Neutrosophic cognitive maps for analysis of social problems analysis

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Abstract

Investors have been flocking to the information technology (IT) industry recently. Any commercial or IT company's success is directly proportional to its employees' efforts. The workforce's contributions are crucial when it comes to the success of technology or any other business on the global stage. However, they will disregard their personal and social lives to achieve their aim. Workers in the private sector, particularly those in the information technology industry, suffer from mental health issues such as stress, depression, anxiety, and addiction. Using Neutrosophic Cognitive Maps (NCM), we evaluated the daily problem they face. The NCM decision-making system incorporates iterative tasks of resolving conflicts until the optimal answer is reached. The NCM uses neutrosophic graphs to model depending on the opinions of experts. Studying the issue with such vague data calls for an approach such as this, which eschews the use of statistics. For unlabeled data, NCM is the most effective method.

Keywords: Social Problem; Neutrosophic Sets; Neutrosophic Cognitive Maps; Decision Making;

1. Introduction

The Fuzzy model is a procedure for predicting future results from a limited collection of inputs and outcomes collected over time. The fields of medicine, engineering, the natural sciences, industry, and statistics are only a few of the many possible applications for the Fuzzy Model[1]–[4]. Zadeh is credited with introducing these fuzzy models, which are a kind of mathematical software. In later years, political scientist Axelord used this Cognitive Map (CM) fuzzy model to investigate the dynamics of political and societal decision-making. It is the purpose of CM, a special kind of signed

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digraph, to describe the causal statement and religious belief of an individual (or group of experts) concerning a specific domain and then to utilize that statement to assess the impact of a given decision on a shared goal[5]–[9].

Bart Kosko offered various models that expand the notion of Cognitive maps by permitting the thought to be defined verbally with an accompanying fuzzy set, using the ideas of neural networks and the fuzzy scientific method. Despite the imprecision, uncertainty, and even contradictions in the inputs, this model is ideally suited to obtain a consistent representation of the information to help make choices and aid in the field of computational thinking. FCM and its improved form, Induced Fuzzy Cognitive Map (IFCM), were employed. IFCM was developed by Pathinathan[10]–[12].

Expert-opinion-based IFCMs is a kind of fuzzy-graph modeling. This method of investigating uncertainty-related issues does not rely on statistical analysis. Real-world problems, such as different types of infectious illnesses (cancer, TB, migration, etc.), students' lives in rural areas, the difficulties faced by private sector workers, etc., have made this model more critical. This discussion will focus on a subset of these issues. Our primary goal in writing this study was to use FCM and IFCM to examine the issues that affect the everyday lives of private sector employees, focusing on those in the IT and commercial sectors[13]–[15].

A questionnaire is used to learn about the dynamics inside the group. The most important member is identified as the security chief in the neutrosophic survey questionnaire (NS) method, and the likelihood of deepening the connection among members is also calculated. These methods' modalities align with those of FCM and NCM. Kosko first developed FCM by adding fuzzy logic to the Cognitive Maps framework. The use of FCM extends to many other domains. Many researchers, including Jason et al.'s FCM model, infer the effects of learners' understanding. In order to classify various kinds of concrete, Senniappan et al. devised an FCM model. Chrispen used FCM models to investigate the interdependence of livelihood's social components. Abdollah discussed the many FCM systems used in medicine. Makrinos et al. created FCM judgment algorithms for taking wise agricultural actions. An environmental and cotton-yield decision-making model was created by Papageorgiou et al. Sung et al. Antonie et al. attempted to expand FCM for further study, whereas Katarzyna et al. extended FCM simulations to draw conclusions.

Papageorgiou et al. explored the different FCM models' techniques and algorithms. Computing applications utilized for FCM models were outlined by Felix et al. [16]–[18].

The FCM is a connected graph where the nodes are the problem-solving components, and the arcs are the causal relationships between them. The edge weights are in the range [-1, 0], which describes the causality of the connections. There are three possible interpretations of the value 0: no impact, 1: positive influence, and -1: bad effect. From the FCM's visual analysis of n components, we may compute the order to do things of order nn. Nodes in a generic FCM representation look like C1, C2,..., Cn, and the momentary vector V looks like V= (V1, V2,.., Vn), where Vi is a vector whose value is either 0 or 1 to indicate whether the factors are active or inactive. For instance, if there are five potential causes of prediabetes, C1, C2, C3, C4, and C5, and if we have a decision variable V = (V1 V2 V3 V4 V5) where vi accepts the value 0 or 1, then the initial factor is in the ON position and the remaining factors are in the OFF position. A directed cycle produced by the edges of a feedback-capable FCM transforms the FCM into a dynamical system. The threshold value is then used to modify the values, allocating 1 to the column's data larger than 1, and -1 to the principles of the vector less than -1. This process is repeated for each connecting matrix M of order 5 5. When the column with any elements remaining in the ON state is replicated after consecutive crossing the threshold of the vectors, the bayesian network has reached its equilibrium state, known as the hidden pattern. When the balance is a single vector, we refer to this as the fixed point; otherwise, we refer to the resulting pattern as a boundary. Each Vi represents whether or not the ith component is active, and each Vj represents whether or not all other variables are inactive. These fundamental ideas of FCM underpin the process of selecting the best course of action.

These are also involved in NCM, albeit indeterminacy is also present. NCM's set of respect to the weights is -1,0, I,1, and the components of the momentary vector take on the numbers 0, 1, and I. Smarandache and Vasantha Kandasamy are credited as being the creators of NCM. Models based on NCM are augmented with integrated overlap modeling and neutrosophic structural maps to aid in deliberation[19]–[22]. The genetic method was used in NCM models by Gaurav et al. Diagnosis, medicine, scenario analysis, pandemic cause elements, decision making, the influence of creative play on kids, and religious impacts are only some of the many areas where NCM has been used as

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an FCM model. When comparing FCM and NCM models, Banerjee et al. concluded that the latter was more mutually agreeable. Best choices in many areas of society, research, and innovation may be made with the help of NCM judgment models. Deep examination reveals striking similarities between the Fuzzy and Neutrosophic Sociogram and the FCM and NCM model methods. Fuzzy and neutrosophic sociogram pathway products are the most influential figure of the collective and the extensiveness of relational suitability among the people in the group. At the same time, FCM and NCM designs ascertain the most key determinants and their inter-relational impacts, with the latter considering indeterminacy. Fuzzy indicates the availability was utilized as a basis for a new kind of FCM model developed by Jegan et al. to examine students' emotional quotient[23]–[25].

The ordering of the components was the same for FCM models using and without using the fuzzy sociogram technique, suggesting that it should be included in FCM template matching. This work means integrating the neutrosophic sociogram technique into the NCM framework based on the novel sociogram method in FCM models. The NCM system considers the uncertainty among the elements and calculates their relative influence. It is possible to ascertain if the variables have a positive, negative, or ambiguous effect on one another. Still, it is impossible to speculate on the potential for resolving ambiguities in the factors' relationships. In some instances, the indeterminacy among the components is also preserved as indeterminate values after being subjected to calculations. Some of the limitations of NCM-based decision-making include the following. Due to this flaw in NCM systems, the NS method is proposed as a replacement.

2. Preliminaries

With these foundational pieces in place, we advocate using NCMs because of the many benefits that come with them (e.g., readability, extensibility, knowledge consolidation, flexibility, capacity to depict feedback, and uncertainty in connections). Beginning in 2003, introduced NCMs. An NCM is a combination of an FCM first proposed by Kosko in 1986 and a Neutrosophic Set (NCM) first proposed by Smarandache in 1995. This method gets around the indeterminacy problem that has plagued NCMs for a long time. With indeterminacy included, it's clear that apathy and ignorance are also varieties of doubt. We see that DCMs are shown to be a method that has been getting more and more attention because of the opportunities it offers for describing causality. Here is a glossary of terms you'll need while dealing with NCMs.

Definition 1:

A neutrosophic graph is a graph with at least one indeterminacy edge, shown by dotted lines.

Definition 2:

A neutrosophic structure is defined as a directed graph with at most one edge that is indeterminacy.

Definition 3:

Neutrosophic-oriented graphs are directed graphs with no symmetric pairs of directed indeterminacy lines.

Definition 4:

Neutrosophic directed graph containing ideas like policies, events, etc. as nodes and causalities or indeterminate as edges; also known as a Neutrosophic Cognitive Map (NCM). It shows how ideas are related and how one affects the other.
Let's suppose k nodes are represented by the letters $C1, C2, \ldots, Ck$. Let each vertex also represent a vector in neutrosophic vector space V. Therefore, the state of a node $Cj\,(j = 1, 2, \ldots, k)$ is

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represented by the set of numbers $(x1, x2, \ldots, xk)$, where each xi is either zero or one (I represent indeterminacy), where xi = 1 indicates that the node Ci is in the on state, $xi = 0$ indicates that the node Ci is in the off state, and xi = I indicates that the state of the node is indeterminate
For simplicity, we'll refer to the NCM's two nodes as $Cm\ and\ Cn$. The directed edge from Cm shows the influence of Cm on Cn to Cn, also known as connections. Each edge of the NCM has a weight from the range $[-1, 0], [1, I]$. The force exerted by the directed edge is denoted by mn. It's a $CmCn, mn\ -1, 0\ 1, I$. If there is no correlation between Cm and Cn, mn = 0, if a rise in Cm increases Cn, if a reduction in Cm reduces Cn, if a drop in Cm decreases Cn, if a decrease in Cm increases Cn, if $mn = -1$. If the impact of $Cm\ on\ Cn$ is unclear, then $mn = I$.

Definition 5:

Simplified NCMs have edge weights in the range [-1, 0, 1, I].

Definition 6:

Allow us to refer to the nodes of an NCM as $C1, C2, \ldots, Ck$. We may write down the neutrosophic matrix $N(E)\ as\ N(E) = ()\ mn$, where mn is the weight of the directed edge $CmCn, and\ mn$ can take on the values -1, 0, 1, and I. The NCM's neutrosophic adjacency matrix is denoted by the symbol $N(E)$.

Definition 7:

Assume the NCM has k nodes, and designate them as $C1, C2, \ldots, Ck$. Consider the expression $A = (21\ k, \ldots,)$ where m = 0, 1, I. At any one time, a node may be in one of three possible states: "on," "off," or "indeterminate," and this is represented by the neutrosophic vector A. For each given value of m $(where\ m = 1, 2, \ldots, k), m = 0$ if m is off (has no effect), $m = 1$ if m has an effect, and m = I if m is uncertain (the effect cannot be determined).

Definition 8:

The NCM's nodes are designated as $C1, C2, \ldots, and\ Ck$. Let
Let C C represent the NCM's borders. After that, the edges form a directed cycle. To have a required cyclic makes an NCM cyclic.

3. Application of NCM

The numerous applications of NCMs are briefly discussed here.

I. The social and economic impact of HIV/AIDS on migrant workers; and
II. Getting the most out of the day's traffic flow.
III. Analyzing the current political climate
IV. Research on the root causes of child labor (d)
V. Analysis of how workers and companies interact.

This study focuses on actual practices that promote work-family harmony in the workplace, with a concentration on corporate companies. An individual's work-life balance is a state of very well that they create for themselves or strive to achieve; it enables them to effectively juggle work, family, and social commitments without negatively affecting their physical, mental, or emotional health or the very well of their friends and loved ones. People working in the private sector are often "at-will" employees who may be let go for any cause. Their dedication to their profession has made it difficult for them to focus on other things or engage in their social lives. The majority of private sector IT professionals experience social issues. Here, we provide a relationship model that considers 12 aspects of a worker's typical day. In this example, we provide the results of a broad survey to gauge the significance of issues faced among private sector staff aged 25–40, focusing on those working in IT and large corporations. There is a dynamic system at play here, and we investigate it. We use this model to uncover its underlying structure. Importantly, we can now build several models of this connection from the data we have collected from other nodes and perspectives. Several methods can

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help us get a clear and complete view of this design. In this case, we can rule out all but one possible scenario. We use the 12 NCM subnetworks listed below:

i. Separation

ii. Arguments with relatives

iii. Conflict within intimate relationships and the family

iv. Collaboration between several shifts

v. Lack of vacation time

vi. Insomniac (Inability to sleep)

vii. Distress in the mind

viii. Negative effects on sight

ix. People who are depressed are more likely to turn to alcohol.

x. Due to weakened immune systems, many people get injured in unexpected ways. Always.

xi. Keeping apart from one's kind

xii. The contrast between coworkers and

xiii. Issues with (family) cooperation

A collection matrix X was constructed using the issues described above and the views of the experts on them.

Table 1: The adjacency matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	0	0	0	1	0	1	1	1	0	1	0	1
C2	1	0	0	1	0	0	1	0	0	0	1	0
C3	1	0	0	1	0	1	0	1	1	0	1	0
C4	0	0	1	0	0	1	0	1	1	0	1	0
C5	0	0	1	1	0	0	0	0	1	1	0	0
C6	0	1	1	1	0	0	1	0	0	0	0	1
C7	0	1	1	1	0	1	0	1	0	1	1	1
C8	1	1	0	1	1	1	0	0	1	1	1	1
C9	1	1	0	1	1	1	0	1	0	1	1	1
C10	1	1	0	1	1	1	1	1	0	0	0	0
C1	0	0	0	1	0	0	0	1	0	1	0	0

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1												
C 1 2	1	0	0	0	1	1	1	1	0	0	1	0

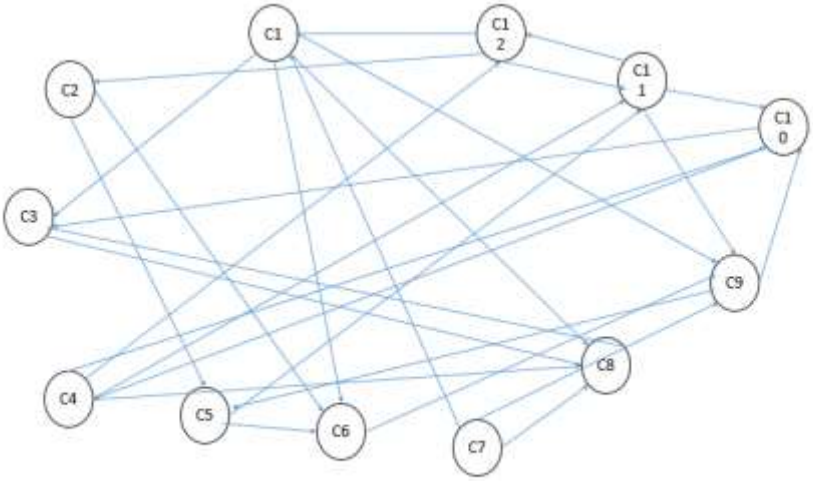

Figure 1: Criteria relationship

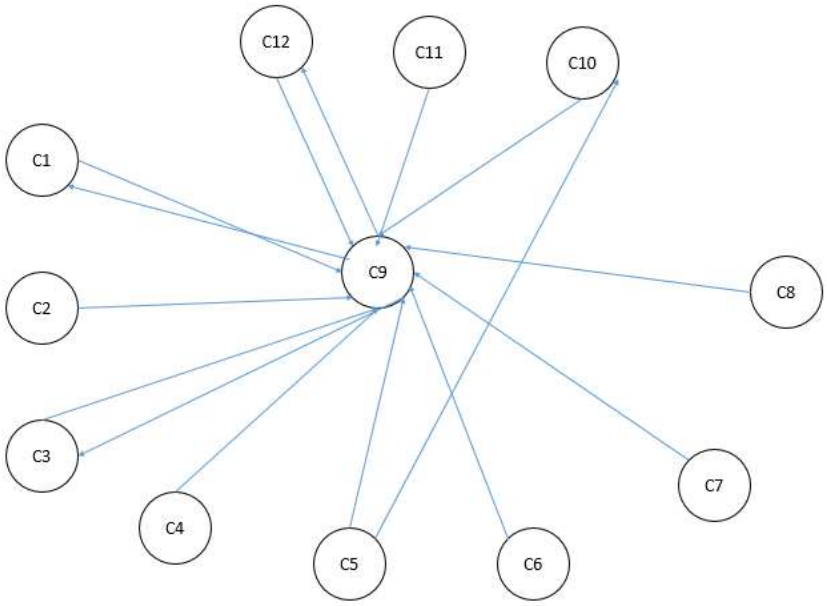

Figure 2: Directed merged graph

For example, if we consider the state "Misunderstanding with family" (X2) to be "on," with a value of $p1 = (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$ and all other states to be "off," we can apply P1 to the connection matrix and, of course, after updating and thresholding the resulting vector, obtain "X2," where "X" is the state "Misunderstanding with family."

$$p1 = (0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0)$$

$$p1x = (1\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1\ 0\ 0\ 1)$$

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$$= (1\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 1\ 0\ 0\ 1)$$

$$p2x = (3\ 3\ 4\ 0\ 0\ 6\ 6\ 1\ 5\ 1\ 2\ 1)$$

$$= (1\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 1\ 1\ 1\ 1)$$

$$p3x = (4\ 4\ 5\ 1\ 1\ 6\ 8\ 4\ 6\ 2\ 2\ 1)$$
$$= (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1)$$

$$p4x = (5\ 6\ 7\ 1\ 1\ 7\ 10\ 4\ 8\ 4\ 4\ 1)$$

$$= (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 1)$$

$$= p5$$

As a consequence, we have a fixed-point solution. Unfortunately, we must now state the obvious. Some of the collateral damage caused by X's "misinterpretation with household" is shown in the following endpoints: "Divorce", "Assertion with partners and family", "Operating in a shift", "Lack of holidays", "Hypersomnia (Loss of the ability to sleep"), "Mental stress', "Vision problem", "Psychological problems such as depression lean out to alcohols, resulting various accidents.", "Less exemption. As such, we need to think about more examples to help us unearth the system's underlying pattern.

Several of the principles are knowable in the context that they are real numbers that suggest the exact quantitative score of impact, and the value range provides the magnitude of influence between the variables; it also shows the existing opportunities of boosting the impacts between variables for the comprehensive growth and progress of the Tech entrepreneurs and Teslin. The findings demonstrate that the NS combined NCM strategy is very flexible.

4. Conclusion

Rather than using the standard NCM, the authors of this work offer an NMC technique that incorporates Neutrosophic Sociograms. In contrast to the standard way, the suggested strategy makes it easier to zero in on the precise collective action influence among the elements. When compared to the status quo, the suggested judgment option is more flexible, adaptable, and straightforward. This study is part of a more considerable effort to refine methods for determining causality; once complete, the methodology will be applied to both the Plithogenic Personal and social level and the Plithogenic Cognitive Map (PCM). Plithogenic sociograms also need to include FCM, NCM, and PCM models.

a) Some corrective steps are described below that people may do to alleviate the issue in their daily lives.
b) i. To reduce the likelihood of a divorce, try to see your loved ones more often on weekends. During the time off, they should travel. The call must be taken even if they are at work.
c) To avoid arguments at home, they should leave work stress and pressure at the workplace and avoid bringing professional issues home with them.
d) Less coworker agreement leads to workplace disagreement; therefore, avoiding arguments with your spouse is a top priority. They need to strengthen their ability to abide.
e) Their abducting mindset and practice of demeaning their spouses should go.
f) They may prevent future sleeplessness by meditating daily to relieve stress and boost focus.
g) They should avoid mental strain by rejecting the notion that being strong is a virtue. They need to give 100% to their job and their personal lives.
h) Preventing a Decrease in Immunity If you're constantly feeling ill, you should eat nutritious foods regularly. They ought to give up drinking if they can.
i) It won't be long before they become sick and has to take vitamin pills.
j) To avoid becoming distant from loved ones, it's essential to communicate frequently with them via phones and other social media. Vacation at home or have a native guest. To overcome their isolation, they should form strong friendships.

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