An Arithmetic Mean of FSM in Making Decision

T. Geetha, S. Anitha Raj

Abstract: This paper is to forward the notion of FSM. We use fuzzy soft matrix as to take decision in the rainfall level for five years. So many functions are expanded in the fuzzy soft matrices. Here we conclude the arithmetic mean of fuzzy soft matrices in decision making.

Keywords: Fuzzy soft matrices, Decision making, Rainfall level, Arithmetic mean.

I. INTRODUCTION
In 2003, Maji et al [1] studied the theory of soft sets initiated by Molodtsov, who was introduced in 1999 [2] the new approaches of soft sets. By the follow of Molodtsov, Maji has developed so many basic notions of soft sets. Let Pei and Miao [3] and chen et al [4] in 2005 improved the fuzzy soft set theory of Maji et al [1]. Maji defined the operations of the soft set, then he described the study on soft set. Fuzzy soft set theory of application in decision making while introduced by cagman et al [5,6]. In this paper we use Arithmetic Mean function of fuzzy soft set theory to take decision in the rainfall level. Rainfall is one of the factors for the crop cultivation. Under the rainfed rice culture, rainfall is the most necessary limiting factor. Here we take rainfall level in based upon the three types of rice cultivation seasons (ie) Kuruvai, Samba, Thaladi.

II. DEFINITIONS

A. Fuzzy Set
Let Y be a space points, with a generic element of Y denoted by y, Thus Y = {y}. A fuzzy set A in Y is characterized as a membership function fA(y) which is associates with every point in Y as a real numbers between [0,1] is the values of fA(y) at y representing the grade of membership of y in A. Thus the nearer value of fA(y) is to unity, the higher grade of membership of y in A.

B. Soft Set
In 1999, Molodtsov was introduced soft set theory. It is a generalization of fuzzy set theory and he has described the uncertainty in a non parametric manner. A soft set is defined as, if y is a universal set and E is a set of parameters of pairs (f,A) where A is a set and f is a function then f(e) is a subset of Y where the element e of the set A for each e of the set f(e) is known as the value set of e in (f,A)

C. Fuzzy Soft Set
Let p (U) is denotes the set of all fuzzy sets of U. Let Ai ! E. Then the pair of (f1Ai) is called a fuzzy soft set over U, the mapping of f1 is F1: A1 ! p(U)

D. Universal Fuzzy Soft Matrix
Let [cij] ∈ FSMm*n. Then [cij] is known as Universal fuzzy soft matrix and it is denoted by [2 ], if cij=1for all i and j.

E. Arithmetic Mean Of Fuzzy Soft Matrix
Let Š = [cij] ∈ FSMn*m. The AM of FSM of membership value denoted by ŠAM is defined as

\[ ŠAM = \frac{\sum_{i=1}^{n} \sum_{j=1}^{m} c_{ij}}{n} \]

F. Fuzzy Soft Matrix
Let U be an initial universal p(U) be the power set of U,E be the set of all parameters and Y be the fuzzy set over E with the membership function,

\[ \mu_{y}: E \rightarrow [0, 1] \]

Then fps-set Fy over U is a set defined by a function fy representing a mapping Fy: E → P (U), Such that fy(y) = φ, if \( \mu_{y}(y) = 0 \)

Here, fy is called an approximate function of the fps set and the value of fy(y) is the set called Y elements of fy set for all y ∈ E.

Thus fps set Fy over U represented by the set of ordered pairs

\[ F_{y} = \{ (\mu_{y}(y) / y, f_{y}(y)) : y \in E, f_{y}(y) \in P (U) \, \mu_{y}(y) \in [0, 1] \} \]

Let (f(E),E) be the fuzzy soft set over U, then U ={u1,u2,…,um} and E={e1,e2,…,en} ∀ u1 ∈ U , ∀ ei ∈ E, there exist the membership degree cij = fj(u1).

Then we write the membership degrees in a table as

| e1 | e2 | …….. | en |
|----|----|-------|----|
| u1 | c11 | c12 | …….. | c1m |
| u2 | c21 | c22 | …….. | c2m |
| …….. | …….. | …….. | …….. | …….. |
| um | cmi | cm2 | …….. | cmn |

Then the fuzzy soft matrix of (f(E),E) over U be as,

Revised Manuscript Received on November 15, 2019

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moment: retrieved number: D6497118419

DOI:10.35940/ijrte.6467.118419

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-4, November 2019

Blue Eyes Intelligence Engineering & Sciences Publication
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\[ \hat{A}_{m \times n} = [c_{ij}]_{m \times n} = \left( \begin{array}{cccc} c_{11}, c_{12}, \ldots, c_{1n} \\ c_{21}, c_{22}, \ldots, c_{2n} \\ \vdots \\ c_{m1}, c_{m2}, \ldots, c_{mn} \end{array} \right) \]

Where \( i=1, 2, 3, \ldots m \), \( j=1, 2, 3, \ldots n \)

\[ c_{ij} = \begin{cases} \mu_j(a_i) & \text{if } e_j \in A \\ 0 & \text{if } e_j \notin A \end{cases} \]

Here \( \mu_j(a_i) \) as the membership of \( a_i \) in the fuzzy set \( F(e_j) \).

We identify a fuzzy soft set with its FSM and use these two concepts interchangeable. The set of all \( m \times n \) fuzzy soft matrices over \( U \) would be denoted by \( \text{FSM}_{m \times n} \).

III. RAINFALL REQUIREMENT

The water requirement of the rice cultivation is 1240 mm. The growth of the rice plant is depends on water irrigation. Water irrigation is provided for the growth and the yields are declared by the temperature and the solar radiation. Rice cultivation is under rainfed, rainfall is the most necessary liming factor for rice cultivation. The rainfall requirement for the five years of Kuruvai, Samba, Thaladi seasons are given as below in the figure.

Fig: 1 The Kuruvai season rainfall requirement for five years

Fig: 2 The Samba season rainfall requirement for five years.

Fig: 3 The Thaladi season rainfall requirement for five years.

IV. ALGORITHM

Step: 1
Take the set of parameters \( U= \{ u_1, u_2, \ldots, u_n \} \) and \( E = \{ e_1, e_2, \ldots, e_n \} \) for \( (f_e(u)) \) over \( U \).

Step: 2
Form the FSM \( [c_{ij}]_{m \times n} \) for the set of parameters, whose membership degree are \( c_{ij} = f_e(u_i) \).

Step: 3
Find \( R_K, R_S \) and \( R_T \) for the \( \text{FSM}_{m \times n} \).

Step: 4
Compute the \( \hat{A}_{AM} = \frac{\sum_{j=1}^{n} \frac{\hat{A}_j}{\mu_j}}{n} \)

Step: 5
Find the decision which has highest membership value.

V. FUZZY SOF MATRICS IN DECISION MAKING

Fuzzy soft matrices are used to Analysis the rainfall level for five years. The five years rainfall level is compute for three types of season cultivation. We take matrices A, B and C is similar to Kuruvai, Samba, Thaladi cultivation.

Step: 1
\[
A = \begin{bmatrix}
0.147 & 0.113 & 0.71 & 0.119 & 0.63 \\
0.116 & 0.44 & 0.219 & 0.182 & 0.109 \\
0.82 & 0.29 & 0.145 & 0.324 & 0.226 \\
0.109 & 0.40 & 0.92 & 0.49 & 0.38 \\
0.253 & 0.124 & 0.125 & 0.214 & 0.110
\end{bmatrix}
\]

\[
B = \begin{bmatrix}
0.63 & 0.14 & 0.12 & 0.53 & 0.1 \\
0.109 & 0.3 & 0.057 & 0.11 & 0.009 \\
0.226 & 0.26 & 0.0 & 0.10 & 0.66 \\
0.38 & 0.0 & 0.0 & 0.0 & 0.0 \\
0.110 & 0.94 & 0.2 & 0.28 & 0.070
\end{bmatrix}
\]

\[
C = \begin{bmatrix}
0.18 & 0.30 & 0.11 & 0.147 & 0.113 \\
0.140 & 0.9 & 0.51 & 0.116 & 0.44 \\
0.97 & 0.30 & 0.41 & 0.82 & 0.29 \\
0.115 & 0.52 & 0.42 & 0.109 & 0.40 \\
0.27 & 0.67 & 0.19 & 0.253 & 0.124
\end{bmatrix}
\]

Step: 2
\[
[c_{ij}] = \begin{bmatrix}
0.147 & 0.113 & 0.71 & 0.119 & 0.63 \\
0.116 & 0.44 & 0.219 & 0.182 & 0.109 \\
0.82 & 0.29 & 0.145 & 0.324 & 0.226 \\
0.109 & 0.40 & 0.92 & 0.49 & 0.38 \\
0.253 & 0.124 & 0.125 & 0.214 & 0.110
\end{bmatrix}
\]

Step: 3
Find the decision which has highest membership value.
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\[ R_K = \begin{pmatrix} 0.513 \\ 0.670 \\ 0.806 \\ 0.328 \\ 0.826 \end{pmatrix} \]

\[ A_{AM}(R_K) = \begin{pmatrix} 0.1026 \\ 0.134 \\ 0.1612 \\ 0.0656 \\ 0.1652 \end{pmatrix} \]

Thus, we get the result 1,2,3 in the above matrix the maximum Rainfall requirement of Kuruvai, Samba, Thaladi. The decision is made depend upon on highest membership value of each season. Hence the maximum rainfall requirement of Kuruvai season \( R_K \) secured in the year 2017, for Samba season \( R_s \) in the year 2015, for Thaladi season in the year 2016.

VI. CONCLUSION

In this paper, the Arithmetic mean of fuzzy soft matrices is to take decision for the five year rainfall requirement. The maximum rainfall requirement is secured in the year 2017 for Kuruvai, in the year 2015 for Samba and in the year 2016 for Thaladi. The future work is regard to the three season cultivation for above five years which years is to be requiring the maximum Achievements.

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