

Problems of Housemaids in Chennai City: A Study Using Combined Fuzzy Cognitive Maps (CFCMs)

A. Praveen Prakash, N. Lakshmi pathy, J. Esther Jerlin

Abstract: A domestic worker is a person who works within the employer's household. Domestic workers perform a variety of household services for an individual or a family, from providing care for children and elderly dependents to cleaning and household maintenance, known as housekeeping. Responsibilities may also include cooking, doing laundry and ironing, food shopping and other household errands. Some domestic workers live within the household where they work. This paper analyses the problems of housemaids in Chennai city using Combined Fuzzy Cognitive Mapping (CFCM) Model. This gives the result in an effective way by combining the opinion of two or more experts. This paper consists of four sections. Section one deals with the causes for the problems, which is introductory in nature. Section two gives the description of Combined Fuzzy Cognitive Map model. Section three deals with the attributes involved that states the causes for such a problem and uses CFCM to analyze the problem. Section four gives the conclusion and suggestions based on the study.

Index Terms: CFCMs, Hidden pattern, fixed point, failure, housemaids.

I. INTRODUCTION

A maid, or housemaid or maidservant, is a female person employed in domestic service. Although now usually found only in the most wealthy of households, in the Victorian era domestic service was the second largest category of employment in England and Wales, after agricultural work.

Maids have a fixed position in the hierarchy of the large households, and although there is overlap between definitions (dependent on the size of the household) the positions themselves would typically be rigidly adhered to. The usual classifications of maid in a large household are: Lady's maid, House-maid, Nursery maid, Kitchen maid, Scullery maid, Between maid, Still room maid. In 2011, the International Labour Organization adopted the Convention Concerning Decent Work for Domestic Workers which covers decent work conditions for domestic workers. Recent ILO estimates based on national surveys of 117 countries, place the number of domestic workers at around 53 million. The ILO also states that 83% of domestic workers are women and many are migrant workers.

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II. Combined Fuzzy Cognitive Map (CFCM)

A. Preliminaries

Fuzzy cognitive maps (FCMs) are more applicable when the data in the first place is an unsupervised one. The FCMs work on the opinion of experts. FCMs model the worlds as a collection of classes and causal relation between classes. It is a very convenient, simple and powerful tool, which is used in numerous fields such as social, economical and medical etc. illustrated by W.B.Vasantha Kandasamy in her book, "Special Fuzzy Matrices for Social Sciences".

Definition 2.1.1: An FCM is a directed graph with concepts like policies, events etc as nodes and causalities as edges. It represents causal relationship between concepts.

Definition 2.1.2: When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition 2.1.3: FCMs with edge weights or causalities from the set $\{-1, 0, 1\}$ are simple FCMs.

Definition 2.1.4: The edges e_{ij} take values in the fuzzy causal interval $[-1,1]$. $e_{ij} = 0$ indicates no causality, $e_{ij} > 0$ indicates causal increase C_j increases as C_i increases (Or C_j Decreases as C_i Decreases). $e_{ij} < 0$ indicates causal decrease or negative causality. That is C_j decreases as C_i increases (and or C_j increases as C_i decreases). Simple FCMs have edge values in $\{-1, 0, 1\}$. Then if causality occurs, it occurs to a maximal positive or negative degree. Simple FCMs provide a quick first approximation to an expert's stand or printed causal knowledge. If increase (Or decrease) in one concept leads to increase (or decrease) in another, then we give the value 1. If there exist no relation between the two concepts, the value 0 is given. If increase (or decrease) in one concept decreases (or increases) another, then we gives the value -1. Thus, FCMs are described in this way. Consider the nodes or concepts C_1, \dots, C_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 the e_{ij} is the weight of the directed edge $C_i C_j$. 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 2.1.5: Let C_1, C_2, \dots, C_n be the nodes of an FCM. Let $A=(a_1, a_2, \dots, a_n)$, where $a_i \in \{0,1\}$. A is called the instantaneous state vector and it denoted the on off position of the node at an instant $a_i=0$ if a_i is off and $a_i=1$ if a_i is on, where $i = 1, 2, \dots, n$.

Definition 2.1.6: Let C_1, C_2, \dots, C_n be the nodes of an FCM. Let $C_1C_2, C_2C_3, \dots, C_iC_j$, 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 2.1.7: An FCM with cycles is said to have a feedback.

Definition 2.1.8: Where 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 2.1.9: Let $C_1C_2, C_2C_3, \dots, C_iC_j$, 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 $i = 1, 2, \dots, n$. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 2.1.10: 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, \dots, C_n as nodes. For example let us start the dynamical system by switching on C_1 . Let us assume that the FCM settles down with C_1 and C_n on, i.e. 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 2.1.11: If the FCM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \dots A_1 \rightarrow A_1$. Then this equilibrium is called limit cycle.

Definition 2.1.12: 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 C_1, C_2, \dots, C_n , then the combined FCM[5,6,7] is got by adding all the adjacency matrices E_1, \dots, E_p . We denote the combined FCM adjacency matrix by $E = E_1 + E_2 + \dots + E_p$

Definition 2.1.13: Method of determining the hidden pattern: Let C_1, C_2, \dots, C_n be the nodes of an FCM, with feedback. Let E be the associated adjacency matrix. Let us find the hidden pattern when C_6 is switched on. When an input is given as the vector $A_1 = (1, 0, 0, \dots, 0)$, the data should pass through the relation matrix E . this is done by multiplying A_1 by the matrix E . Let $A_1 E = (a_1, \dots, a_n)$ with the threshold operation that is by replacing a_i by 1 if $a_i > k$ and a_i by 0 if $a_i < k$ (k is a suitable positive integer). We update the resulting

concept. The concept C_6 is included in the updated vector by making the sixth coordinate as 1 in the resulting vector. Suppose $A_1 E \rightarrow A_2$ then consider $A_2 E$ and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

III. A STUDY ON THE PROBLEM FACED BY HOUSEMAIDS USING CFCM MODEL:

By administering linguistic questionnaire among the housemaids, house masters and the NGO's that are involved in promoting their rights, we arrived at the experts opinion based on which we have taken the following ten nodes $\{C_1, C_2, \dots, C_{10}\}$

They are listed as follows:

- C₁- Poverty
- C₂- Unemployment
- C₃- Ignorance
- C₄- Illiteracy
- C₅- Long hours of work with limited payment
- C₆- Heavy back bending routine physical work
- C₇- Traditional bound attitudes
- C₈- Sexual discrimination in wage structures
- C₉- Ill Treatment / sexual abuse
- C₁₀-Lack of job security

A. ANALYSIS OF THE PROBLEM

Analysis of the First Expert's view

The Problems listed above were collected from the 100 housemaids of Chennai through survey and personal interview, so here the experts are house maids. The following diagram picturises their inter-relationship.

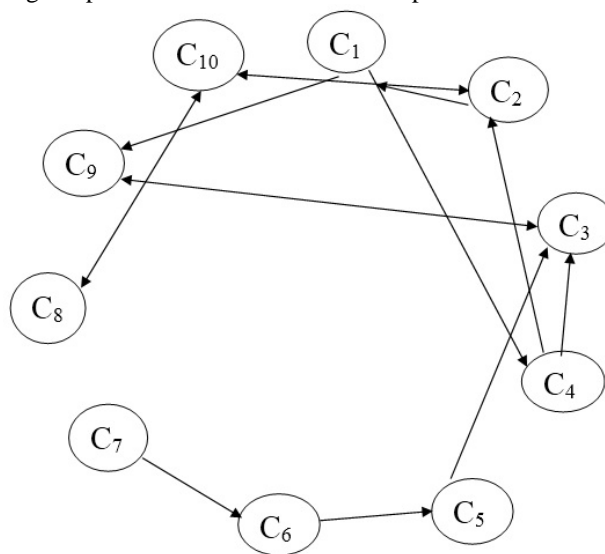


Fig. 1. Directed graph of the first expert

The relational matrix with the above graph is

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	0	0	1	0	0	0	0	1	0
C2	1	0	0	0	0	0	0	0	0	1
C3	0	0	0	0	0	0	0	0	1	0
C4	0	1	1	0	0	0	0	0	0	0
C5	0	0	1	0	0	0	0	0	0	0
C6	0	0	0	0	1	0	0	0	0	0
C7	0	0	0	0	0	1	0	0	0	0
C8	0	0	0	0	0	0	0	0	0	1
C9	0	0	1	0	0	0	0	0	0	0
C10	0	1	0	0	0	0	0	1	0	0

Fig. 2. Relational matrix of the first expert

Now using the matrix A of the Fuzzy Cognitive Map (FCM) model, we determine the hidden pattern. Suppose the concept C₁ (Poverty) is in the 'on state' and other nodes are in the 'off state'.

Then the initial input vector will be

$$\begin{aligned}
 X_0 &= \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} \\
 X_0 A &\rightarrow \{1\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 1\ 0\} = X_1 \\
 X_1 A &\rightarrow \{1\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 1\ 0\} = X_2 \\
 X_2 A &\rightarrow \{1\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 1\ 1\} = X_3 \\
 X_3 A &\rightarrow \{1\ 1\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 1\} = X_4 \\
 X_4 A &\rightarrow \{1\ 1\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 1\} = X_5 = X_4
 \end{aligned}$$

So, X₄ gives the hidden pattern which is the fixed point. When C₁ i.e. "Poverty" is in the on state, all the states other than C₅, C₆, C₇ are in the on state. i.e C₅- Long hours of work with limited payment, C₆- Heavy physical work, C₇- Tradition bound attitudes come to the off state. The rest of the nodes come up to 'on state', highlighting them to be the major problems.

Analysis of the Second Expert's view

The Problems listed above were collected from twenty housemaid's masters of Chennai through survey and personal interview. So the house masters are the experts. The following diagram pictures their inter-relationship.

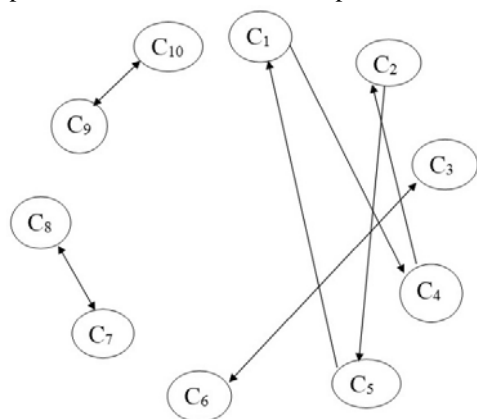


Fig.3. Directed graph of the second expert

The relational matrix with the above graph is

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	0	0	1	0	0	0	0	0	0
C2	0	0	0	0	1	0	0	0	0	0
C3	0	0	0	0	0	1	0	0	0	0
C4	0	1	0	0	0	0	0	0	0	0
C5	1	0	0	0	0	0	0	0	0	0
C6	0	0	1	0	0	0	0	0	0	0
C7	0	0	0	0	0	0	0	1	0	0
C8	0	0	0	0	0	0	0	1	0	0
C9	0	0	0	0	0	0	0	0	0	1
C10	0	0	0	0	0	0	0	0	1	0

Fig. 4. Relational matrix of the second expert

Let the initial input vector be

$$\begin{aligned}
 X_0 &= \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} \\
 X_0 B &\rightarrow \{1\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} = X_1 \\
 X_1 B &\rightarrow \{1\ 1\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} = X_2 \\
 X_2 B &\rightarrow \{1\ 1\ 0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0\} = X_3 \\
 X_3 B &\rightarrow \{1\ 1\ 0\ 1\ 1\ 0\ 0\ 0\ 0\ 0\ 0\} = X_4 = X_3
 \end{aligned}$$

X₃ is the hidden pattern which is the fixed point. Here C₁- Poverty, C₂- Unemployment, C₄- Illiteracy and C₅- Long hours of work with limited payment come up to the 'on state' when C₁ i.e poverty is in the on state.

Analysis of the Third Expert's view

The third expert's opinion is arrived through responses from NGO's that work to promote the rights of housemaids. The following graph and related fuzzy relational matrix are given below:

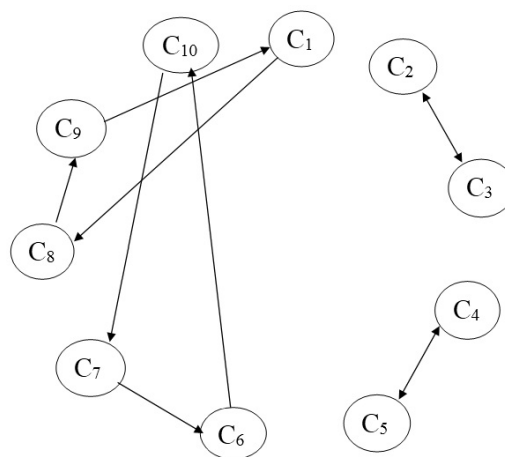


Fig. 5. Directed graph of the third expert

The matrix associated with the above graph is

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	0	0	0	0	0	0	1	0	0
C2	0	0	1	0	0	0	0	0	0	0
C3	0	1	0	0	0	0	0	0	0	0
C4	0	0	0	0	1	0	0	0	0	0
C5	0	0	0	1	0	0	0	0	0	0
C6	0	0	0	0	0	0	0	0	0	1
C7	0	0	0	0	0	1	0	0	0	0
C8	0	0	0	0	0	0	0	0	1	0
C9	1	0	0	0	0	0	0	0	0	0
C10	0	0	0	0	0	0	1	0	0	0

Fig. 6. Relational matrix of the third expert

Let the initial input vector be

$$\begin{aligned}
 X_0 &= \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} \\
 X_0 C &\rightarrow \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\} = X_1 \\
 X_1 C &\rightarrow \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 1\ 0\} = X_2 \\
 X_2 C &\rightarrow \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 1\ 0\} = X_3 = X_2
 \end{aligned}$$

X_2 is the hidden pattern which is the fixed point. When Poverty C_1 is kept in 'on state', we get C_8 - Sexual discrimination in wage structures and C_9 - Ill Treatment sexual abuse come up in the 'on state'. So as per the NGOs, Poverty sexual discrimination in wage structure and ill-treatment / sexual abuse are the major issues to be tackled.

Analysis of the problem combining all the three experts' views

Now we formulate the combined fuzzy cognitive maps (CFCM) using the opinion of the above three experts. Let S denote the combined connection matrix by $S=A+B+C$. The matrix associated with the above graph is

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0	0	0	2	0	0	0	1	1	0
C2	1	0	1	0	1	0	0	0	0	1
C3	0	1	0	0	0	1	0	0	1	0
C4	0	2	1	0	1	0	0	0	0	0
C5	1	0	1	1	0	0	0	0	0	0
C6	0	0	1	0	1	0	0	0	0	1
C7	0	0	0	0	0	2	0	1	0	0
C8	0	0	0	0	0	0	1	0	1	1
C9	1	0	1	0	0	0	0	0	0	1
C10	0	1	0	0	0	0	1	1	1	0

Fig. 7. Combined relational matrix

Let the initial input vector be

$$\begin{aligned}
 X_0 &= \{1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\} \\
 X_0 S &\rightarrow \{1\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ 1\ 0\} = X_1 \\
 X_1 S &\rightarrow \{1\ 1\ 1\ 1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\} = X_2 \\
 X_2 S &\rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\} = X_3 \\
 X_3 S &\rightarrow \{1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\} = X_4 = X_3
 \end{aligned}$$

Here, X_3 is the hidden pattern which is the fixed point. The collective opinion of the above three experts highlight all the listed problems. Where \rightarrow Denotes the resultant vector after thresholding and updating.

IV. CONCLUSION AND SUGGESTIONS

While analyzing the problem using CFCM, when the concept C_1 (i.e) "Poverty" is in the on state, we obtained all the other nodes in on state (i.e) C_2 - Unemployment, C_3 - Ignorance, C_4 - Illiteracy, C_5 - Long hours of work with limited payment, C_6 - Heavy physical work, C_7 - Tradition bound attitudes, C_8 - Sexual discrimination in wage structures, C_9 - Ill Treatment/ Sexual abuse, C_{10} -Lack of job security. This implies that these ten attributes are inter-related to each other. The approach of masters to housemaids and vice versa brings either intimacy or desperation in their relation. The mutual smooth relation between the masters and housemaids benefits each other in their situation. In reality it doesn't happen, the house maids are put to all the hardship in this paper. There need to be an external force to find solution to their problems. This is possible only if there exists a Government Guidelines that ensure minimum wage structure, paid leave, norms of working condition etc and arranging to monitor the implementation of such guidelines.

V. FUTURE WORK

Analyzing the problems of the housemaids at Chennai through various fuzzy models and ultimately arrive at the key issues by settling which many of the major issues are resolved.

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