

## Arithmetic Mean of Interval Valued Intuitionistic Fuzzy Soft Matrices in Decision Making

Dr. P. Rajarajeswari and P. Dhanalakshmi

*Department of Mathematics, Chikkanna Govt Arts College, Tirupur.  
p. rajarajeswari29@gmail.com*

*Department of Mathematics, Tiruppur Kumaran College for Women, Tirupur.  
viga1dhanasekar@gmail.com*

### Abstract

Today is a world of uncertainty with its associated problems, which can be well handled by soft set theory. In this paper, we introduce the concept of arithmetic and weighted arithmetic mean of interval valued intuitionistic fuzzy soft matrix. And we are devolving an algorithm which is a new approach for decision making by employing interval valued intuitionistic fuzzy soft matrices.

**Key words:** Intuitionistic fuzzy soft matrix, interval valued intuitionistic fuzzy soft set, interval valued intuitionistic fuzzy soft matrix.

### 1. Introduction

In real life scenario, we face so many uncertainties, in all walks of life. Zadeh's classical concept of fuzzy set [18] is strong to deal with such type of problems. Since the initiation of fuzzy set theory, there are suggestions for higher order fuzzy sets for different applications in many fields. Among higher fuzzy sets intuitionistic fuzzy set introduced by Atanassov [1, 2] have been found to be very useful and applicable. Atanassov and Gargov [3] extended the intuitionistic fuzzy set [1, 2] to the interval valued intuitionistic fuzzy set which is characterized by a membership function and a non-membership function whose values are intervals rather than real numbers.

Soft set theory has received much attention since its introduction by Molodtsov [11]. The concept and basic properties of soft set theory are presented in [11, 6]. Later on Maji et al [7] have proposed the theory of fuzzy soft set. Majumdar et al [9] have further generalised the concept of fuzzy soft sets. Maji et al [8] extended fuzzy soft sets to intuitionistic fuzzy soft sets which is based on the combination of the intuitionistic fuzzy set [1] and soft set.

Due to the increasing complexity of the scientific environment and the lack of data about the problem domain, in the process of decision making under an intuitionistic fuzzy environment, a decision maker may provide their preferences over alternatives with interval valued intuitionistic fuzzy values. Yang et al [16] presented the concept of the interval valued fuzzy soft sets by combining the interval valued fuzzy sets and soft set. Y. Jiang et al [5] presented the concept of interval valued intuitionistic fuzzy soft set theory which is an extension of the intuitionistic fuzzy soft set theory [8].

Matrices play an important role in the broad area of science and engineering. However, the classical matrix theory cannot solve the problems involving various types of uncertainties. In [17], Yong et al initiated a matrix representation of a fuzzy soft set and applied it in certain decision making problems. Borah et al [10] extended fuzzy soft matrix theory and its application. In [4] Chetia et al and in [12] Rajarajeswari et al defined intuitionistic fuzzy soft matrix and its types. Also extended some operations and an algorithm for medical diagnosis in [13] and also introduced the concept of Interval valued intuitionistic fuzzy soft matrix, and their properties in [14] and applied the concept of Interval valued intuitionistic fuzzy soft matrix in medical diagnosis field in [15].

In this paper, we are developing an algorithm which is a new approach for decision making by employing interval valued intuitionistic fuzzy soft matrices.

## 2. Preliminaries

### 2.1. Fuzzy Soft Matrices [10]

Let  $U = \{c_1, c_2, c_3, \dots, c_m\}$  be the Universal set and  $E$  be the set of parameters given by  $E = \{e_1, e_2, e_3, \dots, e_n\}$ . Let  $A \subseteq E$  and  $(F, A)$  be a fuzzy soft set in the fuzzy soft class  $(U, E)$ . Then fuzzy soft set  $(F, A)$  in a matrix form as  $A_{m \times n} = [a_{ij}]_{m \times n}$  or  $A = [a_{ij}]$   $i=1, 2, \dots, m, j=1, 2, 3, \dots, n$

$$\text{Where } a_{ij} = \begin{cases} \mu_j(c_i) & \text{if } e_j \in A \\ 0 & \text{if } e_j \notin A \end{cases} \quad \mu_j(c_i) \text{ represents the membership of } c_i \text{ in}$$

the fuzzy set  $F(e_j)$ .

### 2.2. Intuitionistic Fuzzy Soft Matrix [12]

Let  $U = \{c_1, c_2, c_3, \dots, c_m\}$  be the Universal set and  $E$  be the set of parameters given by  $E = \{e_1, e_2, e_3, \dots, e_n\}$ . Let  $A \subseteq E$  and  $(F, A)$  be an intuitionistic fuzzy soft set in the intuitionistic fuzzy soft class  $(U, E)$ . Then intuitionistic fuzzy soft set  $(F, A)$  in a matrix form as  $\hat{A}_{m \times n} = [\hat{a}_{ij}]_{m \times n}$  or  $\hat{A} = [\hat{a}_{ij}]$   $i=1, 2, \dots, m, j=1, 2, 3, \dots, n$

$$\text{Where } a_{ij} = \begin{cases} (\mu_j(c_i), \nu_j(c_i)) & \text{if } e_j \in A \\ (0, 1) & \text{if } e_j \notin A \end{cases}$$

$\mu_j(c_i)$  represents the membership of  $c_i$  in the intuitionistic fuzzy set  $F(e_j)$ .

$\nu_j(c_i)$  represents the non-membership of  $c_i$  in the intuitionistic fuzzy set  $F(e_j)$ .

**2. 3 Interval valued Intuitionistic fuzzy soft matrix(IVIFSM) [14]**

Let  $U=\{c_1, c_2, c_3\dots c_m\}$  be an Universal set and  $E$  be the set of parameters given by  $E=\{e_1, e_2, e_3\dots e_n\}$ . Let  $A \subseteq E$  and  $(F, A)$  be a interval valued intuitionistic fuzzy soft set over  $U$ , where  $F$  is a mapping given by  $F: A \rightarrow I^U$ , where  $I^U$  denotes the collection of all interval valued intuitionistic fuzzy subsets of  $U$ . Then the interval valued intuitionistic fuzzy soft set can be expressed in matrix form as

$$\hat{A}_{m \times n} = [a_{ij}]_{m \times n} \text{ or } \hat{A} = [a_{ij}] \text{ } i=1, 2, \dots, m, j=1, 2, 3, \dots, n$$

$$\text{where } a_{ij} = \begin{cases} \left( \left[ \mu_{jL}(c_i), \mu_{jU}(c_i) \right] \left[ \nu_{jL}(c_i), \nu_{jU}(c_i) \right] \right) & \text{if } e_j \in A \\ \left( [0,0][1,1] \right) & \text{if } e_j \notin A \end{cases}$$

$\left[ \mu_{jL}(c_i), \mu_{jU}(c_i) \right]$  represents the membership of  $c_i$  in the interval valued intuitionistic fuzzy set  $F(e_j)$ .

$\left[ \nu_{jL}(c_i), \nu_{jU}(c_i) \right]$  represents the non-membership of  $c_i$  in the interval valued intuitionistic fuzzy set  $F(e_j)$  with the condition  $\mu_{jU}(c_i) + \nu_{jU}(c_i) \leq 1$

**Note:** If  $\mu_{jU}(c_i) = \mu_{jL}(c_i)$  and  $\nu_{jU}(c_i) = \nu_{jL}(c_i)$  then the IVIFSM reduces to an IFSM [12].

**2. 4 Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrices [14]**

If  $\hat{A} = [a_{ij}] \in \text{IVIFSM}_{m \times n}$ ,  $\hat{B} = [b_{ij}] \in \text{IVIFSM}_{m \times n}$ , then we define  $\hat{A} \& \hat{B}$ , arithmetic mean of  $\hat{A}$  and  $\hat{B}$  as

$$\hat{A} \& \hat{B} = [c_{ij}]_{m \times n} = \left[ \left( \left( \frac{\mu_{\hat{A}L} + \mu_{\hat{B}L}}{2} \right), \left( \frac{\mu_{\hat{A}U} + \mu_{\hat{B}U}}{2} \right) \right), \left[ \left( \frac{\nu_{\hat{A}L} + \nu_{\hat{B}L}}{2} \right), \left( \frac{\nu_{\hat{A}U} + \nu_{\hat{B}U}}{2} \right) \right] \right] \text{ for all } i \text{ and } j$$

**2. 5 Weighted Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrices [14]**

If  $\hat{A} = [a_{ij}] \in \text{IVIFSM}_{m \times n}$ ,  $\hat{B} = [b_{ij}] \in \text{IVIFSM}_{m \times n}$ , then we define  $\hat{A} \&_w \hat{B}$ , weighted arithmetic mean of  $\hat{A}$  and  $\hat{B}$  as

$$\hat{A} \&_w \hat{B} = [c_{ij}]_{m \times n} = \left[ \left( \left( \frac{w_{1L}\mu_{\hat{A}L} + w_{2L}\mu_{\hat{B}L}}{w_{1L} + w_{2L}} \right), \left( \frac{w_{1U}\mu_{\hat{A}U} + w_{2U}\mu_{\hat{B}U}}{w_{1U} + w_{2U}} \right) \right), \left[ \left( \frac{w_{1L}\nu_{\hat{A}L} + w_{2L}\nu_{\hat{B}L}}{w_{1L} + w_{2L}} \right), \left( \frac{w_{1U}\nu_{\hat{A}U} + w_{2U}\nu_{\hat{B}U}}{w_{1U} + w_{2U}} \right) \right] \right]$$

$$w_{1L}, w_{1U}, w_{2L}, w_{2U} \in [0, 1]$$

$$w_{1L} + w_{1U} = 1, w_{2L} + w_{2U} = 1$$

**2. 6 Value matrix [12]**

Let  $A = [a_{ij}] \in \text{IFSM}_{m \times n}$ , where  $a_{ij} = (\mu_j(c_i), \nu_j(c_i))$ . Then the Value matrix of

Intuitionistic Fuzzy Soft Matrix A is  $V(A) = [a_{ij}] = [\mu_j(c_i) - \nu_j(c_i)]$   $i=1, 2, \dots, m, j=1, 2, \dots, n$

### 2.7 Score matrix [12]

If  $A = [a_{ij}] \in \text{IFSM}_{m \times n}$ ,  $B = [b_{ij}] \in \text{IFSM}_{m \times n}$ , then the Score matrix of A and B as  $S_{(A,B)} = [d_{ij}]_{m \times n}$  where  $[d_{ij}] = V(A) + V(B) \quad \forall i, j$ .

### 2.8 Neutral reduced intuitionistic fuzzy soft matrix [15]

Let  $U = \{c_1, c_2, c_3, \dots, c_m\}$  be an Universal set and E be the set of parameters given by  $E = \{e_1, e_2, e_3, \dots, e_n\}$ . Let  $A \subseteq E$  and  $(F, A)$  be a interval valued intuitionistic fuzzy soft set over U, where F is a mapping given by  $F: A \rightarrow I^U$ , where  $I^U$  denotes the collection of all interval valued intuitionistic fuzzy subsets of U. Then the interval valued intuitionistic fuzzy soft set

$$F(e_j) = \left\{ c_i, \left( [\mu_{jL}(c_i), \mu_{jU}(c_i)] [v_{jL}(c_i), v_{jU}(c_i)] \right), \forall e_j \in A \text{ and } \forall c_i \in U \right\}$$

$[\mu_{jL}(c_i), \mu_{jU}(c_i)]$  represents the membership of  $c_i$  in the interval valued intuitionistic fuzzy set  $F(e_j)$ .

$[v_{jL}(c_i), v_{jU}(c_i)]$  represents the non-membership of  $c_i$  in the interval valued intuitionistic fuzzy set  $F(e_j)$  with the condition  $\mu_{jU}(c_i) + v_{jU}(c_i) \leq 1$

An interval valued intuitionistic fuzzy soft set can be converted into Neutral reduced intuitionistic fuzzy soft set as

$$F(e_j) = \left\{ c_i, \left( \frac{\mu_{jL}(c_i) + \mu_{jU}(c_i)}{2}, \frac{v_{jL}(c_i) + v_{jU}(c_i)}{2} \right), \forall e_j \in A \text{ and } \forall c_i \in U \right\}$$

And Neutral reduced intuitionistic fuzzy soft matrix as

$$\hat{A}_N = [a_{ij}]_{m \times n} \text{ or } \hat{A}_N = [a_{ij}] \quad i=1, 2, \dots, m, j=1, 2, 3, \dots, n$$

$$a_{ij} = \begin{cases} \left( \frac{\mu_{jL}(c_i) + \mu_{jU}(c_i)}{2}, \frac{v_{jL}(c_i) + v_{jU}(c_i)}{2} \right) & \text{if } e_j \in A \\ (0,1) & \text{if } e_j \notin A \end{cases}$$

### 3. Applications of Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrices in Decision Making

In this section, we introduce the idea to make a decision based on IVIFSM and its arithmetic operator. we apply RIFSM and NRIFSM [15] with special operator Weighted Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrix for making decision.

**3. 1 Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrix**

If  $\hat{A} = [a_{ij}] \in \text{IVIFSM}_{m \times n}$ , then we define arithmetic mean of  $\hat{A}$  as

$$\hat{A}_{AM} = [c_{ij}]_{m \times n} = \left( \left[ \frac{\sum_{j=1}^n \mu_{\hat{A}L}}{n}, \frac{\sum_{j=1}^n \mu_{\hat{A}U}}{n} \right], \left[ \frac{\sum_{j=1}^n \nu_{\hat{A}L}}{n}, \frac{\sum_{j=1}^n \nu_{\hat{A}U}}{n} \right] \right) \text{ when weights are equal}$$

**3. 2 Weighted Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrix**

If  $\hat{A} = [a_{ij}] \in \text{IVIFSM}_{m \times n}$ , then we define, weighted arithmetic mean of  $\hat{A}$  as

$$\hat{A}_{WAM} = [c_{ij}]_{m \times n} = \left( \left[ \frac{\sum_{j=1}^n w_j \mu_{\hat{A}L}}{\sum_{j=1}^n w_j}, \frac{\sum_{j=1}^n w_j \mu_{\hat{A}U}}{\sum_{j=1}^n w_j} \right], \left[ \frac{\sum_{j=1}^n w_j \nu_{\hat{A}L}}{\sum_{j=1}^n w_j}, \frac{\sum_{j=1}^n w_j \nu_{\hat{A}U}}{\sum_{j=1}^n w_j} \right] \right), w_j \text{ for } j=1, 2..n \text{ are respective weights.}$$

**3. 4 Methodology**

Suppose Mr. Gupta wants to choose the best higher institutions among  $I_1, I_2, \dots, I_5$  for his son such that  $U = \{ I_1, I_2, \dots, I_5 \}$  and  $E$  is a set of parameters related to the institutions. We construct IVIFSS  $(F, E)$  over  $U$  represent the selection of institutions by Mrs. Gupta, where  $F$  is a mapping  $F: E \rightarrow \text{IVIF}^U$ ,  $\text{IVIF}^U$  is the collection of all interval valued intuitionistic Fuzzy subsets of  $U$ . We further construct another IVIFSS  $(G, E)$  over  $U$  represent the selection of institutions by Mrs. Gupta, where  $G$  is a mapping  $G: E \rightarrow \text{IVIF}^U$ ,  $\text{IVIF}^U$  is the collection of all interval valued intuitionistic Fuzzy subsets of  $U$ . The matrices  $\hat{A}$  and  $\hat{B}$  corresponding to the interval valued intuitionistic Fuzzy soft sets  $(F, E)$  and  $(G, E)$  are constructed, using def (3. 2), Compute  $\hat{A}_{WAM}$   $\hat{B}_{WAM}$  which is the weighted arithmetic mean of institutions by Mr and Mrs Gupta. Using def(3. 3), Compute Neutral reduced intuitionistic fuzzy soft matrix of  $\hat{A}_{WAM}$  and  $\hat{B}_{WAM}$ . Calculate value matrices and score matrix. Finally find  $I_j = \max(I_i)$ , then conclude that the institution  $I_j$  has selected by Mr and Mrs Gupta. If  $I_j$  has more than one value the process is repeated by reassessing the parameters.

**3. 5 ALGORITHM**

Step1: Input the Interval valued intuitionistic fuzzy soft set  $(F, E)$ ,  $(G, E)$  and obtain the interval valued intuitionistic fuzzy soft matrices  $\hat{A}$  and  $\hat{B}$  corresponding to  $(F, E)$  and  $(G, E)$  respectively.

Step2: Compute  $\hat{A}_{WAM}$   $\hat{B}_{WAM}$  which is the weighted arithmetic mean.

Step3: Compute Neutral reduced intuitionistic fuzzy soft matrices.

Step4: Compute value of the matrices.

Step5: Calculate Score matrix. Find max ( $I_i$ ).

Then we conclude that the institution  $I_j$  is selected for the study.

Incase max  $I_i$  occurs for more than one value, then repeat the process by reassessing the parameters.

### 3. 6 Example

Suppose Mr. Gupta wants to choose the best higher institutions among  $I_1, I_2, \dots, I_5$  for his son such that  $U = \{ I_1, I_2, \dots, I_5 \}$  and  $E = \{ e_1, e_2, e_3, e_4 \}$  is a set of parameters related to the institutions where  $e_1$ =infrastructure of the institution,  $e_2$ =less capitation fees,  $e_3$ =placement,  $e_4$ =Academic result. We construct IVIFSS  $(F, E)$  over  $U$  represent the selection of institutions by Mrs. Gupta, where  $F$  is a mapping  $F: E \rightarrow IVIF^U$ ,  $IVIF^U$  is the collection of all interval valued intuitionistic Fuzzy subsets of  $U$ . We further construct another IVIFSS  $(G, E)$  over  $U$  represent the selection of institutions by Mrs. Gupta, where  $G$  is a mapping  $G: E \rightarrow IVIF^U$ ,  $IVIF^U$  is the collection of all interval valued intuitionistic Fuzzy subsets of  $U$ . The matrices  $\hat{A}$  and  $\hat{B}$  corresponding to the interval valued intuitionistic Fuzzy soft sets  $(F, E)$  and  $(G, E)$  are constructed.

$$\hat{A} = \begin{matrix} & e_1 & e_2 & e_3 & e_4 \\ \begin{matrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \end{matrix} & \begin{bmatrix} [0.8, 0.9][0.1, 0.1] & [0.7, 0.8][0.1, 0.2] & [0.9, 0.9][0, 0.1] & [0.6, 0.8][0.1, 0.2] \\ [0.6, 0.7][0.2, 0.3] & [0.3, 0.4][0.5, 0.6] & [0.7, 0.8][0.1, 0.2] & [0.8, 0.8][0.1, 0.2] \\ [0.5, 0.5][0.3, 0.4] & [0.3, 0.4][0.4, 0.4] & [0.6, 0.7][0.3, 0.3] & [0.7, 0.8][0.2, 0.2] \\ [0, 0.5][0, 0.5] & [0.8, 0.9][0.1, 0.1] & [0.6, 0.7][0.2, 0.3] & [0.6, 0.7][0.2, 0.3] \\ [0.7, 0.8][0.1, 0.2] & [0.9, 1][0, 0] & [0, 0.5], [0, 0.5] & [0.4, 0.6][0.3, 0.3] \end{bmatrix} \end{matrix}$$

$$\hat{B} = \begin{matrix} & e_1 & e_2 & e_3 & e_4 \\ \begin{matrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \end{matrix} & \begin{bmatrix} [0.7, 0.8][0.2, 0.2] & [0.8, 0.9][0.1, 0.1] & [0.9, 0.9][0, 0.1] & [0.7, 0.8][0.1, 0.2] \\ [0.6, 0.7][0.3, 0.3] & [0.4, 0.4][0.5, 0.6] & [0.6, 0.8][0.1, 0.2] & [0.8, 0.9][0.1, 0.1] \\ [0.5, 0.6][0.3, 0.4] & [0.4, 0.5][0.3, 0.3] & [0.6, 0.7][0.2, 0.2] & [0.7, 0.8][0.1, 0.2] \\ [0, 0.5][0, 0.5] & [0.8, 0.9][0.1, 0.1] & [0.6, 0.7][0.2, 0.2] & [0.6, 0.7][0.1, 0.2] \\ [0.8, 0.9][0.1, 0.1] & [0.9, 1][0, 0] & [0, 0.5][0, 0.5] & [0.5, 0.6][0.3, 0.4] \end{bmatrix} \end{matrix}$$

If Mr. Gupta prefer to “ $e_3$ =placement,” of the institutions and weights 0., 1., 8., 1 are given on the parameters “infrastructure of the institution”, “less capitation fees”, “placement”, “Academic result” respectively, and if Mrs. Gupta prefer to the weights 0. 05., 5., 4., 05 on the parameters “infrastructure of the institution”, “less capitation fees”, “placement”, “Academic result” respectively, then

$$\hat{A}_{WAM} = \begin{bmatrix} [0.85, 0.88][0.02, 0.12] \\ [0.67, 0.76][0.14, 0.24] \\ [0.58, 0.68][0.3, 0.3] \\ [0.62, 0.72][0.19, 0.28] \\ [0.13, 0.56][0.03, 0.43] \end{bmatrix} \quad \hat{B}_{WAM} = \begin{bmatrix} [0.83, 0.89][0.065, 0.11] \\ [0.51, 0.6][0.31, 0.4] \\ [0.5, 0.6][0.25, 0.26] \\ [0.67, 0.79][0.135, 0.165] \\ [0.515, 0.775][0.02, 0.225] \end{bmatrix}$$

Neutral reduced intuitionistic fuzzy soft matrices of  $\hat{A}_{WAM}$   $\hat{B}_{WAM}$  are

$$\hat{A}_{WAM} = \begin{bmatrix} (0.865, 0.07) \\ (0.715, 0.19) \\ (0.63, 0.3) \\ (0.67, 0.235) \\ (0.345, 0.23) \end{bmatrix} \quad \hat{B}_{WAM} = \begin{bmatrix} (0.86, 0.0875) \\ (0.555, 0.355) \\ (0.55, 0.255) \\ (0.73, 0.15) \\ (0.645, 0.1225) \end{bmatrix}$$

$$V(\hat{A}_{WAM}) = \begin{bmatrix} 0.795 \\ 0.525 \\ 0.33 \\ 0.435 \\ 0.115 \end{bmatrix} \quad V(\hat{B}_{WAM}) = \begin{bmatrix} 0.7725 \\ 0.2 \\ 0.295 \\ 0.58 \\ 0.5225 \end{bmatrix} \quad S_{(\hat{A}_{WAM}, \hat{B}_{WAM})} = \begin{bmatrix} 1.5675 \\ 0.725 \\ 0.625 \\ 1.015 \\ 0.4425 \end{bmatrix}$$

From the above score matrix, We conclude that the institution one(I1 ) is better choice for their weights given to the parameters.

**Conclusion**

In this paper, we devolved an algorithm which is a new approach for decision making by employing interval valued intuitionistic fuzzy soft matrices. For this, we applied RIFSM and NRIFSM with special operator Weighted Arithmetic mean of Interval valued Intuitionistic Fuzzy Soft Matrix. It’s make our algorithm more flexible and adjustable. In future, we will use other special operators also and compare the results for making decision.

**8. REFERENCES**

[1] Atanassov. K, Intuitionistic fuzzy sets, Fuzzy sets and systems20(1), 1986, 87-96.  
 [2] Atanassov, K. Intuitionistic fuzzy sets, Physica-verlag, Heidelberg, Newyork, 1999.  
 [3] Atanassov. K, Gargov G., Interval valued Intuitionistic fuzzy sets, Fuzzy sets and systems3(1), 1989, 343-349.

- [4] Chetia. B, Das. P. K., "Some results of Intuitionistic Fuzzy soft matrix theory "Advances in Applied science Research, 3(1): 2012 412-423.
- [5] Jiang. Y, Tang. y, Chen. Q, Liu. H, Tang. J, "Interval –valued intuitionistic fuzzy soft sets and their Properties", Computers and Mathematics with applications 60(3)2010, pp: 906-918.
- [6] Maji P. K, Biswas R. and Roy A. R. 2003.. "Soft set theory", Computers and Mathematics with Applications, 45(4-5): pp 555-562
- [7] Maji P. K, Biswas R. and Roy A. R. 2001. "Fuzzy Soft Sets". The Journal of Fuzzy Mathematics, 9(3): pp 589-602.
- [8] Maji, P. K., Biswas, R., Roy. A. R., "Intuitionistic Fuzzy soft sets", Journal of fuzzy mathematics, 12, 2004pp: 669-683.
- [9] Majumdar, P., Samantha, S. K. "Generalised fuzzy soft sets"Computers and Mathematics with applicatios 59, 2010, pp: 1425-1432.
- [10] Manash Jyoti Borah, Tridiv Jyoti Neog, Dushmantha Kumar Sut. " Fuzzy soft matrix theory and its Decision making" International Journal of Modern Engineering Research, VOL2, 2012, pp: 121-127.
- [11] Molodtsov D. "Soft set theory-first result", Computers and Mathematics with Applications, 37(4-5): 1999 pp ; 19-31
- [12] Rajarajeswari. P, Dhanalakshmi. P, Intuitionistic Fuzzy Soft Matrix Theory and its application in Decision Making, International Journal of Engineering Research and Technology, {2} (2013) 1100--1111.
- [13] Rajarajeswari. P, Dhanalakshmi. P, Intuitionistic Fuzzy Soft Matrix Theory and its application in Medical diagnosis, Annals of fuzzy mathematics and informatics, 7(5), 2014, 765-772.
- [14] Rajarajeswari. P, Dhanalakshmi. P, Interval valued Intuitionistic Fuzzy Soft Matrix Theory, International Journal of Mathematical Archive, 5(1)2014, 152-161
- [15] Rajarajeswari. P, Dhanalakshmi. P, An Application of interval valued Intuitionistic Fuzzy Soft Matrix Theory in Medical diagnosis, Annals of fuzzy mathematics and informatics, (in press).
- [16] Yang. X. B, Lin. T. Y. Yang. J. Y, Li. Y, Yu. D, Combination of interval-valued fuzzy set and soft set, Computers and Mathematics with applicatios 58(3)2009, pp: 521-527.
- [17] Yong Yang and Chenli Ji., "Fuzzy soft matrices and their applications "partI, Lecture notes in Computer Science, 7002, 2011, pp: 618-627
- [18] Zadeh, L. A" Fuzzy sets", Information and control, 8(1985), 338-353.