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A Study on Major Causes of Child Trafficking using Induced FCM and Combined Extended Fuzzy Clustering Model

A.Praveen Prakash, M.P.Kannan, J.Esther Jerlin
Dept. of Mathematics, Hindustan University, Chennai, India
Email: apraveenprakash@gmail.com, Mpkannan11@gmail.com, estherjerlin2@gmail.com

Abstract — Uncertainty exist for the situation when thorough knowledge pertaining to the situation does not prevail. Hence, decision making for the problems based on such uncertain situations found to be hard and difficult. The introduction of the fuzzy model called Fuzzy Cognitive Maps by Kosko later which the other fuzzy models by Vasantha Kandasamy et al., justified the use of fuzzy models in many social related problems where in the vagueness of the problems were dealt with in an eminent manner. The growth and benefits of fuzzy models for uncertain situation is seen by its recent development of new fuzzy models which act better than the existing ones. In the same way, a new fuzzy model called Induced and Combined Extended Fuzzy Clustering model have been developed for the first time in this paper in order to analyze any social related and other similar problems of real life world. The new model works on unsupervised data collected from the expert's opinion and analyzes the factors that induces the problem. The algorithm of combined extended fuzzy clustering is applied in order to categorize the factors into range of clusters by taking multiple expert's opinion which gives better and refined solution than, the solution given by other existing fuzzy models. Though many uncertain situation exists in the world to study, one such situation namely major causes for child trafficking to occur in major parts of India need to be focused so that an awareness could be created among the masses with the view to arrest the trends. This paper consists of four sections. Section one is introductory in nature. Section two gives the hidden pattern of Induced FCM and Combined Extended Fuzzy Clustering. Section three gives the analysis of the problem based on the proposed fuzzy model. Finally, section four gives the discussion and conclusion of the study, indicating the future course of action to curb the trafficking of children.

Keywords— Induced FCM, Combined FCM, Clustering, Combined Fuzzy Clustering, Child trafficking.

I. INTRODUCTION

International labour Organization estimated that around 1.2 million children are trafficked every year for various reasons. It is considered as one of the major crimes that existing in every region of the world. A number of solutions have been enforced such as broad protection, prevention, law enforcement and victim in order to reduce the occurrence of sensible problem. Children both gender are trafficked according to the need of the traffickers. They have been trafficked for sexual exploitation, armed force, bonded labours, drug trades etc. The causes are put into three categories like political, cultural and Economic. We analysed the causes for such happening and made the study using Fuzzy models to identify the dominant cause.[1, 11]

II. HIDDEN PATTERN METHODOLOGY

A. Algorithmic approach in induced fuzzy cognitive maps (IFCMs)

Step-1 : The attributes of the problem that are indeterminate in nature are obtained by unsupervised method.
Step-2 : For the attributes the directed graph is drawn by the expert.
Step-3 : The matrix associated with the directed graph is constructed
Step-4 : One of the attributes is considered in on state and other attributes in off state and passed on to the associated matrix
Step-5 : The obtained resultant vector is then updated and threshold
Step-6 : Each component in the resultant vector is then passed on to the associated matrix and the process of FCM is carried out to obtain the maximum no of ones in corresponding resultant vectors.
Step-7 : The resultant vector with maximum no of ones is considered as the instantaneous state vector to continue the process until the fixed point or limit cycle is reached.[6, 7]

B. Algorithmic approach in Combined Extended Fuzzy Clustering model

Step 1: Collect the attributes on a 10-point rating scale
Step 2: Range of clusters are fixed as Low, Moderate and High. The cluster Low with beginning value as 2 and end value as 5, Moderate with beginning value as 3 and end value as 8 and High with beginning value as 7 and end value as 10.
Step 3: An element from the domain D is chosen.
Step 4: If x < ev1 and x > bv2, then x lies in cluster Low and cluster Moderate with membership value given as μk(x) = ev1-x: x- bv2 else in Cluster Low with member value as 1.
Step 5: If x < ev2 and x > bv3, then x lies in cluster Moderate and High with membership value given as μk(x) = ev2-x: x- bv3 else in Cluster Moderate with member value as 1.
Step 6: If x > bv3, the element lies in cluster High with membership value as 1.
Step 7: Else the element lies in cluster Moderate with membership value as 1.
Step 8: The procedure is carried out for 3 experts.
Step 9: Obtain X = (X1+X2+…+Xn)/n, L = (L1+L2+…+Ln)/n, M = (M1+M2+…+Mn)/n and H = (H1+H2+…+Hn)/n
Step 10: if (L<=M) and if (M<=H), put H=1 else M=1.
Step 11: if (L<=H) put H=1 else L=1.
Step 12: The process is carried out for all the attributes in the domain D.[10]

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Here 'bv' denotes the beginning value and ev' denotes the ending the value.
Here 'X' denotes the Mean Value, 'L' denotes the LOW, 'M' denotes the Moderate and 'H' denotes the High.

III. An Analysis On The Causes For Child Trafficking Using Induced Fcm Model

The problem is analysed on a 10-point rating scale. The rating and the standard deviation of the nodes for the causes of child trafficking have been subjected to fuzzy c-means clustering. [2] The cluster low is ranged from 2 to 5 with mid value 3.5, the cluster Moderate ranged from 3 to 8 with a mid-value 5.5 and the cluster High ranged from 7- 10 with a mid-value 8.5. A fuzzy based cluster is characterized with overlapping ranges

Table 1: 3-Cluster Range of Level of Dominant Cause

	Cluster 1	Cluster 2	Cluster 3
Range	2.0-5.0	3.0-8.0	7.0-10
Mid Value	3.5	5.5	8.5
Classification	LOW	MEDIUM	HIGH

NGO's and the experts were interviewed for such problem to occur. They were open to give their reasons for such problem. Reasons varied to each individual. From the collective opinion of the data given by them, according to the expert's opinion we have taken the following twelve attributes (C_1,C_2,…,C_{12}) as the main nodes for study [12]. It is not that only twelve attributes should be considered, one can increase or decrease the number of attributes according to the need.[5] The following twelve attributes are listed below.

C1- Social factors
C2- Poverty
C3- Entertainment
C4- Political uprising
C5- Illegal activities
C6- Unemployment
C7- Bonded Labour
C8- Sexual exploitation
C9- Lack of vocational opportunities
C10- Illiteracy
C11- High profit, low risk
C12- Pornography

The directed graph is obtained from the expert's opinion on the problem

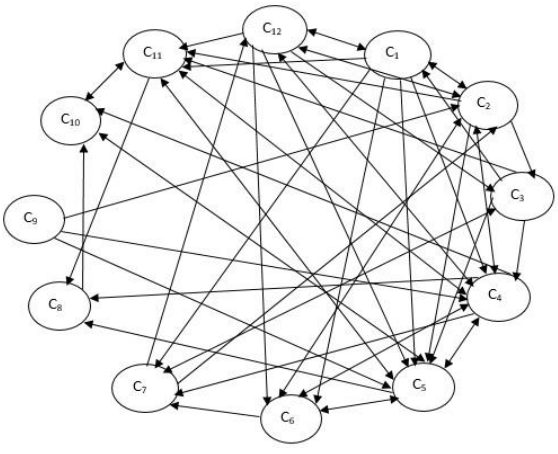

Fig 1. Directed graph of Expert's Opinion

$$E = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \\ C_8 \\ C_9 \\ C_{10} \\ C_{11} \\ C_{12} \end{array} \begin{array}{c} \begin{array}{cccccccccccc} C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 & C_{10} & C_{11} & C_{12} \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

Fig 2. Associated Matrix

Process:1

Consider C_1- Social factors to be in on state and other nodes in off state.

(i.e) C_1= (100000000000)
C_1E ↳ (110111100011) = C_1^1
C_1^1E = (110111100011) x E
C_1^1E ∞ (100000000000) x E
(010111100011)
= (010000000000) x E ↳ (101111000011)
= (000100000000) x E ↳ (010011110111)
= (000010000000) x E ↳ (000101010110)
= (000001000000) x E ↳ (010110100000)
= (000000100000) x E ↳ (011000000001)
= (000000000010) x E ↳ (000110010100)
= (000000000001) x E ↳ (111111000010)

Maximum number of 1's is C_2 (i.e) (010011110111)
Consider C_2 = (010011110111)
C_2E ↳ (111111110111) = C_2^1
C_2^1E = (111111110111) x E
C_2^1E ∞ (100000000000) x E ↳ (111111110111)
= (100000000000) x E ↳ (010111100011)
= (010000000000) x E ↳ (101111000011)
= (001000000000) x E ↳ (100110100010)
= (000100000000) x E ↳ (010011110111)
= (000010000000) x E ↳ (000101010110)
= (000001000000) x E ↳ (010110100000)
= (000000100000) x E ↳ (011000000001)
= (000000010000) x E ↳ (000000000100)
= (000000000100) x E ↳ (000010000010)
= (000000000010) x E ↳ (000110010100)
= (000000000001) x E ↳ (111111000010)

Maximum number of 1's is C_3 (i.e) (010011110111)
(i.e) C_3 = (010011110111)
Thus C_3=C_2

Therefore the fixed point is (010011110111).

Process:2

For the concept C_5- Illegal activities is in on state and rest other nodes in off state we have

C_1= (000010000000)

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$C_1E \quad \hookrightarrow \quad (000111010110) = C_1^1$

$C_1^1E = (000111010110)\ x\ E$

$C_1^1E \ \infty\ (000010000000)\ x\ E \quad \hookrightarrow \quad (000101010110)$

$= (000100000000)\ x\ E \quad \hookrightarrow \quad (010011110111)$

$= (000001000000)\ x\ E \quad \hookrightarrow \quad (010110100000)$

$= (000000010000)\ x\ E \quad \hookrightarrow \quad (000000000100)$

$= (000000000100)\ x\ E \quad \hookrightarrow \quad (000010000010)$

$= (000000000010)\ x\ E \quad \hookrightarrow \quad (000110010100)$

Maximum number of 1's is C_2 (i.e) (010011110111)
Consider $C_2 = (010011110111)$

$C_2E \quad \hookrightarrow \quad (111111110111) = C_2^1$

$C_2^1E = (111111110111)\ x\ E$

$C_2^1E \ \infty\ (100000000000)\ x\ E \quad \hookrightarrow \quad (111111110111)$

$= (100000000000)\ x\ E \quad \hookrightarrow \quad (010111100011)$

$= (010000000000)\ x\ E \quad \hookrightarrow \quad (101111000011)$

$= (001000000000)\ x\ E \quad \hookrightarrow \quad (100110100010)$

$= (000100000000)\ x\ E \quad \hookrightarrow \quad (010011110111)$

$= (000010000000)\ x\ E \quad \hookrightarrow \quad (000101010110)$

$= (000001000000)\ x\ E \quad \hookrightarrow \quad (010110100000)$

$= (000000100000)\ x\ E \quad \hookrightarrow \quad (011000000001)$

$= (000000010000)\ x\ E \quad \hookrightarrow \quad (000000000100)$

$= (000000000100)\ x\ E \quad \hookrightarrow \quad (000010000010)$

$= (000000000010)\ x\ E \quad \hookrightarrow \quad (000110010100)$

$= (000000000001)\ x\ E \quad \hookrightarrow \quad (111111000010)$

Maximum number of 1's is C_3 (i.e) (010011110111)
(i.e) $C_3 = (010011110111)$

Thus $C_3 = C_2$

Therefore the fixed point is (010011110111).

Also when we do the process by keeping 2nd, 3rd, 4th, 6th, 7th, 8th, 9th,10th,11th and 12th nodes in 'on state' , we obtain the same fixed point (i.e) (010011110111).[4,8]

Using Induced FCM we analyzed the social problem and obtained the result through fixed point (010011110111) i.e the nodes C_2, C_5, C_6, C_7, C_8, C_{10}, C_{11} and C_{12} are in the on state denote the dominant causes for the problem.i.e Illiteracy, Lack of vocational opportunities, Sexual exploitation, Political uprising, Entertainment, High profit at low risk, Pornography and Lack of vocational opportunities are the major causes of the problem to take place.

Table 2: Degree of Membership of the attributes – Trafficked Children's

Attributes	$Mean_1$	Low_1	$Moderate_1$	$High_1$
C_2	5.6	0	1	0
C_5	4.2	0.4	0.6	0
C_6	7.8	0	0.1	0.9
C_7	7.2	0	0.8	0.2
C_8	8.8	0	0	1
C_{10}	2.4	1	0	0
C_{11}	4.8	0.1	0.9	0
C_{12}	3.6	0.7	0.3	0

From tabulation 2, Attributes 10 with a mean rating 2.4 lies in the cluster Low with a membership value as 1.
Attributes 2 with a mean rating 5.6 lies in the cluster Moderate with a membership value as 1.
Attributes 8 with a mean rating 7.2 lies in the cluster High with a membership value as 1.
Attributes 5, 11 and 12 with a mean rating 4.2, 4.8 and 3.6 lie 40 % in the cluster Low and 60 % in the cluster Moderate, 10 % in the cluster Low and 90% in the cluster Moderate and 70 % in the cluster Low and 30 % in the cluster Moderate (i.e.) between

LOW and MODERATE.
Attributes 6 and 7 with a mean rating 7.8 and 7.2 lie 10 % in the cluster Moderate and 90 % in the cluster High, 80 % in the cluster Moderate and 20 % in the cluster High (i.e.) between MODERATE and HIGH.

Table 3: Degree of Membership of the attributes – NGO's

Attributes	$Mean_2$	Low_2	$Moderate_2$	$High_2$
C_2	8.6	0	0	1
C_5	9.0	0	0	1
C_6	7.4	0	0.6	0.4
C_7	4.2	0.4	0.6	0
C_8	8.4	0	0	1
C_{10}	7.8	0	0.2	0.8
C_{11}	5.8	0	1	0
C_{12}	2.0	1	0	0

From tabulation 3, Attributes 12 with a mean rating 2.0 lies in the cluster Low with a membership value as 1.
Attributes 11 with a mean rating 5.8 lies in the cluster Moderate with a membership value as 1.
Attributes 2, 5 and 8 with a mean rating 8.6, 9.0 and 8.4 lies in the cluster High with a membership value as 1.
Attributes 7 with a mean rating 4.2 lie 40 % in the cluster Low and 60 % in the cluster Moderate (i.e.) between LOW and

MODERATE.
Attributes 6 and 10 with a mean rating 7.4 and 7.8 lie 60 % in the cluster Moderate and 40 % in the cluster High, 20 % in the cluster Moderate and 80 % in the cluster High (i.e.) between MODERATE and HIGH.

Table 4: Degree of Membership of the attributes – Trafficked Children's

Attributes	$Mean_3$	Low_3	$Moderate_3$	$High_3$
C_2	7.8	0	0.2	0.8
C_5	7.5	0	0.5	0.5
C_6	7.6	0	0.4	0.6
C_7	9.0	0	0	1
C_8	6.8	0	1	0
C_{10}	4.2	0.4	0.6	0
C_{11}	2.0	1	0	0
C_{12}	2.4	1	0	0

From tabulation 4, Attributes 11 and 12 with a mean rating 2.0 and 2.4 lies in the cluster Low with a membership value as 1.
Attributes 8 with a mean rating 6.8 lies in the cluster Moderate with a membership value as 1.

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Attributes 7 with a mean rating 9.0 lies in the cluster High with a membership value as 1.
Attributes 10 with a mean rating 4.2 lie 40 % in the cluster Low and 60 % in the cluster Moderate (i.e.) between LOW and MODERATE.
Attributes 2, 5 and 6 with a mean rating 7.5, 7.8 and 7.6 lie 20 % in the cluster the cluster Moderate and 80 % in the cluster High, 50 % in the cluster Moderate and 50 % in the cluster High and 40 % in the cluster Moderate and 60 % in the cluster High (i.e.) between MODERATE and HIGH.[9]

Table 4: Degree of Membership of the attributes – Combined Fuzzy Clustering Model

Attributes	$Mean_3$	Low_3	$Moderate_3$	$High_3$
C_2	7.3	0	0	1
C_5	6.9	0	0	1
C_6	7.6	0	0	1
C_7	6.8	0	1	0
C_8	8	0	0	1
C_{10}	4.8	1	0	0
C_{11}	4.2	0	1	0
C_{12}	2.6	1	0	0

From tabulation 5, Attributes 10 and 12 with a mean rating 4.8 and 2.6 is entirely (100%) lies in the cluster Low with a membership value as 1.
Attributes 7 and 11 with a mean rating 6.8 and 4.2 is entirely (100%) lies in the cluster Moderate with a membership value as 1.
Attributes 2, 5, 6 and 8 with a mean rating 7.3, 6.9, 7.6 and 8 is entirely (100%) lies in the cluster High with a membership value as 1. [3]

IV. CONCLUSION

Analysis of the problem using Combined Fuzzy Clustering highlighted that among twelve attributes taken for analysis by the collective opinion from the experts we arrived the attributes C2 , C5 , C6 and C8 i.e. Poverty, Illegal activities, Unemployment, Sexual exploitation lie in the cluster High which denoted as the major causes of the problem.

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References
[1] Kaufmann, "Introduction to the Theory of Fuzzy Subsets", Academic Press, INC. (LONDON) LTD, 1975.
[2] Kosko, "Neural Networks and Fuzzy systems: A Dynamical System Approach to Machine Intelligence", Prentice Hall of India, 1997.
[3] W.B VasanthaKandasamy and S.Uma "Combined Fuzzy Cognitive Maps of Socio Economic Model.Appl.Sci.Periodical", Xiquan, Phoenix, 225-27(2000).
[4] W.B Vasantha Kandasamy and Smarandache Florentin; 'Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps', Xiquan, Phoenix. (2003).
[5] H.J. Zimmermann, "Fuzzy Set Theory and its application", Fourth Edition Springer 2011.
[6] A.Praveen Prakash , J.Esther Jerlin and J.Bennilo Fernandes, "A Study on the causes for aversion to mathematics by engineering students using Fuzzy Cognitive Maps" (FCMs), International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 3, Issue 3, March 2014.
[7] T.Pathinathan, M.Peter, "Adaptation of Induced Fuzzy Cognitive Maps to the Problems Faced By the Farmers in Sriperumbudur Taluk Kanchi District", International Journal of Computing Algorithm, Volume: 03, February 2014, Pages: 578-582.
[8] Ponnivalavan.K .,Pathinathan.T, "The Study of Symptoms of Tuberculosis Using Induced Fuzzy Coginitive Maps (IFCMS)", Indo-Bhutan International Conference On Gross National Happiness, Vol 02, October 2013, Pages: 237-241.
[9] Rajkumar., Nikhil Nair N. and Jose Parvin Praveena, " A Study on Poor Academic Performance of Students: Using Fuzzy Clustering", International Journal Of Advanced Research In Computer Science and Software Engineering Research, Volume:05, Issue:01, January 2015.
[10] A.Praveen Prakash , J.Esther Jerlin and J.Bennilo Fernandes, "A Study on the causes for Failures in Mathematics by Engineering Students using Combined Fuzzy Clustering Model" (CFCLM), IJCA, ISSN: 16344-5675, Vol. 94, Issue 6, pp:1-7, March 2014.
[11] https://www.savethechildren.in/resourcecentre/articles/causes-of-child-trafficking-in-india
[12] https://www.theguardian.com/globaldevelopment/2015/apr/28/child-trafficking-india-domestic-labour-chhattisgarh