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Interval Valued Intuitionistic Fuzzy Soft Matrix in Medical Diagnosis

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Abstract

In our day to day life we often faces some problems due to uncertainties so that the decision making is highly essential. In this paper, the concept of Interval Valued Intuitionistic Fuzzy soft Matrix is applied to solve the problem in medical diagnosis. Here we extend Sanchez's approach of medical diagnosis through the Geometric mean and Harmonic mean method of IVIFSM to obtain the solution with an algorithm using various parameters.

Keywords: Fuzzy soft set, Fuzzy soft matrix, Interval Valued Intuitionistic Fuzzy, soft Matrix, Geometric and Harmonic mean

1. Introduction:

The main concept of fuzzy is based on uncertainties. In that case, they do not provide a clear orientation for the decision-making. To reduce this fuzziness, perhaps by applying fuzzy logic or fuzzy set, would generate more certainty. Zadeh's[9] classical concept of fuzzy set is strong to deal with such type of problems. Atanassov[7,8] introduced theory of intuitionistic fuzzy set as a generalization of fuzzy set. Soft set theory has received much attention since its introduction by Molodtsov[4]. Later Maji et al[12,13] extended fuzzy soft sets to intuitionistic fuzzy soft sets which is based on the combination of the intuitionistic fuzzy set and soft set. Yang et al[17] presented the concept of the interval valued fuzzy soft sets.

The concept of fuzzy matrix was studied by Borah et al[11] which is used for dealing with the uncertainties present in the most of our real life situations. It is a list of values in rows and columns that allows an analyst to systematically identify, analyze and make decision between the set of values and information. By using this representation we have discussed the consistency of Interval valued fuzzy relational equation. Thomason[10] published the first work on fuzzy matrices and this work based on the max-min operation. P.Rajarajeswari and P.Dhanalakshmi[15] have introduced interval valued fuzzy soft matrix, its types with examples and some new operations on the basis of weights. The concept of interval valued intuitionistic fuzzy soft matrix is a generalization of intuitionistic fuzzy soft matrix.

In this paper, we have extended sanchez's concept for the medical diagnosis approach. The significance of introducing interval valued geometric and harmonic mean method of intuitionistic fuzzy soft matrix is to avoid tedious representation by using simpler calculations.

2. Preliminaries:

2.1 Fuzzy set:

If X is a universal set and x is an element of X, then a fuzzy set A defined on X may be written as the collection of ordered pairs, $A=\{(x,\mu_{A(x)}),x\epsilon X\}$.Where $\mu_{A(x)}$ is the membership function that contains 0 or 1 as its value.

2.2 Fuzzy Soft set:

A soft set over a universal set X and set of parameters E is a pair (f, A) where A is a subset of E, and f is a function from A to the power set of X. For each e in A, the set f(e) is called the value set of e in (f, A).

2.3 Interval valued fuzzy soft set:

Let X be an initial Universe set and E be the set of parameters, let A ⊆ E. A pair (F,A) is called Interval valued fuzzy soft set over X where F is a mapping given by F: $A\to I^X$ where I^X denotes the collection of all Interval valued fuzzy subsets of X

2.4 Fuzzy Matrix:

A fuzzy matrix A of order m x n is defined $A= [a_{ij}, a_{ij}\mu]_{mxn}$, where $a_{ij}\mu$ is the membership value and $a_{ij}\mu \epsilon [0, 1]$. We write this matix as $A= [a_{ij}\mu]_{mxn}$

2.5 Fuzzy Soft Matrices:

Let X= $\{a_1,a_2,a_3…a_m\}$ be the Universal set and E be the set of parameters given by $E=\{e_1,e_2,e_3…e_n\}$. Let $A \subseteq E$ and (F,A) be a fuzzy soft set in the fuzzy soft class (X,E). Then fuzzy soft set (F,A) in a matrix form as $A_{mxn} =[a_{ij}]_{mxn}$, i=1,2,…m, j=1,2,3,…..n. Where $a_{ij} = \{\mu_j(a_i), e_j \epsilon A$ and $0, e_j \notin A\}$, $\mu_j(a_i)$ represents the membership of a_i in the fuzzy set $F(e_j)$.

2.6 Interval valued fuzzy soft matrix:

Let $X=\{a_1,a_2,a_3…a_m\}$ be an Universal set and E be the set of parameters given by $E=\{e_1,e_2,e_3…e_n\}$.Let $A \subseteq E$ and (F,A) be a interval valued fuzzy soft set over X, where F is a mapping given by F: $A \rightarrow I^X$, where I^X denotes the collection of all interval valued fuzzy subsets of X. Then the interval valued fuzzy soft set can be expressed in matrix form as $A_{mxn} = [a_{ij}]_{mxn}$, i=1,2,…m, j=1,2,3,…n. Where $a_{ij} =\{[\mu_{jL}(a_i), \mu_{jU}(a_i)]$ if $e_j \epsilon A$ and $[0,0]$ if $e_j \notin A\}$

2.7 Intuitionistic fuzzy soft matrix:

Let $X=\{a_1,a_2,a_3…a_m\}$ be an Universal set and E be the set of parameters given by $E=\{e_1,e_2,e_3…e_n\}$.Let $A \subseteq E$ and (F,A) be a intuitionistic fuzzy soft set over X, where F is a mapping given by F: $A \rightarrow I^X$, This can be expressed in matrix form as $A_{mxn} = [a_{ij}]_{mxn}$, i=1,2,…m, j=1,2,3,…n. Where $a_{ij} =\{[\mu_j(a_i), \nu_j(a_i)]$ if $e_j \epsilon A$ and $[0,1]$ if $e_j \notin A\}$. $\mu_j(a_i)$ is the membership value and $\nu_j(a_i)$ is the non-membership value.

2.8 Interval valued Intuitionistic fuzzy soft matrix:

Let $X=\{a_1,a_2,a_3…a_m\}$ be an Universal set and E be the set of parameters given by $E=\{e_1,e_2,e_3…e_n\}$.Let $A \subseteq E$ and (F,A) be a interval valued intuitionistic fuzzy soft set over X, where F is a mapping given by F: $A \rightarrow I^X$. This can be expressed in matrix form as $A_{mxn} = [a_{ij}]_{mxn}$, i=1,2,…m, j=1,2,3,…n. Where $a_{ij} = \{[\mu_{jL}(a_i), \mu_{jU}(a_i)] [\nu_{jL}(a_i), \nu_{jU}(a_i)]$ if $e_j \epsilon A$ and $[0,0] [1,1]$ if $e_j \notin A\}$. In this $[\mu_{jL}(a_i), \mu_{jU}(a_i)]$ represents the membership values and $[\nu_{jL}(a_i), \nu_{jU}(a_i)]$ represents the non-membership values.

2.9 Interval valued intuitionistic fuzzy soft complement matrix:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM where $[a_{ij}] = \{[\mu_{jL}(a_i), \mu_{jU}(a_i)] [\nu_{jL}(a_i), \nu_{jU}(a_i)]\}$. Then A^c is called interval-valued intuitionistic fuzzy soft complement matrix if $A^c = [b_{ij}]_{mxn}$, where $[b_{ij}]= \{[\nu_{jL}(a_i), \nu_{jU}(a_i)] [\mu_{jL}(a_i), \mu_{jU}(a_i)]\}$

2.10 Addition of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}=[b_{ij}]_{mxn}$, then the sum of A and B denoted by $A+B = [c_{ij}]_{mxn} = \{[max(\mu_{AL}, \mu_{BL}), max(\mu_{AU}, \mu_{BU})], [min(\nu_{AL}, \nu_{BL}), min(\nu_{AU}, \nu_{BU})]\}$

2.11 Subtraction of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}=[b_{ij}]_{mxn}$, then the subtraction of A and B denoted by $A\text{-}B = [c_{ij}]_{mxn} = \{[min(\mu_{AL}, \mu_{BL}), min(\mu_{AU}, \mu_{BU})], [max(\nu_{AL}, \nu_{BL}), max(\nu_{AU}, \nu_{BU})]\}$

2.12 Product of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}=[b_{ij}]_{mxn}$, then the product of A and B denoted by $A*B = [c_{ij}]_{mxn} = \{[maxmin(\mu_{AL},\mu_{BL}),maxmin(\mu_{AU},\mu_{BU})], [minmax(\nu_{AL,}\nu_{BL}), minmax(\nu_{AU,}\nu_{BU})]\}$

2.13 Max Min Composition of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}=[b_{ij}]_{mxn}$, then the maxmin composition of A and B denoted by $A\$B = [c_{ij}]_{mxn} = \{[max(min(\mu_{AL},\mu_{BL})), max(min(\mu_{AU},\mu_{BU}))],[min(max(\nu_{AL,}\nu_{BL})), min(max(\nu_{AU,}\nu_{BU}))]\}$

2.14 Geometric Mean of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}=[b_{ij}]_{mxn}$, then the interval valued geometric mean is denoted by $A@B = [c_{ij}]_{mxn} = \sqrt{\{[(\mu_{AL}.\mu_{AU}), (\nu_{AL}.\nu_{AU})], [(\mu_{BL}.\mu_{BU}), (\nu_{BL}.\nu_{BU})]\}}$

2.15 Harmonic Mean of IVIFSM:

If $A_{mxn}=[a_{ij}]_{mxn}$ be IVIFSM, $B_{mxn}= [b_{ij}]_{mxn}$, then the interval valued harmonic mean is denoted by $A\$B = [c_{ij}]_{mxn} = \{[(2.\mu_{AL}.\mu_{AU})/(\mu_{AL}+\mu_{AU}),(2.\nu_{AL}.\nu_{AU})/(\nu_{AL}+\nu_{AU})],[(2.\mu_{BL}.\mu_{BU})/(\mu_{BL}+\mu_{BU}), (2.\nu_{BL}.\nu_{BU})/(\nu_{BL}+\nu_{BU})]\}$

3. Interval Valued Intuitionistic Fuzzy Soft Matrix:

3.1 Working Rule:

Step 1: Give the input of the Interval Valued Intuitionistic Fuzzy Soft Sets (F,A) and $(F,A)^c$ over the sets of symptoms in relation matrices $\tilde{A}_1$ and $\tilde{A}_2$,

$$\tilde{A}_1 = \{[(\tilde{A}_{1L}\mu_1, \tilde{A}_{1R}\mu_1),(\tilde{A}_{1L}\nu_1, \tilde{A}_{1R}\nu_1)] \quad [(\tilde{A}_{1L}\mu_2, \tilde{A}_{1R}\mu_2),(\tilde{A}_{1L}\nu_2, \tilde{A}_{1R}\nu_2)]\}$$

$$\tilde{A}_2 = \{[(\tilde{A}_{2L}\mu_1, \tilde{A}_{2R}\mu_1),(\tilde{A}_{2L}\nu_1, \tilde{A}_{2R}\nu_1)] \quad [(\tilde{A}_{2L}\mu_2, \tilde{A}_{2R}\mu_2),(\tilde{A}_{2L}\nu_2, \tilde{A}_{2R}\nu_2)]\}$$

Where A is the set of diseases, μ is the Membership values and ν is the Non-Membership values.

Step 2: Input the IVIFSS (F_1,S) over the set of patients and write its relation matrix R.

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$R = \{[(R_L\mu_1, R_R\mu_1),(R_L\nu_1, R_R\nu_1)] \quad [(R_L\mu_2, R_R\mu_2),(R_L\nu_2, R_R\nu_2)]\}$

Step 3: By using the definition, find the Geometric Mean for the matrix $\tilde{A}_1$ and $\tilde{A}_2$,

$$gm(\tilde{A}_1) = \sqrt{\{[(\tilde{A}_{1L}\mu_1 \cdot \tilde{A}_{1R}\mu_1), (\tilde{A}_{1L}\nu_1 \cdot \tilde{A}_{1R}\nu_1)] \; [(\tilde{A}_{1L}\mu_2 \cdot \tilde{A}_{1R}\mu_2), (\tilde{A}_{1L}\nu_2 \cdot \tilde{A}_{1R}\nu_2)]\}}$$

$$gm(\tilde{A}_2) = \sqrt{\{[(\tilde{A}_{2L}\mu_1 \cdot \tilde{A}_{2R}\mu_1), (\tilde{A}_{2L}\nu_1 \cdot \tilde{A}_{2R}\nu_1)] \; [(\tilde{A}_{2L}\mu_2 \cdot \tilde{A}_{2R}\mu_2), (\tilde{A}_{2L}\nu_2 \cdot \tilde{A}_{2R}\nu_2)]\}}$$

$$gm(R) = \sqrt{\{[(R_L\mu_1 \cdot R_R\mu_1), (R_L\nu_1 \cdot R_R\nu_1)] \; [(R_L\mu_2 \cdot R_R\mu_2), (R_L\nu_2 \cdot R_R\nu_2)]\}}$$

Step 4: Combining the relation matrices $gm(\tilde{A}_1)$ and $gm(\tilde{A}_2)$ separately with $gm(R)$ under the max.min composition we get,

$$T_1 = gm(R) \cdot gm(\tilde{A}_1)$$
$$T_2 = gm(R) \cdot gm(\tilde{A}_2)$$
$$T_3 = gm(R) \cdot [J - gm(\tilde{A}_1)]$$
$$T_4 = gm(R) \cdot [J - gm(\tilde{A}_2)]$$

Where J is the matrix with all entries 1.

Step 5: Compute the scores of diagnosis S_{T1} and S_{T2},

$$S_{T1} = [\max(\mu_1, \mu_2), \min(\nu_1, \nu_2)] \text{ for } (T_1,T_4)$$
$$S_{T2} = [\max(\mu_1, \mu_2), \min(\nu_1, \nu_2)] \text{ for } (T_2,T_3)$$

Step 6: Find the total score using,

$$S = [(\mu_1+\mu_2)/2, (\nu_1-\nu_2)/2]$$

Step 7: The same algorithm is used for the Harmonic Mean for the matrix $\tilde{A}_1$ and $\tilde{A}_2$ by using the definition,

$$hm(\tilde{A}_1)=\{[(2\cdot\tilde{A}_{1L}\mu_1\cdot\tilde{A}_{1R}\mu_1)/(\tilde{A}_{1L}\mu_1+\tilde{A}_{1R}\mu_1), (2\cdot\tilde{A}_{1L}\nu_1\cdot\tilde{A}_{1R}\nu_1)/(\tilde{A}_{1L}\nu_1+\tilde{A}_{1R}\nu_1)] \; [(2\cdot\tilde{A}_{1L}\mu_2\cdot\tilde{A}_{1R}\mu_2)/(\tilde{A}_{1L}\mu_2+\tilde{A}_{1R}\mu_2), (2\cdot\tilde{A}_{1L}\nu_2\cdot\tilde{A}_{1R}\nu_2)/(\tilde{A}_{1L}\nu_2\cdot\tilde{A}_{1R}\nu_2)]\}$$

$$hm(\tilde{A}_2)=\{[(2\cdot\tilde{A}_{2L}\mu_1\cdot\tilde{A}_{2R}\mu_1)/(\tilde{A}_{2L}\mu_1+\tilde{A}_{2R}\mu_1), (2\cdot\tilde{A}_{2L}\nu_1\cdot\tilde{A}_{2R}\nu_1)/(\tilde{A}_{2L}\nu_1+\tilde{A}_{2R}\nu_1)] \; [(2\cdot\tilde{A}_{2L}\mu_2\cdot\tilde{A}_{2R}\mu_2)/(\tilde{A}_{2L}\mu_2+\tilde{A}_{2R}\mu_2), (2\cdot\tilde{A}_{2L}\nu_2\cdot\tilde{A}_{2R}\nu_2)/(\tilde{A}_{2L}\nu_2\cdot\tilde{A}_{2R}\nu_2)]\}$$

$$hm(R)=\{[(2\cdot R_L\mu_1\cdot R_R\mu_1)/(R_L\mu_1+R_R\mu_1), (2\cdot R_L\nu_1\cdot R_R\nu_1)/(R_L\nu_1+R_R\nu_1)] \; [(2\cdot R_L\mu_2\cdot R_R\mu_2)/(R_L\mu_2+R_R\mu_2), (2\cdot R_L\nu_2\cdot R_R\nu_2)/(R_L\nu_2\cdot R_R\nu_2)]\}$$

Step 8: Combining the relation matrices $hm(\tilde{A}_1)$ and $hm(\tilde{A}_2)$ separately with $hm(R)$ under the max.min composition we get,

$$T_1 = hm(R) \cdot hm(\tilde{A}_1)$$
$$T_2 = hm(R) \cdot hm(\tilde{A}_2)$$
$$T_3 = hm(R) \cdot [J - hm(\tilde{A}_1)]$$
$$T_4 = hm(R) \cdot [J - hm(\tilde{A}_2)]$$

Where J is the matrix with all entries 1.

Step 9: Determine the total score as given in the step 5 and step 6.

3.2 Example:

Consider [1],

$F(d_1)=\{(e_1,[0.5,0.6],[0.3,0.4]),(e_2,[0.4,0.5],[0.2,0.3]),(e_3,[0.7,0.8],[0.1,0.2]), (e_4,[0.3,0.4],[0.4,0.5])\}$

$F(d_2)=\{(e_1,[0.4,0.5],[0.3,0.4]),(e_2,[0.7,0.8],[0.1,0.2]),(e_3,[0.6,0.7],[0.2,0.3]), (e_4,[0.1,0.2],[0.5,0.6])\}$

$\tilde{A}_1=$

$$\begin{bmatrix} & d1 & d2 \\ e1 & [0.5,0.6][0.3,0.4] & [0.4,0.5][0.3,0.4] \\ e2 & [0.4,0.5][0.2,0.3] & [0.7,0.8][0.1,0.2] \\ e3 & [0.7,0.8][0.1,0.2] & [0.6,0.7][0.2,0.3] \\ e4 & [0.3,0.4][0.4,0.5] & [0.1,0.2][0.5,0.6] \end{bmatrix}$$

$\tilde{A}_2= (\tilde{A}_1)^c$

$\tilde{A}_2=$

$$\begin{bmatrix} & d1 & d2 \\ e1 & [0.3,0.4][0.5,0.6] & [0.3,0.4][0.4,0.5] \\ e2 & [0.2,0.3][0.4,0.5] & [0.1,0.2][0.7,0.8] \\ e3 & [0.1,0.2][0.7,0.8] & [0.2,0.3][0.6,0.7] \\ e4 & [0.4,0.5][0.3,0.4] & [0.5,0.6][0.1,0.2] \end{bmatrix}$$

$F(e_1)=\{(p_1,[0.6,0.7],[0.2,0.3]),(p_2,[0.4,0.5],[0.3,0.4]),(p_3,[0.5,0.6],[0.1,0.2])\}$

$F(e_2)=\{(p_1,[0.5,0.6],[0.1,0.2]),(p_2,[0.3,0.4],[0.4,0.5]),(p_3,[0.6,0.7],[0.2,0.3])\}$

$F(e_3)=\{(p_1,[0.3,0.4],[0.4,0.5]),(p_2,[0.6,0.7],[0.2,0.3]),(p_3,[0.2,0.3],[0.5,0.6])\}$

$F(e_4)=\{(p_1,[0.4,0.5],[0.2,0.3]),(p_2,[0.7,0.8],[0.1,0.2]),(p_3,[0.3,0.4],[0.4,0.5])\}$

R=

$$\begin{bmatrix} & e1 & e2 & e3 & e4 \\ P1 & [0.6,0.7][0.2,0.3] & [0.5,0.6][0.1,0.2] & [0.3,0.4][0.4,0.5] & [0.4,0.5][0.2,0.3] \\ P2 & [0.4,0.5][0.3,0.4] & [0.3,0.4][0.4,0.5] & [0.6,0.7][0.2,0.3] & [0.7,0.8][0.1,0.2] \\ P3 & [0.5,0.6][0.1,0.2] & [0.6,0.7][0.2,0.3] & [0.2,0.3][0.5,0.6] & [0.3,0.4][0.4,0.5] \end{bmatrix}$$

$$\tilde{A}_{1L} = \begin{bmatrix} & d1 & d2 \\ e1 & [0.5,0.3] & [0.4,0.3] \\ e2 & [0.4,0.2] & [0.7,0.1] \\ e3 & [0.7,0.1] & [0.6,0.2] \\ e4 & [0.3,0.4] & [0.1,0.5] \end{bmatrix}$$

$$\tilde{A}_{1R} = \begin{bmatrix} & d1 & d2 \\ e1 & [0.6,0.4] & [0.5,0.4] \\ e2 & [0.5,0.3] & [0.8,0.2] \\ e3 & [0.8,0.2] & [0.7,0.3] \\ e4 & [0.4,0.5] & [0.2,0.6] \end{bmatrix}$$

$$\tilde{A}_{2L} = \begin{bmatrix} & d1 & d2 \\ e1 & [0.3,0.5] & [0.3,0.4] \\ e2 & [0.2,0.4] & [0.1,0.7] \\ e3 & [0.1,0.7] & [0.2,0.6] \\ e4 & [0.4,0.3] & [0.5,0.1] \end{bmatrix} \quad \tilde{A}_{2R} = \begin{bmatrix} & d1 & d2 \\ e1 & [0.4,0.6] & [0.4,0.5] \\ e2 & [0.3,0.5] & [0.2,0.8] \\ e3 & [0.2,0.8] & [0.3,0.7] \\ e4 & [0.5,0.4] & [0.6,0.2] \end{bmatrix}$$

$$R_L = \begin{bmatrix} & e1 & e2 & e3 & e4 \\ P1 & [0.6,0.2] & [0.5,0.1] & [0.3,0.4] & [0.4,0.2] \\ P2 & [0.4,0.3] & [0.3,0.4] & [0.6,0.2] & [0.7,0.1] \\ P3 & [0.5,0.1] & [0.6,0.2] & [0.2,0.5] & [0.3,0.4] \end{bmatrix}$$

$$R_R = \begin{bmatrix} & e1 & e2 & e3 & e4 \\ P1 & [0.7,0.3] & [0.6,0.2] & [0.4,0.5] & [0.5,0.3] \\ P2 & [0.5,0.4] & [0.4,0.5] & [0.7,0.3] & [0.8,0.2] \\ P3 & [0.6,0.2] & [0.7,0.3] & [0.3,0.6] & [0.4,0.5] \end{bmatrix}$$

Now, we calculate the Geometric Mean for the above matrices using Step3 in the algorithm,

$$gm(\tilde{A}_1) = \begin{bmatrix} & d1 & d2 \\ e1 & [0.55,0.35] & [0.45,0.35] \\ e2 & [0.45,0.24] & [0.75,0.14] \\ e3 & [0.75,0.14] & [0.65,0.24] \\ e4 & [0.35,0.45] & [0.14,0.55] \end{bmatrix}$$

$$gm(\tilde{A}_2) = \begin{bmatrix} & d1 & d2 \\ e1 & [0.35,0.55] & [0.35,0.45] \\ e2 & [0.24,0.45] & [0.14,0.75] \\ e3 & [0.14,0.75] & [0.24,0.65] \\ e4 & [0.45,0.35] & [0.55,0.14] \end{bmatrix}$$

$$gm(R) = \begin{bmatrix} & e1 & e2 & e3 & e4 \\ P1 & [0.65,0.24] & [0.55,0.14] & [0.35,0.45] & [0.45,0.24] \\ P2 & [0.45,0.35] & [0.35,0.45] & [0.65,0.24] & [0.75,0.14] \\ P3 & [0.55,0.14] & [0.65,0.24] & [0.24,0.55] & [0.35,0.45] \end{bmatrix}$$

By using Step4, the above geometric matrices are combined using maxmin composition,

$$T_1 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.24] & [0.55,0.14] \\ P2 & [0.65,0.24] & [0.65,0.24] \\ P3 & [0.55,0.24] & [0.65,0.24] \end{bmatrix} \quad T_2 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.45,0.35] & [0.45,0.24] \\ P2 & [0.45,0.35] & [0.55,0.14] \\ P3 & [0.35,0.45] & [0.35,0.45] \end{bmatrix}$$

$$T_3 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.55] & [0.55,0.45] \\ P2 & [0.65,0.55] & [0.75,0.45] \\ P3 & [0.55,0.55] & [0.55,0.45] \end{bmatrix} \quad T_4 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.65,0.45] & [0.65,0.25] \\ P2 & [0.65,0.25] & [0.65,0.35] \\ P3 & [0.65,0.45] & [0.65,0.25] \end{bmatrix}$$

The Scores of diagnosis S_{T1} and S_{T2} are determined using Step5,

$$S_{T1} = \begin{bmatrix} & d1 & d2 \\ P1 & [0.65,0.24] & [0.65,0.14] \\ P2 & [0.65,0.24] & [0.65,0.24] \\ P3 & [0.65,0.24] & [0.65,0.24] \end{bmatrix}$$

$$S_{T2} = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.35] & [0.55,0.24] \\ P2 & [0.65,0.35] & [0.75,0.14] \\ P3 & [0.55,0.45] & [0.55,0.45] \end{bmatrix}$$

The Total Score is calculated using the Step6,

$$S = \begin{bmatrix} & d1 & d2 \\ P1 & [0.60,-0.05] & [0.60,-0.05] \\ P2 & [0.65,-0.05] & [0.70,0.05] \\ P3 & [0.60,-0.105] & [0.60,-0.105] \end{bmatrix}$$

Result:

From this, it has been observed that patient P_2 is surely suffering from the disease d_2 since it has maximum membership and non-membership values. By comparing the values, P_2 is more affected by the disease d_1 than P_1 and P_3.

Now, we calculate the Harmonic Mean for the above matrices using Step7 in the algorithm,

$$hm(\tilde{A}_1) = \begin{bmatrix} & d1 & d2 \\ e1 & [0.55,0.34] & [0.44,0.34] \\ e2 & [0.44,0.24] & [0.75,0.13] \\ e3 & [0.75,0.13] & [0.65,0.24] \\ e4 & [0.34,0.44] & [0.13,0.55] \end{bmatrix}$$

$$hm(\tilde{A}_2) = \begin{bmatrix} & d1 & d2 \\ e1 & [0.34,0.55] & [0.34,0.44] \\ e2 & [0.24,0.44] & [0.13,0.75] \\ e3 & [0.13,0.75] & [0.24,0.65] \\ e4 & [0.44,0.34] & [0.55,0.13] \end{bmatrix}$$

$$hm(R) = \begin{bmatrix} & e1 & e2 & e3 & e4 \\ P1 & [0.65,0.24] & [0.55,0.13] & [0.34,0.44] & [0.44,0.24] \\ P2 & [0.44,0.34] & [0.34,0.44] & [0.65,0.24] & [0.75,0.13] \\ P3 & [0.55,0.13] & [0.65,0.24] & [0.24,0.55] & [0.34,0.44] \end{bmatrix}$$

By using Step8, the above harmonic matrices are combined using maxmin composition,

$$T_1 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.24] & [0.55,0.13] \\ P2 & [0.65,0.24] & [0.65,0.24] \\ P3 & [0.55,0.24] & [0.65,0.24] \end{bmatrix} \quad T_2 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.44,0.34] & [0.44,0.24] \\ P2 & [0.44,0.34] & [0.55,0.13] \\ P3 & [0.34,0.44] & [0.34,0.44] \end{bmatrix}$$

$$T_3 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.56] & [0.56,0.45] \\ P2 & [0.66,0.56] & [0.75,0.45] \\ P3 & [0.56,0.56] & [0.55,0.45] \end{bmatrix} \quad T_4 = \begin{bmatrix} & d1 & d2 \\ P1 & [0.65,0.44] & [0.65,0.25] \\ P2 & [0.65,0.25] & [0.65,0.35] \\ P3 & [0.65,0.45] & [0.65,0.25] \end{bmatrix}$$

The Scores of diagnosis S_{T1} and S_{T2} are determined using Step5,

$$S_{T1} = \begin{bmatrix} & d1 & d2 \\ P1 & [0.65,0.24] & [0.65,0.13] \\ P2 & [0.65,0.24] & [0.65,0.24] \\ P3 & [0.65,0.24] & [0.65,0.24] \end{bmatrix}$$

$$S_{T2} = \begin{bmatrix} & d1 & d2 \\ P1 & [0.55,0.34] & [0.56,0.24] \\ P2 & [0.66,0.34] & [0.75,0.13] \\ P3 & [0.56,0.44] & [0.55,0.44] \end{bmatrix}$$

The Total Score is calculated using the Step6,

$$S = \begin{bmatrix} & d1 & d2 \\ P1 & [0.60,-0.05] & [0.60,-0.05] \\ P2 & [0.65,-0.05] & [0.70,0.05] \\ P3 & [0.60,-0.10] & [0.60,-0.10] \end{bmatrix}$$

Result:

From this, it has been observed that patient P_2 is surely suffering from the disease d_2 since it has maximum membership and non-membership values. Comparing the values, P_2 is more affected by the disease d_1 than P_1 and P_3.

4. Conclusion:

In this paper, we introduce an algorithm for solving medical diagnosis problem by using Interval valued intuitionistic Geometric and Harmonic Mean method. The results obtained here is nearly similar to the results in [1]. Further the work can be extended to other basic operations.

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