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An Analysis of Dengue Fever Using Fuzzy Matrix

R. Sophia Porchelvi[1] and M.Slochana[2]

[1]Department of Mathematics, ADM College for women (Autonomous)
Nagapattinam, Tamilnadu, India.
E-mail: [1]sophiaporchelvi@gmail.com; [2]slochana27phd@gmail.com
[2]Corresponding author

Abstract. This paper studies a CETD model for finding the peak age group of people affected by Dengue in Nagapattinam District of Tamil Nadu, India. The data are analyzed by using fuzzy time dependent data matrices and some useful suggestions and concluding remarks are provided.

Keywords: ATD Matrix, RTD Matrix and CETD Matrix.

AMS Mathematics Subject Classification (2010): 03E72

1. Introduction
Dengue has some major effects on our society's health and has created a havoc regarding hygiene known about the causes is not enough. Dengue has attacked all age groups around the world and therefore, the severity of it among different age groups is important to be discussed. The burden of severe dengue was found majorly in infants 4-9 months of age and in children 5-9 years old. There are four serotypes of the virus that causes dengue- DEN1, DEN2, DEN3 and DEN4 [6]. World Health organization (WHO) reported, Dengue is a mosquito-borne viral disease that has rapidly spread in all regions of WHO to in recent years [6]. Dengue virus is transmitted by female mosquitoes mainly of the species Aedesa egypti severe dengue was first recognized in the 1950s during dengue epidemics in the Philippines and Thailand. The Aedesa egypti mosquito is the primary vector of dengue. The virus is transmitted to humans through the bites of infected female mosquitoes. After virus incubated for 4-10 days. An infected mosquito is a capsule of transmitting the virus for the rest of its life [7,8,10].

Dengue fever is a severe flu-like illness that affects infants, young children and adults, but seldom causes death. The following are identified as the symptoms of dengue fever, severe headache, pain behind the eyes, muscles and joint pains, nausea, vomiting, swollen glands or rash [7]. Symptoms usually last for 2-7 days after an incubation period of 4-10 days after the bite of an infected mosquito. Severe dengue is a potentially deadly complication due to plasma leaking fluid accumulation, respiratory distress, severe bleeding, or organ impairment [6].

The fuzzy set theory was introduced by professor Zadeh in 1965 and can be seen as an infinite value. The Fuzzy logic theory is based on making the membership function lie over a range of real numbers from 0.0 to 1.0 [2]. In this paper, by using RTD matrix analysis to find the maximum age group of people who affected by Dengue [3,5]. This

paper is organized as follows: Section 2 discusses the basic concept of ATD, RTD and CETD matrix [1,3,4,5]. Section 3 gives the description of the problem and the symptoms of Dengue[6,9]. In section 4, we discuss the maximum age group people affected by Dengue, with this knowledge 3x6 matrix are constructed and solved. Some suggestions and conclusions are given in Section 5.

2. The concept of ATD, RTD and CETD matrix
2.1. Average time dependent (ATD) matrix
Raw data is transformed into a raw time dependent data matrix by taking along the rows the details of the age group and along the columns the number of occurrences of different reasons. 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.

2.2 Refined time dependent (RTD) matrix
Using the average μ_j of each jth column and σ_j the S.D of the each jth column, we choose a parameter α from the interval and form the interval $[0,1]$ from the Refined time dependent Matrix (RTD matrix), Using the formula

$\quad if\ a_{ij} \leq (\mu_j - \alpha * \sigma_j)$ then $e_{ij} = -1$
$\quad$ else if $a_{ij} \in (\mu_j - \alpha * \sigma_j, \mu_j + \alpha * \sigma_j)$ then $e_{ij} = 0$
$\quad$ else if $a_{ij} \geq (\mu_j + \alpha * \sigma_j)$ then $e_{ij} = 1$.

We redefine the ATD matrix into the Refined time dependent fuzzy matrix for here the entries are = 0 or 1. Now the row sum of this matrix gives the maximum age group.

2.3. Combined effective time dependent data (CETD) matrix
We also combine the above RTD matrices by varying the $\alpha \in [0,1]$, 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, which can be even understood by a layman.

3. Description of the problem
We have interviewed 100 people in the Nagapattinam town of Tamil Nadu. The causes of dengue affected persons, we analyze this problem using fuzzy matrix, we call the RTD matrix is fuzzified by the entries from the set $\{-1,0,1\}$. In this paper, we will discuss the number of people affected in dengue fever, which are taken as the columns of the initial row matrix data, the age group in years, 11-25, 26-50, 51-80.

In the first stage, we have given the matrix representation of the raw data. The 3X6 matrix is not uniform. i.e. the number of individual years in each interval may not be the same. So in the second stage, 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 (ATD) matrix. To make the calculations easier and simpler, in the third stage using the simple average techniques convert the above average time dependent data matrix into a matrix with entries $e_{ij} \in \{-1,0,1\}$. We name this matrix as the refined time dependent

data matrix (RTD Matrix) or as the fuzzy matrix. The value of corresponding e_{ij} to each entry is determined in a special way. At the fourth stage using the fuzzy matrices we obtain the combined effect time dependent data matrix (CETD matrix) which gives the cumulative effect of all these entries. In the final stage we obtain the row sums of the CETD matrix. The graph of the RTD matrix and CETD matrix are given.

Symptoms of Dengue fever are
- Severe headache (S_1)
- Pain behind the eyes (S_2)
- Muscles and joint pains (S_3)
- Nausea (S_4)
- Vomiting (S_5)
- Swollen glands or rash (S_6)

4. Estimation of maximum age group of dengue fever patients by using 3X6 matrices
In this section, we take six attributes related to dengue fever namely severe headache (S_1), Pain behind of the eyes (S_2), Muscles and joint pains (S_3), Nausea (S_4), Vomiting (S_5), Swollen glands or rash (S_6).

Years/ Symptoms	S_1	S_2	S_3	S_4	S_5	S_6
11-25	51	30	50	44	60	47
26-50	19	20	23	24	26	10
51-80	05	10	07	15	10	05

Table 1: Initial raw data matrix of order 3×6

Years/ Symptoms	S_1	S_2	S_3	S_4	S_5	S_6
11-25	3.4	2	3.33	2.93	4	3.13
26-50	0.76	0.8	0.92	0.96	1.04	0.4
51-80	0.16	0.33	0.23	0.5	0.33	0.16

Table 2: The ATD matrix of order 3×6

Average	1.44	1.04	1.49	1.46	1.79	1.23
S.D	1.72	0.86	1.62	1.29	1.94	1.64

Table 3: Average and standard deviation of the above ATD matrix

The RTD matrix for $\alpha = 0.25$

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

The row sum matrix

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

The RTD matrix for $\alpha = 0.45$

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

The row sum matrix

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

The RTD matrix for $\alpha = 0.65$

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

The row sum matrix

$$\begin{bmatrix} 6 \\ 0 \\ -6 \end{bmatrix}$$

The RTD matrix for $\alpha = 0.75$

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

The row sum matrix

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

The CETD matrix

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

The row sum matrix

$$\begin{bmatrix} 24 \\ -7 \\ -22 \end{bmatrix}$$

The following graph depicts the maximum age group of people affected by Dengue:
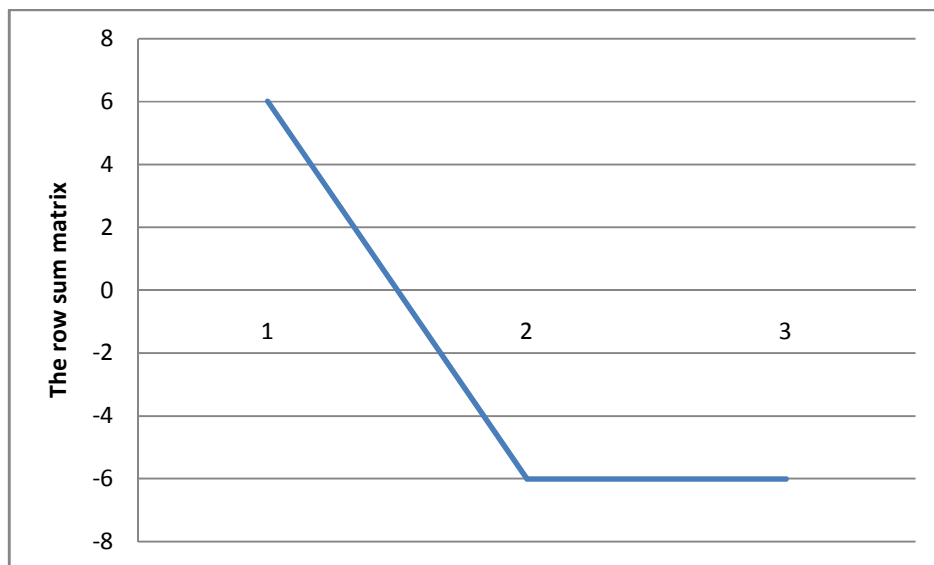

Figure 1: Maximum age group of dengue fever patients $\alpha = 0.25$

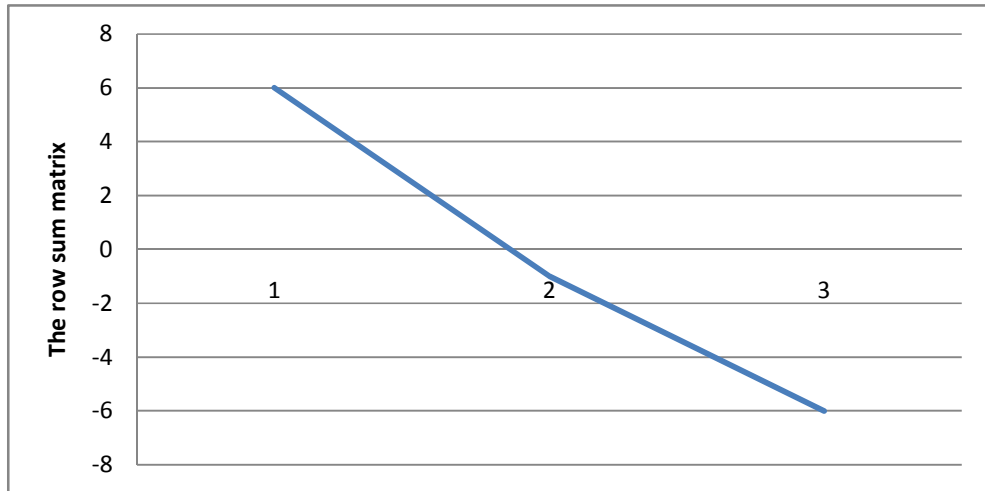An Analysis of Dengue Fever Using Fuzzy Matrix

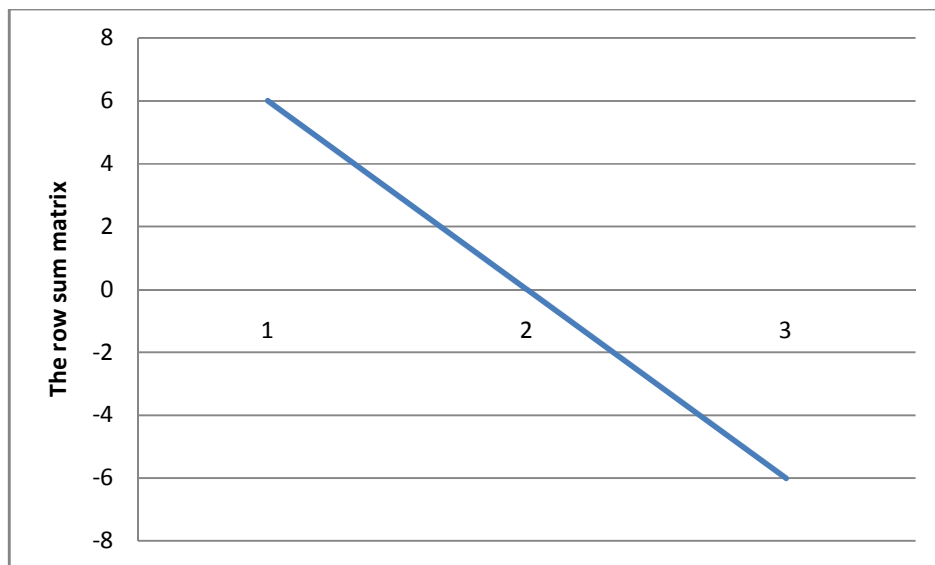**Figure 2:** Maximum age group of dengue fever patients $\alpha = 0.45$

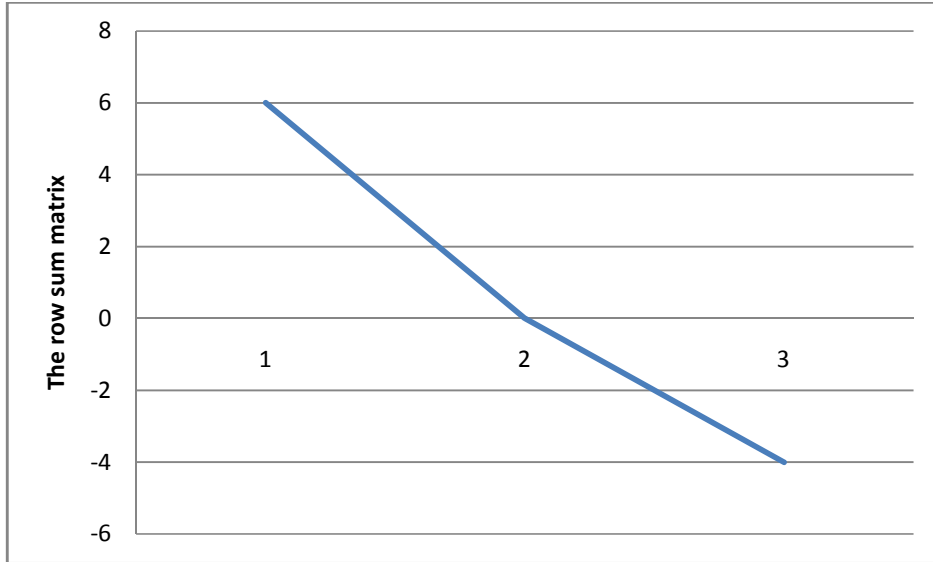**Figure 3:** Maximum age group of dengue fever patients $\alpha = 0.65$

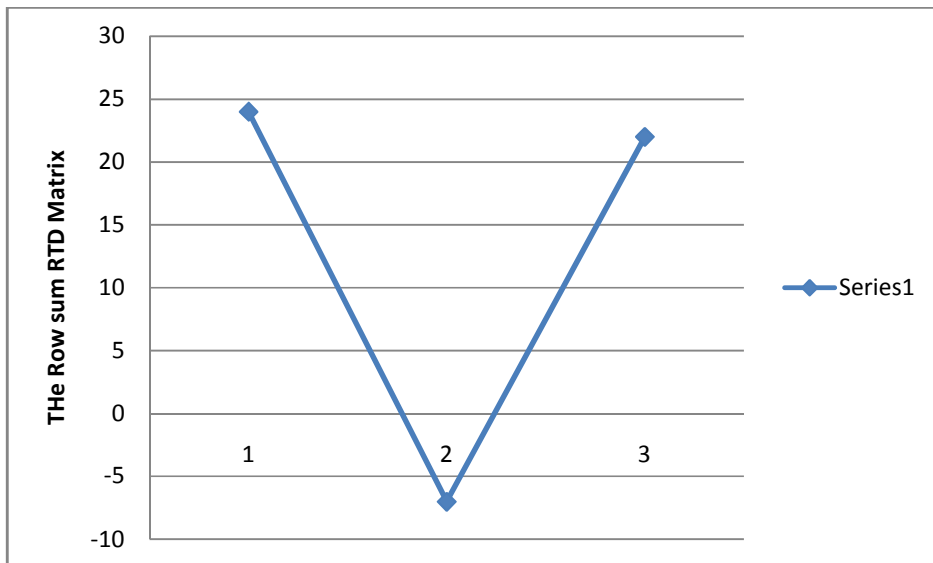**Figure 4:** Maximum age group of dengue fever patients $\alpha = 0.75$

Figure 5: Maximum age group of dengue fever patients using CETD matrix

In the above graph we observe that dengue fever mostly affected peoples at the age of 15. The peak age of most affected peoples is 17. The peak period is 11-25.

5. Conclusion

From the above analysis, fever mostly affected peoples at the age of 15. The peak age of people having affected is 17. The above analysis with CETD matrix, the result gets confirmed. It is suggested that, there is no specific treatment for dengue fever. No

vaccine can protect against dengue fever only avoiding mosquito bites can prevent it. Reduce the amount of skin exposed by wearing long pants, etc., and mosquito repellents, mosquito traps and nets. Personal protection and the environmental management of mosquitoes are important in preventing illness. Prevent access of mosquitoes to an infected person with a fever. Protect yourself from mosquito bites at all times in dengue area.

REFERENCES

1. V.Kandasamy, W.B.Elumalai., V.Devadoss and M.John, Application of CETD matrix techniques to study the social and psychological problems faced by rag pickers, *Vikram Mathematical Journal*, 25 (2005) 1-8.
2. L.A.Zadeh, Fuzzy sets, *Information and Control*, 8 (1965) 338-353.
3. M.A.William, A.V.Devadoss and J.J.Sheeba, An analysis of breast cancer using RTD matrix, *International Journal of Computing Algorithm*, 2 (2013) 190-194.
4. A.V.Devadoss and A.Felix, Immaculate Anbarasi. 'Women teachers affected by stress in Chennai schools using CETD matrix, *International Journal of Business Intelligents,* 2 (2013) 28-32.
5. J.P.Nicholas, R.Arthur and P.P.Ayyadurai, Estimation of maximum age group affected by stress problems for the teachers in Chennai by using (RTD matrix) (or) fuzzy matrix, *IJAPM*, 2(3) (2012) 224-226.
6. A.J.McMichael, et al, Eds., *Climate Change and Human Health – Risks and Responses*, WHO, Geneva, 2003.
7. M.N.Karim, S.U.Munshi, N.Anwar and M.S.Alam, Climatic factors influencing dengue cases in Dhaka city: a model for dengue prediction, *Indian J. Med. Res.,* 136 (2012) 32–39.
8. P.K.Singh and R.C.Dhiman, Climate change and human health, *Indian context. J. Vector Borne Dis.,* 49(2) (2012) 55–60.
9. R.Chandran and P.A.Azeez, Outbreak of dengue in Tamil Nadu, India, *Current Science,* 109 (2015) 171-176.
10. S.M.Mehendale, A.R.Risbud, J.A.Rao and K.Banerjee, Outbreak of dengue fever in rural areas of Parbhani district of Maharashtra (India), *Indian J. Med. Res.,* 93 (1991) 6–11.