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Interval Valued Fuzzy Number Matrices on Psoriasis

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Abstract:

Psoriasis is common, over term diseases with no remedy. Datasets that are available for psoriasis describe information about the patients suffering with psoriasis diseases and without psoriasis diseases along with their symptoms like: Swollen joints, irritated skin spots, whitish scales on the red patches, Dry skin that may crack, burning sensations surrounding patches. In this paper we discuss various algorithm approaches of interval valued fuzzy number matrix that have been utilized for psoriasis diseases prediction.

The principle goal of this paper is to classify information and assist the consumer in extracting use complete statistics from information and easily identify an appropriate set of rules for correct predictive version from it. In addition, we prolonged our method inside the quarter addition and multiplication factors of interval valued fuzzy number matrix based on membership and non-membership function. Finally, we presented a decision-making problem based on one of the operations of Interval Valued Fuzzy Matrix.

Keyword: Fuzzy matrix, Interval valued fuzzy matrix, Membership function, Max – Min composition on membership function, Interval valued fuzzy number.

I. Introduction:

Most of our problems in real life in medical science again and again include data that aren't always crisp. Exact and Given the multiple uncertainties involved, determinism with this problem. Due to a number of causes, uncertainty has increased. The medico understands the patients' health status from his past theory, a physical examination, and a test in a laboratory result etc. Thus, the doctor can view the patients' condition and symptoms only with a modest degree of precision. Typically, such uncertainties are handling through the use of fuzzy numbers and fuzzy matrices in medicine involving medical diagnosis and fuzzy decision making for deal with different complicated aspect of medical diagnosis Sanchez's formulated the diagnosis models involving fuzzy matrices representing positive medical expertise relating to symptoms and disease [6,9,10]. Meenakshi and Kaliraja [7] have extended Sanchez's a medical valued fuzzy matrix technique. The Interval Valued Fuzzy Matrix's arithmetic mean matrix was also introduced, and Sanchez's method of diagnosing illnesses was directly applied to it.

An inflammatory disease known as psoriasis causes that a fast increase in pores and skin cells. This accumulation of cells reasons skin-related scanlines floor. Psoriasis may also expand anywhere at the body which includes then Hand, Toes, Neck, Scalp, Face. Much less not unusual sorts of psoriasis have an effect on the nails, the mouth, and the vicinity round genitals.

The survey found that approximately 7.4 million Americans have psoriasis. It frequently co-occurs with a number of other conditions. The symptoms of psoriasis are different from one to another depending on the individual and the psoriasis type.

II.Preliminaries:

Definition (2.1):

Interval Valued Fuzzy Number:

The definition of an interval-valued fuzzy number is,

$$A = [X_1, X_2], X_1, X_2 \in R, X_1 < X_2$$

Definition (2.2):

Interval valued fuzzy number matrix:

Interval valued fuzzy number matrix of order $m \times n$ is represent as

$X = (x_{ij})_{m\times n}$ where $X_{ij} = [X_{ijL}, X_{ijU}]$ (interval valued fuzzy number) is the ij^{th} element of A.

Definition (2.3):

Defuzzification formula of Interval valued fuzzy number:

The defuzzification value t of the interval valued fuzzy number

$X = [x, y]$ is calculated as follows for,

$$x < t < y, (t - x)(1) = (x - t)(1) => x - a = y - t$$
$$=> 2t = x + y$$
$$t = \frac{x+y}{2}$$

This is the Arithmetic Mean of (A) denoted by AM (A). This same condition holds for the membership function of interval valued fuzzy numbers.

Definition (2.4):

New membership function of interval valued fuzzy number:

Membership Function $x_{ij} = \left[x_{ijL}, x_{ijU}\right]$ is defined as,

$\mu_{x_{ij}} = \left[\frac{x_{ijL}}{10}, \frac{x_{ijU}}{10}\right]$ if $0 \le X_{ijL} \le x_{ijL} \le x_{ijU} \le 10$

Where $0 \le \frac{X_{ijL}}{10} \le \frac{X_{ijU}}{10} \le 1$.

Definition (2.5):

Arithmetic Operation of Interval Valued Fuzzy Number Matrix:

Let $X = (x_{ij})_{m\times n}$ and $Y = (y_{ij})_{m\times n}$ be two interval valued fuzzy number matrices of same order. Then,

(i) Addition Operation:

$X \oplus Y = (x_{ij} + y_{ij})_{m\times n}$ Where $X_{ij} + Y_{ij} = \left[x_{ijL} + y_{ijL}, X_{ijU} + Y_{ijU}\right]$ is the ij^{th} element of $X(+)Y$.

(ii) Subtraction Operation:

$X(-)Y = (x_{ij} - y_{ij})_{m\times n}$ Where $X_{ij} - Y_{ij} = \left[x_{ijL} - y_{ijL}, X_{ijU} - Y_{ijU}\right]$ is the ij^{th} element of $X(-)Y$.

Medical diagnosis based on Interval Valued Fuzzy Number Matrices. The same condition holds for interval valued fuzzy membership number.

Definition (2.6):

Max – Min Composition on membership Function of interval valued fuzzy numbers:

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

For $X = (x_{ij}) \in F_{mp}$ and $Y = (y_{ij}) \in F_{pn}$ the Max – Min Product.

$$X.Y = \left[{}^{Sup}_{k}\{\text{inf}\left\{X_{iK}, Y_{kj}\right\}\}\right] \in F_{mn}$$

Definition (2.7):

Maximum / Minimum Operation on interval valued fuzzy number:

Let $X = (a_{ij})_{m\times n}$ where $X_{ij} = [x_{ijL}, X_{ijU}]$ and $Y = (y_{ij})_{m\times n}$ where $[Y_{ijL}, Y_{ijU}]$ be two interval valued fuzzy number matrices of is given by,

$$L_{mn} = Max(X, Y) = \sup\{X_{ij}, b_{ij}\})$$

Where $Sup\{X_{ij}, Y_{ij}\} = (Sup\left[X_{ijL}, b_{ijL}\right]$, is the ij^{th} element of max (x, y)

The minimum operation on it is given by,

$$L_{min} = Min(X, Y) = (\text{inf}\{X_{ij}, b_{ij}\})$$

Where inf $\left\{X_{ij}, b_{ij}\right\} = (\text{inf}\left[x_{ijL}, Y_{ijL}\right]$, inf $[X_{ijU}, Y_{ijU}]$ is the ij^{th} element of min (X, Y)). The same holds for membership function of interval valued fuzzy numbers.

Definition (2.8):

Psoriasis:

A skin condition called psoriasis that reason red, itchy, scaly patches, maximum commonly on the knees, elbows, trunk and scalp. Psoriasis is a common, long term illness with incurable. It tends to go through cycles, flaring for a few week or months, then settling down or entering remission.

You can manage your symptoms with the help of treatments. And you may contain way of life behavior and coping techniques to help you stay higher with psoriasis.

III. Algorithm:

Step 1: Interval-valued fuzzy matrices that are constructed (F, C) over S and (F, S) over P use the health records presently on site. Here F is a mapping given by $F: C \to \tilde{F}(S)$. The interval valued fuzzy matrix given the relation matrix $R_I$called symptoms disease Matrix F_I is a mapping given by $F_I: S \to \tilde{F}(P)$. This interval valued fuzzy matrix gives the relation Matrix R called patient – symptoms matrix.

Step 2: Invent the compliment $(F, C)^C$ gives another relation matrix say

R_2 called non- symptoms disease matrix that is $R_2 = J - R_1$ where $J = [10,10]$.

Step 3: Convert $R_1, Q, R_2\ to\ (R_1)_{mem}, (Q)_{mem}, (R_2)_{mem}$ using new Membership function of interval valued fuzzy number.

Step 4: Calculate the disease using the relational matrix below.

(i) $(R_3)_{mem} = (Q)_{mem}(.)\ (R_1)_{mem} \in [0,1]$

(ii) $(R_4)_{mem} = (Q)_{mem}\ (.)\ (R_2)_{mem}\ \in [0,1]$

(iii) $(R_5)_{mem} = AM(R_3)_{mem} - AM(R_4)_{mem}\ \in [-1,1]$

Determine each row's highest value in a matrix $(R_5)_{mem}$ this provides patients with a solid diagnosis of their ailment

IV. Case Study:

There are five patients P_1, P_2, P_3, P_4, P_5. They have difficult symptoms like on the body,

1. Pain Full, Swollen Joints,
2. Red, Raised, Inflamed patches of skin,
3. Whitish – silver scales on the red patches,
4. Dry skin that may cracked and bleed,
5. Itchy and burning sensations around patches.

immune system should be considered as one of the potential reasons of the symptoms and genetic problem.

Consider the set $S = S_1, S_2, S_3, S_4, S_5$ as universal sets. Where S_1, S_2, S_3, S_4, S_5 represent the symptoms, pain full, swollen joints, Red, Raised, Inflamed patches of skin, Whitish – silver scales on the red patches, Dry skin that may cracked and bleed, Itchy and burning sensations around patches respectively and the set $C = \{C_1, C_2\}$ where C_1 and C_2 represent the parameter immune system and genetic play a role respectively.

This gives relation matrix Q called patient – symptom matrix.

$$R_1 = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{array}{c} \begin{array}{cc} C_1 & C_2 \end{array} \\ \begin{pmatrix} (7,10) & (4,6) \\ (5,8) & (3,6) \\ (4,6) & (1,4) \\ (2,4) & (5,7) \\ (8,10) & (7,7) \end{pmatrix} \end{array}$$

And

$$Q = \begin{array}{c} \\ P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \end{array} \begin{array}{c} \begin{array}{ccccc} S_1 & S_2 & S_3 & S_4 & S_5 \end{array} \\ \begin{pmatrix} (3,5) & (8,10) & (6,10) & (4,8) & (4,7) \\ (6,8) & (6,9) & (8,12) & (3,6) & (6,10) \\ (2,6) & (3,5) & (10,16) & (4,7) & (4,8) \\ (5,7) & (2,5) & (2,8) & (3,5) & (3,9) \\ (2,5) & (3,7) & (6,9) & (5,9) & (2,6) \end{pmatrix} \end{array}$$

Case 2:

$R_2 = J - R_1$ where $J = 10$

$$R_2 = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{array}{c} \begin{array}{cc} C_1 & C_2 \end{array} \\ \begin{pmatrix} (3,0) & (6,4) \\ (5,2) & (7,4) \\ (8,4) & (9,6) \\ (8,6) & (5,3) \\ (2,0) & (3,3) \end{pmatrix} \end{array}$$

Case 3:

$$(R_1)_{mem} = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{array}{c} \begin{array}{cc} C_1 & C_2 \end{array} \\ \begin{pmatrix} (0.7,0.1) & (0.4,0.6) \\ (0.5,0.8) & (0.3,0.6) \\ (0.4,0.6) & (0.1,0.4) \\ (0.2,0.4) & (0.5,0.7) \\ (0.8,0.1) & (0.7,0.7) \end{pmatrix} \end{array}$$

$$(R_2)_{mem} = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{array}{c} \begin{array}{cc} C_1 & C_2 \end{array} \\ \begin{pmatrix} (0.3,0) & (0.6,0.4) \\ (0.5,0.2) & (0.7,0.4) \\ (0.6,0.4) & (0.9,0.6) \\ (0.8,0.6) & (0.5,0.3) \\ (0.2,0.0) & (0.3,0.3) \end{pmatrix} \end{array}$$

And

$$(Q)_{mem} = \begin{array}{c} \begin{array}{ccccc} S_1 & S_2 & S_3 & S_4 & S_5 \end{array} \\ \begin{pmatrix} (0.3,0.5) & (0.8,0.1) & (0.6,0.1) & (0.4,0.8) & (0.4,0.7) \\ (0.6,0.8) & 0.6,0.9) & (0.8,0.1) & (0.3,0.6) & (0.6,0.1) \\ (0.2,0.6) & (0.3,0.5) & (0.1,0.1) & (0.4,0.7) & (0.4,0.8) \\ (0.5,0.7) & (0.2,0.5) & (0.2,0.8) & (0.3,0.5) & (0.3,0.9) \\ (0.2,0.5) & (0.3,0.7) & (0.6,0.9) & (0.5,0.9) & (0.2,0.6) \end{pmatrix} \end{array}$$

Case 4:

$$(R_3)_{mem} = Q_{mem} - (R_1)_{mem}$$

$$(R_3)_{mem} = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{array}{c} \begin{array}{cc} C_1 & C_2 \end{array} \\ \begin{pmatrix} (0.5,0.4) & (0.4,0.7) \\ (0.6,0.4) & (0.6,0.6) \\ (0.4,0.4) & (0.4,0.7) \\ (0.5,0.6) & (0.3,0.7) \\ (0.4,0.6) & (0.5,0.7) \end{pmatrix} \end{array}$$

$C_1 \quad C_2$

$$A(R_3)_{mem} = \begin{pmatrix} 0.45 & 0.55 \\ 0.5 & 0.6 \\ 0.4 & 0.55 \\ 0.55 & 0.5 \\ 0.5 & 0.6 \end{pmatrix}$$

$$(R_4)_{mem} = Q_{mem} - (R_2)_{mem}$$

$$(R_4)_{mem} = \begin{matrix} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{matrix} \begin{matrix} C_1 \\ \begin{pmatrix} (0.6,0.6) \\ (0.6,0.6) \\ (0.4,0.6) \\ (0.3,0.4) \\ (0.6,0.6) \end{pmatrix} \end{matrix} \begin{matrix} C_2 \\ \begin{pmatrix} (0.7,0.4) \\ (0.8,0.4) \\ (0.4,0.4) \\ (0.5,0.6) \\ (0.6,0.6) \end{pmatrix} \end{matrix}$$

$$A(R_4)_{mem} = \begin{matrix} C_1 & C_2 \\ \begin{pmatrix} 0.6 & 0.6 \\ 0.6 & 0.6 \\ 0.5 & 0.8 \\ 0.4 & 0.6 \\ 0.6 & 0.6 \end{pmatrix} \end{matrix}$$

Finally,

$$(R_5)_{mem} = A(R_3)_{mem} - A(R_4)_{mem}$$

Row $W_i = maximum\ of\ i^{th}\ row$

$$(R_5)_{mem} = \begin{matrix} \\ P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \end{matrix} \begin{matrix} C_1 & C_2 \\ \begin{pmatrix} 0.1 & 0.0 \\ -0.1 & 0.0 \\ -0.1 & 0.15 \\ 0.2 & -0.05 \\ -0.1 & 0 \end{pmatrix} \end{matrix} \begin{matrix} \\ 0.1 \\ 0.0 \\ 0.15 \\ 0.2 \\ 0.0 \end{matrix}$$

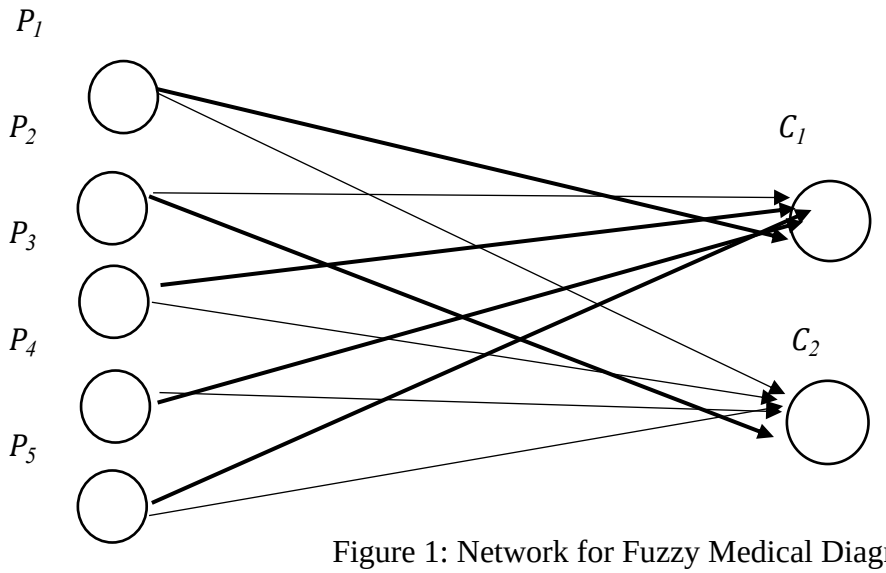

Figure 1: Network for Fuzzy Medical Diagnosis.

The darkened edges in the above network indicate that a patient's illness has been strongly confirmed. Hence, we determine that Persons P_1, P_2, P_3, P_4, P_5 are suffering from the cause C_2 and the patients $P_3$is suffering from the Cause C_1 .

Conclusion:

One industry where fuzzy numbers and fuzzy matrices have great applicability is medicine. 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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