Volume 9, No. 3, March - 2018 (Special Issue)
International Journal of Mathematical Archive-9(3), 2018, 159-164
Available online through www.ijma.info ISSN 2229 – 5046

A STUDY ON GOODS AND SERVICE TAX (GST) USING FUZZY MATRIX

B. AMUDHAMBIGAI[1], K. SUGAPRIYA[2] AND R. VIGNESWARI[3]

[1]Department of Mathematics,
Sri Sarada College for Women, Salem-636016, Tamil Nadu, India.

E-mail: rbamudha@yahoo.co.in[1], nirmalapriya97@gmail.com[2] and vickymathi95@gmail.com[3].

ABSTRACT

This paper gives a brief survey on Goods and service tax (GST). 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 advantages of goods and service tax 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 media has been taken. The graphical representation of advantages of goods and service tax at different parameters of α were drawn using MATLAB. Although GST has received a positive response from all sector of people, to be more specific, in this paper an effort has been taken to find out which group of people welcome GST the most and finally the conclusion is given.

Key words: *Fuzzy mixed column vector, Fuzzy mixed row vector, CETD matrix, RTD matrix, ATD matrix.*

AMS Mathematics subject classification: *15B15.*

1. INTRODUCTION

GST means Goods and Service Tax. Goods and Service Tax is a complete tax imposed on manufacture, sale and expenditure of goods and service tax. Experts say that GST will help in economic growth of the country. The statement regarding GST given by our honourable Prime Minister Mr.Narendra Modi is that GST will include 'One Tax, One Nation'.

France is the first country to introduce GST in 1954. After France it was adopted by 165 nations. India is the 166th nation to adopt GST. GST is an indirect tax levied in India and the tax came into effect from july 1, 2017 through the implementation of One hundred and First Amendment of the Constitution of India by the Government of India. The general benefits of GST are as follows:

- Understanding and maintaining easily
- Elimination of cross cascading
- Competitive development
- Optimization of GST rate and infrastructure
- Implementation of one and only sparkling tax system
- Reduction of overall tax burden

Fuzzy rationale begins with and expands on an arrangement of client provided human dialect rules. The fuzzy frameworks change over these principles to their numerical counterparts. This streamlines the activity of the framework originator and the PC, and results in substantially more exact portrayals of the way frameworks carry on in reality. Fuzzy Set Theory was formalized by Professor Lofti Zadeh at the University of California in 1965. The idea of fuzzy connection on a set was characterized by Zadeh L.A [14, 15]. Over the most recent thirty years Bell D.A [2], Dubois D. and Prade H. [3], Kerre E. E. [4], Lowen [5], Meenakshi A. R. *et al.* [6, 7, 8, 9], Roesenfeld A. [10], Zimmermann H.J. [16] and others have expanded the thoughts of fuzzy set hypothesis Topology, Algebra, Hilbert spaces, Graphs, Game

CONFERENCE PAPER
National Conference dated 26th Feb. 2018, on "New Trends in Mathematical Modelling" (NTMM - 2018), Organized by Sri Sarada College for Women, Salem, Tamil Nadu, India.

theory, Logic and Computing and so on. The essential idea of fuzzy lattices was given by Vasantha Kandasamy W.B., Florentin Smarandache and Ilanthenral K [12]. They gave the fundamental thoughts of lattices and the properties of fuzzy frameworks. Fuzzy Logic utilizing MATLAB was examined by S. N. Sivanandam, S. Sumathi and S. N. Deepa [11]. The points of interest of products and administration charge are modified utilizing MATLAB and the animated outcomes are given.

2. PRELIMINARIES

In this section the basic concepts required are studied.

Definition 2.1: [**13**] Let T_{mn} denote the set of all m x 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: [**13**] Let A ϵ $(a_{ij}) \in T_{mn}$. Then the element a_{ij} 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: [**13**] The n x 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 δ_{ij} =1 if i = j and δ_{ij} =0 if i ≠ j. The n x m universal matrix J is the matrix all of whose entries are 1.

Definition 2.4: [**1**] 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:

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

Thus A is a fuzzy matrix.

Definition 2.5: [**1**] Let $X = X_1 \cup X_2 \cup . . . \cup X_M$ (M ≥2) where each X_i is a 1 x s fuzzy row vector / matrix then we define X to be a special fuzzy row vector / matrix (i = 1, 2, . . . , M). If in particular $X = X_1 \cup X_2 \cup . . . \cup X_M$ (M ≥ 2) where each X_i is a 1 x 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: [**1**] Let $Y = Y_1 \cap Y_2 \cap . . . \cap Y_m$ (m ≥ 2) we have each Y_i to be a t x 1 fuzzy column vector / matrix then we define Y to be a special fuzzy column vector / matrix. If in particular in $Y = Y_1 \cap Y_2 \cap . . . \cap Y_m$ (m ≥ 2) we have each Y_i to be t_i x 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 the advantages of GST based on the collected data is discussed. At first, the gathered information is changed into a fuzzy network demonstrate. The underlying crude information grid must be made which is shaped by taking the rates in lines and favorable circumstances of GST in sections. Average Time Dependent Data Matrix (ATD Matrix) is gotten by isolating the sections of starting crude information lattice by the distinction of range in percentage. This framework speaks to an information which is absolutely uniform. Mean (μ_j) and standard deviation (σ_j) of each j^{th} segment has been discovered independently for ATD Matrix. Utilizing the mean and standard deviation for every section and picking the parameter lying in [0, 1] we develop a Refined Time Dependent Matrix (RTD Matrix) a_{ij} utilizing the equation:

If $a_{ij} \leq (\mu_j - \alpha * \sigma_j)$ then e_{ij} = -1 else
If a_{ij} ϵ $(\mu_j - \alpha * \sigma_j , \mu_j + \alpha * \sigma_j)$ 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 RTD Matrix consists only -1, 0, 1. The ATD Matrix is changed over into the Refined Time Dependent Data (RTD) Matrix by utilizing the above equations. Now, the row sum of this RTD network gives the most extreme rate which is inclined to focal points of products and administration tax. We can likewise join these frameworks by changing $\alpha \in [0, 1]$ so the Combined Effective Time Dependent Data (CETD) Matrix is obtained. The row sum is discovered for the CETD lattice and conclusions are determined in light of the column entireties. All these are spoken to by diagrams and this was done effectively by utilizing the product MATLAB with R2012a form.

4. IDENTIFICATION OF MAXIMUM GROUP OF PEOPLE'S VIEWS ON ADVANTAGES OF GOODS AND SERVICE TAX

Goods and Service Tax is characterized as any duty on supply of products and enterprises. It offer a more extensive expense base, brings down assessment rates and dispenses with question on characterization. Goods and Service Tax (GST) is a backhanded duty, supplanted Value Added Tax (VAT), as of late in India from July 01'2017. The GST is administered by a GST committee and its director. Under GST, merchandise and ventures are exhausted at the accompanying rates 0%, 25%, 50%, 75%. Despite the fact that GST has got a constructive reaction from all segments of individuals. To be more particular, in this paper an exertion has been taken to discover which gathering of individuals welcome GST the most.

Using the linguistic questionnaire we have taken the following 10 advantages (A_1, A_2 . . . A_{10}) to our study.

- A_1-Eliminate multiple taxes on firms
- A_2-Beneficial for consumers
- A_3-To curb tax evasion
- A_4-Spirit of ‘One Nation, One Tax’
- A_5-Development of our India economy
- A_6-Helpful for small industrial business
- A_7 -Rise in the production of goods
- A_8 -Reduce overall tax burden
- A_9 -Transparent and corruption free tax administration
- A_{10}-current service tax compliances are easier than the direct tax compliances

4.1 Fuzzy matrix for survey taken from Buisnessmen

The advantages are taken as the columns of the initial raw data matrix. The advantages are grouped between 0%-25%, 25%-50%, 50%-75%, 75%-100% which are taken as the row of the matrix.

Table-1: Initial Raw Data Matrix of Views on Advantages of GST of order 4 x 10

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
0%- 25%	2	2	1	1	3	2	1	3	3	1
25%- 50%	2	1	3	3	3	2	3	3	1	3
50%-75%	3	3	2	2	2	4	2	1	2	3
75%-100%	3	4	4	4	2	2	4	3	4	3

Table-2: The ATD Matrix of Views on Advantages of GST of order 4 x 10

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
0%- 25%	0.08	0.08	0.04	0.04	0.12	0.08	0.04	0.12	0.12	0.04
25%- 50%	0.08	0.04	0.12	0.12	0.12	0.08	0.12	0.12	0.04	0.12
50%-75%	0.12	0.12	0.08	0.08	0.08	0.16	0.08	0.04	0.08	0.12
75%-100%	0.12	0.16	0.16	0.12	0.08	0.08	0.16	0.12	0.16	0.12

Table-3: The Average and Standard Deviation of above ATD matrix

Average (μ)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standard Deviation(σ)	0.02	0.04	0.04	0.04	0.02	0.03	0.04	0.03	0.04	0.03

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

The RTD Matrix for α = 0.1

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

The row sum matrix

$$\begin{bmatrix} -4 \\ +2 \\ -2 \\ +6 \end{bmatrix}$$

The RTD Matrix for α = 0.3

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

The row sum matrix

$$\begin{bmatrix} -4 \\ +2 \\ -2 \\ +6 \end{bmatrix}$$

The RTD Matrix for α = 0.5

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

The row sum matrix

$$\begin{bmatrix} -4 \\ +2 \\ -2 \\ +6 \end{bmatrix}$$

The RTD Matrix for α = 0.7

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

The row sum matrix

$$\begin{bmatrix} -4 \\ -1 \\ +2 \\ +6 \end{bmatrix}$$

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

CETD Matrix

$$\begin{bmatrix} -4 & -3 & -4 & -4 & +4 & -4 & -4 & +4 & +3 & -4 \\ -4 & -4 & +3 & +3 & +4 & -4 & +3 & +4 & -4 & +4 \\ +4 & +3 & -3 & -3 & -3 & +4 & -3 & -4 & -3 & +4 \\ +4 & +4 & +4 & +4 & -4 & -4 & +4 & +4 & +4 & +4 \end{bmatrix}$$

The row sum matrix

$$\begin{bmatrix} -16 \\ +5 \\ -4 \\ +24 \end{bmatrix}$$

From the above discussion and calculations it is observed that according to businessmen the benefits of GST are 75% - 100%. It is represented graphically below:

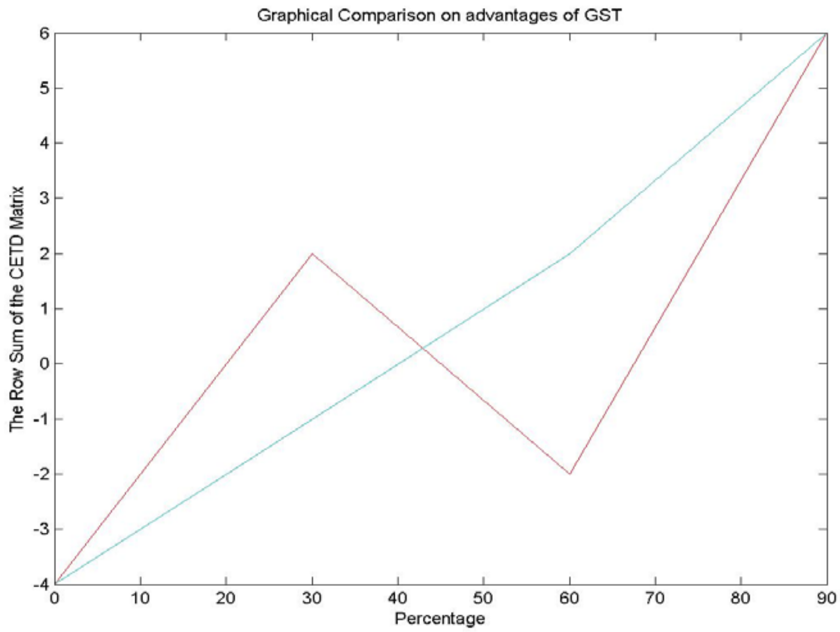

Figure-1: Percentage of businessmen welcoming GST

4.2 Graphical Representation:

Similarly the data has been collected from various streams of people such as Advocates, Bankers, Doctors, Teachers, Farmers, Drivers, Weavers, Homemakers. The benefits of GST according to these sectors of people are

- Advocates - 50%-75%
- Bankers -50%-75%
- Doctors - 0%-25%
- Teachers - 25%-50%
- Drivers - 25%-50%
- Farmers - 25%-50%
- Homemakers - 50%-75%
- Weavers - 25%-50%

These are represented in piechart as follows:

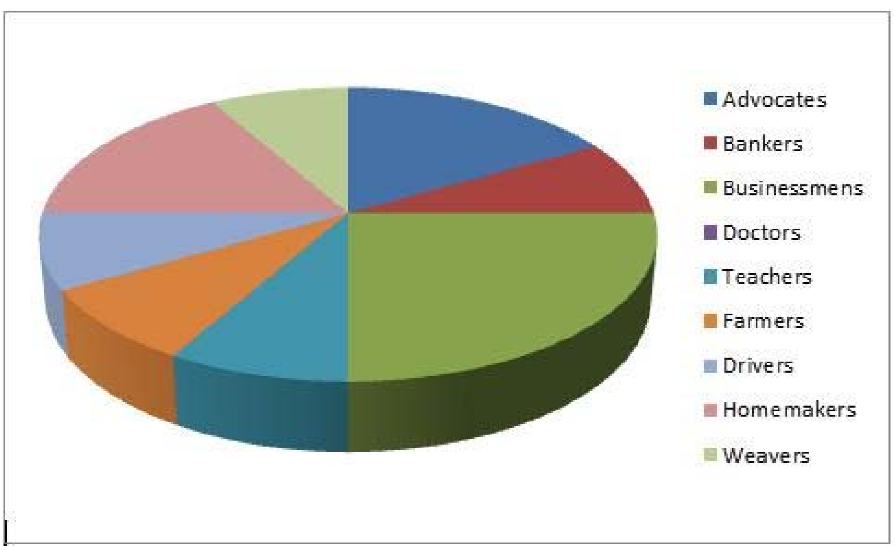

Figure-2: Pie chart denoting benefits of GST according to people

Thus, from the above discussion it is found that Businessmen are welcoming the GST most.

5. CONCLUSION

Every new idea or scheme implemented in a country will definitely have its own advantages and disadvantages. These schemes will be beneficial to some sector of people while proving to be somewhat non-beneficial to other sectors. Thus, in this paper, the methods of CETD and RTD matrix are used to find out which group of people welcome GST the most and it is found that people in business sector are welcoming it the most. Though other people too welcome GST, it will receive still more appreciation if some changes beneficial to all sectors are implemented.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude and thanks to the referees for the betterment of this paper.

REFERENCES

1. Amudhambigai, B. and Sugapriya, K. “A Study of Demonitisation Using Fuzzy Matrix”, International Journal of Current Research and Modern Education, Special Issue, January, Page Number 64 - 69, 2017.
2. Bell, D.A. (1953). Inf. Theory and its Engineering Applications. Pitman, New York.
3. Dubois, D. and Prade, H. (1980). Fuzzy Sets and System: Theory and Applications. Academic press, San Diego.
4. Kerre, E.E. (1982). “The use of fuzzy set theory electro cardio logical diagnostics”. In: Approximate Reasoning Decision Analysis. Gupta and Sanchez. (eds). North Holland, New York. 277-282.
5. Lowen, R. (1976). “Fuzzy topological spaces and fuzzy compactness”. J. Math Anal and Appl. 56: 621-633.
6. Meenakshi, A.R. and Cokilavany, R. (2001). “On fuzzy 2 - normed linear spaces”. Int. J. Fuzzy Math. 9: 345-351.
7. Meenakshi, A.R. and Cokilavany, R. (2002). “On fuzzy 2 - inner product spaces”. Int. J. Fuzzy Math. 10: 575-585.
8. Meenakshi, A.R., Narayanan, A.L. and Ramasamy, A.M.S. (2002). “Fuzzy games”. Int. J. Fuzzy Math. 10: 817-829.
9. Meenakshi, A.R., (1944). “Fuzzy Matrix Theory and Applications”, MJP Publishers, 2008.
10. Rosenfeld, A. (1971). “Fuzzy groups”. J. Math. Analysis and Appl. 35: 512-517.
11. Sivanandam S. N., Sumathi S and Deepa S.N., “Introduction to Fuzzy Logic using MATLAB”, Springer-Verlag Berlin Heidelberg 2007.
12. Vasantha Kandasamy, W.B., Florentin Smarandache and Ilanthenral, K. (2007). “Special Fuzzy Matrices for Social Scientists”, Infolearnquest, Ann Arbor, 2007.
13. Vasantha Kandasamy, W.B., Florentin Smarandache and Ilanthenral, K. (2007). “Elementary Fuzzy Matrix Theory and Fuzzy Models for Social Scientists”, Automaton, Los Angeles, 2007.
14. Zadeh, L.A., Fuzzy Sets, Inform and Control; 8 (1965), 338-365.
15. Zadeh, L.A. (1971). “Similarity relations and fuzzy orderings”. Information Sci. 3:177-200.
16. Zimmermann, H.J. (1991). Fuzzy Set Theory and its Applications 2nd edn. Allied publishers Ltd. New Delhi.

Source of support: National Conference on “New Trends in Mathematical Modelling” (NTMM - 2018), Organized by Sri Sarada College for Women, Salem, Tamil Nadu, India.

