FAILURE IN MATHEMATICS AMONG STUDENTS STUDYING ENGINEERING COURSES IN COLEGES – A STUDY USING FRM MODEL

W.B.VASANTHA KANDASAMY, A.PRAVEEN PRAKASH, J.ESTHER JERLIN

Abstract: Herethe study of failure in Mathematics among engineering students isanalyze dusing simple Fuzzy Relational Maps (FRMs).It is important to note that the performance in mathematics in all engineering colleges including IITs by students undergoing BE and B.Tech courses are considerably poor. Here we analyze the problem by taking a pilotsurvey from 30 engineering students and10mathematics teachers working in engineering colleges. This paper consists of four sections. The first section is about the introduction for the failure in mathematics by engineering students which obtained through interview. Section two gives the description of FRM models. Section three deals with the study related to the failure in mathematics by engineering students through the attributes of teacher and student and their analysis. Section four gives conclusions and suggestions based on the analysis.

Keywords: FRM model, fixed point, hidden pattern, relational matrix, limit cycle, failure

Introduction: In all Engineering degree courses a level of mathematical ability is required. It acts as a challenge for the students that how they cope with this subject than any other subjects. We analyses the problem by taking a pilot survey from 30 engineering students and 10 mathematics teachers working in engineering colleges. The main reason attributed by mathematics teacher is that the student sare not well acquainted with the basis of mathematics. But however from the students point of view they are bored in class and do not follow in the class as the portionsare completedhastily bythe teachersand hence the outcome. On our survey, we found most of the engineering students saying that they have fear for their mathematics teachers since they start their class by asking formula and for their harsh way of approach to them. Engineering teachers find students not to be thorough in XI and XII standard syllabus which makes them to lose their concentration while teaching also the impact of mass media makes them to enjoy their college life by not respecting for their teachers.

Fuzzy Relational Map (FRM) Model:

Fuzzy Relational Map (FRM): Initially the causal associations are divided into two disjoint units. To define a Fuzzy Relational Map these two disjoint units are taken as a domain space and a range space. Here the term disjoint we mean the sense of concepts which we have taken. Further it is assumed that no intermediate relations exist among the domain elements itself and within the elements of the range space. In general, the number of elements in the range space need not be equal to the number of elements in the domain space. In this discussion, the elements of the domain space are from the real vector space of dimension n and the range space is of dimension m. Here n need not be equal to m. The domain space and the range space are denoted by D and R respectively. Thus $D = \{D_1, D_2, \ldots, D_n\}$ is the domain space, where each $D_i = \{(x_1, x_2, \ldots, x_n) \mid x_j = 0 \text{ or } 1\}$, for i = 1, …, n. Similarly $R = \{R_1, R_2, \ldots, R_m\}$ is the range space, where $R_j = \{(x_1, x_2, \ldots, x_m) \mid x_j = 0 \text{ or } 1\}$ for j=1, 2, …, m.

Definition: 2.1.1: A FRM is a directed graph or a map from Domain Space to Range Space with concepts like policies or events etc. as nodes and causalities as edges. It represents casual relations between spaces D and R.

Definition 2.1.2: The directed edge from D to R denotes the casuality of D on R, called relations. Every edge in the FRM is weighted with a number in the set {0, 1}.

Definition 2.1.3: Let Di and Rj denote the two nodes of an FRM. Let e_{ij} be the weight of the edge D_iRj, $e_{ij} \in \{0,1\}$. The weight of the edge D_iR_j is positive if increase in D_i implies increase in R_j or decrease in D_i implies decrease in R_j. i.e., casuality of D_i on R_j is 1. If $e_{ij} = 0$ then D_i does not have any effect on R_j. We do not discuss the cases when increase in D_i implies decrease in R_j or decrease in D_i implies increase in R_j. When the nodes of the FRM are fuzzy sets, then they are called fuzzy nodes, FRMs with edge weights {0, 1} are called simple FRMs. Let D1, …,Dn be the nodes of the domain space D of an FRM and $R_1, \ldots, R_m$ be the nodes of the range space R of an FRM.

Definition 2.1.4: Let the matrix E be defined as $E = (e_{ij})$ where $e_{ij} \in \{0, 1\}$ is the weight of the directed edge DiRj(or RjDi), E is called the relational matrix of the FRM. It is pertinent to mention here that unlike the FCMs, the FRMs can be a rectangular matrix; with rows corresponding to the domain space and columns corresponding to the range space. This is one of the marked differences between FRMs and FCMs.

Definition 2.1.5: Let $D_1, \ldots, D_n$ and $R_1, \ldots, R_m$ be the nodes of an FRM. Let DiRj (or RjDi) be the edges of an FRM, j = 1, 2, …, m, i = 1, 2, …, n. The edges form a directed cycle if it possesses a directed cycle. An FRM is said to be acyclic if it does not possess any directed cycle.

Definition 2.1.6: An FRM with cycles is said to be an FRM withfeedback.When the casual relations flow through a cycle in a revolutionary manner, the FRM is called a dynamical system.

Definition 2.1.7: Let DiRj(or RjDi), $1 \leq j \leq m$, $1 \leq i \leq n$. When Rj(or Di) is switched on and if causality flows through edges of the cycle and if it again causes Rj(orDi), we say that the dynamical system goes round and round. This is true for any node Rj(or Dj) for $1 \leq i \leq n$, (or $1 \leq j \leq m$). The equilibrium state of this dynamical system is

called the hidden pattern. If the equilibrium state of the dynamical system is a unique state vector, then it is called a fixed point. Consider an FRM with $R_1 \ldots R_m$ and $D_1 \ldots D_n$ as nodes. For example let us start the dynamical system by switching on R_1or D_1. Let us assume that the FRM settles down with R_1 and R_m (or D_1 and D_n) on i.e. the state vector remains as (1 0 … 0 1) in R [or (1 0 … 0 1) in D], this state vector is called the fixed point. If the FRM settles down with a state vector repeating in the form A1 → A2→….→Ai→ A1or (B1 → B2 … Bi→ B1) then this equilibrium is called a limit cycle.

Determination of Hidden pattern: Let R_1, …,R_m and D_1, …, D_n be the nodes of a FRM with feedback. Let E be the relational matrix. Find a hidden pattern when D_1 is switched ON, that is when an input is given as vector A_1 = (1 0 0 … 0) in D_1 the data should pass through the relational matrix E. This is obtained by …….multiplying A_1 with the relational matrix E. Let A_1E = (r_1, …,r_m) after thresholdingand updating the resulting vector A_1E we get a vector B. Now we pass on B onto E^T to obtain BE^T. We update and threshold the vector BE^T so that the BE^T is equal to A_2. This procedure is repeated till we get a limit cycle or a fixed point.

Justification for using FRM:

1. Since we cannot categorically express the cause of failure in any statistical data we are forced to use fuzzy models for this study.
2. Hence the data is an unsupervised one.
3. Since the attributes are based on the relation between a teacher and a student, we divide the casual associations into two disjoint units as domain space and range space.
4. Hence FRM model is best suited for this study.

Analysis of failure in Mathematics among students studying in engineering courses in colleges and the expected outcome using FRM:

We have taken the domain space as the concepts belonging to the teacher as D_1,…,D_{10} regarding their teaching and approach to the students.

D_1-Good knowledge about the subject
D_2-Interest in teaching
D_3-Dedication to profession
D_4-Kind, considerate and understanding the students
D_5-Teaching methodology used by them
D_6-Taking interest in the students in class and outside class
D_7-Giving punishment infront of all in the class
D_8-Being rude to the students
D_9-Failing to give continuous test
D_{10}-Providing notes and encouraging self-study without working out the problems.

We have taken 10nodes / concepts related to the outcomes of the students in this study.

These concepts form the range space which is listed below.

R_1- Interested in mathematics
R_2- Sincere student
R_3- Regular to class
R_4-Attentive in class
R_5- Complete their assignments
R_6-Lose their confidence level
R_7-Have fear for the subject
R_8-Doesn't fair well in the exams
R_9-Fail to understand the concept and lack in application skill
R_{10}-Feel shy to ask doubt in front of their classmates

The relational directed graph is given below

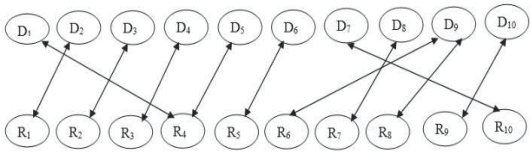

Fig 1: The relational directed graph is given below

The associated matrix is given below

$$E_1 = \begin{bmatrix} 0&0&0&1&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 0&1&0&0&0&0&0&0&0&0 \\ 0&0&1&0&0&0&0&0&0&0 \\ 0&0&0&1&0&0&0&0&0&0 \\ 0&0&0&0&1&0&0&0&0&0 \\ 0&0&0&0&0&0&0&0&0&1 \\ 0&0&0&0&0&0&1&0&0&0 \\ 0&0&0&0&0&1&0&1&0&0 \\ 0&0&0&0&0&0&0&0&1&0 \end{bmatrix}$$

Consider the node D_3 to be in the on state and rest of the nodes in the off state.

i.e G_1= (0 0 1 0 0 0 0 0 0 0).
Then G_1E_1= (0 1 0 0 0 0 0 0 0 0) = H_1
$H_1E_1^T$= (0 0 1 0 0 0 0 0 0 0) = G_2
G_2E_1= (0 1 0 0 0 0 0 0 0 0) = H_1

When the node D_3 is in the on state we get a fixed pair as{(0 0 1 0 0 0 0 0 0 0), (0 1 0 0 0 0 0 0 0 0)}, i.eR_2 is on the on state. The students are sincere in his/ her work.

Consider the node D_1 to be in the on state and rest of the nodes in the off state.

i.e G_1= (1000000000).
Then G_1E_1= (0001000000) = H_1
$H_1E_1^T$= (1000100000) = G_2⟶
G_2E_1= (0002000000)(0001000000) = H_1

When the node D_1 is in the on state we get a fixed pair as{(1000100000), (0001000000)}, i.e R_4 is in the on state. The students are attentive in class.

Now we analyze from the range the set

Consider the node R_6 to be in the on state and rest of the nodes in the off state.

i.e.S_1= (0000010000).
$S_1E_1^T$= (0000000010) = T_1
T_1E_1= (0000010100) = S_2
$S_2E_1^T$=(0000000020)⟶ (0000000010) = T_1

We get the fixed pair as {(0000000010) , (0000010100)}

When the node R_6 is in the on state we get D_9 in the on state. When teachers do not take interest in keeping continuous test, the students lose their confidence level and doesn't fair well in the exams.

Consider the node R_4 to be in the on state and rest of the nodes in the off state.

i.e.S_1= (0001000000).

$S_1E_1^T$= (1000100000) = T_1

T_1E_1= (0002000000) ⟶ (0001000000) = S_2

We get the fixed pair as {(1000100000) ,(0001000000)}

When the node R_3 is in the on state we get D_1,D_5 in the on state. The students are attentive in the class only when the teachers have good knowledge about the subject and deliver them by using appropriate teaching methods.

Conclusion and suggestion: According to the analysis,When the teachers have good knowledge about the subject they teach and deliver the content in well defined way which makes the students to be attentive in the class. When teachers are interested in teaching, students are also interested in mathematics to learn. Different teaching methodology used by the teachers ensures students to be sincere in his/ her work by listening and doing his/her own activities.

Teachers who are kind enough to handle their students make them to be regular to class without making them to bunk thehour. Teachers who take interest for the students both in and out of the class makes the students to complete their assignments without having fear for the subject.

Teachers who are harsh or rude to the students create fear for the subject among them. Teachers giving punishment often makes the students to feel shy in asking doubts infront their classmates and thus skip out to clear their doubts. Teachers who just provide notes without working out the problem on the board makes the students not to understand all the steps written in their notes and thus results in lacking of application skill when needed.

Thus the role of mathematics teachers plays a major part in moulding and shaping the behaviour of the students, for they should pay more attention to the students or else aversion for maths takes place which carries over till they complete their engineering courses. Students too should understand their responsibilities in respecting the teachers and gaining knowledge from them.

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W.B.Vasantha Kandasamy/ Hindustan University/ Chennai – 603103/apraveenprakash@gmail.com.

A.Praveen Prakash /Prof & HOD/Department of Mathematics/ Hindustan University/ Chennai -603103

J.Esther Jerlin/Assistant Professor/Hindustan University/Chennai – 603103/estherjerlin2@gmail.com.