $A + B$.

(ii) Subtraction Operation:

$A - B = (a_{ij} - b_{ij})_{n\times n}$ Where $(a_{ij} - b_{ij}) = (a_{ijL} - b_{ijL}, a_{ijM} - b_{ijM}, a_{ijU} - b_{ijU}$ is the ij^{th} element of $A - B$.

For the triangular fuzzy membership number, the same condition holds.

Definition (2.4):

Multiplication Operation on Triangular Fuzzy Number Matrix:

Let $A = (a_{ij})_{m\times p}$ and $B = (b_{ij})_{p\times n}$ then the Multiplication:

$A(.)B = (c_{ij})_{m\times n}$ Where $(c_{ij}) = \sum_{k=1}^{p} a_{ik} \ . b_{kj}$ for $i = 1,2, \ldots . m \ and \ j = 1,2, \ldots \ldots n.$

Definition (2.5):

Max- Min Composition On Fuzzy Membership Valued Matrices:

Let F_{mn} denote the whole set of all $m \times n$ matrices over F. Elements of F_{mn} are called as Fuzzy membership valued matrices.

For $A = (a_{ij}) \in F_{mn}$ and $B = (b_{ij}) \in F_{pn}$ the max-min product

$$A(.)B = (sup_k[\{\inf\{a_{ik}, b_{ik}\}\}]) \in F_{mn}$$

Definition (2.6):

Maximum Operation on triangular fuzzy number:

Let $A = (a_{ij})_{n\times n}$ where $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijU})$ and $B = (b_{ij})_{n\times n}$ where $b_{ij} = (b_{ijL}, b_{ijM}, b_{ijU})$ be Two Fuzzy triangular matrices of the same order. Then the maximum operation on it is given by

$$L_{max} = \max(A, B) = (\sup\{a_{ij}, b_{ij}\})$$

Where $\sup\{a_{ij}, b_{ij}\} = (\sup(a_{ijL}, b_{ijL}), \sup(a_{ijM}, b_{ijM}), \sup(a_{ijU}, b_{ijU})$ is the ij^{th} element of $\max(A, B)$.

Definition (2.7):

Arithmetic Mean (AM) for triangular fuzzy number:

Let $A = (a_1, a_2, a_3)$ be a triangular fuzzy number then $(A) = \frac{a_1, a_2, a_3}{3}$. For triangular fuzzy membership number, the same condition holds.

MEDICAL DIAGNOSIS UNDER FUZZY ENVIRONMENT:

Let S be the set of disease symptoms D is a set of illnesses, and P is a set of patients. The elements of the matrix with triangular numbers are defined as,

$A = (a_{ij})_{m\times l}$ Where $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijU})$ is the ij^{th} element of A

$$0 \le a_{ijL} \le a_{ijM} \le a_{ijU} \le 10 \qquad (1)$$

Here a_{ijL} is the lower bound, a_{ijM} is the moderate value and a_{ijU} is the upper bound.

Procedure (3.1):

Step 1: Create a triangular fuzzy number matrix (F, D) over S, where F is a mapping of all triangular fuzzy set of S given by, $F: D \to \tilde{F}(S)$. $\tilde{F}(S)$ is a set of all triangular fuzzy set, R_0 represent the matrix, which is the occurrence of the fuzzy set or the triangular fuzzy number of symptoms - disease.

Step 2: Create different triangular fuzzy matrix number (F_1, S) over$P$, where mapping is F_1 given by $F_1: S \to \tilde{F}(P)$ this matrix is denoted by R_s the matrix of the patient's triangular fuzzy number.

Step 3: Convert the triangular fuzzy number matrix elements as follows in its membership function: Membership function of $a_{ij} = (a_{ijL}, a_{ijM}, a_{ijU})$ is defined as ,

$$\mu_{aij} = \left(\frac{a_{ijL}}{10}, \frac{a_{ijM}}{10}, \frac{a_{ijU}}{10}\right), \text{if } 0 \le a_{ijL} \le a_{ijM} \le a_{ijU} \le 10 \qquad (2)$$

$$\text{where } 0 \le \frac{a_{ijL}}{10} \le \frac{a_{ijM}}{10} \le \frac{a_{ijU}}{10} \le 1$$

Now the matrix R_0 and R_S are converted into triangular fuzzy membership matrices namely $(R_0)_{mem}$ and$(R_s)_{mem}$.

Step 4: Calculate the following relation matrices.

$R_1 = (R_s)_{mem}(.)(R_0)_{mem}$ It is calculated using Definition 2.5.

$R_2 = (R_s)_{mem}(.)(J(-)\,(R_0)_{mem})$, where J is the triangular fuzzy membership matrix in which all entries are (1, 1, 1). $(J(-)\,R_0)_{mem}$ Is the complement of and it is called as non symptom-disease triangular fuzzy membership matrix.

$R_3 = (J(-)\,(R_s)_{mem})(.)(R_0)_{mem}$ Where $(J(-)\,(R_s)_{mem}$ is the complement of R_s and it is called as non patient-symptom triangular fuzzy membership matrix.

R_2 and R_3 are calculated using subtraction operation and Definition 2.5.

$R_4 = \max\{R_2, R_3\}$. It is calculated using Definition 2.6. The elements of R_1, R_2, R_3, R_4, R_5 is of the form $y_{ij} = (y_{ijL}, y_{ijM}, y_{ijU})$ where

$$0 \le y_{ijL} \le y_{ijM} \le y_{ijU} \le 10$$

$R_5 = R_1(-)R_4$. It is calculated using subtraction operation. The elements of R_5 is of the form; $z_{ijL} \le Z_{ijM} \le z_{ijU}$.

Step 5: Calculate $R_6 = AM(z_{ij})$ and $Row_i' =$ Maximum of i^{th} row which helps the decision maker to strongly confirm the disease for the patient.

Eczema:

Eczema is a term used for a group of medical conditions which cause inflammation or irritation of the skin. The most common type of eczema is called atopic dermatitis, or eczema that is atopic.

Atopic refers to a group of disorders that tend to develop certain allergic problems, such as asthma and hay fever, also inherited from it.

With proper treatment the diseases often can be controlled. Not curable.

4. Case Study:

There are five patientsP_1, P_2, P_3 . They have difficult symptoms like on the body, Rashes, Dryness, Peeling on skin, Dark colored patches skin, Bumps.

Let the possible causes relating to the above symptoms are abnormal function of immune system, Genetics.

Consider the set $S = \{S_1, S_2, S_3, S_4\}$ as universal sets. Where S_1, S_2, S_3, S_4 represent the Symptoms, Rashes, Dryness, Peeling on skin, Dark colored patches skin, Bumps respectively and the set $D = \{d_1, d_2\}$ Where d_1 and d_2 represent the parameter abnormal function of Immune system, Genetics respectively.

This gives the relation matrix Q called Patient - Symptom Matrix.

Step 1:

$$R_0 = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} (6,7.5,9) & (5,6.5,8) \\ (0,1.5,3) & (3,4,5) \\ (4,4.5,5) & (2,3.5,5) \\ (1,2,3) & (7,8,9) \end{bmatrix} \end{array}$$

Step 2:

$$R_s = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & S_3 & S_4 \end{array} \\ \begin{bmatrix} (5,6.5,8) & (2,3,4) & (7,8,9) & (5,6.5,8) \\ (2,3,4) & (2,4,6) & (1,2,6) & (2,3,4) \\ (5,6,7) & (1,3,5) & (4,5,6) & (1,2.5,4) \end{bmatrix} \end{array}$$

Step 3:

$$(R_0)_{mem} = \begin{array}{c} \\ s_1 \\ s_2 \\ s_3 \\ s_4 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} (0.6,0.75,0.9) & (0.5,0.65,0.8) \\ (0,0.15,0.3) & (0.3,0.4,0.5) \\ (0.4,0.45,0.5) & (0.2,0.35,0.5) \\ (0.1,0.2,0.3) & (0.7,0.8,0.9) \end{bmatrix} \end{array}$$

$$(R_s)_{mem} = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & S_3 & S_4 \end{array} \\ \begin{bmatrix} (0.5,0.65,0.8) & (0.2,0.3,0.4) & (0.7,0.8,0.9) & (0.5,0.65,0.8) \\ (0.2,0.3,0.4) & (0.2,0.4,0.6) & (0.1,0.2,0.6) & (0.2,0.3,0.4) \\ (0.5,0.6,0.7) & (0.1,0.3,0.5) & ().4,0.5,0.6) & (0.1,0.25,0.4) \end{bmatrix} \end{array}$$

Step 4:

Computing the following relation matrices,

$$R_1 = (R_s)_{mem}(.)(R_0)_{mem}$$

$$R_1 = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} (0.5,0.65,0.8) & (0.5,0.65,0.8) \\ (0.2,0.3,0.5) & (0.2,0.4,0.6) \\ (0.5,0.6,0.7) & (0.5,0.65,0.7) \end{bmatrix} \end{array}$$

$$R_2 = (R_s)_{mem}(.)(J(-)(R_0)_{mem})$$

$$R_2 = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \begin{array}{cc} d_1 & d_2 \end{array} \\ \begin{bmatrix} (0.6,0.65,0.7) & (0.7,0.65,0.5) \\ (0.2,0.4,0.6) & (0.2,0.4,0.5) \\ (0.4,0.5,0.5) & (0.5,0.5,0.5) \end{bmatrix} \end{array}$$

$$R_3 = (J(-)(R_s)_{mem})(.)((R_0)_{mem})$$

$$R_3 = \begin{array}{c} \\ p_1 \\ p_2 \\ p_3 \end{array} \begin{array}{c} \\ \begin{bmatrix} (0.5,0.35,0.3) & (0.5,0.4,0.5) \\ (0.6,0.7,0.6) & (0.7,0.7,0.6) \\ (0.5,0.7,0.4) & (0.5,0.75,0.6) \end{bmatrix} \end{array}$$

$$R_4 = \max\{R_2, R_3\}$$

$$R_4 = \begin{matrix} p_1 \\ p_2 \\ p_3 \end{matrix}\begin{bmatrix} (0.6,0.65,0.7) & (0.7,0.65,0.5) \\ (0.6,0.7,0.6) & (0.7,0.7,0.6) \\ (0.5,0.7,0.5) & (0.5,0.75,0.6) \end{bmatrix}$$

$R_5 = R_1(-)R_4$

$$R_5 = \begin{matrix} & d_1 & d_2 \\ p_1 \\ p_2 \\ p_3 \end{matrix}\begin{bmatrix} (-0.1,0,0.1) & (-0.2,0,0.3) \\ (-0.4,-0.4,-0.1) & (0.5,-0.3,0) \\ (0,-0.1,0.2) & (0,-0.1,0.1) \end{bmatrix}$$

$R_6 = AM(Z_{ij})$

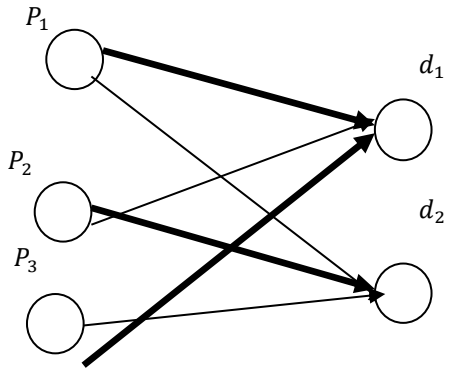
$$R_6 = \begin{bmatrix} 0.1 & 0.03 \\ -0.3 & -0.27 \\ 0.03 & 0 \end{bmatrix}$$

Step 5:

$$Row_i' = Maximum\ of\ i^{th}\ row$$

$$R_6 = \begin{matrix} d_1 & d_2 \end{matrix}\begin{bmatrix} 0.1 & 0.03 \\ -0.3 & -0.27 \\ 0.03 & 0 \end{bmatrix}\begin{matrix} 0.1 \\ -0.27 \\ 0.03 \end{matrix}$$

This can be representing in the form of graph namely network as follows:



In theabove network, nodes or vertices denote the patients and diseases, length or edges denote the diseases to the patients. The darken edges denotes the strong confirmation of dieases to the patients.

Conclusion :

Medicine is one of the areas where the applicability of fuzzy set theory has been recognized early on. The physician generally gathers knowledge about the patients from the past history, laboratory test result and investigative procedures such as x - rays and ultra sonic rays etc. The knowledge given by each of these sources carries varying degrees of uncertainty with it. Thus the most useful description of disease entities often use linguistic terms that are vague.

As fuzzy decision making is a most important scientific, social and economic endeavour, there exist several majore approches within the theories of fuzzy decision making.Hence it can be concluded that the method developed in this paper will be an efficient tool for medical diagnosis and the medico's decision.

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