

A Study on the Problems faced by Women Entrepreneurs using Neutrosophic Associative Fuzzy Cognitive Dynamical System

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ABSTRACT

Women Entrepreneurship has been recognised as an important source of economic growth for developing the country. Women Entrepreneurs have involved themselves in different sectors as it helps to create accomplishment by finding their own individuality in the society. The aim of this paper is to study the problems of women entrepreneurs and their effects. Section one deals with introduction. Section two gives the definitions. Section three describes the adaptation of the problem. Ultimately section five reveals the conclusion.

Keywords

Women Entrepreneur, Neutrosophic Associative Memories, Fuzzy Cognitive Map, Bihidden patterns, Limit cycle

1. INTRODUCTION

L.A.Zadeh introduced Fuzzy Set theory in 1965 to deal with vagueness and imprecision [1]. In 1976, Axelrod [2] used cognitive maps to study decision making in social and political systems. Then Kosko enhanced cognitive maps by considering fuzzy values for the concept of cognitive maps and fuzzy degrees of interrelationships between the concepts. Neutrosophic models are fuzzy models which allow for the factor of indeterminacy. Neutrosophic Associative Memories (NAM) were introduced by Vasantha Kandasamy and Floretin Smarandache in 2005 and Fuzzy Cognitive Maps (FCM) were pioneered by Bart Kosko in 1986 [6]. Some bimodels were introduced, namely Fuzzy Cognitive Relational Map [3], Bidirectional Associative Fuzzy Cognitive Dynamical System [4], Bidirectional Associative Neutrosophic Cognitive Dynamical System [5] and Neutrosophic 'Associative Fuzzy Cognitive Map' [6]. Women entrepreneurs are women or groups of women who create and manage a business as it helps to empower them to increase their economic strength and identity in society. According to the Women Business Ownership Index, India was in a low position (41.7 points) among 54 countries. India gives low opportunities for women in leadership, participation in the workforce. Mostly women are prone to shutting down their business due to a lack of finance. Lack of education, cultural bias, and weak technological skills are some key impediments for raising their position in business [7]. Neutrosophic Associative Fuzzy Cognitive Map (NAFCM) was chosen to study the problems of women entrepreneurs and effects faced by them in society and works on when the study is in an unsupervised one. The dynamical bisystem NAFCM consists of NAM dynamical system and FCM dynamical system by giving stage-by-stage effects to the attributes. NAM consists of a pair of attributes where indeterminacy occurs in the relationship by dealing with the problems of women entrepreneurs and effects faced by them. In FCM, one set of attributes involves the problems

faced by women entrepreneurs. This bimodel helps to capture the hidden pattern for the problems faced by them.

2. NEUTROSOPHIC ASSOCIATIVE FUZZY COGNITIVE BIMODEL

2.1 Definition

M is said to be a biset if $M = M_1 \cup M_2$ where M_1, M_2 are non-empty sets.

Example: $M = (3 \ 1 \ 7), (2 \ 1 \ 0) \cup (1 \ 0 \ 1 \ 4), (7 \ 5 \ 4 \ 3)$. Clearly M is a biset.

2.2 Definition

Let $A_1 = (a_1, a_2, \dots, a_n)$, $A_2 = (a'_1, a'_2, \dots, a'_m)$ be two vectors of length n and m respectively. Then $A = A_1 \cup A_2$ is a Neutrosophic bivector. Example $A = A_1 \cup A_2 = (2 \ 1 \ 1 \ 5) \cup (2 \ 8 \ 1 \ 5 \ 4)$, A is a Neutrosophic bivector.

2.3 Definition

Let G be said to be a bigraph where $G = G_1 \cup G_2$

2.4 Definition

Let $F = F_1 \cup F_2$ be a Neutrosophic bimatrix. Then the bitranspose of the bimatrix F is defined as

$$F^t = (F_1 \cup F_2)^t = F_1^t \cup F_2^t$$

2.5 Definition

A Neutrosophic Associative Fuzzy Cognitive Map (NAFCM) is a directed bigraph with concepts like policies, events as nodes and causalities as edges. It represents causal relationships between concepts. In a NAFCM, the pair of associated nodes are binodes. If the order of the bimatrix associated with the NAFCM is a $p \times m$ matrix and a $n \times n$ square matrix, then the binodes are bivectors of length (m, n) or (p, n).

2.6 Definition

Consider the binodes $\{C_1, C_2, \dots, C_n\}$ and $\{E_1, E_2, \dots, E_m\}$ of the NAM and $\{A_1, A_2, \dots, A_n\}$ of the FCM of the NAFCM bimodal. The bimatrix $F = F_1 \cup F_2$ is defined as $e_{ij}^1 \cup e_{mn}^2$ where e_{ij}^1 is the directed edge of $C_i E_j$ and e_{mn}^2 is the directed edge of $A_m A_n$. $F = F_1 \cup F_2$ is called an adjacency matrix.

2.7 Definition

Simple NAFCM consists of edge biweights $\{1, 0, -1, 1\}$. Let $\{\{C_1, C_2, \dots, C_n\}, \{E_1, E_2, \dots, E_m\}\} \cup \{A_1, A_2, \dots, A_n\}$ be the binodes of a NAFCM. $A = A_1 \cup A_2 = \{C_1, C_2, \dots, C_n\}$

or $\{E_1, E_2, \dots, E_n\} \cup \{A_1, A_2, \dots, A_n\}$ where $C_i, E_j, A_m \in \{0, 1, I\}$. $1 \leq i \leq l, 1 \leq j \leq n, 1 \leq m \leq k$. A is called instantaneous state bivectors and it denotes ON-OFF-INDETERMINATE position of the node at an instant.

$C_i = 0, E_j = 0, A_m = 0$ if C_i, E_j, A_m are in off position.

$C_i = 1, E_j = 1, A_m = 1$ if C_i, E_j, A_m are in on position

$C_i = I, E_j = I, A_m = I$ if C_i, E_j, A_m are in Indeterminate position.

2.8 Definition

Let $\{\{C_1, C_2, \dots, C_y\}, \{E_1, E_2, \dots, E_q\}\} \cup \{A_1, A_2, \dots, A_n\}$ be the binodes of an NAFCM. Let $C_o E_p \cup A_c A_s$ be the biedges where $1 \leq o \leq y, 1 \leq p \leq q, 1 \leq c, 1 \leq s (s \neq c)$. Then the biedges form bidirected cycle. A NAFCM is said to be bicyclic if it possesses a directed bicycle.

2.9 Definition

If the NAFCM settles down with a bistate, bivectors repeats in the form of $C_1 \rightarrow C_2 \rightarrow \dots \rightarrow C_i \rightarrow C_1$ or $E_1 \rightarrow E_2 \rightarrow \dots \rightarrow E_j \rightarrow E_1 \cup A_1 \rightarrow A_2 \rightarrow \dots \rightarrow A_m \rightarrow A_1$ then this equilibrium is called as limit bicycle.

2.10 Definition

The biedges $e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ takes the values in fuzzy casual binterval $[-1, 1] \cup [-1, 1] \cup I$.

$e_{ij} = 0$ indicates no causality occurs between the binodes

$e_{ij} > 0$ indicates that $(e_{mn}^1) > 0$ and $(e_{ij}^2) > 0$ implies that increase in the binodes $C_i \cup X_k$ (or Y_s) implies increase in the binodes $C_i \cup X_s$ (or Y_k)

$e_{ij} < 0$ indicates that $(e_{mn}^1) < 0$ and $(e_{ij}^2) < 0$ implies that decrease in the binodes $C_i \cup X_k$ (or Y_s) implies decrease in the binodes $C_i \cup X_s$

$e_{ij} = I$ indicates Indeterminate position occurs between the binodes.

We can also have possibilities other than $e_{ij} = 0, e_{ij} > 0, e_{ij} < 0$

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ if $(e_{mn}^1) > 0$ and $(e_{ij}^2) = 0$.

Indicates that no relation in (e_{ij}^2) and increase in (e_{mn}^1)

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ if $(e_{mn}^1) < 0$ and $(e_{ij}^2) = 0$.

Indicates that no relation in (e_{ij}^2) and decrease in (e_{mn}^1)

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ we can have $(e_{mn}^1) > 0$ and $(e_{ij}^2) \leq 0$

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ we can have $(e_{mn}^1) = 0$ and $(e_{ij}^2) < 0$

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ we can have $(e_{mn}^1) = 0$ and $(e_{ij}^2) > 0$

$e_{ij} = (e_{mn}^1) \cup (e_{ij}^2)$ we can have $(e_{mn}^1) = 0$ and $(e_{ij}^2) > 0$

In NAFCM there are nine possibilities where as in NAM or FCM there are only four possibilities. Thus extra possibilities make the resultant more sensible

3. ADAPTATION OF THE MODEL

The bimodel NAFCM consists of NAM and FCM in which Y be the connection bimatrix. Let X_1 be the input bivectors which is in ON State and all other components are kept in OFF state. Pass the state vector X_1 into connection bimatrix and convert the resultant vector into signal function by using thresholding process. choose one highest values in NAM as 1 and all other values as 0. similarly follow the same process in FCM. The resulting vector which is obtained in NAM is multiplied with M^T and thresholding yields new vector X_2 where as the resulting vector is kept as it is in FCM. The process has been repeated for all the vectors separately. In NAM, the domain space consists of attributes related to problems faced by women entrepreneurs are denoted as $P_1, P_2, P_3, P_4, P_5, P_6, P_7$. The effects are as $E_1, E_2, E_3, E_4, E_5, E_6$ in the range space. FCM consists of main attributes and denoted as $A_1, A_2, A_3, A_4, A_5, A_6, A_7$.

The attributes related to the problem of women entrepreneurs

P_1 – Financial problems

P_2 – Marketing problems

P_3 – Lack of Motivation from family

P_4 – Casteism

P_5 – Heavy competition

P_6 – Patriarchal society

P_7 – Limited mobility

Effects in the family

E_1 – Lack of Confidence

E_2 – Psychological Problems

E_3 – Family Conflicts

E_4 – Divorce

E_5 – Opportunities are denied

E_6 – Domestic Violence

Major problems faced by women entrepreneurs

A_1 – Lack of Finance

A_2 – Family Conflicts

A_3 – Lack of support in family

A_4 – Lack of Mental Strength

A_5 – Lack of Education

A_6 – Family Restriction

A₇ – Low risk bearing ability

The expert's opinion is given in the form of connection Bimatrix Y

$$Y = \begin{matrix} P_1 \\ P_2 \\ P_3 \\ P_4 \\ P_5 \\ P_6 \\ P_7 \end{matrix} \begin{matrix} E_1 & E_2 & E_3 & E_4 & E_5 & E_6 \\ \begin{bmatrix} 0.7 & 0.8 & 0.6 & 0 & 0 & 0.2 \\ 0.6 & 0.7 & 0.2 & 0 & 0 & 0 \\ 0.6 & 0.7 & 0.5 & 0 & 0 & 0.6 \\ 0.3 & 0.4 & 0 & 0 & 0.5 & 0.2 \\ 0.4 & 0.5 & 0 & 0 & 0 & 0 \\ 0.2 & 0.3 & 0.4 & 0 & 0.2 & 0.1 \\ 0.3 & 0.4 & 0.3 & 1 & 0.1 & 0.5 \end{bmatrix} \end{matrix} \cup \begin{matrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_6 \\ C_7 \end{matrix} \begin{matrix} \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

$$Y = Y_1 \cup Y_2$$

Let X₁ is kept in ON state where other nodes are in OFF state

$$\begin{aligned} X_1 &= (1000000) \cup (1000000) \\ X_1.M &= (1000000).Y_1 \cup (1000000).Y_2 \\ &= (0.7 \ 0.8 \ 0.6 \ 0 \ 0 \ 0.2) \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1) \\ &\hookrightarrow (0 \ 1 \ 0 \ 0 \ 0 \ 0) \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1) \\ &= (0 \ 1 \ 0 \ 0 \ 0 \ 0).Y_1^T \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1).Y_2 \\ &= (0.8 \ 0.7 \ 0.7 \ 0.4 \ 0.5 \ 0.3 \ 0.4) \cup (3 \ 1 \ 3 \ 2 \ 0 \ 4 \ 1) \\ &\hookrightarrow (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \cup (0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0) = X_2 \\ X_2.M &= (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0).Y_1 \cup (0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0).Y_2 \\ &= (0.7 \ 0.8 \ 0.6 \ 0 \ 0 \ 0.2) \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1) \\ &\hookrightarrow (0 \ 1 \ 0 \ 0 \ 0 \ 0) \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1) \\ &= (0 \ 1 \ 0 \ 0 \ 0 \ 0).Y_1^T \cup (0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 1).Y_2 \\ &= (0.8 \ 0.7 \ 0.7 \ 0.4 \ 0.5 \ 0.3 \ 0.4) \cup (3 \ 1 \ 3 \ 2 \ 0 \ 4 \ 1) \\ &\hookrightarrow (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \cup (0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0) = X_3 \\ (0 \ 1 \ 0 \ 0 \ 0 \ 0), (1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \cup (0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0) &\text{ is the fixed point} \end{aligned}$$

Table 1. The set of all limit points with respect to the different input vectors

Input Vectors	Limit Points
(1000000)	(010000), (1000000) ∪ (0000010)
(0100000)	(010000), (1000000) ∪ (0000010)
(0010000)	(010000), (1000000) ∪ (0000010)

(0001000)	(000010), (0001000) ∪ (0000010)
(0000100)	(010000), (1000000) ∪ (0000010)
(0000010)	(010000), (1000000) ∪ (0111001)
(0000001)	(010100), (10 00001) ∪ (0000010)

4. CONCLUSIONS

We analyzed the problems faced by women entrepreneurs by using NAFCM, it highlights P₁(Financial problems), P₄(Casteism), P₇(Limited mobility), E₂(Psychological Problems), E₅ (Opportunities are denied), but E₄ is in Indeterminate position and A₂(Family Conflicts), A₃(Lack of support in family) , A₄(Lack of Mental Strength), A₆(Family Restriction), A₇(Low risk bearing ability) are the problems and effects faced by them.

5. ACKNOWLEDGMENTS

This research work is supported by UGC Scheme RGNF Award letter NoF1-17.1/2016-17/RGNF-2015-17-SC-TAM-18451/(SA-III Website)

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