On Tensions and Causes for School Dropouts – An Induced Linked Fuzzy Relational Mapping (ILFRM) Analysis

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Abstract

The teachers and the school authorities often call the parents in connection with a child's 'performance' in school. The children have to face the wrath of both the parents and the teachers. This tension slowly builds up and the child decides to quit the school forever. This paper analyzes the causes for dropouts and concentrates mainly on the tensions experienced by teachers, parents and the students in India. To achieve this, Linked Fuzzy Relational Maps is constructed and Induced Linked Fuzzy Relational Maps is introduced in this paper together with the analysis of the school dropouts.

Keywords: Dropouts, Induced Fuzzy, Hidden pattern, Fuzzy cognitive maps.

1. Introduction

The school formation must be aimed towards the mental, physical and emotional growth of a child. When the enrollment rate in schools is very satisfying, the dropout rate is very disturbing. We are analyzing the issue of school dropouts mainly by the tensions involved in the schools. By our interview with school dropouts, their parents and teachers we gathered their experiences and expectations. The paper analyzes the causes for dropouts using Induced Fuzzy Relational Maps (ILFRM).

Section two presents the background and studies related to school dropouts using fuzzy models. We also present the basic notions and the definitions relevant to this paper [1-2, 5]. The description and method of finding the hidden pattern in ILFRM is given in Section three and Section four presents the analysis using the ILFRM model. In the fifth section, we draw the conclusions from our study and propose remedial measures.

2. Background Information

We have found that the different kinds of rating scales used in the field of mental health [3] are not suitable to highlight the real issues involved here. Since the data under consideration happens to be an unsupervised one, we are justified in applying fuzzy analysis to the problem. Using various fuzzy models, the causes for school dropouts have been studied in the literature [4, 6, 7].

Contrasting from the Fuzzy Cognitive Maps (FCM) introduced by Bart Kosko [1], Vasantha, W.B., and Yasmin, S., introduced the notion called Fuzzy Relational Maps (FRM) [8] to study the Employee-Employer relationship. FRM was developed as Linked Fuzzy Relational Maps (LFRM) [6] to study school dropouts with relation to migration of parents. In order to bring out much stronger relationship among the attributes, in this paper, we introduce a new model called Induced Linked Fuzzy Relational Maps (ILFRM).

2.1. Basic Notion and definitions

We proceed to state the definitions of Linked FRM and the corresponding Induced Fuzzy Relational Maps. In FRMs we divide the very causal associations into two disjoint units, like for example the relation between the parent (Domain space) and the children (Range space) in the case of school dropouts.

We denote by D, the nodes $D_1,\ldots,D_n$ of the domain space where $D_i = \{(x_1,\ldots, x_n)/x_j= 0 \text{ or } 1\}$ for i = 1,…,n.

Similarly R, the set of nodes $R_{1,\ldots,}R_m$ of the range space, where $R_i = \{(x_1,x_2\ldots,x_m)/ x_j = 0 \text{ or } 1\}$ for i = 1,…,m. When $x_i = 1$ or 0 then the node R_i is in the ON state or OFF state respectively.

Definition 2.1. The FRM 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.

Let D_i and R_j denote the two nodes of an FRM. The directed edge from D to R denotes the causality of D on R, called relations. Every edge in the FRM is weighted with a number in the set{0,1}. Let e_{ij} be the weight of the edge $D_i R_j$, $e_{ij} \in \{0,1\}$

The weight of the edge $D_i R_j$ is positive if increase in D_i implies increase in R_j or decrease in D_i implies decrease in R_j. That is, causality 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.

Relational matrix of the FRM:Let D1,…,Dn be the nodes of the domain space D of an FRM and R1, …, Rm be the nodes of the range space R of an FRM. Let the matrix E be defined as: E = (ei j) where ei j is the weight of the directed edge DiRj (or RjDi), E is called the relational matrix of the FRM.

Let A = (a1,..,an), ai $\in$ {0,1}. A is called the instantaneous state vector of the domain space and it denotes the on-off position of the nodes at any instant.

Similarly let B = (b1,…,bm), bi $\in$ {0,1}. B is called the instantaneous state vector of the range space and it denotes the on-off position of the nodes at any instant. When ai = 0 or 1, if ai is on or off respectively, for i = 1,…,n. Similarly bi = 0 or 1 if bi is on or off respectively, for i = 1,..,m.

Hidden Pattern: Consider D_iR_j (or R_jD_i), 1<j<m, 1<i<n. When R_j (or D_i) is switched on and if causality flows through the edges of the cycle and if it again causes R_i (or D_j), we say that the dynamical system goes round and round. This is true for any node R_i (or D_j) for 1 < i < m, (or 1 < j < n). The equilibrium state of this dynamical system is called the hidden pattern.

Fixed point: 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,..,R_m and D_1,…, D_n as nodes. For example let us start the dynamical system by switching on R_1 or 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 (10…01) in R [or (10…01) in D], this state vector is called the fixed point.

Limit cycle: If the FRM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \ldots \rightarrow A_i \rightarrow A_1$ (or $B_1 \rightarrow B_2 \rightarrow \ldots \rightarrow B_i \rightarrow B_1$) then this equilibrium is called a limit cycle.

Definition 2.2 Linked FRM (LFRM)

Two FRMs represented by a relational matrix, say E_1 or order m×n and E_2 of order n×t can be linked to form a new relational matrix E of order m × t. There may not be a direct relationship between the domain space of relational matrix E_1 and the range space of E_2 but certainly we could find out the hidden pattern in the Linked FRMs.

3. Method of finding the hidden pattern in Induced LFRM

Let R_1,.. R_m and D_1,..,D_n be the nodes of a FRM with feed back. Let M be the relational matrix. Let us find a hidden pattern when D_1 is switched on. We pass the state vector C_1 through the Connection matrix M. A particular attribute, say, D_1 is kept in ON state and all other components are kept in OFF state. Let C_1 o M yields, C_1'. To convert to signal function, choose the first two highest values to ON state and other values to OFF state with 1 and 0 respectively. We make each component of C_1' vector pass through M repeatedly for each positive entry 1 and we use the symbol (≈). Then choose that vector which contains the maximum number of 1's. That which causes maximum attributes to ON state and call it, say, C_2. Supposing that there are two vectors with maximum number of 1's are in ON state, we choose the first vector. Repeat the same procedure for C_2 until we get a fixed point or a limit cycle. We do this process to give due importance to each vector separately as one vector induces another or many more vectors into ON state. We get the hidden pattern either from the limit cycle or from the fixed point. We observe a pattern that leads one cause to another and may end up in one vector or a cycle.

Next we choose the vector by keeping the second component in ON state and repeat the same to get another cycle and it is done for all the vectors separately. We observe the hidden pattern of some vectors found in all or in many cases. Inference from this hidden pattern summarizes or highlights the causes.

4. Analysis using Induced LFRM Model

We take the following attributes in the case of parents

P_1– Allocating money for educational expenses is a major problem for poor parents.

P_2 - Poverty and the tension to make both ends meet is the main issue among the poor.

P_3 – Importance and value of education is neglected as other issues occupy their mind.

P_4 – Selfishness on the part of the parents or guardian; they worry about the present expenses.

P_5 – Family problem / broken families have their own tensions.

P_6 – No proper earning member in the family and the pressure is passed on to the child to help out in all possible ways even by being absent in the classes.

P_7 – Hereditary job requires the child's attention and time than classes at school.

P_8 – Frustration on the existing educational system with tests, home works etc.,

We take the following attributes in the case of Teachers

T_1: Class strength is too high or too many classes are given to a teacher to handle.

T_2: Not enough facilities and teaching aids, other than the canes, are available to the teachers.

T_3: Insufficient number of capable teachers with usual salary.

T_4: Poor parents depend on their children's meager earnings or helping hand in their hereditary job. When the students are regularly irregular to the school it is not easy for a teacher to repeat every thing they missed.

T_5: Pressure and demands from school authorities and even senior teachers other than teaching work, which increases a teacher's tension.

T_6: Teachers' performance is rated by the class results and discipline maintenance. The teachers mostly shout since the class is too big, they are under pressure and tension.

T_7: Correcting the misbehavior of students some times creates tension and teachers have to face the fury of parents and even the management.

An expert, a lady teacher, presents the following relation between the domain (Parents) and range (Teachers) attributes and we represent it as relational matrix called as

$$PT = \begin{array}{c} \\ P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \\ P_6 \\ P_7 \\ P_8 \end{array} \begin{array}{c} \begin{array}{ccccccc} T_1 & T_2 & T_3 & T_4 & T_5 & T_6 & T_7 \end{array} \\ \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

We take the following attributes in the case of children.

C_1 - Children are not properly motivated; some times demanded more than what they are capable of doing. Parents always pester them to "STUDY".

C_2 – Teachers are not good and the capable teachers are insufficient in number. When the required attention is not given, then the children feel neglected.

C_3 - Language problem and children are not able to cope up with homework, slip tests and assignments, projects and the usual examinations.

C_4 –Uneducated parents and the children have no way to clear their doubts at home.

C_5 – Attraction of the media and peer group pressure to play and have fun rather than to sit and study.

Another expert, a boy who had dropped out in 7^{th} standard, gives the following relation between the domain (Teachers) and range (Children) attributes and we represent it as a relational matrix called

$$TC = \begin{array}{c} \\ T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \\ T_7 \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & C_2 & C_3 & C_4 & C_5 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

In Linked FRM, the relation between the Parents' and the Children's attributes are combined and the resultant connection matrix is given below. We name it as M.

$$PToTC = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 \end{bmatrix}_{8\times 5} = M$$

Step 1: Let C_1 = (1 0 0 0 0 0 0 0)

C_1 M = (1 1 0 0 0);

(1 1 0 0 0) M^T = (2 2 0 2 1 0 1 1)

Ξ (1 1 0 1 1 0 1 1) = C_1'

C_1' M ≈ (1 0 0 0 0 0 0 0) M = (11 0 0 0);

(11 0 0 0) M^T = (2 2 0 2 1 0 1)

Ξ (1 1 0 1 1 0 1 1)

(0 1 0 0 0 0 0 0) M = (11 0 1 0);

(1 1 0 1 0) M^T = (2 3 1 3 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1) = C_2

(0 0 0 1 0 0 0 0) M = (0 0 0 1 0);

(0 0 0 01) M^T = (01 1 1 1 0 1 0)

Ξ (0 1 1 1 1 0 1 0)

(0 0 0 0 1 0 0 0) M = (1 0 0 1 0);

(1 0 0 1 0) M^T = (1 2 1 2 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1)

(0 0 0 0 0 0 1 0) M = (1 0 0 1 0);

(1 0 0 1 0) M^T = (1 2 1 2 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1)

(0 0 0 0 0 0 0 1) M = (1 0 1 0 0);

(1 0 1 0 0) M^T = (1 1 0 1 1 1 1 2)

Ξ (1 1 0 1 1 1 1 1).

C_2 M = (5 2 1 5 1) $\hookrightarrow$ (1 1 1 1 1);

(1 1 1 1 1) M^T = (2 3 2 3 2 1 2 1)

Ξ (1 1 11 1 1 1 1) = C_2'

C_2' M ≈(1 0 0 0 0 0 0 0) M = (1 1 0 0 0);

(11 0 0 0) M^T = (2 2 0 2 1 0 1 1)

Ξ (1 1 0 11 0 1 1)

(0 1 0 0 0 0 0 0) M = (1 1 0 1 0);

(1 1 0 1 0) M^T = (2 3 1 3 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1)= C_2

(0 0 1 0 0 0 0 0) M = (0 0 0 1 1);

(0 0 0 1 1) M^T = (0 1 2 1 1 0 1 0)

Ξ (0 1 1 1 1 0 1 0)

(0 0 0 1 0 0 0 0) M = (0 0 0 1 0);

(0 0 0 0 1) M^T = (0 1 1 1 1 0 1 0)

Ξ (0 1 1 1 1 0 1 0)

(0 0 0 0 1 0 0 0) M = (1 0 0 1 0);

(1 0 0 1 0) M^T = (1 2 1 2 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1)

(0 0 0 0 0 1 0 0) M = (0 0 1 0 0);

(0 0 1 0 0) M^T = (0 0 0 0 0 1 0 1)

Ξ (0 0 0 0 0 1 0 1)

(0 0 0 0 0 0 1 0) M = (1 0 0 1 0);

(1 0 0 1 0) M^T = (1 2 1 2 2 0 2 1)

Ξ (1 1 1 1 1 0 1 1)

(0 0 0 0 0 0 0 1) M = (1 0 1 0 0);

(1 0 1 0 0) M^T = (1 1 0 1 1 1 1 2)

Ξ (1 1 0 1 1 1 1 1)

((1 1 0 1 0),(1 1 1 1 1 0 1 1) is the fixed point.

Using the row representation of M, namely D_1, D_2, we get the triggering pattern as $P_1 \Rightarrow P_2 \Rightarrow P_2$ when the first attribute is kept in ON state. The following table gives the triggering patterns when other attributes are kept in ON state consecutively.

Step no	Attribute ON	Triggering pattern
Step 1	P_1	$P_1 \Rightarrow P_2 \Rightarrow P_2$
Step 2	P_2	$P_2 \Rightarrow P_2 \Rightarrow P_2$
Step 3	P_3	$P_3 \Rightarrow P_2 \Rightarrow P_2$
Step 4	P_4	$P_4 \Rightarrow P_2 \Rightarrow P_2$
Step 5	P_5	$P_5 \Rightarrow P_2 \Rightarrow P_2$
Step 6	P_6	$P_6 \Rightarrow P_8 \Rightarrow P_2 \Rightarrow P_2$
Step7	P_7	$P_7 \Rightarrow P_2 \Rightarrow P_2$
Step8	P_8	$P_8 \Rightarrow P_2 \Rightarrow P_2$

Merging all these induced paths on a single graph we obtain the following Graph.

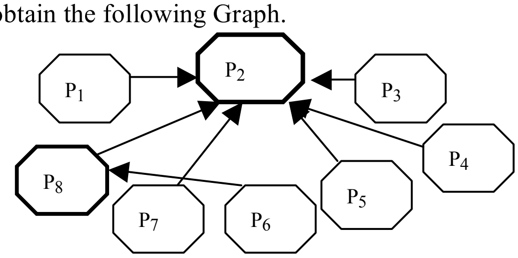

Fig.1: Induced paths on a merged graph

The interrelationship between the attributes reveals that P_2 [Poverty and the tension to make both ends meet is the main issue among the poor] is the terminal node and P_8 [Frustration on the existing educational system with tests, home works etc.,] plays the role of intermediary node.

The limit point corresponding to P_2 ((1 1 1 1 1 0 1 1), (1 1 0 1 0)) high lights the attributes P_1, P_2, P_3, P_4, P_5, P_7, P_8 and C_1, C_2, C_4, which creates tension.

5. Conclusion

It is said that children walk to school in the morning and run back home in the evening. The school must become a second home for the children. That is, children must feel at home in the school and all that causes tension, irritation must be removed.

We suggest the following remedial measures to stop students' exodus from school.

- Employment opportunities to earn their livelihood must be provided to parents.
- Every teacher must be paid as per the fixed government norms and welfare of the staff and students must be given the top priority.
- Encouragement must be the key word while performance is insisted from Teachers and students. Teacher student ratio must be maintained in all schools.
- Every school must have a student counselor to help the children with their emotional problems.

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