

# A FUZZY MODEL FOR ANALYSING VEDIC MATHEMATICS

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## Abstract

The Vedas are considered divine in origin and are assumed to be revelation from God. The argument that Vedas means all knowledge and hence the fallacy of claiming even 20<sup>th</sup> century inventions to belong to the Vedas clearly reveals that there is a hidden agenda in presenting such a relic upon a subject of such a recent origin. The analysis of its mathematical content and hidden motives are of high interest. This paper presents a systematic analysis in this regard by using fuzzy models like fuzzy cognitive maps, fuzzy relational maps (even by using newly constructed fuzzy dynamical system as that can be analyze multi-experts opinion at a time using a single model). The issue of Vedic mathematics involves religious politics, caste supremacy, apart from elementary arithmetic. So we cannot use simple statistics for this analysis. In this work, a linguistic questionnaire was used for data collection; experts filled in these questionnaires: these aided for constructing fuzzy model to analyse the problem of handling opinion of multi-experts. Finally, observations from the study have been given.

KEY WORDS: Fuzzy set, fuzzy cognitive map, fuzzy relational map, fuzzy dynamical system, Vedic mathematics, hidden pattern.

## 1. Introduction

The “Vedic Mathematics” is called so because of its origin from Vedas. To be more specific, it has originated from the fourth Veda “Atharva Vedas”. The Sanskrit word Veda is obtained from the root Vid, meaning to know without limit. The Veda is an arsenal of all knowledge, invaluable, ever useful as it is explored deeper. Vedic Mathematics is a system of reasoning and mathematical working based on ancient Indian teachings, Veda. It is fast, competent and easy to learn and use. It simplifies arithmetic and algebraic operations, and has found increasing acceptance over the world.

Vedic Mathematics is an ancient technique and was revived only due to the efforts of Jagadguru Swami Bharathi Krishna Tirthaji of Govardhan Peeth, Puri Jaganath [1]. The basis of Vedic mathematics, are the 16 sutras, which ascribe a set of qualities to operations with number and algebra that are used effectively for solving divisions, reciprocals, squares and square roots, and so on. The simplicity of Vedic Mathematics encourages most calculations to be carried out without the paper and pen. This mental approach sharpens the mind, improves memory and concentration also helps in innovation.

The Vedas are considered divine in origin and are assumed to be direct revelations from God. The complete Vedic literature is in Sanskrit. In traditional Hinduism, the Vedas are for upper caste and not for the lower caste. For many centuries, the Vedas were not written down but passed from generation to generation by word of mouth in an oral tradition [11]. In recent

times Vedic mathematics was introduced as a subject in some schools of Uttar Pradesh and Madhya Pradesh. Further, schools run by Hindutva trusts introduced it into their curriculum. and Fuzzy models are applied in Vedic mathematics as it involves religious politics, caste supremacy, hidden motives apart from elementary arithmetic where simple statistics is not helping much. For this purpose, we used linguistic questionnaires for our data collection; experts filled in these questionnaires. Apart from this, several group discussions and meetings with various groups of people were held.

Paper is organized in four sections. First section gives the basic definitions needed in the study as preliminaries. Second section demonstrates the method of determining the hidden patterns through an example. Third section discloses students views, teachers feelings, opinion of heterogeneous group of parents and opinion of public about the use of Vedic Mathematics by using the fuzzy models. Finally conclusions are given followed by references.

## 2. Preliminaries

Hereby we furnish some basic definitions required in this study.

*Definition 2.1:* A fuzzy set [FS] is characterized by a membership (or fuzzy characteristic) function mapping the elements of a domain, space, or universe of discourse  $X$  to the unit interval  $[0, 1]$ . i.e.,  $\mu_A : X \rightarrow [0, 1]$  [5-9].

*Definition 2.2:* A fuzzy cognitive map [FCM] [2, 4] is a directed graph [3] with concepts like policies, events etc. as nodes and causalities as edges. It represents causal relationship between concepts.

Definitions related to FCM such as fuzzy nodes, simple FCMs, adjacency matrix of FCM, instantaneous state vector, cyclic FCM, acyclic FCM, feedback, dynamical system, hidden pattern, fixed point, limit cycle can be found in [1, 2, 4]

*Definition 2.3:* A fuzzy relational map [FRM] [1, 10] is a directed graph or a map from  $D$  to  $R$  with concepts like policies or events etc, as nodes and causalities as edges. It represents causal relations between spaces  $D$  and  $R$ .

Definitions related to FCMs can be extended easily for FRMs. Also note that the matrices associated with a FRM are need not be always square matrices.

*Definition 2.4:* New Fuzzy Dynamical System

This new system is constructed when we have the opinion of several experts. It functions more like a FRM but in the operations max min principle is used. We just describe how we construct it. We have  $n$  experts who give their opinion about the problem using  $p$  nodes along the column and  $m$  nodes along the rows. Now we define the new fuzzy system.

$M = (a_{ij})$  to be a  $m \times p$  matrix with  $(a_{ij}) \in [0, 1]$ ;  $1 \leq i \leq m$  and  $1 \leq j \leq p$ , giving equal importance to the views of the  $n$  experts.

The only assumption is that all the  $n$  experts choose to work with the same  $p$  sets of nodes/ concepts along the columns and  $m$  sets of nodes/concepts along the rows. Suppose  $P_1, \dots, P_p$  denotes the nodes related with the columns and  $C_1, \dots, C_m$  denotes the nodes of the rows. Then  $a_{ij}$  denotes how much or to which degree  $C_i$  influences  $P_j$  which is given a membership degree in the interval  $[0, 1]$  i.e.,  $a_{ij} \in [0, 1]$ ;  $1 \leq i \leq m$  and  $1 \leq j \leq p$  by any  $t^{\text{th}}$  expert.

Now  $M_t = (a_{ij}^t)$  is a fuzzy  $m \times p$  matrix which is defined as the new fuzzy vector matrix. We take the views of all the  $n$  experts and if  $M_1, \dots, M_n$  denotes the  $n$  number of fuzzy  $m \times p$  matrices where  $M_t = (a_{ij}^t)$ ;  $1 \leq t \leq n$ .

Let

$$M = \frac{M_1 + M_2 + \dots + M_n}{n}$$

$$M = \frac{(a_{ij}^1) + (a_{ij}^2) + \dots + (a_{ij}^n)}{n}$$

$$= (a_{ij}); 1 \leq i \leq m \text{ and } 1 \leq j \leq p.$$

i.e.,

$$a_{11} = \frac{(a_{11}^1) + (a_{11}^2) + \dots + (a_{11}^n)}{n}$$

$$a_{12} = \frac{(a_{12}^1) + (a_{12}^2) + \dots + (a_{12}^n)}{n} \text{ and so on.}$$

Thus,  $a_{ij} = \frac{(a_{ij}^1) + (a_{ij}^2) + \dots + (a_{ij}^n)}{n}$

The matrix  $M = (a_{ij})$  is defined as the new fuzzy dynamical model of the  $n$  experts or the dynamical model of the multi expert  $n$  system. It can simultaneously work with  $n$  experts view. Clearly  $a_{ij} \in [0, 1]$ , so  $M$  is called as the new fuzzy dynamical model.

### 3. Determination of a Hidden Pattern

Let  $R_1, R_2, \dots, R_n$  and  $V_1, V_2, \dots, V_m$  be the nodes of fuzzy relational maps represents respectively the domain set  $R$  and range set  $V$  with feed back. Let  $M$  be the relational matrix. When  $R_1$  is switched on given an input vector  $(1, 0, \dots, 0)$  in  $R$  the data should pass through the matrix  $M$ . Let  $A_j M = \{s_1, s_2, \dots, s_m\}$  after updating the resultant vector, we get  $A_1 M \in V$ . Now let  $B = A_1 M$ , we pass on  $B$  into  $M^T$  and obtain  $B M^T$ . We update the vector  $B M^T \in R$ .

This process is repeated till we get a limit cycle.

Example: Let us consider the relationship between a doctor and a patient. Let the domain space belongs to doctors be  $R_1, R_2, R_3, R_4, R_5$  and the range space belongs to their patients be  $V_1, V_2, V_3$ . We describe the nodes as follows:-

Domain Space	Range Space
$R_1 \rightarrow$ Treatment is nice	$V_1 \rightarrow$ Healthy Patient
$R_2 \rightarrow$ Treatment is poor	$V_2 \rightarrow$ Thin Patient
$R_3 \rightarrow$ Treatment is average	$V_3 \rightarrow$ Average Patient.
$R_4 \rightarrow$ Treatment is kind	
$R_5 \rightarrow$ Treatment is rude	

The relational graph of the doctor patient model is as follows:-

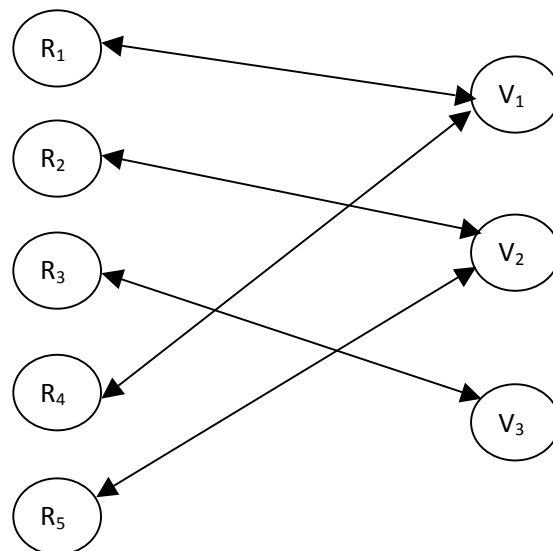


Fig 3.1

The relational matrix  $M$  of the map is given by

$$M = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

If  $A = (10000)$  is passed on in the relational matrix  $M$  the vector  $AM = (100)$  means that the patient is a healthy patient. Now let  $AM = B$ ,  $BM^T = (10010)$  which means that the treatment is good and the doctor is kind.

#### 4. Vedic Mathematics by Using the Fuzzy Models

In this section, we use fuzzy method to analyse the unknown motives of imposing Vedic Mathematics in Bangalore city and its surrounding rural schools/colleges. We tried to analyse this from four categories of people: Students, Teachers, Parents and Educationalists.

Firstly, for students, we prepared a linguistic questionnaire and asked them to answer. The criteria were that these students must have attended Vedic Mathematics classes. We prepared 50 photocopies of the questionnaire. Some main questions and their answers (consolidated) are given below.

1. Did you like the Vedic Mathematics classes?
2. Who took Vedic Mathematics classes?
3. Did you find any difference between Vedic Mathematics classes and your other classes?
4. How useful is Vedic Mathematics in doing your usual mathematical courses?
5. Does Vedic Mathematics help in the competitive exams?
6. Do you feel Vedic Mathematics can be included in the curriculum?
7. Can Vedic Mathematics help you in any other subject?
8. Were you taught anything like higher-level (advanced) Vedic Mathematics?

**Answers:** 1) Many told that they were asked to recall the Sanskrit sutras and they felt difficult but they felt easy and good for recalling the sutras in English. 2) In schools it was taught by temple priests and in colleges by maths faculty. 3) Compared with other classes, it was bit boring (till 5<sup>th</sup> standard) for some and nice for few. 4) It was useful while simplifying numbers and mathematical expressions by its own way. 5) Maximum college level students replied yes as they observe simple tricks for solving many sums which helped to crack competitive examinations. 6) Reply is 50-50. 7) No as it mainly deal with numbers. 8) Many replied that only the basics were thought and asked for reference to some books for higher-level in colleges but in schools, except elementary, nothing were covered.

Secondly, teachers/lectures (50 from all forms of schools and few colleges) shared their views for the following listed points.

T<sub>1</sub> - Why is it called Vedic Mathematics?

T<sub>2</sub> - The mathematical content of Vedic Mathematics.

T<sub>3</sub> - Vedic value of Vedic Mathematics.

T<sub>4</sub> - Use of Vedic Mathematics in higher learning.

T<sub>5</sub> - Vedic Mathematics is an exciting subject as well as Math Enthusiasts for school children.

T<sub>6</sub> - Vedic Mathematics will induce caste and discrimination among children and teachers.

The following views were given by the majority of the teachers about the standard and use of Vedic Mathematics:

U<sub>1</sub> - Vedic Mathematics is very elementary

U<sub>2</sub> - Vedic Mathematics is primary school level mathematics

U<sub>3</sub> - Vedic Mathematics is secondary school level mathematics

U<sub>4</sub> - Vedic Mathematics is high school level mathematics

U<sub>5</sub> - Nil (No use in Vedic Mathematics education)

U<sub>6</sub> - Hindutva imposition through Vedic Mathematics

U<sub>7</sub> - Imposition of Brahminism and caste systems

U<sub>8</sub> - Has some Vedic value

The first sets of points are considered as the nodes of the domain space and the second set of points as the nodes of the range for constructing FRM to analyze the problem. All nodes are self-explanatory so the description is not given.

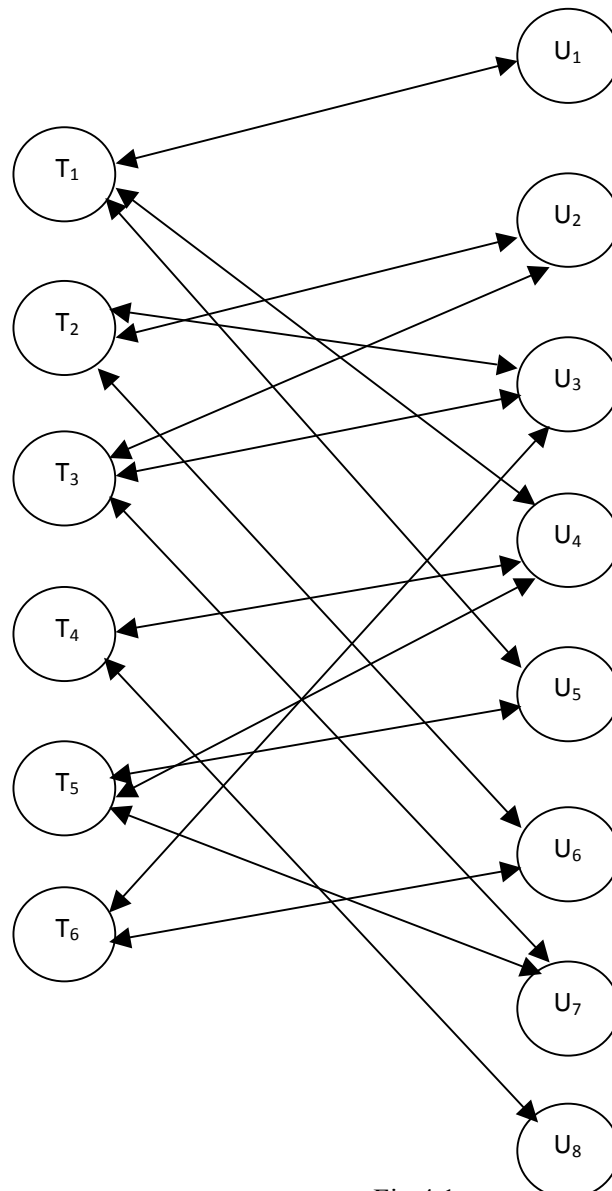


Fig 4.1

The above directed graph was given by the first expert who works as a teacher in a trusty school. First we prepared the relational matrix  $M$  for the above graph of order  $6 \times 8$  and studied the effect of the state vector  $X = (000100)$  from the domain space in which, except the node  $T_4$ , all other nodes are in the OFF state. We arrived at the hidden pattern of the dynamical system given by  $X$  is a binary pair fixed in  $M$  i.e., when  $T_4$  is ON all nodes in the domain space turns to the ON state. In the range space all nodes except  $U_6$  stand in the ON state. Here the binary pair is given by  $\{(111111), (1111011)\}$ . Similarly, by taking node  $U_7$  as ON and remaining in the OFF mode we get the same combinations of binary sets as above. Thus, we conclude that, one can work with the ON mode of any number of nodes from the domain space or range space and can get the resultant binary pair.

We continued the reviews of some more teachers in the similar way. From the teachers' viewpoints we see that they are least bothered about the level in Vedic Mathematics or whether it has a Vedic value or any mathematical value because what they are interested is whether Vedic Mathematics has no mathematical value or even any true Vedic value (that is why they remain zero at all stages).

Thirdly, we took the views of parents (near about 50) of heterogeneous group. Most of their views are similar to the views mentioned in [1].

Finally, when we interacted with Educationalists, their views were on the social structure or changes that Vedic Mathematics could inculcate on the mindset of students. Since the group has various types of people, we took their vital points as nodes.

$P_1$  - Vedic Mathematics: the hidden motive is imposition of religion among the youth.

$P_2$  - Vedic Mathematics motivates the supremacy of Brahmins (Aryans) in the minds of the youth.

$P_3$  - Vedic Mathematics develops complexes in young minds like caste difference and so on.

$P_4$  - Vedic Mathematics has no real Vedic content.

$P_5$  - Vedic Mathematics is not an alternative for mathematics or arithmetic.

We divided the educated respondents in this category into four sub-categories.

$O_1$  – Educationalists,  $O_2$  - Technical Experts,  $O_3$  - Religious people,  $O_4$  - Social analysts

Now the number of people in each group varied. The biggest group was educationalists and the least were the social scientists. Since all of them were educated, we placed before them the 10 conceptual nodes and asked them to give scores between 0 and 1 (including 0 and 1). Using the experts opinion, we obtained a  $5 \times 4$  fuzzy vector matrix called as the New Fuzzy Dynamical System and by using max-min operations; and obtained the effect of any state vector on the dynamical system.

$$M = \begin{bmatrix} 0.6 & 0.3 & 0.8 & 0.9 & 0.8 \\ 0.7 & 0.8 & 0.9 & 0.6 & 0.7 \\ 0.6 & 0.6 & 0.5 & 0 & 0 \\ 0.5 & 0.6 & 0.4 & 0 & 0 \end{bmatrix}$$

By considering a state vector given by the experts, and by applying max min operations we arrive at a real number between 0 and 1. When they give zero, it suggests no influence, if they give positive small value say 0.01 it denotes a very small influence but something like 0.9 denotes a very large positive influence.

## 5. Conclusion

The hidden pattern given by dynamical system FRM used by the teachers revealed that the resultant was always a fixed binary pair. In most cases only the nodes Vedic Mathematics is primary level mathematics, Vedic Mathematics is secondary level mathematics, Vedic Mathematics is high school level mathematics and it has neither Vedic value nor mathematical value remained as 0, that is unaffected by the ON state of other nodes because teachers at the first stage did not feel that Vedic Mathematics had any mission of teaching mathematics.

The new fuzzy dynamical system gives results with membership degrees in  $[0, 1]$ . If the degree is 0.8 or 0.9 it is very high. The least degree 0 corresponds to the node "Vedic Mathematics has no Vedic content." No other node ever gets its membership degree to be too low. In almost all the cases the resultant vector gets a membership grade greater than or equal to 0.6. Thus all the nodes given by the educated under the four categories happens to give more than 0.5 membership degree. The largest number of persons belonged to this group and everyone's views were taken to form the new fuzzy dynamical system.

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