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A FUZZY matrix Analysis an approach-A study on Induced Fuzzy Cognitive Maps

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Abstract:
In this paper analyzes the problems of transgender through the parents and the nongovernmental organizations. From this paper, we can analyze the major problems of Transgender in India by using Induced Fuzzy Cognitive Maps. A numerical example is provided to illustrate the proposed method.

Keywords: Unsupervised transgender, Fuzzy Cognitive Maps, Induced Fuzzy Cognitive Maps, Hidden patterns.

1. Introduction:
Transgender is one who is in between category of gender. They are these peoples be the combination of both male and female. They are called such as transgender, multi-transgender, third gender. In India there are estimated 1, 50,000 transgenders. But this third gender is not accepted society anywhere in the world. It is due to different activities such as way of behavior, the way of talking, hair style, dressing, etc. This can be changed by supporting them in education, health care etc. Parents, colleagues, friends and society should give equal rights in all activities. Gender identity refers to a internal feeling of being male of female gender expression. On the other hand in external, the social and behavioral characteristics with being male or female. A transgender person would be nuterosexual, gay or lesbian or bisexual. The policeman who is given the safeguard, they also misusing themselves. So, these peoples are affected deadly like HIV/AIDS due to illiteracy. For this government should take actions such as counseling, job, education, etc.

Kinds of discrimination faced by transgender
Transgender face discrimination in nearly every aspect of their lives. The study report in 2011 by the National Centre for Transgender Equality and the National Gay and Lesbian Task Force in USA confirmed the pervasive and severe discrimination faced by transgender people. Out of a sample of about 6500 transgender people, the report found that transgender experience high levels of discrimination in employment, education, housing, health care, legal systems, and even in their societies and families.
Ref: http://endtransdiscrimination.org.

In this section we recall the previous research of Fuzzy Cognitive Maps (FCMs) and an Induced Fuzzy Cognitive Maps (IFCMs}.

Zadeh L.A (1965) investigated the Fuzzy sets through his Information Control System. FCMs have a major role to play mainly when the data concerned is an unsupervised one. Further this method is most simple and an effective one as it can analyze the data by directed graphs and connection matrices. Lotfi A. Zadeh (1965) introduced a mathematical model called Fuzzy Cognitive Maps [1].

The Political scientist R.Axelrod (1976) popularized cognitive maps (FCMs) for representing social scientific knowledge and described the methods that are used for decision making in social and political systems [3]. Then Kosko (1986), (1988) enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive map and fuzzy degrees of interrelationships between concepts [2], [4]. W.B.Vasantha Kandasamy and Smarandache Florentine (2004) proposed of an analysis of social aspects of migrant laborers living with HIV/AIDs using Fuzzy Theory and Neutrosophic Cognitive Maps, Xiuan Phoenix and it has been illustrated in her book of application of Fuzzy Models in Social Sciences[5],[6].

T.Pathinathan (2014) investigated this model by using Symptoms of Breast Cancer [8]. He used this model of the causes for school Drop outs by using this Calculations [12]. Later S.Narayanamoorthy, S.Kalaiselvan (2012) studied investigated this calculation by the Power Loom Workers [9]. A. Victor Devadoss, Clement Joe Anand (2013) studied this model about suicide thought in Domestic Violence [11]. Ponnivalavan K., Pathinathan T.(2012) investigated this model to analyze the Study of Symptoms of Tuberculosis Using Induced Induced Fuzzy Cognitive Maps [13].

This paper we study about Transgender using Induced Fuzzy cognitive maps. The rest of the paper is organized as follows. In Section two shows preliminaries of FCM and Induced FCM. In section three, we introduce the Induced Fuzzy Cognitive Maps method and perform the calculations based on the collected data's through data collection survey among the Transgenders in Tamilnadu. In section four, a numerical example is provided to show the efficiency of the proposed method. In section five, we give the conclusion and some suggestions based on our discussion.

2. Preliminaries

Fuzzy Cognitive Maps are techniques that attempt to depict and analyze the cognitive process of human thinking and human behavior on specific domains by creating models. These models are represented assigned directed graphs of concepts and by the various casual relationships that exists between the concepts.

Axelrod (1976) proposed cognitive maps as a formal tool for decision-making. He used the matrix representation of the directed graph to represent and study the social scientific knowledge.

2.1 Fuzzy Sets

Lotfi A.Zedah (1965) proposed FCM based on his Fuzzy Sets.

Definition 2.1.1 In a crisp set, membership or non-membership of element 'x' in set $\mu_A(x)$, where $\mu_A(x)=1$ if $x \in A$ and $\mu_A(x)=0$ if $x \notin A$.

A is described by a characteristic function; Fuzzy set theory extends this concept by defining partial membership. A fuzzy set A on a universe of discourse U is characterized by a membership function that $\mu_A(x)$ takes values in the interval [0, 1].

Fuzzy Cognitive Map 2.1.2

Kosko (1986) proposed FCMs based on the cognitive maps structure.

Now we recall the notion of Fuzzy Cognitive Maps (FCMs), which was introduced by Bart Kosko (1986) through his Fuzzy Virtual worlds.

- Virtual worlds show how actors relate to one another .Events cause one another to some degree.
- Fuzzy cognitive maps (FCMs) show how causal concepts affect one another to some degree. Causal concepts in virtual worlds include events, values, moods, trends, or goals.

Definition 2.1.3

Fuzzy number A fuzzy number is a convex, normalized fuzzy set $\tilde{A} \subseteq R$ whose membership function is at least segmentally continuous and has the functional value $\mu_A(x)=1$ at precisely one element. This can be likened to the funfair game "guess your weight," where someone guesses the contestant's weight, with closer guesses being more correct, and where the guesser "wins" if he or she guesses near enough to the contestant's weight, with the actual weight being completely correct (mapping to 1 by the membership function).

Definition 2.1.4

Fuzzy interval A fuzzy interval is an uncertain set $\tilde{A} \subseteq R$ with a mean interval whose elements possess the membership function value $\mu_A(x)=1$.As in fuzzy numbers, the membership function must be convex, normalized, at least segmentally continuous.

Transfer function of FCM:

1. $f_{sign}(x)=\begin{cases}1, & x>0\\ 0, & x\le 0\end{cases}$

2. $f_{tri}(x)=\begin{cases}1, & x>0\\ 0, & x=0\\ -1, & x<0\end{cases}$

2.2 Fuzzy Cognitive Maps and Induced Fuzzy Cognitive Maps

Definition 2.2.1

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 2.2.2

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

Definition 2.2.3

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

Definition 2.2.4

Consider the nodes or concepts $C_1, C_2, \ldots C_n$ of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \in \{0,1,-1\}$. The matrix E is defined by $E=(e_{ij})$ where e_{ij} is the weight of the directed edge C_iC_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 2.2.5

Let $C_1, C_2, ...C_n$ be the nodes of an FCM. $A = (a_1, a_2, ...a_n)$ 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.

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

Definition 2.2.6

Let $C_1, C_2, ...C_n$ be the nodes of an FCM. Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, ...\overrightarrow{C_iC_j}$ 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 2.2.7

An FCM with cycles is said to have a feedback.

Definition 2.2.8

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 2.2.9

Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, ...\overrightarrow{C_iC_j}$ be a cycle. When C_i is switched ON and if the causality flows through the edges of a cycle and if it again causes C_i, we say that the dynamical system goes round and round. This is true for any node C_i for i = 1, 2… n. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 2.2.10

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

Consider a FCM with $C_1, C_2, ...C_n$ as nodes. For example, let us start the dynamical system by switching ON C_i. Let us assume that the FCM settles down with C_1 and C_n ON that is, the state vector remains as (1, 0, 0… 0, 1). This state vector (1, 0, 0… 0, 1) is called the fixed point.

Definition 2.2.11

If the FCM settles down with a state vector repeating in the form $A_1 \to A_2 \to ... \to A_i ... \to A_1$, then this equilibrium is called a limit cycle.

Definition 2.2.12

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

Finite number of FCMs can be combined together to produce the joint effect of all the FCMs. Let $E_1, E_2, ...E_p$ be adjacency matrices of the FCMs with nodes $C_1, C_2, ...C_n$, and then the combined FCM is got by adding all the adjacency matrices $E_1, E_2, ...E_p$.

Notation

Suppose $A = (a_1, a_2, ...a_n)$ is a vector which is passed into a dynamical system E. Then $AE = (a_1', a_2', ...a_n')$ After thresholding and updating the vector suppose we get $(b_1, b_2, ...b_n)$ we denote that by $(a_1', a_2', ..a_n') \hookleftarrow (b_1, b_2, ..b_n)$. Thus, the symbol $\hookleftarrow$ means the resultant vector has been threshold and updated.

2.2.13 Advantages and Disadvantages of FCM

The main **advantage** of this method it is simple. It functions on expert's opinion. When the data happens to be an unsupervised one the FCM comes handy. This is the only known fuzzy technique that gives the hidden pattern of the situation. As we have a very well known theory, which states that the strength of the data depends on, the number of experts' opinion we can use combined FCMs with several experts' opinions.

At the same time the **disadvantage** of FCM is when the weightages are1 and -1 for the same C_i C_j, we have the sum adding to zero thus at all times the connection matrices $E_1 \ldots E_k$ may not be conformable for addition. Combined conflicting opinions tend to cancel out and assisted by the strong law of large numbers, a consensus emerges as the sample opinion approximates the underlying population opinion.

This problem will be **easily** overcome if the **FCM** entries are **only 0 and 1.**

2.2.14 Applications of FCM in Various Field:

Modeling- Knowledge representation, Decision making, Enterprise Resource Management, Socio-economic systems, Engineering & Technology Management, Adaptation and Learning, Classification tasks, Robots and control, Political and Social Fields, Military planning, Production Systems, Prediction capabilities, Ecology and environmental.

3. The induced Fuzzy Cognitive Maps

A person as a transsexual transvestite who identifies with or expresses a gender identity that differs them the one which corresponds to the person's sex at birth. In day to day these peoples are facing so many problems without solutions.

We have interviewed and collected a data from 100 Transgender by using linguistic Questionnaire the expert's opinion was arrived by administering the same to 100 Transgender, 10 parents and three NGO leaders as listed below:

3.1 Adapdation of Induced FCM to the problems faced by the Transgender in Tamilnadu:

Now we illustrate the dynamical system by a very simple

model from the problem of Transgenders. At the first stage we have taken the following nine arbitrary attributes $(S_1, S_2, ...S_9)$. It is not a hard and fast rule we need to consider only these nine attributes but one can increase or decrease the number of attributes according to needs.

In our study, we consider the following problems faced by transgender based on our interview and survey:

S_1 – Discrimination

S_2 – Lack of education facilities

S_3 – Unemployment

S_4 – Lack of shelter

S_5 – Lack of medical facilities like HIV care and hygiene

S_6 – Depression

S_7 – Hormone pill abuse

S_8 – Tobacco and alcohol abuse

S_9 – No property

3.2 The survey was based on the following questionnaire

- What is your perspective of Transgender
- Why do you feel you are a victim?
- Why do you give up and beg
- Why do you accept discrimination
- Is the society accepting you are right now
- Why don't you try to make people understanding your nature
- Why do you take humiliation personally and not of the other persons immaturity
- What is your sex preference
- Have you tried adopt children
- Have you tried as a group to innovate and work for a revolution
- Do you hate your body? Have you ever regretted for who you are
- Did your family support you
- Why do you think you can't make a productive difference to the society

3.2 The Proposed method to analyze the Problems of cause and effect of Transgender

To derive an optimistic solution to the problem with an unsupervised data, the following steps to be followed:

Step 1: For the given model (problem), collect the **unsupervised data that is in determinant factors** called nodes.

Step 2: According to the expert opinion, draw the **directed graph.**

Step 3: Obtain the **connection matrix,** M, from the directed graph (FCM). Here the number of rows in the given matrix = number of steps to be performed.

Step 4: Consider the **state vector** C_1 **which is in ON position.** Find $C_1 \times M$. The state vector is updated and threshold at each stage.

Step 5: Threshold value is calculated by assigning 1 for the values >1 and 0 for the values < 0. The symbol '↵' represents the threshold value for the product of the result.

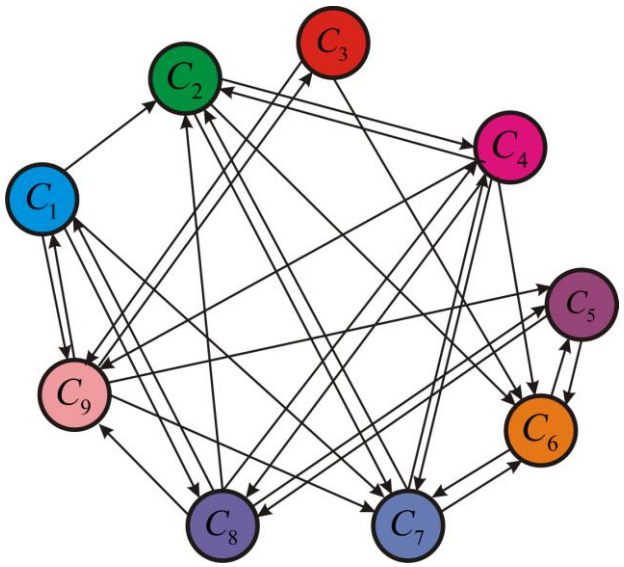
Step 6: Now each component in the C_1 vector is taken separately and **product of the given matrix is calculated**. The vector which has maximum number of one's is found. The vector with maximum number of one's which occurs first is considered as C_2.

Step 7: When the same threshold value occurs twice. **The value is considered as the fixed point.** The iteration gets terminated

4. Numerical Example

Even though IFCM is an advancement of FCM it follows the foundation of FCM, it has a slight modification only in Algorithmic approaches.

According to the expert opinion, draw the **directed graph.**



Directed Graph

4.1 Implementation of IFCMs Model to the Study

Based on the expert's opinion, the directed diagram is drawn and the corresponding connection matrix M is given as

Connection matrix M

$$M = \begin{array}{c|ccccccccc} & C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 \\ \hline C_1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\ C_2 & 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ C_3 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ C_4 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ C_5 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ C_6 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ C_7 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ C_8 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 1 \\ C_9 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 0 \end{array}$$

Now using the matrix M we determined the problems. Let us start **Illiteracy** is taken as the **ON** state and all the other nodes are in the **OFF** state.

Let $C_1 = (1\,0\,0\,0\,0\,0\,0\,0\,0)$

Product of C_1 and M is calculated.

$$S_1 M = (0\,1\,0\,0\,0\,0\,1\,1\,1) = C_1'$$

$$C_1' \times M = (0\,1\,0\,0\,0\,0\,0\,0\,0)$$

$$= (0\,0\,0\,1\,0\,1\,1\,0\,0)$$

Threshold value is calculated by assigning 1 for the values >1 and 0 for the values <0. The symbol '↪' represents the threshold value for the product of the result.

Now as per Induced Fuzzy Cognitive Map methodology, each component in the S_1' vector is taken separately and product of the given matrix is calculated. The vector which has the maximum number of one's which occurs first is considered as C_2. The symbol ~ denotes the calculation performed with the respective vector, here C_1'. Now,

$$C_1' \times M = (0\,0\,0\,0\,0\,0\,1\,0\,0) \times M = (010101000)$$

$$C_1' \times M = (000000001) \times M = (101010100)$$

$$C_1' \times M = (000000010) \times M = (110110001) = C_2$$

$$C_2 M = (110001111) \times M = (321213432)$$

$$\Box\ (111111111) = C_2'$$

$$C_2' \times M \approx (100000000) \times M = (010000111)$$

$$C_2' \times M = (010000000) \times M = (000101100)$$

$$C_2' \times M = (001000000) \times M = (000001001)$$

$$C_2' \times M = (000100000) \times M$$

$$= (110001111) = C_3$$

$$C_2' \times M = (000010000) \times M = (100001010)$$

$$C_2' \times M = (000001000) \times M = (000010100)$$

$$C_2' \times M = (000000100) \times M = (010101000)$$

$$C_2' \times M = (000000010) \times M = (110110001)$$

$$C_2' \times M = (000000001) \times M = (101010100)$$

$$C_3' \times M \approx (100000000) \times M = (010000111)$$

$$C_3 \times M = (110110001) \times M = (231332412)$$

$$\Box\ (111111111) = C_3'$$

$$C_3' \times M = (010000000) \times M = (000101100)$$

$$C_3' \times M = (001000000) \times M = (000001001)$$

$$C_3' \times M = (000100000) \times M = (110001111) = C_4$$

$$C_3' \times M = (000010000) \times M = (100001010)$$

$$C_3' \times M = (000001000) \times M = (000010100)$$

$$C_3' \times M = (000000100) \times M = (010101000)$$

$$C_3' \times M = (000000010) \times M = (110110001)$$

$$C_3' \times M = (000000001) \times M = (101010100)$$

$$C_3 \times M = (110110001) \times M = (231332412)$$

$$\Box\ (111111111) = C_4'$$

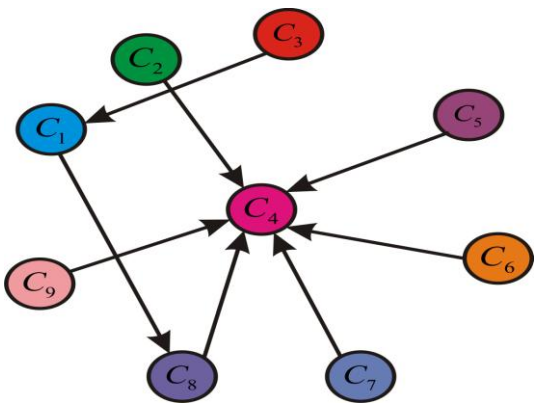
$$C_3' \times M = (110001111) = C_4$$

$$\therefore\ C_3 = C_4$$

(1 1 0 0 0 1 1 1 1) is the fixed point which is the triggering pattern is $C_1 \to C_8 \to C_4 \to C_4$ when the first attributes kept in on state vector. Similarly, the following table is the Triggering patterns when **Induced patterns for M by IFCM**

Induced patterns for M

No.	Attributes of ON state	Triggering pattern
Step 1	C_1 : (**1** 0 0 0 0 0 0 0 0)	$C_1 \to C_8 \to C_4 \to C_4$
Step 2	C_2 : (0 **1** 0 0 0 0 0 0 0)	$C_2 \to C_4 \to C_4$
Step 3	C_3 : (0 0 **1** 0 0 0 0 0 0)	$C_3 \to C_1 \to C_4 \to C_4$
Step 4	C_4 : (0 0 0 **1** 0 0 0 0 0)	$C_4 \to C_4 \to C_4$
Step 5	C_5 : (0 0 0 0 **1** 0 0 0 0)	$C_5 \to C_4 \to C_4$
Step 6	C_6 : (0 0 0 0 0 **1** 0 0 0)	$C_6 \to C_4 \to C_4$
Step 7	C_7 : (0 0 0 0 0 0 **1** 0 0)	$C_7 \to C_4 \to C_4$
Step 8	C_8 : (0 0 0 0 0 0 0 **1** 0)	$C_8 \to C_4 \to C_4$
Step 9	C_9 : (0 0 0 0 0 0 0 0 **1**)	$C_9 \to C_4 \to C_4$



Induced Path on a merged Graph

5. Results

The inter relationship between the attributes reveals that C_4 Lack of shelter is the terminal node.

$\therefore$ The limit point corresponding $C_4 : (1\,1\,0\,0\,0\,1\,1\,1\,1)$ highlights the attributes and $(C_1, C_2, C_6, C_7, C_8, C_9)$ which seem to be major problems of Transgender.

The fixed point $C_3 = C_4 : (1\,1\,0\,0\,0\,1\,1\,1\,1)$. When the same threshold value occurs twice, the value in considered as the fixed point. The iteration gets terminated and the calculation gets terminated.

If discrimination C_1 is ON state, **C_1 Discrimination, C_2 Lack of education facilities, C_6 Depression, C_7 Hormone pill abuse, C_8 Tobacco and alcohol abuse, C_9 - no property** are also 'ON' state. This clearly shows that **C_1,C_2,C_6,C_7,C_8,C_9** are the main causes of the problems.

5.1 Conclusion

The Transgender are away by their parents at a very early age and so finding no other way they come in contact with bad companionship. They stay away from their family are forced to cut all these from relatives. They are often abused by the society and starve from Depression. From the many causes of the sufferings of a transgender Discrimination is one of the causes which also lead to the lack of education.

Transgender should be considered as "god gift" due to their unique characteristic but in today's society, they are being shamelessly cheated upon and are sexually harassed. Due to their exploitation, they get affected by SID's like HIV/AIDS. Since the public is unaware of the Transgender plight, they are mistreated and it only adds up to their suffering. Thus it is essential to eradicate public irresponsibility and also improve to cure the hormonal defects.

Since, the transgenders are stay away from their homes, they have no one by their side and this makes them even more guilty and lonely and might even lead to many mental problems. They don't have their own parents to support them or encourage them. Being transgender is not a choice but it happens as a result of hormonal problems.

So it's really stupid on the part of humans to discriminate them. Transgender should be treated equally likely how the other sexes are treated, because even they are humans. Another main cause of discrimination in **lack of property.**

Since, these transgender are sent away from home, they have nobody who can fund them for their education. This results in poverty as even nobody is ready to fund them with any job opportunities. This leads to lack of property.

5.2 Solutions

Equal rights should be given to these people just like how other men and women are treated.,They should be given the right to education, Severe punishment should be imposed on people ill-treating or discriminating them,Instead of seducing them as inferior people, they should be treated as one among us.

They should be encouraged in other fields like sports, research, etc.,They should not send out of the home, they should be brought up with the same love and affection that a normal child receives. Transgender should be treated as another sex and that should be present I all forms that ask for sex.Transgender should have the right to marry if they require partner.

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