

FUZZY CETD MATRIX TECHNIQUE AND ITS APPLICATION

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Abstract: We use Combined Effect Time Dependent Matrix(CETD) technique to study the brick makers who work as bonded labourers in places around Chennai viz., Ponneri, Koyambedu, Chengalpet and Cuddalore has been carried out in this paper. For the purpose of this research paper we interviewed 105 bonded labourers. They have been bonded only for a six-month period (January to July) with an entire family working for Rs. 7,000 to Rs. 10,000. This money is not paid back to their owners, but instead they do an indentured labour for a period of six months.

Keywords: ATD matrix, bonded , CETD matrix , Fuzzy matrix, RTD matrix.

1. THE METHOD OF APPLICATION OF CETD MATRIX

A very simple but a very effective technique on the collected data of the 105-bonded laborers and their related social problems. We take the data as it is and transform it into a raw time dependent data matrix by taking along the rows the age group and along the columns the social problems they suffer. Using the raw data matrix we make it into the Average Time Dependent Data (ATD) matrix (a_{ij}) by dividing each entry of the raw data matrix by the number of years i.e., the time period. This matrix represents a data, which is totally uniform. At the third stage we find the average and Standard Deviation (S.D) of every column in the ATD matrix. Using the average μ_j of each j^{th} column and σ_j the S.D of each j^{th} column we chose a parameter α from the interval $[0, 1]$ and form the Refined Time Dependent Matrix (RTD matrix), using the formula if $a_{ij} \leq (u_j - \alpha * \sigma_j)$ then $e_{ij} = -1$ else if $a_{ij} \in (u_j - \alpha * \sigma_j, u_j + \alpha * \sigma_j)$ then $e_{ij} = 0$ else if $a_{ij} \geq (u_j + \alpha * \sigma_j)$ then $e_{ij} = 1$. We redefine the ATD matrix into the Refined Time Dependent fuzzy matrix. For this matrix the entries are $-1, 0, \text{ or } 1$. Now the row sum of this matrix gives the maximum age group, which is prone to social problems. We also combine these matrices by varying $\alpha \in [0,1]$, so that we get the Combined Effective Time Dependent Data (CETD) matrix. The row sum is obtained for CETD matrix and conclusions are derived based on the row sums. All these are represented by graphs and graphs play a vital role in exhibiting the data by the simplest means that can be even understood by a layman.

2. DESCRIPTION OF THE PROBLEM

The study of brick makers who serve as bonded labourers has been carried out with the following motivations. Most of them are agriculturist coolies who have taken up this profession and have become bonded for their sheer existences. The main difference between usual bonded labour and these bonded labourers are i) The whole family including children below the age of 8 are labourers and should work for them. ii) They work as bonded labour only for six months and they are bonded

only for the period from January to July..Thus after six month they are free so they go back to their home. The living conditions of them are not so poor for they are happy for they get some means to exist.

3. ADAPTATION OF CETD MATRIX TECHNIQUE

In this section we apply the problem faced by bonded labourer to the CETD matrix and derive our conclusions.

Using the linguistic questionnaire we have taken the following nine attributes (X_1, X_2, \dots, X_9)

- X_1 - Agricultural Failure
- X_2 - Poverty
- X_3 - Illiteracy
- X_4 - Family Depts.
- X_5 - Unemployment/ Underemployment
- X_6 - Modernization
- X_7 - Non planning
- X_8 - Government Indifference
- X_9 - No Knowledge of any other trade, which are taken as the columns of the initial raw data matrix. The age group in years 11-16, 17-20, 21-30, 31-36, 37-40, 41-50 , 51-60 and 61-70 are taken as the rows of the matrix.

Initial Raw Data Matrix of brick workers of order 8×9

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
11-16	3	7	3	6	2	0	0	1	0
17-20	2	5	4	4	4	0	0	1	0
21-30	13	18	14	16	8	0	6	8	0
31-36	12	13	12	10	2	0	2	2	0
37-40	8	6	12	11	01	0	3	2	0
41-50	15	25	16	20	12	0	7	4	0
51-60	8	9	4	5	0	0	1	0	0
61-70	1	4	2	2	0	0	0	0	0

The ATD Matrix of brick workers of order 8×9

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
11-16	0.5	1.17	0.5	1.0	0.33	0	0	0.17	0
17-20	0.5	1.25	1.0	1.0	1.0	0	0	0.25	0
21-30	1.3	1.8	1.4	1.6	0.8	0	0.6	0.8	0
31-36	2.0	2.17	2.0	1.67	0.33	0	0.33	0.33	0
37-40	2.0	1.5	3.0	2.5	0.5	0	0.5	0.5	0
41-50	1.5	2.5	1.6	2.0	1.2	0	0.7	0.4	0
51-60	0.8	0.9	0.4	0.5	0	0	0.1	0	0
61-70	0.1	0.4	0.2	0.2	0	0	0	0	0

The Average and the Standard Deviation of the above ATD matrix

Average	1.09	1.46	1.26	1.31	0.52	0	0.28	0.31	0
Standard Deviation	0.64	0.64	0.88	0.72	0.42	0	0.27	0.25	0

The RTD matrix for $\alpha = 0.1$

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 0 \\ 7 \\ 7 \\ 7 \\ 7 \\ -3 \\ -7 \end{bmatrix}$$

The RTD matrix for $\alpha = 0.15$

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 1 \\ 7 \\ 7 \\ 7 \\ 7 \\ -3 \\ -7 \end{bmatrix}$$

The RTD matrix for $\alpha = 0.2$

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

The row sum matrix

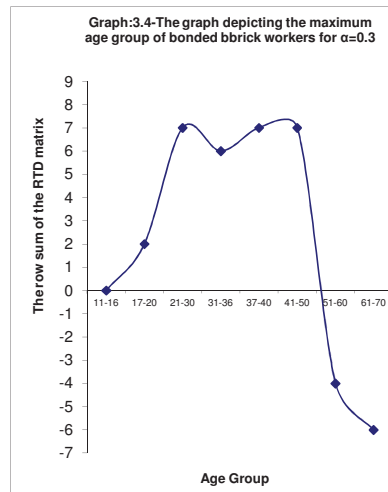
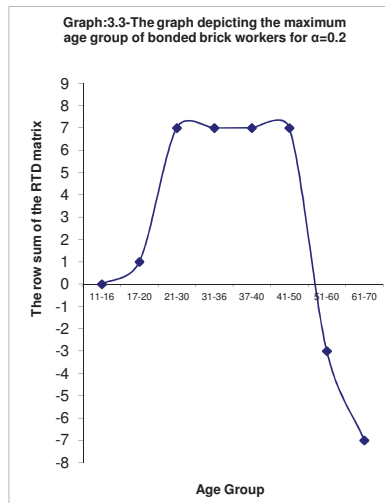
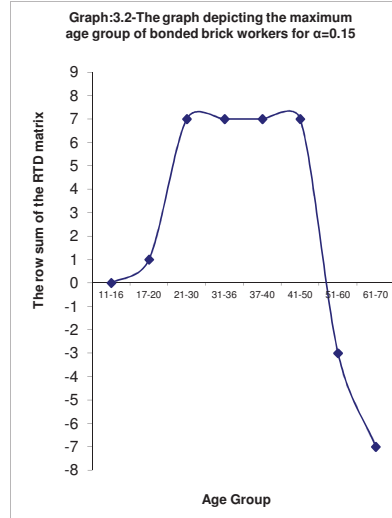
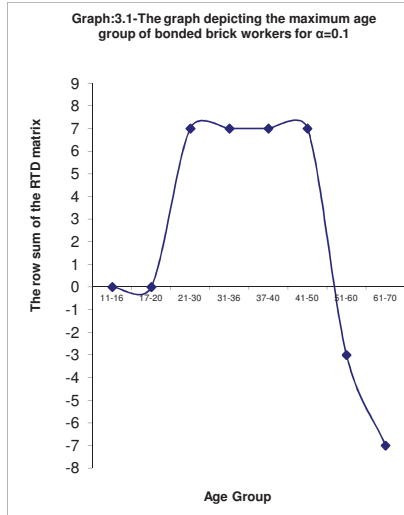
$$\begin{bmatrix} 0 \\ 1 \\ 7 \\ 7 \\ 7 \\ 7 \\ -3 \\ -7 \end{bmatrix}$$

The RTD matrix for $\alpha = 0.3$

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 2 \\ 7 \\ 6 \\ 7 \\ 7 \\ -4 \\ -6 \end{bmatrix}$$

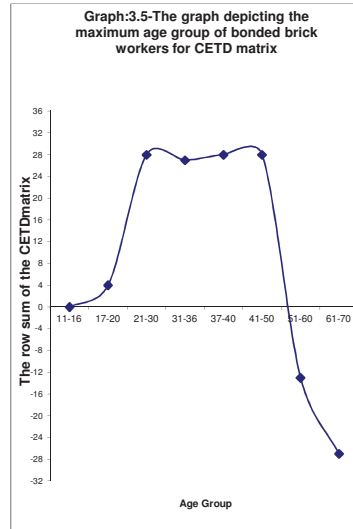


CETD matrix

$$\begin{bmatrix} -4 & 4 & -4 & 0 & 3 & 0 & -3 & 4 & 0 \\ -4 & 4 & -1 & 0 & 4 & 0 & -3 & 4 & 0 \\ 4 & 4 & 4 & 4 & 4 & 0 & 4 & 4 & 0 \\ 4 & 4 & 4 & 4 & 3 & 0 & 4 & 4 & 0 \\ 4 & 4 & 4 & 4 & 4 & 0 & 4 & 4 & 0 \\ 4 & 4 & 4 & 4 & 4 & 0 & 4 & 4 & 0 \\ 2 & 0 & -4 & -4 & -4 & 0 & 1 & -4 & 0 \\ -4 & -4 & -4 & -4 & -4 & 0 & -3 & -4 & 0 \end{bmatrix}$$

The row sum matrix

$$\begin{bmatrix} 0 \\ 4 \\ 28 \\ 27 \\ 28 \\ 28 \\ -13 \\ -27 \end{bmatrix}$$



4. CONCLUSION

In this section, we give the conclusions based on the above analysis and interviews. From the above fuzzy matrix analysis bonded brick workers are maximum in the age groups of 21-30,37-40,41-50.The various causes are agriculture failure, poverty, family debts, illiteracy. From the CETD graph (3.5), we come to know that people become bonded labourers at the age of 15. The whole family works for more than 10 hours every day. Bonded labourers in the age group 31-36 seem to be less. This may be because most of the people get married in this age and they don't want to be bonded. But after four or five years, because of poverty, they also become bonded.

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