



A Fuzzy Mathematical Model to Find the Problems Faced by Gypsies in Tamilnadu

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Abstract

In this research paper, the authors investigate about the problem faced by Gypsies in Tamil Nadu using Fuzzy Cognitive maps. In 1986, Bart Kosko introduced the FCM and its properties. Fuzzy Cognitive maps are more applicable when the data is an unsupervised one.

Keywords: Gypsies, Fuzzy Theory, FCM.

1. INTRODUCTION

The modern concept of uncertainty was introduced in the publication of the seminal paper by L. A. Zadeh (1965), even though some ideas presented in the paper were envisioned by the American philosopher Max Black (1937).

In that seminal paper, Zadeh introduced a theory whose objects are fuzzy sets i.e., sets with boundaries that are not precise. Bellman, Zadeh, Zimmermann and many more authors studied intensively the concept of fuzzy set theory to solve decision-making problems. Dutta and Tiwari discussed the effect of tolerance in fuzzy linear fractional programming.

Fuzzy Cognitive Maps (FCMs) are more applicable when the data in the first place, is an unsupervised one.

In a society there are several downtrodden people are living. One of the sympathetic downtrodden people is gypsies. They are moving from one place to another place towards survive of life because of not having any home at any place to live. They do not have mother tongue. Their spoken language is a combined language, which doesn't have any script; they are facing lot of difficulties in all walk of their life. In this research

paper, we have interviewed 250 gypsies in Tamilnadu using a linguistic questionnaire. As the problems faced by them at large involve so much of feeling, uncertainties and unpredictability's. We felt that it deem fit to use fuzzy theory in general and FCM in particular.

2. FUZZY COGNITIVE MAPS (FCMs)

Definition 2.1

An FCM is a directed graph with concepts like policies, events etc. as nodes and causalities as edges. It represents causal relationship between concepts.

If increase (or decrease) in one concept, leads to increase (or decrease) in another, then give the value 1. If there exists no relation between two concepts, then the value 0 is given. If increase (or decrease) in one causalities decreases (or increases) another, then give the value -1. Thus FCMs are described in this way.

Definition 2.2

When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition 2.3

FCMs with edge weights or causalities from the set $\{-1, 0, 1\}$, are called simple FCMs.

Definition 2.4

Consider the nodes or concepts S_1, \dots, S_n of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \in \{0, 1, -1\}$. The matrix E be defined by $E = (e_{ij})$, where e_{ij} is the weight of the directed edge $S_i S_j$. E is called the adjacency matrix of the FCM, also known as the connection matrix of the FCM.

It is important to note that all matrices associated with an FCM are always square matrices with diagonal entries as zero.

Definition 2.5

Let S_1, S_2, \dots, S_n be the nodes of an FCM. $A = (a_1, a_2, \dots, a_n)$, where $a_i \in \{0, 1\}$. A is called the instantaneous state vector and it denotes the on-off position of the node at an instant.

$$a_i = \begin{cases} 0 & \text{if } a_i \text{ is OFF} \\ 1 & \text{if } a_i \text{ is ON, where } i= 1, 2, \dots, n. \end{cases}$$

Definition 2.6

Let S_1, S_2, \dots, S_n be the nodes of an FCM. Let $\overrightarrow{S_1 S_2}, \overrightarrow{S_2 S_3}, \dots, \overrightarrow{S_i S_j}$ be the edges of the FCM ($i \neq j$). Then, the edges form a directed cycle. An FCM is said to be cyclic if it possesses a directed cycle. An FCM is said to be acyclic if it does not possess any directed cycle.

Definition 2.7

An FCM with cycles is said to have a feedback.

Definition 2.8

When there is a feedback in an FCM, i.e., when the causal relations flow through a cycle in a revolutionary way, the FCM is called a dynamical system.

Definition 2.9

Let $\overrightarrow{S_1 S_2}, \overrightarrow{S_2 S_3}, \dots, \overrightarrow{S_i S_j}$ be a cycle. When S_i is switched ON and if the causality flows through the edges of a cycle and if it again causes S_i , we say that the dynamical system goes round and round. This is true for any node S_i , for $i = 1, 2, \dots, n$. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 2.10

If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point.

Example 2.1

Consider a FCM with S_1, S_2, \dots, S_n as nodes. For example, let us start the dynamical system by switching ON S_1 . Let us assume that the FCM settles down with S_1 and S_n ON that is, the state vector remains as $(1, 0, 0, \dots, 0, 1)$. This state vector $(1, 0, 0, \dots, 0, 1)$ is called the fixed point.

Definition 2.11

If the FCM settles down with a state vector repeating in the form,

$$A_1 \rightarrow A_2 \rightarrow \dots \rightarrow A_i \dots \rightarrow A_1, \text{ then this}$$

equilibrium is called a limit cycle.

Definition 2.12

We denote the combined FCM adjacency matrix by $E=E_1+E_2+\dots +E_p$.

Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let E_1, E_2, \dots, E_p be adjacency matrices of the FCMs with nodes S_1, S_2, \dots, S_n , then the combined FCM is got by adding all the adjacency matrices E_1, \dots, E_p .

3. ADAPTATION OF FCM TO THE PROBLEM

In this section, we adapt Fuzzy Cognitive Maps (FCMs) to the problems faced by Gypsies.

An expert spells out the eight major concepts relating to the Gypsies as

S_1 – No education/facility, S_2 -Poverty

S_3 – Unemployment living condition is very poor,

S_4 – Not owners of any property/land

S_5 - Living condition/health condition is very poor

, S_6 –Problems given by forest officers/public,

S_7 – Child labor is at peak,

S_8 - Government indifferent about the problems faced by gypsies.

Simple FCM

The related connection matrix R is given by the expert is

$$R = \begin{matrix} & \begin{matrix} S_1 & S_2 & S_3 & S_4 & S_5 & S_6 & S_7 & S_8 \end{matrix} \\ \begin{matrix} S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \\ S_6 \\ S_7 \\ S_8 \end{matrix} & \begin{pmatrix} 0 & 0 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 \end{pmatrix} \end{matrix}$$

Using the dynamical system given by the first expert, we determine the hidden pattern. Let the initial input vector be $A = (10000000)$, where only the node S_1 "No education / no facilities" is in the ON state and all the nodes are in the OFF state.

The effect of A on the dynamical system R is given by:

$$AR = (00110011) \leftrightarrow (10110011) = A_1 \text{ (Say)}$$

$$A_1R = (24132023) \leftrightarrow (11111011) = A_2 \text{ (Say)}$$

$$A_2R = (24142045) \leftrightarrow (11111011) = A_2$$

(Where \leftrightarrow denotes the resultant vector after thresholding and updating) A_2 is the hidden pattern, which is the fixed point. When S_1 , "No education/ no facilities" is in the ON state makes the living condition/ health conditions is very poor., poverty, unemployment, not owners of any poverty, child labour, Govt. indifferent all are in the ON state. Problem given by forest officers/ public is in the OFF state. (i.e) $B = (00000001)$

The effect of B on the dynamical system R is given by:

$$BR = (01010010) \leftrightarrow (01010011) = B_1 \text{ (Say)}$$

$$B_1R = (23021012) \leftrightarrow (11011011) = B_2 \text{ (Say)}$$

$$B_2R = (23131044) \leftrightarrow (11111011) = B_3 \text{ (Say)}$$

$$B_3R = (23142045) \leftrightarrow (11111011) = B_3$$

(Where \leftrightarrow denotes the resultant vectors after thresholding and updating) B_3 is the hidden patterns, which is the fixed point. When S_8 , Govt. indifferent is in the ON state makes expect S_6 and all other nodes comes to ON State.

CONCLUSIONS

- Most of them were uneducated, living below poverty line.
- A school must be built separately so that the children of these gypsies are sent to school regularly. The education must be fully free for them, as our study state no education must be fully free for them, as our study state no education in the root cause of all problems.
- A medical center/ health center must be built by government to cater to the needs of these gypsies.
- We see the child labour is at its peak, for the children do not even step the school premises, Education for the children of these gypsies should be made compulsory.
- From our study the whole family works for over ten hours a day and live below poverty line. They don't even have a square meal a day.
- No one can prevent these gypsies from starvation and death, unless the government takes steps to provide them an alternative

means of living.

- The illegal practice of gypsies must be punished severely so that such practices are totally stopped.

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