International Journal of Applied Engineering Research
ISSN 0973-4562 Volume 10, Number 6 (2015) pp. 15661-15670

http://www.ripublication.com

A New Fuzzy Mathematical Apporach To Study The Socio-Economic Problems Faced By Gypsies

C. Ramkumar*, R. Ravanan+ and S. Narayanamoorthy**
**Research Scholar, Dept. of Mathematics, Manonmaniam Sundranar University, Tirunelveli, India.*
+Department of Statistics, Presidency College, Chennai – 600 005, India.
***Department of Applied Mathematics, Bharathiar University, Coimbatore-46, Tamilnadu, India.*

Abstract

In this research article the authors introduce a new fuzzy mathematical approach is called Average Super Fuzzy Cognitive Maps (ASFCMs) to study the socio-economic problems faced by Gypsies in Tamil Nadu, India. In the society there are several poor people are living. One of the sympathetic poor people is gypsies. This paper we investigate about their problems and solutions via ASFCMs.

Introduction

Study of Fuzzy Theory in the context of application to the real world problems has become an important one, as in these days we do not have a method by which even an adequate information can be given as a statistical data; which can be an analyzed. Still all the techniques used in the statistical analysis of any real data has no capacity to give any form of weight age to the feeling or qualities or attributes which ought to be associated with the problem in order to get a true situation of these problems.

Gypsies are moving from one place to another place towards survive of life because of not having any permanent place to live. In this paper we have interviewed more than 300 gypsies in Tamilnadu using a linguistic questionnaire. As the problems faced by them to improve their life at large involve so much of feeling, uncertainties and unpredictability's. I felt that it deem fit to use fuzzy theory in general and Average Super Fuzzy Cognitive Maps in particular.

Kosko, B (1986), has introduced Fuzzy cognitive maps [FCM]. Gotoh, J, Murakami, J, Yamaguchi, T and Yamanaka (1989), adapted FCM in plant control. Craiger, J. P., and Coovert, M.D (1994), wrote a paper on Modeling Dynamic Social and Psychological process with Fuzzy Cognitive Maps. In 1996, Tsadiras, A. K, and Margaritis, K.G, published a paper entitled 'Using certainty Neurons in Fuzzy

Cognitive Maps'. Vasantha Kandasamy. W.B,(2000), published a paper on FCM to determine the Maximum Utility of a Route.

For more about FCM and its properties please refer [2].

Super Fuzzy Cognitive Maps (SFCMS)

Suppose n experts want to work with a problem P using a FCM model, then how to form an integrated dynamical system which can function simultaneously using the n experts opinion.

Suppose the first experts spells out the attributes of a problem as x_1^1 , x_2^1……., x_{t1}^1 ,the second expert gives the attributes as x_1^2 , x_2^2 ,……, x_{t2}^2 and so on. Thus the expert gives the attributes with which he wishes to work as x_1^i,x_2^i,……,x_{ti}^i; i=1,2,3,…….,n. Now we model the problem using the special diagonal super fuzzy matrix; this super matrix will be called as the super connection matrix of the Super FCM (SFCM).

We see the special feature of this special super diagonal fuzzy matrix would be all the diagonal matrices are square matrices and the main diagonal of each of these sub matrices of the special fuzzy super diagonal matrix is zero. The special diagonal super fuzzy matrix for the problem P takes the following form and is denoted by M_p.

	x_1^1 , x_2^1....., x_{t1}^1	x_1^2 , x_2^2 ,. …, x_{t2}^2	...	x_1^n , x_2^n ,…, x_{tn}^n
x_1^1				
x_2^1				
⋮	M_1^1	(0)	...	(0)
x_{t1}^1				
x_1^2				
x_2^2	(0)	M_2^2	...	(0)
⋮				
x_{t2}^2				
⋮				
x_1^n				
x_2^n				
⋮	(0)	(0)	....	M_n^n
x_{tn}^n				

We see M_i^i is a fuzzy with main diagonal elements to be zero i.e

$$M_i^i = \begin{pmatrix} 0 & m^i_{12} & \dots & m^i_{1ti} \\ m^i_{21} & 0 & \dots & m^i_{2ti} \\ \dots & \cdots & \dots & \cdots \\ m^i_{t1} & m^i_{t2} & \dots & 0 \end{pmatrix}$$

i = 1,2,3,…,n.

This model will be known as the multi expert super fuzzy cognitive maps model and the associated fuzzy super matrix would be known as the special diagonal fuzzy super matrix.

Average Super Fuzzy Cognitive Maps (ASFCMs)

Here we for the first time introduce the new fuzzy mathematical tool Average Super Fuzzy Cognitive Maps (ASFCMs).Using the Combined Super FCMs, we define ASFCMs as follows.

Let the CSFCM matrix be denoted by C = (c_{ij}).Suppose the CSFCM is got by using n group of experts say.

Then we define the ASFCM=A, as A=($c_{ij\,/\,n}$) . Thus the entries of the ASFCM matrix take values only from the interval [-1, 1].We unlike, in the SFCM or CSFCM defined the operation as a min-max operation

Suppose X= (x_1 ,x_2 , … , x_n) is a state vector with $x_i \in [0,1]$ we find XA using min-max value. We repeat this process until we get a limit cycle or a fixed point. This resultant vector R is the hidden pattern of the ASFCM. The entries in R can take any value between 0 and 1 (including 0 and 1).Thus ASFCM gives the gradations of preferences.

Application of ASFCMs

ASFCMs are the best known fuzzy tool when one is interested in getting the hidden pattern with gradations further when the data under study/analysis is an unsupervised one.The cause of being a gypsies and the problems faced by them are varying with individuals and goup of experts. There cannot be a fixed reason for it involves a lot of uncertainty and unpredictability. So we after the study of the problem, by taking interviews with several of the gypsies, using linguistic questionnaire felt ASFCM may be the best suited tool for such analysis.

Using the linguistic questionnaire and the experts opinion we have taken the following nine attributes related with the problem of a Gypsies.

The First Expert Group wishes to work with the following four nodes.

A_1^1 - Living Condition/Health Condition is Poor

A_2^1 - Reservation Policy

A_3^1 - Illtreatment of Society

A_4^1 - Inheritor Property

The Second Expert Group wishes to work with the following four nodes

A_1^2 - No Education Facilities

A_2^2 - Unemployment

A_3^2 - Government indifference

The Third Expert Group wishes to work with the following four nodes.

A_1^3 - Child Labour at its peak

A_2^3 - Not Owners of any land/Property

A_3^3 - Poor Awareness

First we obtain the opinion of 3 experts and get the related connection matrices S_1,S_2 and S_3. Using these 3 connection matrices we obtain the combined SFCM; $S = S_1 + S_2 + S_3$. The ASFCM matrix $N = S/3$ is found.

The Super Fuzzy Cognitive matrix S_1 is given by the first expert group is as follows:

	A_1^1	A_2^1	A_3^1	A_4^1	A_1^2	A_2^2	A_3^2	A_1^3	A_2^3	A_3^3
A_1^1	0	1	0	1						
A_2^1	0	0	0	0			(0)			(0)
A_3^1	1	0	0	0						
A_4^1	1	0	0	0						
A_1^2					0	1	0			
A_2^2			(0)		1	0	0			(0)
A_3^2					1	0	0			
A_1^3								0	1	0
A_2^3			(0)				(0)	0	0	0
A_3^3								1	1	0

The Super Fuzzy Cognitive matrix S_2 is given by the first expert group is as follows:

	A_1^1	A_2^1	A_3^1	A_4^1	A_1^2	A_2^2	A_3^2	A_1^3	A_2^3	A_3^3
A_1^1	0	1	0	0						
A_2^1	0	0	0	0		(0)			(0)	
A_3^1	1	1	0	0						
A_4^1	1	0	0	0						
A_1^2					0	1	1			
A_2^2		(0)			1	0	0		(0)	
A_3^2					1	1	0			
A_1^3								0	0	0
A_2^3		(0)				(0)		0	0	0
A_3^3								1	1	0

The Super Fuzzy Cognitive matrix S_3 is given by the third expert group is as follows:

	A_1^1	A_2^1	A_3^1	A_4^1	A_1^2	A_2^2	A_3^2	A_1^3	A_2^3	A_3^3
A_1^1	0	1	0	1						
A_2^1	0	0	0	0			(0)			(0)
A_3^1	1	1	0	0						
A_4^1	1	0	0	0						
A_1^2					0	1	1			
A_2^2			(0)		0	0	1		(0)	
A_3^2					1	0	0			
A_1^3								0	1	0
A_2^3			(0)				(0)	0	0	0
A_3^3								1	1	0

Now using S_1, S_2 and S_3 we obtain the combined super Fuzzy Cognitive Maps matrix $S = S_1 + S_2 + S_3$

	A_1^1	A_2^1	A_3^1	A_4^1	A_1^2	A_2^2	A_3^2	A_1^3	A_2^3	A_3^3
A_1^1	0	3	0	2						
A_2^1	0	0	0	0		(0)			(0)	
A_3^1	3	2	0	0						
A_4^1	3	0	0	0						
A_1^2					0	3	2			
A_2^2		(0)			2	0	1		(0)	
A_3^2					3	1	0			
A_1^3								0	2	0
A_2^3		(0)				(0)		0	0	0
A_3^3								3	3	0

ASFCM matrix N is got by dividing every entry of S by 3.

	A_1^1	A_2^1	A_3^1	A_4^1	A_1^2	A_2^2	A_3^2	A_1^3	A_2^3	A_3^3
A_1^1	0	1	0	0.67						
A_2^1	0	0	0	0		(0)			(0)	
A_3^1	1	0.67	0	0						
A_4^1	1	0	0	0						
A_1^2					0	1	0.67			
A_2^2		(0)			0.67	0	0.33		(0)	
A_3^2					1	0.33	0			
A_1^3								0	0.67	0
A_2^3			(0)			(0)		0	0	0
A_3^3								1	1	0

The effect of X on the dynamical system N is given by using the 'max-min' operation

X = [(1 0 0 1) | (0 0 1) | (1 0 0)]

XA = [(1 1 0 0.67) | (1 0.33 0) | (0 0.67 0)]

↪ [(1 1 0 1) | (1 0.33 1) | (1 0.67 0)] = X_1

X_1A = [(1 1 0 0.67) | (1 1 0.67) | (0 0.67 0)]

↪ [(1 1 0 1) | (1 1 1) | (1 0.67 0)] = X_2

X_2A = [(1 1 0 0.67) | (1 1 0.67) | (0 0.67 0)]

↪ [(1 1 0 1) | (1 1 1) | (1 0.67 0)] = X_3

X_3 is a fixed point

Let us consider another input vector

Y = [(0 0 0 1) | (1 0 0) | (1 0 0)]

YA = [(1 0 0 0) | (0 1 0.67) | (0 0.67 0)]
↪ [(1 0 0 1) | (1 1 0.67) | (1 0.67 0)] = Y_1
Y_1A = [(1 1 0 0.67) | (0.67 1 0.67) | (0 0.67 0)]
↪ [(1 1 0 1) | (1 1 0.67) | (1 0.67 0)] = Y_2
Y_2A = [(1 1 0 0.67) | (0.67 1 0.67) | (0 0.67 0)]
↪ [(1 1 0 1) | (1 1 0.67) | (1 0.67 0)] = Y_3
Y_3 is a fixed point

Conclusions and Suggestions Are Based on Working With More Number of State Vectors and Experts Group

i. While analysing ASFCMs when A_1^1 & A_4^1 are ON state, this makes $A2^1$ ON state and $A3^1$ in OFF state.
ii. When Govt. indifference ON state which gives all the nodes i.e., A_1^2 & A_2^2 are ON state.
iii. When A_1^3 ON state this makes A_2^3 ON state and A_3^3 in OFF state i.e., poor awareness is OFF state.
iv. When we take another set of Input vectors which gives the same fixed point i.e., Y3. Likewise any group of state vectors can be taken and its effect can be analysed.
v. The Govt. should take steps to control the moving of gypsies from one place to another place.
vi. A school must be build separately, so that the children of these gypsies are sent to school regularly.

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