A NEW FUZZY TOOL TO ANALYZE THE PROBLEMS OF OLD AGE PEOPLE

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ABSTRACT

In this paper, we presents a new fuzzy tool called Trapezoidal Fuzzy Cognitive Maps(TpFCM) to analyze the social problem. Usually in Fuzzy Cognitive Maps (FCMs) we analyze the causes and effects of the relationships among the concepts to model the behavior of any system. But this new model gives the causes and effects of the relationships among the concepts to model behavior with ranking of any system. In our present-day society, where money is the measure of everything, the elderly are looked upon as an economic liability and a social burden. The prospect of loneliness often accompanies the process of aging. Many people get extremely panicky when they become old. In their earlier years, they never paused to think of this inevitability and now they are emotionally ill prepared to accept the fact. They become fearful and depressed. Old age has become a widespread social problem in our time. Improvement in diet, technology, and medicine has increased the longevity of a person.In this paper, we analyze the old age people problem using TpFCM. It is organized as follows: In first , we give the brief introduction to FCMs. Section two gives the basic definitions of FCM. In section three, we derive the definitions for TpFCM and Hidden pattern of the dynamical system. In fourth section, we analyzed the concept of the problem using TpFCM. In final section, we give the conclusion based on our study.

Keywords: Fuzzy Cognitive Maps (FCMs), Unsupervised, Trapezoidal fuzzy numbers, Old age people.

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1. Introduction

Lotfi A. Zadeh (1965)[10] has introduced a mathematical model called Fuzzy Cognitive Maps (FCMs). After a decade, Political scientist Axelord (1976) used this fuzzy model to study decision making in social and political systems. Then Kosko (1986, 1988,1997) [7,8] enhanced the power of cognitive maps considering fuzzy values for the concepts of the cognitive map and fuzzy degrees of interrelationships between concepts. FCMs can successfully represent knowledge and human experience, introduced concepts to represent the essential elements and the cause and effect relationships among the concepts to model the behavior of any system. It is a very convenient, simple and powerful tool, which isused in numerous fields such as social, economical and medical, etc. Usually we analyze the number of attributes as ON-OFF position. The concept of general fuzzy number was introduced by chang and Zadeh [22] in 1972.Since then, many researchers studied the theory of fuzzy number, and achieved fruitful results[23,24]. On the other hand ranking is very important concept, and many methods for ranking have also been studied[25,26]. The ranking of Trapezoidal fuzzy number plays an very important role in linguistic decision making and some other fuzzy application systems. The method Trapezoidal Fuzzy Cognitive Maps(TpFCM) gives the weightage of each and every attribute using which ranking of the attribute is done. Now we provide the basic definitions for FCMs to develop the Trapezoidal Fuzzy Cognitive Maps (TpFCM).

2. Preliminaries

In this section, some concepts and methods used in this paper are briefly introduced.

2.1. Fuzzy set theory

The fuzzy set theory is to deal with the extraction of the primary possible outcome from a multiplicity of information that is expressed in vague and imprecise terms. Fuzzy set theory treats vague data as probability distributions in terms of set memberships. Once determined and defined, sets of memberships in probability distributions can be effectively used in logical reasoning.

2.2. Trapezoidal fuzzy number and the algebraic operations

2.2.1.Trapezoidal fuzzy number

A Trapezoidal fuzzy number A with four parameters $a_1 \leq a_2 \leq a_3 \leq a_4$ is denoted as

$A = (a_1, a_2, a_3, a_4)$ in the set of real numbers R.

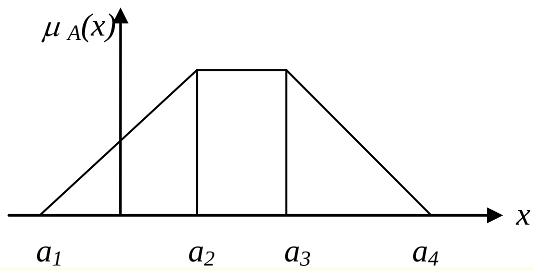

Figure 1: Trapezoidal fuzzy number A= (a_1, a_2, a_3, a_4)

Its membership function can be given by

$$\mu_A(x) = \begin{cases} 0 & , x < a_1 \\ \dfrac{x-a_1}{a_2-a_1} & , a_1 \le x \le a_2 \\ 1 & , a_2 \le x \le a_3 \\ \dfrac{x-a_4}{a_3-a_4} & , a_3 \le x \le a_4 \\ 0 & , a_4 < x \end{cases} .$$

2.2.2. Operation of Trapezoidal fuzzy number

Let $A_1 = (a_{11}, a_{12}, a_{13}, a_{14})$ and $A_2 = (a_{21}, a_{22}, a_{23}, a_{24})$ be two Trapezoidal fuzzy numbers in the set ofreal numbers R. Then, the following are the operations that can be performed on Trapezoidal fuzzy numbers:

(i) Addition:

$A_1+A_2 = (a_{11}+a_{21}, a_{12}+a_{22}, a_{13}+a_{23}, a_{14}+a_{24})$.

(ii) Subtraction:

$A_1-A_2 = (a_{11}-a_{21}, a_{12}-a_{22}, a_{13}-a_{23}, a_{14}-a_{24})$.

2.2.3. Degrees of the Trapezoidal fuzzy number[5]

Table 1 : The linguistic values of the Trapezoidal fuzzy numbers are

Linguistic term	Linguistic values of Trapezoidal fuzzy number
Very low	(0.0, 0.0, 0.0, 0.0)

Low	(0.0, 0.1, 0.2, 0.3)
Fairly low	(0.2, 0.3, 0.4, 0.5)
Fair	(0.4, 0.5, 0.6, 0.7)
Fairly high	(0.6, 0.7, 0.8, 0.9)
High	(0.8, 0.9, 1, 1)
Very high	(1, 1, 1, 1)

2.3. Fuzzy Cognitive Maps (FCMs)

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 world as a collection of classes and causal relations between classes.

Definition 2.3.1: A FCM is a directed graph with concepts like policies, events, etc. as nodes and causalities as edges. It represents casual relationship between concepts.

Definition 2.3.2: When the nodes of the FCM are fuzzy sets then they are called as fuzzy nodes.

Definition 2.3.3: FCMS with edge weights or causalities from the set {−1, 0, 1} are called simple FCMs.

Definition 2.3.4: The edges e_{ij} take values in the fuzzy casual interval $[-1,1]$. $e_{ij} = 0$ indicates no causalities. $e_{ij} > 0$ indicates causal increase, C_j increases as C_i increases (or C_j decreases as C_i decreases). $e_{ij} < 0$ indicates casual decrease (or negative causality), C_j decreases as C_i increases (or C_j increases as C_i decreases). Simple FCMs have edge values in {−1, 0, 1}. Then if causalities occur, it occurs to a maximal positive or negative degree. If increase (or decrease) in one concept leads to increase (or decrease) in another, then we give the value 1. If there exists no relation between the two concepts, the value 0 is given. If increase (or decrease) in one concept leads to decrease (or increase) in another, then we give the value −1. Thus FCMs are described in this way. Consider the concepts $C_1, C_2, \ldots, C_n$ of the FCM. Suppose the directed graph is drawn using edge weight $e_{ij} \in \{-1, 0, 1\}$. The matrix E be 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 a FCM are always square matrices with diagonal entries as zero.

Definition 2.3.5: Let $C_1, C_2, \ldots, C_n$ be the nodes of a FCM. Let $A = (a_1, a_2, \ldots, a_n)$, 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.

$a_i = 0$ if a_i is off,

$a_i = 1$ if a_i is on, where $i = 1, 2, \ldots, n$.

Definition 2.3.6: Let $C_1, C_2, \ldots, C_n$ be the nodes of a FCM. Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, \ldots, \overrightarrow{C_iC_j}$, be the edges of the FCM

$(i \neq j)$. Then, the edges form a directed cycle. A FCM is said to be cyclic if it possesses a directed cycle. A FCM is said to be acyclic if it does not possess any directed cycle.

Definition 2.3.7: A FCM with cycles is said to have a feedback.

Definition2.3.8: When there is a feedback in a FCM, i.e., when the causal relations flow through a cycle in a revolutionary way, the FCM is called a dynamical system.

Definition2.3.9: Let $\overrightarrow{C_1C_2}, \overrightarrow{C_2C_3}, \ldots, \overrightarrow{C_iC_j}$, 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 $i = 1, 2, \ldots, n$. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 2.3.10: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider a FCM with $C_1, C_2, \ldots, C_n$ 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 i.e., the state vector remains as $(1, 0, 0, \ldots, 0, 1)$. This state vector $(1, 0, 0, \ldots, 0, 1)$ is called the fixed point.

Definition 2.3.11: If the FCM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \ldots \rightarrow A_i \rightarrow A_1$, then this equilibrium is called limit cycle.

2.4. Method of determining the hidden pattern of FCMs

Let C_1, C_2,…,C_n be the nodes of a FCM with feedback. Let E be the associated adjacency matrix. Let us find the hidden pattern when C_1 is switched on. When an input is given as the vector A_1 = (1, 0,…, 0), the data should pass through the relation matrix E. This is done by multiplying Ai by the matrix E. Let $A_iE = (a_1, a_2, \ldots, a_n)$ with the threshold operation that is by replacing ai 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_1 is included in the updated vector by making the first coordinate as 1 in the resulting vector. Suppose $A_iE \rightarrow A_2$ then consider A_2E and repeat the same procedure. This procedure is repeated till we get a limit cycle or a fixed point.

3. Proposed T_PFCMs

TpFCM are more applicable when the data in the first place is an unsupervised one. The TpFCM works on the opinion of four experts. TpFCM models the world as a collection of classes and causal relations between classes. It is a different process when we compare to FCM. Usually the FCM gives only the ON-OFF position. But this TpFCM is more precise and it gives the ranking for the causes of the problem by using the weightage of the attribute, it is the main advantage of this new TpFCM.

3.1. Basic definitions of TpFCM

3.1.1. Definition

When the nodes of the TpFCM are fuzzy sets then they are called as Fuzzy Trapezoidal nodes.

3.1.2. Definition

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

3.1.3. Definition

A TpFCM is a directed graph with concepts like policies, events, etc., as nodes and causalities as edges. It represents causal relationships between concepts.

3.1.4. Definition

Consider the nodes/concepts TpC_1, TpC_2,…,TpC_n of the TpFCM. Suppose the directed graph is drawn using edge weight $Tpe_{ij} \in \{-1, 0,1\}$. The Trapezoidal matrix M be defined by Tp(M) = (Tpe_{ij}) where Tpe_{ij} is the Trapezoidal weight of the directed edge $\overrightarrow{TpC_iTpC_j}$. Tp(M) is called the adjacency matrix of TpFCMs, also known as the connection matrix of the TpFCM. It is important to note that all matrices associated with a TpFCM are always square matrices with diagonal entries as zero.

3.1.5. Definition

Let $TpC_1, TpC_2, \ldots, TpC_n$ be the nodes of a TpFCM. $A=(a_1, a_2, \ldots, a_n)$ where $Tpe_{ij} \in \{-1, 0, 1\}$. A is called the instantaneous state vector and it denotes the on-off position of the node at an instant.

Instantaneous vector = $\begin{cases} Tpa_i = 1 & , Maximum(Weight) \\ Tpa_i = 0 & , Otherwise \end{cases}$

Definition 3.1.6: Let $TpC_1, TpC_2, \ldots, TpC_n$ be the nodes of a TpFCM. Let $\overrightarrow{TpC_1TpC_2}, \overrightarrow{TpC_2TpC_3}, \ldots, \overrightarrow{TpC_iTpC_j}$, be the edges of the TpFCM ($i \neq j$). Then, the edges form a directed cycle. A TpFCM is said to be cyclic if it possesses a directed cycle. A TpFCM is said to be acyclic if it does not possess any directed cycle.

Definition 3.1.7: A TpFCM with cycles is said to have a feedback.

Definition3.1.8: When there is a feedback in a TpFCM, i.e., when the causal relations flow through a cycle in a revolutionary way, the TpFCM is called a dynamical system.

Definition3.1.9: Let $\overrightarrow{TpC_1TpC_2}, \overrightarrow{TpC_2TpC_3}, \ldots, \overrightarrow{TpC_iTpC_j}$, be a cycle. When TpC_i is switched on and if the causality flows through the edges of a cycle and if it again causes TpC_i, we say that the dynamical system goes round and round. This is true for any node TpC_i, for i = 1, 2, …, n. The equilibrium state for this dynamical system is called the hidden pattern.

Definition 3.1.10: If the equilibrium state of a dynamical system is a unique state vector, then it is called a fixed point. Consider a TpFCM with $TpC_1, TpC_2, \ldots, TpC_n$ as nodes. For example let us start the dynamical system by switching on TpC_1. Let us assume that the TpFCM settles down with TpC_1 and TpC_n i.e., the state vector remains as (1, 0, 0, …, 0, 1). This state vector (1, 0, 0,…, 0, 1) is called the fixed point.

Definition 3.1.11: If the TpFCM settles down with a state vector repeating in the form $A_1 \rightarrow A_2 \rightarrow \ldots \rightarrow A_i \rightarrow A_1$, then this equilibrium is called limit cycle.

3.2. Method of determining the hidden pattern ofTpFCMs

Step 1: Let $TpC_1, TpC_2, \ldots, TpC_n$ be the nodes of a TpFCM with feedback. Let Tp(M) be the associated adjacency matrix.

Step 2: Let us find the hidden pattern when TpC_1 is switched ON. When an input is given as the vector$A_1 = (1, 0, \ldots, 0)$, the data should pass through the relation matrix M. This is done by multiplying A_i by the trapezoidal matrix M.

Step 3: Let $A_iTp(M) = (a_1, a_2, \ldots, a_n)$ is a Trapezoidal vector. Suppose $A_1Tp(M) = (1, 0, \ldots, 0)$ gives a Trapezoidal weight of the attributes, we call it as $A_iTp(M)_{weight}$.

Step 4: Taking average of the corresponding node of the four experts opinion, we call it as $A_iTp(M)_{Average}$.

Step 5: The threshold operation is denoted by($\hookrightarrow$) i.e., $A_1Tp(M)_{Max(weight)}$. That is by replacing a_i by 1 if a_i is the maximum weight of the Trapezoidal node (i.e.,ai=1), otherwise by 0(i.e., ai=0).

Step 6: Suppose $A_1Tp(M) \rightarrow A_2$ then consider $A_2Tp(M)_{weight}$ is nothing but addition of weightage of the ON attribute and $A_1Tp(M)_{weight}$.

Step 7: Find $A_2Tp(M)_{Average}$ (i.e., Taking average of the four experts opinion of each attributes).

Step 8: The threshold operation is denoted by($\hookrightarrow$) i.e., $A_2Tp(M)_{Max(weight)}$. That is by replacing ai by 1 if a_i is the maximum weight of the Trapezoidal node (i.e.,ai=1), otherwise by 0 (i.e., ai=0).

Step 9: If $A_1Tp(M)_{Max(weight)} = A_2Tp(M)_{Max(weight)}$ then it is dynamical system end otherwise repeat the same procedure.

Step 10: This procedure is repeated till we get a limit cycle or a fixed point.

4. Concept of the problem

We have taken the following 10 concepts $\{TpC_1, TpC_2, \ldots, TpC_{10}\}$ to analyze of the major problem of the old age people using linguistic questionnaire and the expert's opinion. The following concepts are taken as the main nodes of our problem.

TpC_1-Neglected

TpC_2- Treating as Burden

TpC_3-Forced to sell their property

TpC_4- Lack of care

TpC_5-Abandaned

TpC_6- Lack of reason to live

TpC_7-Depression

TpC_8-Isolation

TpC_9-Lack of emotional support

TpC_{10}-Lack of economical support

Now we give the connection matrix related with the FCM.

Table 2 : Connection matrix

Tp(M)=

	TpC_1	TpC_2	TpC_3	TpC_4	TpC_5	TpC_6	TpC_7	TpC_8	TpC_9	TpC_{10}
TpC_1	VL	L	FL	F	VH	VH	H	H	FH	L
TpC_2	F	VL	L	FH	VH	H	VH	FH	H	VH
TpC_3	L	L	VL	L	H	FH	H	H	FL	VH
TpC_4	L	L	L	VL	H	H	VH	H	VH	FL
TpC_5	L	L	L	L	VL	VH	H	H	H	VH
TpC_6	L	L	L	FL	L	VL	VH	FH	H	FL
TpC_7	FL	L	L	FL	FL	VH	VL	F	FH	F
TpC_8	FL	FL	L	H	H	FH	VH	VLVL	H	F
TpC_9	FL	FL	L	VH	H	FL	H	FH	VL	L
TpC_{10}	L	FL	FL	L	L	FH	FH	F	L	VL

Table 3 : The linguistic values of the connection matrix

	TpC_1	TpC_2	TpC_3	TpC_4	TpC_5
TpC_1	(0.0,0.0,0.0,0.0)	(0.0,0.1,0.2,0.3)	(0.2,0.3,0.4,0.5)	(0.4,0.5,0.6,0.7)	(1,1,1,1)
TpC_2	(0.4,0.5,0.6,0.7)	(0.0,0.0,0.0,0.0)	(0.0,0.1,0.2,0.3)	(0.6,0.7,0.8,0.9)	(1,1,1,1)
TpC_3	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.0,0.0,0.0)	(0.0,0.1,0.2,0.3)	(0.8,0.9,1,1)
TpC_4	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.0,0.0,0.0)	(0.8,0.9,1,1)
TpC_5	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.0,0.0,0.0)
TpC_6	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.2,0.3,0.4,0.5)	(0.0,0.1,0.2,0.3)
TpC_7	(0.2,0.3,0.4,0.5)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)	(0.2,0.3,0.4,0.5)	(0.2,0.3,0.4,0.5)
TpC_8	(0.2,0.3,0.4,0.5)	(0.2,0.3,0.4,0.5)	(0.0,0.1,0.2,0.3)	(0.8,0.9,1,1)	(0.8,0.9,1,1)
TpC_9	(0.2,0.3,0.4,0.5)	(0.2,0.3,0.4,0.5)	(0.0,0.1,0.2,0.3)	(1,1,1,1)	(0.8,0.9,1,1)
TpC_{10}	(0.0,0.1,0.2,0.3)	(0.2,0.3,0.4,0.5)	(0.2,0.3,0.4,0.5)	(0.0,0.1,0.2,0.3)	(0.0,0.1,0.2,0.3)

Table 3 Continues : The linguistic values of the connection matrix

	TpC_6	TpC_7	TpC_8	TpC_9	TpC_{10}
TpC_1	(1,1,1,1)	(0.8,0.9,1,1)	(0.8,0.9,1,1)	(0.6,0.7,0.8,0.9)	(0.0,0.1,0.2,0.3)
TpC_2	(0.8,0.9,1,1)	(1,1,1,1)	(0.6,0.7,0.8,0.9)	(0.8,0.9,1,1)	(1,1,1,1)
TpC_3	(0.6,0.7,0.8,0.9)	(0.8,0.9,1,1)	(0.8,0.9,1,1)	(0.2,0.3,0.4,0.5)	(1,1,1,1)
TpC_4	(0.8,0.9,1,1)	(1,1,1,1)	(0.8,0.9,1,1)	(0.6,0.7,0.8,0.9)	(0.2,0.3,0.4,0.5)
TpC_5	(1,1,1,1)	(0.8,0.9,1,1)	(0.8,0.9,1,1)	(0.8,0.9,1,1)	(0.8,0.9,1,1)
TpC_6	(0.0,0.0,0.0,0.0)	(1,1,1,1)	(0.6,0.7,0.8,0.9)	(0.8,0.9,1,1)	(0.2,0.3,0.4,0.5)
TpC_7	(1,1,1,1)	(0.0,0.0,0.0,0.0)	(0.4,0.5,0.6,0.7)	(0.6,0.7,0.8,0.9)	(0.4,0.5,0.6,0.7)
TpC_8	(0.6,0.7,0.8,0.9)	(1,1,1,1)	(0.0,0.0,0.0,0.0)	(0.8,0.9,1,1)	(0.4,0.5,0.6,0.7)
TpC_9	(0.2,0.3,0.4,0.5)	(0.8,0.9,1,1)	(0.6,0.7,0.8,0.9)	(0.0,0.0,0.0,0.0)	(0.0,0.1,0.2,0.3)
TpC_{10}	(0.6,0.7,0.8,0.9)	(0.6,0.7,0.8,0.9)	(0.4,0.5,0.6,0.7)	(0.0,0.1,0.2,0.3)	(0.0,0.0,0.0,0.0)

Attribute TpC_1 is ON:

$A^{(1)} = (\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ )$

$A^{(1)}Tp(M)_{weight}$ = ((0.0,0.0,0.0,0.0), (0.0,0.1,0.2,0.3), (0.2,0.3,0.4,0.5), (0.4,0.5,0.6,0.7), (1,1,1,1),

(1,1,1,1), (0.8,0.9,1,1), (0.8,0.9,1,1), (0.6,0.7,0.8,0.9),

(0.0,0.1,0.2,0.3))

$A^{(1)}Tp(M)_{Average}$ = (0, 0.15, 0.35, 0.55, 1, 1, 0.925, 0.925, 0.75, 0.15)

$A^{(1)}Tp(M)_{Max(Weight)} \hookrightarrow$ = (0, 0, 0, 0, 1, 1, 0, 0, 0, 0) = $A_1^{(1)}$

$A_1^{(1)}Tp(M)_{Average}$ = (0.3, 0.3, 0.3, 0.5, 0.15, 1, 1.925, 1.675, 1.85,1.275)

$A_1^{(1)}Tp(M)_{Max(Weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 0, 1, 0, 0, 0) = $A_2^{(1)}$

$A_2^{(1)}Tp(M)_{Average}$ = (0.6737, 0.2887, 0.2887, 0.6737, 0.6737, 1.925, 0, 1.0587,1.4437, 1.0587)

$A_2^{(1)}Tp(M)_{Max(Weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 1, 0, 0, 0, 0) = $A_3^{(1)}$

$A_3^{(1)}Tp(M)_{Average}$ = (0.2887, 0.2887, 0.2887, 0.6737, 0.2887, 0.925, 1.4437, 1.7806, 0.6737)

$A_3^{(1)}Tp(M)_{Max(Weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 0, 1, 0, 0, 0) = $A_4^{(1)}$

$A_2^{(1)} = A_4^{(1)}$

Attribute TpC_2 is ON:

$A^{(2)} = (\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ )$

$A^{(2)}Tp(M)_{weight}$ = ((0.4,0.5,0.6,0.7),(0.0,0.0,0.0,0.0), (0.0,0.1,0.2,0.3),(0.6,0.7,0.8,0.9), (1,1,1,1),

(0.8,0.9,1,1), (1,1,1,1), (0.6,0.7,0.8,0.9), (0.8,0.9,1,1), (1,1,1,1))

$A^{(2)}Tp(M)_{Average}$ =(0.55, 0, 0.15, 0.75, 1, 0.925, 1, 0.75, 0.925, 1)

$A^{(2)}Tp(M)_{Max(weight)} \hookrightarrow$ =(0, 0, 0, 0, 1, 0, 1, 0, 0, 1) = $A_1^{(2)}$

$A_1^{(2)}Tp(M)_{Average}$ =(0.65, 0.65, 0.65, 0.65, 0.5, 2.75, 1.675, 2.025, 1.825, 1.475)

$A_1^{(2)}Tp(M)_{Max(weight)} \hookrightarrow$ =(0, 0, 0, 0, 0, 1, 0, 0,0, 0) = $A_2^{(2)}$

$A_2^{(2)}Tp(M)_{Average}$ =(0.4125, 0.4125, 0.4125, 0.9625, 0.4125, 0, 2.75, 2.0625, 2.5437,0.9625)

$A_2^{(2)}Tp(M)_{Max(weight)} \hookrightarrow$ =(0, 0, 0, 0, 0, 0,1, 0,0, 0) = $A_3^{(2)}$

$A_3^{(2)}Tp(M)_{Average}$ =(0.9625, 0.4125, 0.4125, 0.9625, 0.9625, 2.75, 0, 1.5125, 2.0625, 1.5125)

$A_3^{(2)}Tp(M)_{Max(weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 1, 0, 0 ,0, 0) = $A_4^{(2)}$

$A_2^{(2)} = A_4^{(2)}$

Attribute TpC_3 is ON:

$A^{(3)} = (\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ )$

$A^{(3)}Tp(M)_{weight}$ = ((0.0,0.1,0.2,0.3) ,(0.0,0.1,0.2,0.3) ,(0.0,0.0,0.0,0.0) , (0.0,0.1,0.2,0.3) ,(0.8,0.9,1,1) ,

(0.6,0.7,0.8,0.9) , (0.8,0.9,1,1) , (0.8,0.9,1,1) , (0.2,0.3,0.4,0.5) ,(1,1,1,1))

$A^{(3)}Tp(M)_{Average}$ =(0.15, 0.15, 0, 0.15, 0.925, 0.75, 0.925, 0.925, 0.35, 1)

$A^{(3)}Tp(M)_{Max(weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 0, 0, 0, 0, 1) = $A_1^{(3)}$

$A_1^{(3)}Tp(M)_{Average}$ =(0.15, 0.35, 0.35, 0.15, 0.15, 0.75, 0.75, 0.55, 0.15, 0)

$A_1^{(3)}Tp(M)_{Max(weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 1, 1, 0, 0, 0) = $A_2^{(3)}$

$A_2^{(3)}Tp(M)_{Average}$ =(0.375, 0.225, 0.225, 0.525, 0.375, 0.75, 0.75, 0.975, 1.2562, 0.675)

$A_2^{(3)}Tp(M)_{Max(weight)} \hookrightarrow$ = (0, 0, 0, 0, 0, 0, 0, 0, 1,0) = $A_3^{(3)}$

$A_3^{(3)}Tp(M)_{Average}$ =(0.4396, 0.4396, 0.1884, 1.2562, 1.1619, 0.4396, 1.1619, 0.9421, 0, 0.1884)

$A_3^{(3)}Tp(M)_{Max(weight)} \hookrightarrow$ = (0, 0, 0, 1, 0, 0, 0, 0, 0, 0) = $A_4^{(3)}$

$A_4^{(3)}Tp(M)_{Average}$ =(0.1884, 0.1884, 0.1884, 0, 1.1619, 1.1619, 1.2562, 1.1619, 0.9421, 0.4396)

$A_4^{(3)}Tp(M)_{Max(weight)} \rightarrow$ = (0, 0, 0, 0, 0, 0, 1, 0, 0, 0) = $A_5^{(3)}$

$A_5^{(3)}Tp(M)_{Average}$ =(0.4396, 0.1884, 0.1884, 0.4396, 0.4396, 1.2562, 0, 0.6909, 0.9421, 0.6909)

$A_5^{(3)}Tp(M)_{Max(weight)} \rightarrow$ = (0, 0, 0, 0, 0, 1, 0, 0, 0, 0) = $A_6^{(3)}$

$A_6^{(3)}Tp(M)_{Average}$ =(0.1884, 0.1884, 0.1884, 0.4396, 0.1884, 0, 1.2562, 0.9421, 1.1619, 0.4396,)

$A_6^{(3)}Tp(M)_{Max(weight)} \rightarrow$ = (0, 0, 0, 0, 0, 0, 1, 0, 0, 0) = $A_7^{(3)}$

$A_5^{(3)} = A_7^{(3)}$

Do the process for the remaining attributes

Table 4: Weightage of the attributes

Attributes	TpC_1	TpC_2	TpC_3	TpC_4	TpC_5	TpC_6	TpC_7	TpC_8	TpC_9	TpC_{10}
(1 0 0 0 0 0 0 0 0 0)	0.2887	0.2887	0.2887	0.6737	0.2887	0	1.925	1.4437	1.7806	0.6737
(0 1 0 0 0 0 0 0 0 0)	0.9625	0.4125	0.4125	0.9625	0.9625	2.75	0	1.5125	2.0625	1.5125
(0 0 1 0 0 0 0 0 0 0)	0.1884	0.1884	0.1884	0.4396	0.1884	0	1.2562	0.9421	0.1619	0.4396
0 0 0 1 0 0 0 0 0 0)	0.15	0.15	0.15	0.35	0.15	0	1	0.75	0.925	0.35
(0 0 0 0 1 0 0 0 0 0)	0.35	0.15	0.15	0.35	0.35	1	0	0.55	0.75	0.55
(0 0 0 0 0 1 0 0 0 0)	0.35	0.15	0.15	0.35	0.35	1	0	0.55	0.75	0.55
(0 0 0 0 0 0 1 0 0 0)	0.15	0.15	0.15	0.35	0.15	0	1	0.75	0.925	0.35
(0 0 0 0 0 0 0 1 0 0)	0.15	0.15	0.15	0.35	0.15	0	1	0.75	0.925	0.35
(0 0 0 0 0 0 0 0 1 0)	0.15	0.15	0.15	0.35	0.15	0	1	0.75	0.925	0.35
(0 0 0 0 0 0 0 0 0 1)	0.1884	0.1884	0.1884	0.4396	0.1884	0	1.2562	0.9421	0.1619	0.4396
Total Weight	2.928	1.978	1.978	4.6154	2.928	4.75	8.4374	8.9404	9.3669	5.5654
Total Average Weight	0.2928	0.1978	0.1978	0.46154	0.2928	0.475	0.84374	0.89404	0.93669	0.55654

5.Conclusion

We derived the ranking of problems of old age people using a new fuzzy model called TpFCM. This model gives the ranking of the attributes TpC_9, TpC_8, TpC_7, TpC_{10}, TpC_6, TpC_4, $TpC_{5\&1}$ and $TpC_{2\&3}$ accordingly as 0.93669>0.89404 > 0.84374 > 0.55654 > 0.475> 0.4615 >0.2928 >0.1978.From this we could conclude that 0.93669 of attribute TpC_9 which accounts for " Lack of emotional support" is the major problem, next 0.89404 of TpC_8 for "Isolation", followed by 0.84374 of TpC_7 for "Depression". By this ranking method we also found that the least value 0.1978 of TpC_2 & TpC_3 for "Treating as Burden", "Forced to sell their property" is a negligible value that not all old people are having this problem.

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