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5 authors, including:

Naveed Jafar
University of Management and Technology (Pakistan)

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MEDICAL DIAGNOSIS USING NEUTROSOPHIC SOFT MATRICES AND THEIR COMPLIMENTS

Muhammad Naveed Jafar, Raiha Imran, Sabahat Hassan Asma Riffat &Rubina Shuaib
Department ofMathematics
Lahore Garrison University
Lahore Pakistan

Abstract: Neutrosophic soft set is a mathematical technique to solve the uncertainties and imprecisions and for decision making problems. In this paper, it is intended to use Neutrosophic soft relations and compliments for medical diagnosis. This paper deals with the symptoms, patients and diseases and then by using compliment algorithm to diagnose the disease.

Keywords: Medical Diagnosis, Soft Set, Neutrosophic Soft Matrices, Compliment of NSS.

INTRODUCTION

There are many phases oflife in which we face the Uncertainty, Vagueness, complexities and unpredictability. Numerous complexities in engineering, financial, societal disciplines, therapeutic fields and numerous different arenas include provisional information. All such issues, a person comes to confront within life, cannot be illuminated utilizing traditional mathematical techniques. In traditional arithmetic, a numerical model of an entity is created and concept of particular elucidation of this classical paradigm is resolved. Therefore, the numerical model is excessively mind boggling, the particular result can't be found. To resolve these complexities many theories were introduced namely Probability theory, Fuzzy set theory introduced by LotfiZadeh in 1965[20]. Interval valued fuzzy set (IVFS) in 1975[21], Rough set theory developed by Z.Pawlak in 1982[10, 11],Intuitionistic sets were introduced by KassimirrAtanassov in 1983 [7], Neutrosophic sets were proposed by Smarandachein 1998 [18, 19] It is more powerful deals with truthiness, indeterminacy and falseness which exist in the real world. As in uncertain environment decision making is very complex issue so to resolve this issue D. Molodtsov presented Soft set theory in 1999[8].In 2010, Intuitionistic fuzzy matrices have been derived by Maji.et.al[9] use these terms for decision making.Jafar et al (2019) [2] use soft matrices to disease identification, in this paper we enhance the same work and use Neutrosophic soft matrices relations and their complement for the purpose of medical diagnosis. Neutrosophic sets gives more accurate results then fuzzy or intuitionistic sets. Neutrosophic sets based on Truthiness, Indeterminacy and falseness due to these factors it give more imprecise and accuracy in results. Many researchers [3-6, and 12-17]has work on decision making using soft sets and their relative concepts.

PRELIMINARIES

Fuzzy set [2]

If X is a universal setand $x_1 \in X$, then a fuzzy set Bdefined as$\lambda: B \to [0\,,1]$ such that

$$B \;= \{(x_1, u_\lambda(x_1)), x_1 \in X\}$$

Soft Set [2]

LetŨbe universal set and Ȩ is the set of attributes. Let Ƥ (Ũ) represents power set of Ũ and Ã ⊆Ȩ,a pair (ğ, B) is called a soft set overŨ, where f is a mapping defined by f:B→Ƥ(Ũ)

Fuzzy Soft Set [2]

The pair (ʌ,ɛ́) is called a FSS over ý, where ʌ: ɛ́→Ƥ (ý) defined a mapping from ɛ́ into Ƥ (ý). In fuzzy soft set we give fuzzy numbers to each alternative.

Intuitionistic Fuzzy Set [4]

Let Ũ be the universal set and Ȩ is the set of attributes. IFS (Ũ) are the power set of Ũ. ConsiderB⊆Ȩ. The pair (ğ, B) is an IFS overŨ where f is the mapping defined by ğ: B→IFS (Ũ).

Neutrosophic Set [5]

A set B that deals with the order triplet contains the degree of truthiness (T), indeterminacy (I) and falseness (F) value. All Neutrosophic sets of B denoted by F_N (B).

$$\boldsymbol{B: E} \to [\mathbf{0}, \mathbf{1}] \times [\mathbf{0}, \mathbf{1}] \times [\mathbf{0}, \mathbf{1}]$$

Neutrosophic Soft Set [5]

Let Ũ be a universal set andȨ be a set of attributes and B⊆Ȩ, and then the set (ğ, B) is known as NSS over Û, where ğ is a mapping defined by ğ: B→$ğ_N$ (B).

Complement of NSS [4]

The complement of NNS is defined as ($ğ^c$→B) where $ğ^c$: B→$ğ_N$(X), and $ğ^c(b_1)$=<x_1,$T_{ğ^c}(x_1) = F_{ğ}(x_1)$, $I_{ğ^c}(x_1) = 1- I_{ğ}(x_1)$, $F_{ğ^c}(x_1) = T_{ğ}(x_1)$> for all b_l∈B, x_1∈X.

Neutrosophic Soft Matrices [4]

Neutrosophic soft matrices deals with the order triplet contains the degree of truthiness (T), indeterminacy (I) and falseness (F) value, in matrices form.

PRODUCT OF MATRICES

Let Y be a nonempty set and

B= <x_1, $T_b(x_1)$, $I_b(x_1)$, $F_b(x_1)$>, E =<x_2, $T_e(x_2)$, $I_e(x_2)$, $F_e(x_2)$> be the neutrosophic fuzzy sets.

B∨E = < x, ș ($T_b(x_1)$, $T_e(x_2)$), average ($I_b(x_1)$, $I_e(x_2)$), t ($F_b(x_1)$, $F_e(x_2)$)>

B ^ E = < x, t ($T_b(x_1)$, $T_e(x_2)$), average ($I_b(x_1)$, $I_e(x_2)$), ș ($F_b(x_1)$, $F_e(x_2)$)>

Relations on NSS [4]

Let Ĥ⊆B×E. Then a NSS relation Ŗ between two NSS (ğ, B) and (g, E) is defined by$Ŗ_1$ (b_1, e_1) = ğ (b_1) ∧g (e_1) for all b_1∈B, e_1∈E, where$Ŗ_1$: Ĥ→Gn (Ũ)

EVALUATION OF NSS

Let (ğ, B) be NSS. Then the function (ğ, B) is defined as

Đ (ğ, B) = T_b+ (1-I_b) – $ğ_b$, where T_b, $I_b$and $ğ_b$ denotes the truthiness, indeterminacy and falseness value of (ğ, B) respectively.

ALGORITHM AND METHODOLOGY

Here, we describe a process used for medical diagnosis by NSS. Suppose that a set of patients is P°, set of symptoms Š and the set of diseases is D̄.

ALGORITHM

i. The set of diseases related to its symptoms is obtained the symptoms-diseases relation $\hat{R}_1$
ii. The patient symptoms set is obtained the patient symptoms relation Q_1
iii. Evaluate their corresponding complement matrices $\hat{R}_2$ and Q_2
iv. The relation of patient symptoms disease matrices is T_1
v. Compute relation T_2 called patient non-symptoms non-disease matrices.
vi. Evaluate $Š_{T_1}$and $Š_{T_2}$NSS by using definition of "evaluation of NSS"
vii. Compute $Š_k$ i.e. Higher value of possibility of patient suffer with that disease

CASE STUDY

Assume that the three patients P_1, P2, P3 in hospital with symptoms headache, temperature and severe pain is represented by c_1, c2, c3. Now consider P̄= {P_1, P2, P3} represents the patient and

Š = {$ç_1$, ç2, ç3} shows the symptoms and set D̄= {$ď_1$, ď2, ď3} shows the diseases like fever, typhoid and malaria.

According to our data, we construct symptoms-diseases relation $\hat{R}_1$and patient- symptoms relation Q_1.

$$\hat{R}_1 = \begin{bmatrix} (0.3,0.2,0.4) & (0.4,0.1,0.3) & (0.5,0.1,0.3) \\ (0.7,0.1,0) & (0.6,0,0.1) & (0.4,0.2,0.1) \\ (0.1,0.5,0.3) & (0,0.4,0.3) & (0,0.6,0.2) \end{bmatrix}$$

$$Q_1= \begin{bmatrix} (0,0.5,0.2) & (0.4,0.2,0.1) & (0.3,0.4,0.1) \\ (0.5,0.2,0.3) & (0.6,0.1,0.4) & (0.2,0.3,0.5) \\ (0.7,0.2,0.1) & (0.1,0.3,0.6) & (0.3,0.5,0.1) \end{bmatrix}$$

The complement of $\hat{R}_1$ and Q_1 is represented by $\hat{R}_2$ and Q_2 respectively.

$$\hat{R}_2 = \begin{bmatrix} (0.4,0.8,0.3) & (0.3,0.9,0.4) & (0.3,0.9,0.5) \\ (0,0.9,0.7) & (0.1,1,0.6) & (0.1,0.8,0.4) \\ (0.3,0.5,0.1) & (0.3,0.6,0) & (0.2,0.4,0) \end{bmatrix}$$

$$Q_2 = \begin{bmatrix} (0.2,0.5,0) & (0.1,0.8,0.4) & (0.1,0.6,0.3) \\ (0.3,0.8,0.5) & (0.4,0.9,0.6) & (0.5,0.7,0.2) \\ (0.1,0.8,0.7) & (0.6,0.7,0.1) & (0.1,0.5,0.3) \end{bmatrix}$$

Here $\hat{R}_2$ represents the non-symptoms disease matrix and Q_2 represents the patient non-symptoms matrix. As we have

$$T_1 = Q_1.\hat{R}_1= \begin{bmatrix} (0.4,0.4,0.1) & (0.4,0.4,0.1) & (0.5,0.5,0.1) \\ (0.6,0.4,0.1) & (0.4,0.15,0.3) & (0.5,0.15,0.3) \\ (0.3,0.5,0.3) & (0.4,0.15,0.3) & (0.5,0.55,0.3) \end{bmatrix}$$

$$T_2 = Q_2.\hat{R}_2= \begin{bmatrix} (0.2,0.85,0.3) & (0.2,0.9,0.3) & (0.2,0.8,0.3) \\ (0.3,0.9,0.2) & (0.3,0.95,0.2) & (0.3,0.85,0.2) \\ (0.1,0.8,0.3) & (0.1,0.85,0.3) & (0.1,0.85,0.3) \end{bmatrix}$$

Now calculate $Š_{T_1}$and $Š_{T_2}$of Neutrosophic fuzzy set

$$Š_{T_1}= \begin{bmatrix} 0.9 & 0.9 & 0.9 \\ 1.1 & 0.95 & 0.55 \\ 0.5 & 0.95 & 0.65 \end{bmatrix} \quad \text{and}$$

$$Š_{T_2}= \begin{bmatrix} 0.05 & 0 & 0.1 \\ 0.2 & 0.15 & 0.25 \\ 0 & -0.05 & -0.05 \end{bmatrix}$$

$$Š_k= Š_{T_1} - Š_{T_2}= \begin{bmatrix} 0.85 & 0.9 & 0.8 \\ 0.9 & 0.8 & 0.3 \\ 0.5 & 1 & 0.7 \end{bmatrix}$$

From the result, this is the highest possibility that patient suffer from that disease

CONCLUSION

We have executed the idea of NSS for medical diagnosis. The result $Š_k$shows the highest possibility that patient suffer from that disease. It is an approach to evaluate which patient is affected from what disease. By using Neutrosophic fuzzy soft sets we can solve other decision making problems.

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