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A STUDY OF DEMONITISATION USING FUZZY MATRIX

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Abstract:

This paper gives a brief survey on Demonetisation. The method of application of Combined Effective Time Dependent Data (CETD) Matrix, Average Time Dependent Data (ATD) Matrix and Refined Time Dependent Data (RTD) Matrix which are the fuzzy models are studied using fuzzy matrices. The effects and objectives of demonetisation using the concept of mean and standard deviation (SD) of the real data matrices are obtained. In order to make an analysis a sample study from social Medias has been taken. The graphical representation of effects and objectives of demonetisation at different parameters of α are drawn using MATLAB. Conclusion and some suggestions are also provided.

Key Words: Fuzzy mixed column vector, Fuzzy mixed row vector, CETD Matrix, RTD Matrix, ATD Matrix.

1. Introduction:

Fuzzy logic starts with and builds on a set of user-supplied human language rules. The fuzzy systems convert these rules to their mathematical equivalents. This simplifies the job of the system designer and the computer, and results in much more accurate representations of the way systems behave in the real world. Fuzzy Set Theory was formalised by Professor Lofti Zadeh at the University of California in 1965. The concept of fuzzy relation on a set was defined by Zadeh [20, 21]. In the last thirty years Bell [1], Dubois and Prade [2], Kerre [5], Lowen [8], Meenakshi et al.[9], [10], [11], Roesenfeld [14], Zimmermann [22] and others have extended the ideas of fuzzy set theory to topology, algebra, Hilbert spaces, graphs, games theory, logic and computing, etc. The basic concept of fuzzy matrices introduced by Vasantha Kandasamy W.B., Florentin Smarandache and Ilanthenral K. [17, 18]. They gave the basic notions of matrices and the properties of fuzzy matrices. Fuzzy Logic using MATLAB was studied by S. N. Sivanandam, S. Sumathi and S. N. Deepa [16] .The effects and objectives of demonetisation are programmed using MATLAB 6.0 and the stimulated results are given.

2. Preliminaries:

Definition 2.1 [12]

Let T_{mn} denote the set of all m × n matrices over T. If m = n, in short, we write T_n. Elements of T_{mn} are called as membership value matrices, binary fuzzy relation matrices (or) in short, fuzzy matrices. Boolean matrices over the Boolean algebra {0, 1} are special types of fuzzy matrices.

Definition 2.2 [12]

Let $A = (a_{ij}) \in T_{mn}$ .Then the element aij is called the (i, j) entry of A. Let A_{i*} (A_{*j}) denote the i^{th} row (j^{th} column) of A.

Definition 2.3 [12]

The n × m zero matrix *O* is the matrix all of whose entries are zero. The n x n identity matrix I is the matrix δ_{ij} such that $\delta_{ij} = 1$ if i = j and $\delta_{ij}=0$ if $i \neq j$. The n x m universal matrix J is the matrix all of whose entries are 1.

Definition 2.4 [17]

In certain fuzzy matrices we include [1, -1] to be the fuzzy interval. So any element $a_{ij} \in [1, -1]$ can be positive or negative. If a_{ij} is positive then $0 < a_{ij} \leq 1$, if a_{ij} is negative then $-1 < a_{ij} \leq 0$; $a_{ij} = 0$ can also occur. So [0, 1] or [-1, 1] will be known as fuzzy interval. Thus if $A = (a_{ij})$ is a matrix and if in particular $a_{ij} \in [1, -1]$ we call A to be fuzzy matrix.

Example 2.1

$$A = \begin{bmatrix} .4 & 1 & .6 & .5 \\ .8 & .6 & .2 & 0 \\ .3 & .2 & 1 & .5 \end{bmatrix}$$

Thus A is a fuzzy matrix.

Definition 2.5 [18]

Let $X = X_1 \cup X_2 \cup \ldots \cup X_M$ ($M \geq 2$) where each X_i is a 1 × s fuzzy row vector/matrix then we define X to be a special fuzzy row vector / matrix (i = 1, 2, …, M). If in particular $X = X_1 \cup X_2 \cup \ldots \cup X_M$ ($M \geq 2$) where each X_i is a 1 × s_i fuzzy row vector/matrix where for atleast one $s_i \neq s_j$ with $i \neq j$, $1 \leq i, j \leq M$ then we define X to be a special fuzzy mixed row vector / matrix.

Definition 2.6 [18]

Let $Y = Y_1 \cup Y_2 \cup \ldots \cup Y_m$ ($m \geq 2$) we have each Y_i to be a t × 1 fuzzy column vector / matrix then we define Y to be a special fuzzy column vector / matrix. If in particular in $Y = Y_1 \cup Y_2 \cup \ldots \cup Y_m$ ($m \geq 2$) we have eachY_i to be t_i × 1 fuzzy column vector where at least for one or some $t_i \neq t_j$ for $i \neq j$, $1 \leq i, j \leq m$ then we define Y to be a special fuzzy mixed column vector/matrix.

3. The Method of Application of Cetd Matrix:

In this section on the collected data about effects on demonetisation (simple fuzzy matrix model) is discussed. At first the collected raw data is transformed into a fuzzy matrix model. In the first stage, the raw data of effects on demonetisation is given in the matrix representation which is converted into a time dependent matrix. Secondly, after obtaining the time dependent matrix, using the techniques of average and standard deviation the time dependent data matrix is converted into an Average Time Dependent Data Matrix (ATD Matrix) by taking age group along the rows and the effects on demonetisation along the columns.

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ATD Matrix is obtained by dividing each entry of the raw data matrix by the number of years. This matrix represents a data which is totally uniform. At the third stage, using the average μ_j of each j^{th} column and σ_j the Standard Deviation of each j^{th} column, a parameter α has been chosen from the interval [0, 1] and then the Refined Time Dependent Matrix (RTD Matrix) a_{ij} is formed using the formula:

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 $a_{ij} \geq (\mu_j + \alpha * \sigma_j)$ then $e_{ij} = 1$

where a_{ij}'s are the entries of the ATD Matrix.

The ATD Matrix is thus converted into the Refined Time Dependent Data (RTD) Matrix by using the above formulas. Now, the row sum of this RTD matrix gives the maximum age group which is prone to effects on demonetisation. We can also combine these matrices by varying $\alpha \in [0, 1]$ so that the Combined Effective Time Dependent Data (CETD) Matrix is obtained. The row sum is found out for the 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.

4. Identification Of Maximum Age Group of People's Views on Demonetisation Using 6×10 Matrices:

Demonetization of currency means discontinuity of the particular currency from circulation and replacing it with a new currency. In the current context it is the banning of the 500 and 1000 denomination currency notes as a legal tender.

Using the linguistic questionnaire we have taken the following 10 effects (E_1, E_2….E_{10}) to our study.

E_1 - Cash Rush
E_2– Decreasing Black Money
E_3 - Transportation Halts
E_4 - Income Tax Raids and Cash Seizures
E_5 - Seizures of New Rs. 2000 Notes
E_6 - Gold Purchases
E_7 - Donations
E_8 - Railway Bookings
E_9-Municipal and Local Tax Payments
E_{10}-Buy Debit Card Machines and Install Paytm App

These effects are taken as the columns of the initial raw data matrix. The age group in years 21-30, 31-40, 41-50, 51-60, 61-70 and 71-80 are taken as the row of the matrix.

Table 1: Initial Raw Data Matrix of Views on Demonetisation of Order 6×10

	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
21-30	28	21	18	28	19	22	39	37	34	22
31-40	15	28	32	29	27	32	34	29	29	27
41-50	32	26	11	15	25	37	17	31	32	29
51-60	31	19	25	21	26	36	22	37	25	31
61-70	25	25	27	25	19	29	21	36	38	21
71-80	12	25	31	27	21	26	39	38	26	25

Table 2: The ATD Matrix of views on Demonetisation of order 6×10

	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
21-30	2.8	2.1	1.8	2.8	1.9	2.2	3.9	3.7	3.4	2.2
31-40	1.5	2.8	3.2	2.9	2.7	3.2	3.4	2.9	2.9	2.7
41-50	3.2	2.6	1.1	1.5	2.5	3.7	1.7	3.1	3.2	2.9
51-60	3.1	1.9	2.5	2.1	2.6	3.6	2.2	3.7	2.5	3.1
61-70	2.5	2.5	2.7	2.5	1.9	2.9	2.1	3.6	3.8	3.4
71-80	1.2	2.5	3.1	2.7	2.1	2.6	3.9	3.8	2.6	2.5

Table 3: The Average and Standard deviation of the above ATD Matrix

Average(μ)	2.38	2.4	2.4	2.42	2.28	3.03	2.87	3.47	3.07	2.8
Standard Deviation (σ)	0.77	0.31	0.74	0.48	0.33	0.53	0.90	0.34	0.45	0.39

Now by using the formula defined in Section 3, we get the RTD Matrix for different Parameters α.

The RTD Matrix for $\alpha = 0.1$

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 4 \\ 2 \\ 2 \\ 2 \\ 3 \end{bmatrix}$$

The RTD Matrix for $\alpha = 0.3$ The row sum matrix

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$$\begin{bmatrix} 1 & -1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 & -1 \\ -1 & 1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & 0 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 & 0 & 1 \\ 1 & -1 & 0 & -1 & 1 & 1 & -1 & 1 & -1 & 1 \\ 0 & 1 & 1 & 0 & -1 & 0 & -1 & 1 & 1 & -1 \\ 1 & 1 & 1 & 1 & -1 & 0 & 1 & 1 & -1 & 1 \end{bmatrix} \qquad \begin{bmatrix} 0 \\ 3 \\ 1 \\ 1 \\ 1 \\ 5 \end{bmatrix}$$

The RTD Matrix for $\alpha = 0.5$ — The row sum matrix

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

The RTD Matrix for $\alpha = 0.7$ — The row sum matrix

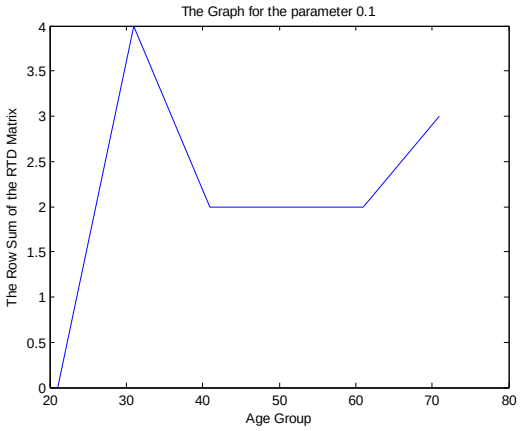
$$\begin{bmatrix} 0 & -1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 & 1 \\ -1 & 1 & 1 & 1 & 1 & 0 & 0 & -1 & 0 & 0 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 & 0 & 1 \\ 1 & -1 & 0 & 0 & 1 & 1 & -1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & -1 & 0 & -1 & 0 & 1 & 1 \\ -1 & 0 & 1 & 1 & 0 & -1 & 1 & 1 & -1 & 0 \end{bmatrix} \qquad \begin{bmatrix}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

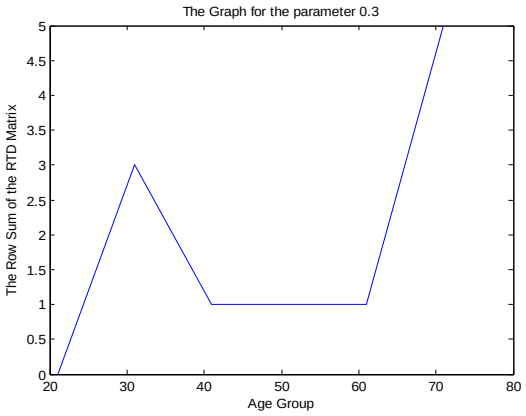
Now we combine these matrices by varying α belongs to [0, 1] and we get the Combined Effective Time Dependent Data (CETD) Matrix which is given as below.

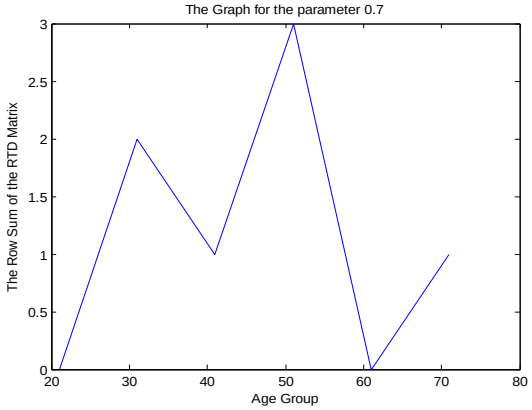
CETD Matrix — The row sum matrix

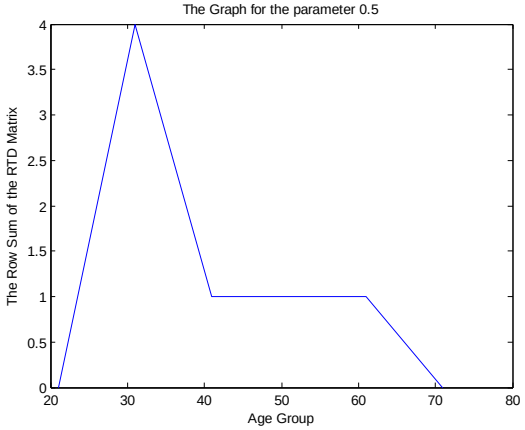
$$\begin{bmatrix} 3 & -4 & -4 & 4 & -4 & -4 & 4 & 4 & 4 & -2 \\ -4 & 4 & 4 & 4 & 4 & 3 & 3 & -4 & -2 & 1 \\ 4 & 4 & -4 & -4 & 4 & 4 & -4 & -4 & 1 & 4 \\ 4 & -4 & 1 & -3 & 4 & 4 & -4 & 4 & -3 & 4 \\ 1 & 3 & 3 & 1 & -4 & -1 & -4 & 3 & 4 & -2 \\ 0 & 2 & 4 & 4 & -3 & -3 & 4 & 4 & -4 & 1 \end{bmatrix} \qquad \begin{bmatrix} 1 \\ 13 \\ 5 \\ 7 \\ 4 \\ 9 \end{bmatrix}$$

The Graphical Representations:









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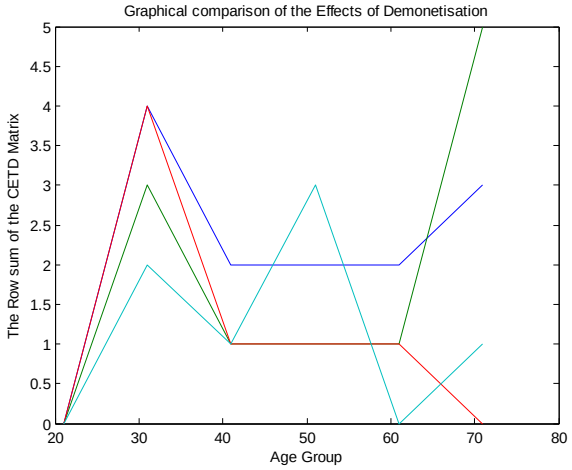

6. Objectives of Demonitisation:

The main objective of this move was to curb the black money, corruption and fake money menace. All the people but those who were indulged in malpractices welcomed the move. The whole opposition shook hand against this move under one pretence or the other. They called this decision a draconian law and wanted the govt to roll back it. Tirades were made to target the decision. Govt also carried out counter attacks.

Using the linguistic questionnaire we have taken the following four objective (O_1, O_2, O_3, O_4) to our study.

$\mathbf{O_1}$–Black money decreased
$\mathbf{O_2}$–Corruption decresed
$\mathbf{O_3}$-Fake money menace
$\mathbf{O_4}$-Terrorism decresed

Table 4: Initial Raw Data

	O_1	O_2	O_3	O_4
21-30	28	21	28	18
31-40	20	25	23	25
41-50	29	25	27	19
51-60	24	26	25	22
61-70	15	25	26	25
71-80	25	27	29	23

Table 5: The Average and the Standard Deviation of the above table

Average (μ)	23.3	24.5	26.17	22
Standard Deviation (σ)	5.39	1.97	2.04	2.96

Now by using the formula defined in section 3, we get the RTD Matrix for different parameters α.

The RTD Matrix for α = 0.1

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 0 \\ 2 \\ 1 \\ 1 \\ 4 \end{bmatrix}$$

The RTD Matrix for α = 0.3

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

The row sum matrix

$$\begin{bmatrix} 0 \\ 0 \\ 2 \\ 0 \\ 1 \\ 4 \end{bmatrix}$$

The RTD Matrix for α = 0.5

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

The row sum matrix

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

The RTD Matrix for α = 0.7

The row sum matrix

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

Now we combine these matrices by varying α belongs to [0, 1] and we get the Combined Effective Time Dependent Data (CETD) Matrix which is given as below.

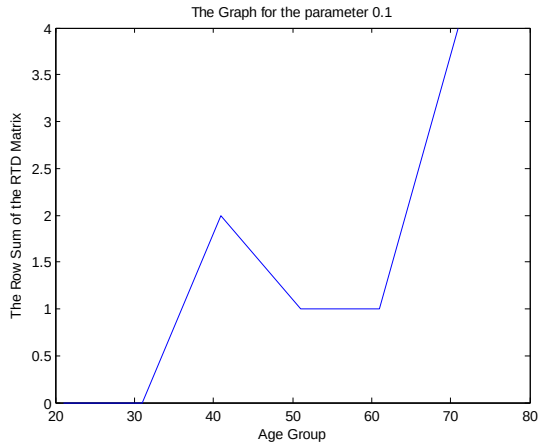
CETD Matrix

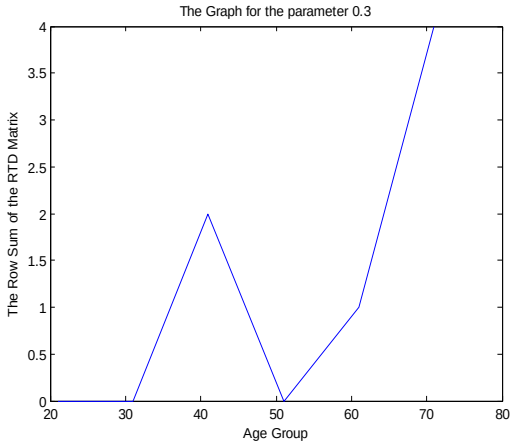
$$\begin{bmatrix} 4 & -4 & 4 & -4 \\ -3 & 2 & -5 & 7 \\ 4 & 2 & 2 & -4 \\ -1 & 4 & -3 & 0 \\ -4 & 2 & 0 & 4 \\ 2 & 4 & 4 & 2 \end{bmatrix}$$

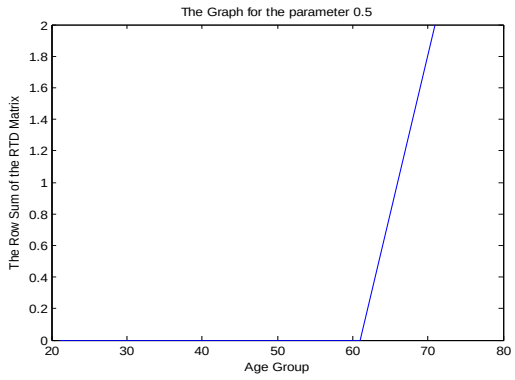
The row sum matrix

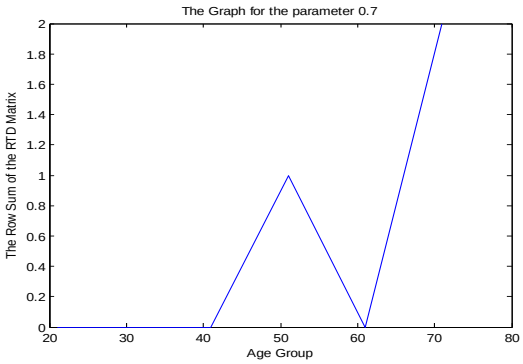
$$\begin{bmatrix} 0 \\ 0 \\ 4 \\ 2 \\ 2 \\ 12 \end{bmatrix}$$

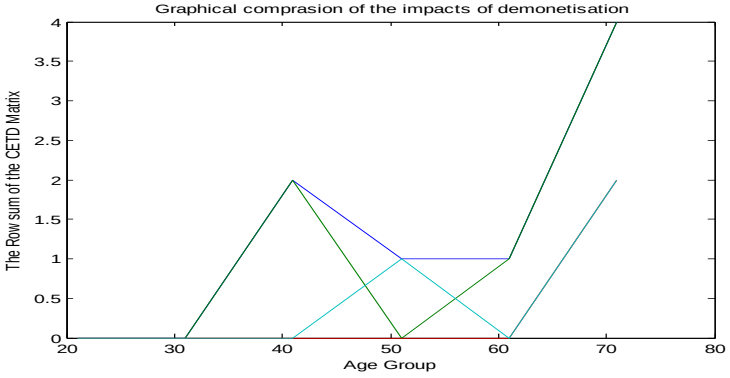
The Graphical Representations:











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Conclusion and Suggestions:

The demonetization policy will help India to become corruption-free. Those indulging in taking bribe will refrain from corrupt practices as it will be hard for them to keep their unaccounted cash. This move will help the government to track the black money. Those individuals who have unaccounted cash are now required to show income and submit PAN for any valid financial transactions. The government can get income tax return for the income on which tax has not been paid. The move will stop funding to the unlawful activities that are thriving due to unaccounted cash flow. Banning high-value currency will rein in criminal activities like terrorism etc. The ban on high value currency will also curb the menace of money laundering. Now such activity can easily be tracked and income tax department can catch such people who are in the business of money laundering. From the graph it was seen that people in the age of 31-60 feel that the effects of demonetisation has been higher among people. But it is generally accepted by everyone that this will bring an end to corruption in the country. Thought it is true that the problems faced by people such as withdrawal or depositing cash in Banks, the long time waiting in front of ATM for even normal expenses. The tremendous increase of the circulation of fake notes. This should be taken in a good sense by the people just for one simple reason: The Welfare of the Nation. The government is taking all the necessary steps and actions to meet the currency demand and soon the trial and tribulations of the people will be over with the smooth flow of the new currency. Based on the above study we suggest the following steps

- ✓ Do not deposite money in the accounts of poor relatives and friends.
- ✓ Do not Entice the people with some percentage of money for exchange.
- ✓ Do not Hire labors for some Rupees ranging from Rs 500/- to 700/- for becoming the part of long queues in front of banks/ ATMs.
- ✓ Do not Converte black money in to gold.
- ✓ Do not Pay a few months salaries in advance.
- ✓ Do not Pay back loans forcibly.
- ✓ Pay the previous tax

It is very difficult to point out the merits and demerit of this policy. However, if we compare the merits verses demerits, it will be safe to conclude that the former outweighs the latter. Even though there is suffering and agony among the masses right at the moment but the forecast is that its benefits will be seen in the long run.

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