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Fuzzy Matrix Analysis of Seasonal Fishing in Cuddalore District

Research Article*

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Abstract: Fuzzy matrices play an important role in the formulation and analysis of many classes of discrete structural models which are in physical, biological, medical, social and engineering sciences. The aim of this paper is study the Seasonal fishing of fishermen. To study the life style of fishermen we use various fuzzy matrix techniques.

Keywords: Fuzzy matrix, CETD matrix, ATD matrix.

1. Introduction

Fuzzy Matrix theory was developed by W.B.Vasantha and V.Indira in the year 1998 to study the passenger transportation problem. They divided and defined four types of new matrices called Initial Raw Matrix, Average Time dependent Data matrix (ATD) ,Refined Time Dependent Data matrix (RTD Matrix) and Combined Effect Time Depen dent Data matrix(CETD matrix) to study this problem. In the year 2003 the same technique was used by the first author to study the migrant laborers who were affected by HIV/AIDS. In 2004, W. B.Vasantha and A.Victor Devedoss used this technique to study the agriculture laborers. In 2001, S.Narayanamoorthy used this model to study the problem of silk weavers as bonded laborers and Dr.A.Kalaichelvei and S.Gnanamalar used to analyse the problems encountered by the coffee cultivators in kodai hills. Now we use the same model to study how frequently the fishing people are gathering information regarding seasonal their fishing. Fuzzy matrices play important role in the formulation and analysis of many classes of discrete structural models, social and engineering sciences. The aim of this paper is study the seasonal fishing of fishermen. To study the life style of fishermen we use various fuzzy matrix techniques. "A fuzzy matrix is a matrix with elements having values in the fuzzy interval" In this article the unit interval [0,1] and the interval [-1,1] are called fuzzy interval. Fuzzy matrix (or) CETD matrix model is the one which helps to analysis carried out in five stages. In this 1^{st} stage the collected the raw data which is made into an initial raw data (IRD-Matrix). In the 2^{nd} stage the IRD matrix is transformed into an ATD-matrix. In the 3^{rd} stage we use the simple average time dependent data (ATD-Matrix) with entries e_{ij} , where e_{ij} ? {-1, 0, 1}.

2. Background Information

In this paper we have discussed about the suitable season for fishing by the fishermen of cuddalore district. Here me used ATD and CETD matrices to predict this season for the people, who go fishing in river and sea. Thus it predicted that the

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suitable season for suitable season for fishing is the morning session for the people who go fishing in rivers and sea which is discussed in this paper.

Average Time dependent Data Matrix (ATD): The Raw data transformed into a raw Time dependent Data Matrix by taking along the columns River and Sea. Using the raw data matrix we make into the average Time dependent Data Matrix (a_{ij}) by dividing each entry of the raw data matrix by the number of the time period. In order to obtain an unbiased uniform effect on each and every data so collected, transform this initial matrix into an average Time dependent Data Matrix (ATD), to make the calculation easier and simpler, we in the third stage using the simple average techniques, convert the above seasonal fishing data matrix into a matrix with entries e_{ij} where e_{ij}? {-1, 0, 1}. The value of the e_{ij} corresponding to each entry is determined in a special way. At the fourth stage, using the refined Time dependent Data Matrix (RTD), We get the combine effect Time dependent Data Matrix (CETD), which gives the cumulate effect of all the these entries, in the final stage we obtain the row sums of the combined effect Time dependent Data Matrix.

Algorithm: In order to study how frequency the fishing people spend time for gathering seasonal information, a linguistic questionnaire was given to them and the data were collected from both River and Sea discipline fishermen.

Step 1: In this stage of the problem, we split the fishermen information gathering attitude may be classified as three frequency. The discipline the respondents were grouped into two categories River and Sea. The finer frequency are divided the better is the prediction. This is also established in this chapter. These frequency can vary from one analyst to another and from one type to another. The various seasonal work are treated as row and Discipline are treated as columns of the matrix thus from the row data, we obtain the initial m x n matrix the number of individual type in each seasonal fishing might not be the same.

Step 2: In the second stage, in order to obtain consistency in the initial matrix the entries corresponding to the intersection of each seasonal fishing data and Discipline of the initial matrix are transform so that each new entry corresponding to the types. Thus we convert the above initial matrix into the average Time dependent Data Matrix (ATD). ie.., $[a_{ij}]$.

Step 3: In the third stage, we use average and the standard division to convert to above average time dependent data matrix into a matrix with entries e_{ij}, e_{ij} ? { -1, 0, 1} where I represent the i^{th} row and j represent a j^{th} column respectively. Then we call this formed matrix as Refined Time Dependent Data Matrix (RTD Matrix) ie, $[e_{ij}]_{m\times n}$. The value of the entry e_{ij} corresponding to each intersection is determined from an interval. This interval is obtained strictly by using the average and standard deviation calculation from the row data. The choice of the interval made by us might not be able to identified the seasonal fishing of the discipline, hence we introduce and define a parameter α enables us to get a better solution. Using the average (μ_j) and the standard deviation (σ_j) and a parameter α from the interval [0, 1] a fuzzy matrix called the Refined Time Dependent data matrix (RTD) was formed. For each of the alternatives j (j = 1, 2, ... n) we have the rule. If $a_{ij} \leq (\mu_j - \alpha^*\sigma_j)$ then $e_{ij} = -1$. Else, if $a_{ij} \in (\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j)$ then $e_{ij} = 0$. Else, if $a_{ij} \geq (\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j)$ then $e_{ij} = 1$. For different value of α, we obtain different refined Time dependent data matrices. Then we have the simple arithmetic calculations and operations on the matrix.

Step 4: In the fourth stage, we bring in the notion of combined effect time dependent data matrix (CETD matrix) ie, $[c_{ij}]_{m\times n}$ which gives the combined effect of all the refined time dependent data matrix (RTD matrix) obtained by varying the parameters α.

Step 5: The final stage we add up the rows of the combined effect time dependent data matrix. The overall time period utility of a seasonal fishing is obtained by inferring the rows sums of a CETD-matrix. The highest positive value is taken as the highly utilized time period of the seasonal fishing next lower value is taken as the next seasonal fishing for the Discipline. Thus for a particular seasonal we grade the fishermen fishing a vital role in the seasonal fishing of fishermen.

Application of CETD Matrix: In order to study how frequently the fishing people spend time for gathering seasonal information, a linguistic questionnaire was given to them and the data were collected from both River and Sea discipline fisher men. The fishermen information gathering attitude may be classified as; 1. Morning 2. Evening 3. Night. The above three attributes are taken as the rows of the matrix. Based on their discipline the respondents were grouped into two Categories River and Sea. By taking the seasonal wise information gathering attitude of fisherman as rows and the respondents of the two disciplines of the fisherman are taken as columns, a 3×2 initial raw matrix called Time Dependent matrix (TD) was formed.

Frequency/Discipline	River	Sea
Morning	20	40
Evening	10	20
Night	15	35
Total	45	95

Table 1.

The initial raw data matrix has been converted into the Average Time Dependent Matrix (ATD) (a_{ij}) by dividing each entry with the total of the corresponding column.

Frequency/discipline	River	Sea
Morning	0.44	0.42
Evening	0.22	0.21
Night	0.33	0.37

Table 2.

After we find the average and standard Deviation (S. D) of every column of the matrix. Average (or) Mean of n terms x_1, x_2,..., x_n is given by

$$\overline{x} \text{ (or) } \mu_j = \frac{x_1 + x_2 + \cdots + x_n}{n} \text{ (or)}$$
$$\overline{x} \text{ (or) } \mu_j = \frac{\sum x}{n}$$

And the standard Deviation of terms x_1, x_2,...,x_n is given by

$$\sigma_j = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}$$

The average (μ_j) and standard deviation (σ_j) of every column were worked out as follows:

(i) River process

$$\begin{aligned} \text{Mean} &= \frac{\sum x}{n} \\ &= \frac{0.33 + 0.22 + 0.44}{3} \\ &= \frac{0.99}{3} = 0.3300 \\ \text{Standard deviation} &= \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2} \\ &= \sqrt{\frac{0.3509}{3} - (0.3300)^2} \\ &= 0.0900 \end{aligned}$$

(ii) Sea process

$$\begin{aligned}\text{Mean} &= \frac{\sum x}{n}\\ &= \frac{0.42+0.21+0.37}{3}\\ &= 0.3333\\ \text{Standard deviation} &= \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2}\\ &= \sqrt{\frac{0.3574}{3} - (0.3333)^2}\\ &= 0.0894\end{aligned}$$

	River	Sea
Average (μ_j)	0.3300	0.3333
Standard deviation (σ_j)	0.0900	0.0894

Table 3.

Using the average (μ_j) and standard deviation (σ_j) and a parameter α from the interval [0,1], a fuzzy matrix called the Refined Time Dependent matrix (RTD) was formed. The RTD matrix with entries $e_{ij} \in \{-1, 0, 1\}$ was formed using the formula.

If $a_{ij} \le \mu_j - \alpha^*\sigma_j$ then $e_{ij} = -1$

Else if $a_{ij} \ge \{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\}$ then $e_{ij} = 1$

Else if $a_{ij} \in \{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\}$ then $e_{ij} = 0$

where a_{ij}'s are entries of Average Time Dependent matrix. By varying the parameter $\sigma[0,1]$, any number of Refined Time Dependent Data matrices can be obtained. Three of such matrices obtained were as follows;

If $\alpha = 0.25$

River

For $\mu_j = 0.3300$ and $\sigma_j = 0.0900$. Then

$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\} = \{(0.33 - (0.25)(0.09), (0.33 + (0.25)(0.09)\} = (0.31, 0.35)$$

Sea

For $\mu_j = 0.3333$ and $\sigma_j = 0.0894$. Then

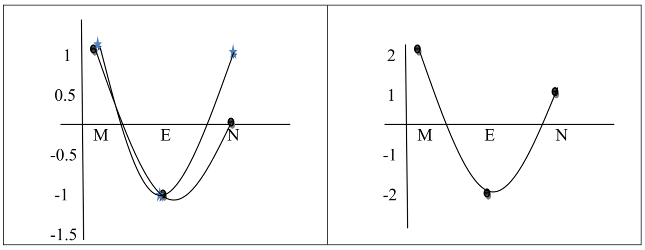
$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\} = \{(0.3333 - (0.25)(0.0894), (0.3333 + (0.25)(0.0894)\} = (0.31, 0.36)$$

RTD matrix

$$\begin{bmatrix} 1 & 1 \\ -1 & -1 \\ 0 & 1 \end{bmatrix}$$

Row sum matrix

$$\begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$$



Graph of RTD matrix Row sum matrix chart

If $\alpha = 0.50$

River

For $\mu_j = 0.3300$ and $\sigma_j = 0.0900$. Then

$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha*\sigma_j\} = \{(0.3300 - (0.50)(0.0900)), (0.3300 + (0.50)(0.09))\} = (0.29, 0.38)$$

Sea

For $\mu_j = 0.3333$ and $\sigma_j = 0.094$. Then

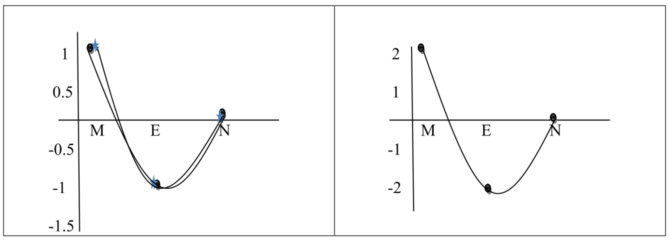
$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\} = \{(0.3333 - (0.50)(0.0894)), (0.3333 + (0.50)(0.0894))\} = (0.29, 0.38)$$

RTD matrix

$$\begin{bmatrix} 1 & 1 \\ -1 & -1 \\ 0 & 0 \end{bmatrix}$$

Row sum matrix

$$\begin{bmatrix} 2 \\ -2 \\ 0 \end{bmatrix}$$



Graph of RTD matrix Row sum matrix chart

If $\alpha = 0.75$

River

For $\mu_j = 0.3300$ and $\sigma_j = 0.0900$ then

$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\} = \{(0.33 - (0.75)(0.09)), ((0.33 + (0.75)(0.09))\} = (0.26, 0.40)$$

Sea

For $\mu_j = 0.3333$ and $\sigma_j = 0.094$. Then

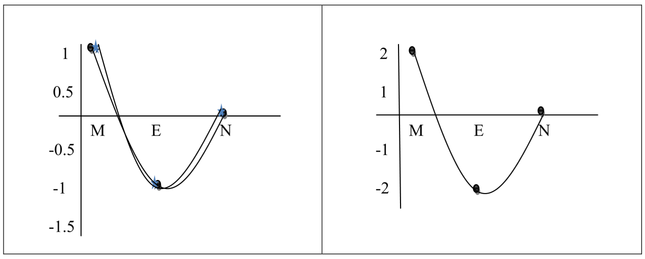
$$\{\mu_j - \alpha^*\sigma_j, \mu_j + \alpha^*\sigma_j\} = \{(0.3333 - (0.75)(0.0894)), (0.3333 + (0.75)(0.0894))\} = (0.27, 0.40)$$

RTD matrix

$$\begin{bmatrix} 1 & 1 \\ -1 & -1 \\ 0 & 0 \end{bmatrix}$$

Row sum matrix

$$\begin{bmatrix} 2 \\ -2 \\ 0 \end{bmatrix}$$



Graph of RTD matrix

Row sum matrix chart

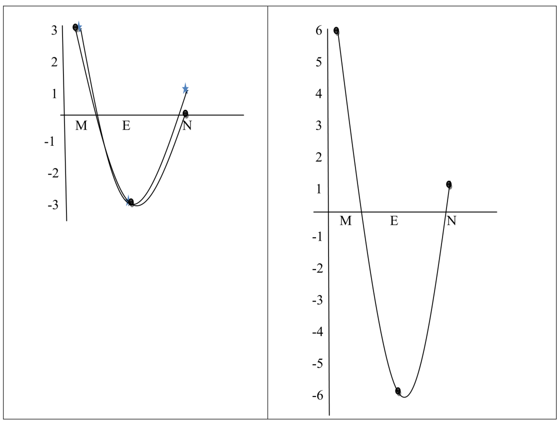
By combining all the three matrices, the combined effect time Dependent Data Matrix (CETD matrix), which gives the cumulative effect of all these entries, was obtained as follows;

CETD matrix

$$\begin{bmatrix} 3 & 3 \\ -3 & -3 \\ 0 & 1 \end{bmatrix}$$

Row Sum Matrix

$$\begin{bmatrix} 6 \\ -6 \\ 1 \end{bmatrix}$$



Graph of CETD Matrix

Row Sum Matrix chart

3. Conclusion

The above discussion shows that for $\alpha = 0.25$ fishing in river and sea is better in the morning and night session. The graph $\alpha = 0.50$ show that fishing in both river and sea is better in morning session. From the graph $\alpha = 0.75$ we infer that both discipline of fishermen who choose morning has the best session. Thus most of the fishermen spend time in fishing in morning session which is the best suitable time for fishing.

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