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A Novel Approach for Neutrosophic Complete Graph and Neutrosophic Excellent Domination

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Abstract: Social networks have a crucial role in forming contemporary society. The way they operate and reach allow them to have a large-scale impact on beliefs, behaviours, and trust. These days, they act as international forums for information sharing, opinion development, and public debate. Each profession is impacted by them, including politics, business, healthcare, and education. The demand for advanced systems to track, evaluate, and control their effects grows along with their reach. Despite their apparent advantages, unregulated social media usage can result in the spread of false information and conspiracy theories, toxicity and cyberbullying, manipulated trends and a decline in public confidence in scientific and institutional organizations. Intelligent analysis and Ongoing monitoring are now crucial for addressing these issues. However, Constant Smart Monitoring is required due to their intricacy and vulnerability to abuse. This study explores the variants, advantages and utilization of Neutrosophic Excellent Domination on Dynamic Social Networks using Neutrosophic Complete graph.

Keywords: Neutrosophic set; Neutrosophic graph, Complete graph; Neutrosophic Complete graph; Neutrosophic Excellent Dominating set; Dynamic Social Networks

1. Introduction

Social Networks [1] have developed essential networking tools, particularly in time of crisis like pandemics, natural disasters and political upheavals. These networks are dynamic systems where relationships, trust and users change over time. In order to control the flow of information and guarantee the trustworthy spread of the truth, it is important to comprehend and model these changes. The function of social media sites like Facebook and Twitter [2, 3] during the COVID-19 outbreak is a powerful illustration of a dynamic social network [4] in operation. During such occasions, there is a significant rise in the volume and urgency of communication, as well as a chance that false information may spread quickly. Every user in a dynamic social network can be visualized as a vertex in a graph, with the edges being formed by interactions like thumbs up, shares, retweets and responses. These edges have weights that represent the frequency and quality of interaction, making them more than just binary links, importantly, these weights change according to use behaviour, the dependability of the content, and shifting public opinion. A user who consistently disseminates material that is supported by science, for such as is likely to earn credibility and influence, while a person who disseminates false information may eventually lose influence. Determining trustworthy information in real time grew more difficult as the network progressed. Neutrosophic Excellent Domination is particularly potent notion in this context. With Neutrosophic Excellent Domination, it represents a social network in terms of untruth, ambiguity, and uncertainty in addition to connection. Each edge in a Neutrosophic graph is given one of three values: truth(T), Indeterminacy(I), or Falsity(F). These values together represent the complex state of trust or influence between vertices. This approach allows us to determine a subset of users that is Neutrosophic Excellent Domination Set those consistently and distinctively influence others with an extensive level of trust and not much uncertainty or false information.

A simple undirected graph [5] that has a unique edge connecting each pair of distinct vertices is called a complete graph. The assumption that all connectivity can be considered reliable, precise or dependable is generally valid in almost every instance of real-world systems, including social, biological, and information networks. The graph theory concepts can be found in the studies [5, 6, 7]. Kandasamy et al. [8] presented the Complete Pure Neutrosophic Graph as well as different kinds of Neutrosophic graphs. Sivasankar and Broumi [9] presented an overview into some of the aspects of balanced Neutrosophic graphs and presented the idea of graphs based on density functions. If graph G is a self-complementary, regular, complete, and strong Neutrosophic graph, then it satisfies the requirements for being a balanced Neutrosophic graph. Devi et al. [10] presented the new concept of Dominance in Neutrosophic over graph and addressed some of the fascinating features of Neutrosophic over bridge, complete and complete bipartite domination. Boppana et al. [11] expressed a quasi-complete strong fuzzy graph's domination and strong domination number. By putting out new graph classes like General Neutrosophic Graph, Anti-Neutrosophic Graph, *-Balanced-Neutrosophic Graph, and Semi- Neutrosophic Graph, Fujita and Smarandache [12] broadened the scope of research on Neutrosophic Graphs. Broumi et al. [13] established specific kinds of single valued Neutrosophic Graphs and examined some of their characteristics using examples and proofs. Broumi et al. [14] presented some interval valued Neutrosophic Graph types and examined some of their characteristics using examples and proofs. Kumar [15] provided a summary of fuzzy graph types, fuzzy graph structures and intuitionistic fuzzy graph types along with individuals associated with each issue. Sridharan and Yamuna [16] proposed the ideas of Just Excellence and Very Excellence in graphs and demonstrated that every graph is an induced subgraph of Just Excellent graph and that not every Just Excellent graph has a cut vertex. Harinarayanan et al. [17] stated about Just Excellence and Very Excellence in graphs related to strong domination. Raji [18] showed Excellent Domination in WhatsApp group chat network by complete graph. Vijayavani and Raji [19] proved that the Ice Crystalline graph follows Excellent Domination. Samodivkin [20] exposed the results on γ-excellent regular graphs and a generalized lexicographic product of graphs. Raut et al. [21] presented an overview of Fermatean Neutrosophic Graphs. Das et al. [22] presented pentapartitioned neutrosophic graph based on pentapartitioned neutrosophic set [23] and Neutrosophic Graph [13].

Research gap:

As an instance, Complete graphs are crucial to the graph theory and are substantially in areas such as matching, scheduling and clustering, still their Neutrosophic counterparts are either ineffectively defined or detached. The development of their Neutrosophic analogue is still in its formative years. The existence of indeterminacy complicates the concepts of completeness and keeps them mostly unexplored. The gaps reveal that although the essential foundation has been put in effect, a methodical strategy for characterizing and evaluating typical graph types in the Neutrosophic graphs for standard graphs is still relatively unexplored, regardless of the fact that these systems have been progressively recognized as a valuable framework for uncertain and indeterminate scenarios. In the research, Neutrosophic equivalents of domination concepts are frequently stated inconsistently whereas their typical analogues have clear definitions. Unified Models that take into consideration the functions of degrees of membership and indeterminacy in dominating sets are required. The fundamental gap and decreased by possibilities for consequences are additionally emphasized by the absence of actual studies on Neutrosophic Domination in real world domains, such as insufficient biological networks and influence replication in uncertain social networks.

In this article, we explore Neutrosophic Excellent Domination, Neutrosophic Excellent Dominating sets and provide applications.

Rest of the article is organized as follows: Section 2 provides preliminaries. Section 3 presents the Neutrosophic Complete Graph and Neutrosophic Excellent Domination. Section 4 presents applications of the Neutrosophic Excellent Domination. Section 5 concludes paper by stating the future scope of research.

2. Preliminaries

Definition 2.1

A subset $D \subseteq V(G)$ is $Excellent\ Dominating\ Set\ (EDS)$ [18] if Every vertex $v \in V - D$ is adjacent to exactly one vertex in D. In complete graphs, this is impossible for $n \geq 3$, since each vertex is adjacent to all others.

Definition 2.2

A Neutrosophic Graph [12] is represented as: $G = (V, E, T, I, F)$. Each vertex or edge is associated with a triplet (T, I, F) where $T: degree\ of\ truth, I: degree\ of\ indeterminacy\ and\ F: degree\ of\ falsity$.

3. Neutrosophic Complete Graph and Neutrosophic Excellent Domination

The complete graph is one of the key concepts of graph theory that denotes a network's maximum connectivity, in which each vertex is linked with every other vertex directly. Although this provides a convenient mathematical model, real-world networks are frequently more intricate, particularly those involving trust, decision-making, and interpersonal communication. Neutrosophic graphs have been developed to better represent the complexity. The Neutrosophic Complete graph is unique and it incorporates falsehood, uncertainty, and indeterminacy into each interaction.

Definition 3.1

The Neutrosophic Complete graph, denoted $N - K_n$, retains the whole connectivity of a complete graph but enhances it by assigning a *Neutrosophic triple* to each edge. Each connection is distinguished by:

- $\boldsymbol{Truth - membership\ (T)}$: Degree of truth or trust in the relationship.
- $\boldsymbol{Indeterminacy\ (I)}$: Degree of uncertainty or ambiguity.
- $\boldsymbol{Falsehood - membership\ (F)}$: Degree of falsehood, misinformation, or distrust.

These parameters satisfy $T, I, F \in [0,1]$ and typically $T + I + F \leq 3$.This approach, which has its origins in Neutrosophic set [24] and was first introduced by Florentin Smarandache, is particularly helpful for modelling systems in which the status of information or relations is not binary. Neutrosophic sets [24] and their extensions and hybrid sets have been employed in different areas such as decision making [25-61], conflict resolution [62], mathematics education [63, 64], artificial intelligence [65], and so on. Details of development and applications of Neutrosophic sets can be found in the studies [66-75].

For modelling completely interconnected systems, a Complete graph is helpful, but it is unable to capture complexities in relational qualities. The Neutrosophic Complete graph is extremely useful in decision networks, uncertainty modelling, and trust-based systems because it makes these inconsistencies evident.

For $Neutrosophic\ Excellent\ Dominating\ Set\ (NEDS)$, every vertex $v \in V - D$ is:

- Adjacent to one vertex $u \in D$ with high truth (T) and

- Adjacent to all others in D with low T and high I or F — effectively ignoring them.

Definition 3.2

A subset $D \subseteq V(G)$ is called Neutrosophic Excellent Dominating Set if for each vertex $v \in V - D$, there exists a unique vertex $u \in D$ such that $T(u,v) \geq \theta$, for some fixed threshold $\theta \in (0.7,1]$ (strong truth/influence), For all other $w \in D - \{u\}$, $T(w,v) < \theta$ and either $I(w,v)$ or $F(w,v)$ is high (ambiguity/false influence).

Example 3.3

Consider Complete graph with 4 vertices, K_4

Vertices: $\{v_1 , v_2 , v_3 , v_4 \}$

Let's define $D = \{v_1 , v_2 \}$

We assign Edge Neutrosophic Weights:

Edge	T	I	F	Notes
$v_3 \rightarrow v_1$	0.9	0.05	0.05	Strong domination from v_1
$v_3 \rightarrow v_2$	0.1	0.6	0.3	Weak/indeterminate → ignored
$v_4 \rightarrow v_2$	0.85	0.1	0.05	Strong domination from v_2
$v_4 \rightarrow v_1$	0.2	0.6	0.2	Weak/indeterminate → ignored

So,v_3 is uniquely dominated by v_1 and v_4 is uniquely dominated by v_2.

$D = \{v_1 , v_2 \}$ is a Neutrosophic Edge Weight Set for k_4.

Theorem 3.4: If K_n is a Complete graph with $n \geq 3$, Then K_n has no Neutrosophic Edge Weight.

Proof: In K_n , each vertex is adjacent to every other vertex. So, any $v \in V - D$ is adjacent to all of D, violating the condition that v must be adjacent to exactly one vertex in D.

Theorem 3.5: If $G = K_n$ is a Complete graph of order $n \geq 3$, and Neutrosophic Edge Weight is assigned such that each vertex $v \in V - D$ is strongly connected (with $T \geq \theta$) to exactly one vertex in D, and weakly/ambiguously connected to the others. Then D forms a Neutrosophic Excellent Dominating Set .

Proof: Although $v \in V - D$ is adjacent to all of D, we selectively assign edge weights:

- One edge $(u, v) \in E, u \in D$: set $T(u, v) \geq \theta, I = F = low$
- Other edges $(w, v), w \in D - \{u\}$: set $T(w, v) < \theta$, and either I or F is high.

Thus, from the Neutrosophic perspective, v is strongly influenced by only one vertex, satisfying NEDS conditions.

Theorem 3.6: Let $G = K_n$ and assume a threshold $\theta \in (0.7,1]$ for dominant influence. Then the lower bound of a Neutrosophic Excellent Dominating Set D is:$|D| \geq \lceil \frac{n}{2} \rceil$

Proof:

Each vertex in D can dominantly influence at most one vertex in V-D, since Dominance must be unique. To cover all $n - |D|$, i.e., $|D| \geq \lceil \frac{n}{2} \rceil$.

Theorem 3.6: In a Complete Neutrosophic Graph $G = K_n$, it is possible to assign edge weights (Truth, Indeterminacy and Falsity) such that: Each individual (vertex) is primarily influenced by exactly one unique leader (i.e., member of a Neutrosophic Excellent Dominating Set), even though every vertex is linked to every other vertex.

Proof:

Let $G = (V, E)$ and $G = K_n$ be Complete graph on n vertices.

Here Each edge $e_{uv} \in E$ has a Neutrosophic Weight (T_{uv}, I_{uv}, F_{uv}) where $T_{uv} \in [0,1]$: strength of influence (truth) and $I_{uv}, F_{uv} \in [0,1]$: uncertainty and falsity of influence.

Also, a subset $D \subset V$ is a Neutrosophic Excellent Dominating Set if every $v \in V - D$ is strongly influenced by exactly one $u \in D$ and only weakly or ambiguously influenced by others in D.

Let's prove the theorem by construction and logical deduction.

Step 1: Complete Connectivity

Since $G = K_n$, every pair of nodes is adjacent.

So, each node has $n - 1$ neighbours.

Step 2: Assigning Unique Influencers

Consider $D \subset V$ such that:

- Each $v \in V - D$ is strongly influenced by exactly one vertex in D, say u_v , i.e., $T(u_v, v) \geq \theta$ where θ ∈ (0.7,1]
- For all other $w \in D - \{uv\}$, set:
  - $T(w, v) < \theta$
  - Either $I(w, v) \geq \gamma I(w, v)$ where $\gamma \geq 0.6$ (high indeterminacy or falsity)

Thus, the influence from u_v is dominant, while the others are neutralized.

Step 3: Ensuring Unique Influence

We ensure that each $v \in V - D$ is mapped to a distinct influencer $u_v \in D$.

So, no v is primarily influenced by more than one node.

This guarantees the Excellent Domination Condition:

Every non-dominating node is uniquely and primarily dominated by one node in D.

Step 4: Existence of such a partition

To guarantee that each $v \in V - D$ has a unique influencer in D, we require: $| D | \geq \lceil \frac{n}{2} \rceil$.

because each node in D can be assigned to dominate at most one node in *V- D*.

This partitioning is always possible for any n, and the Neutrosophic Weights can be assigned accordingly.

Neutrosophic Excellent Domination can be achieved by assigning edge weights so that each person is uniquely and strongly influenced by one leader, despite the fact that every individual in the entire Neutrosophic graph is connected. Through perception-based weighting, rather than structural isolation, unique leadership arises in closely coupled social systems, simulating influence routing. Use in this theory with dynamic networks whose edge weights change according to behavioural data or trust criteria.

4. Applications of Neutrosophic Excellent Domination

4.1 Numerical Illustration

This Illustration describes how Neutrosophic Excellent Domination (NED) can be applied in a Dynamic Social Network during a crisis, such as misinformation control on social media during a public health emergency. During a pandemic, five users on a platform are actively sharing content about safety measures. We want to dynamically identify trustworthy influencers using Neutrosophic Excellent Domination.

Consider the following:

Vertices:

Users:

- U_1 : Public Health Expert (CDC)
- U_2 : Doctor with a local practice
- U_3: Independent blogger
- U_4: Verified journalist
- U_5: User known to sometimes share conspiracy theories.

Edges:

Edges represent influence between users based on retweets or mentions. Each edge is labelled with a Neutrosophic Weight (T, I, F) where:

- $\boldsymbol{T}$ = Trustworthiness of information
- $\boldsymbol{I}$ = Indeterminacy due to lack of evidence
- $\boldsymbol{F}$ = Falsity from misinformation risk

Let's say we compute these weights based on content analysis and user interaction history.

From \ To	U_1	U_2	U_3	U_4	U_5
U_1	—	(0.9, 0.05, 0.05)	(0.85, 0.1, 0.05)	(0.88, 0.07, 0.05)	(0.7, 0.2, 0.1)
U_2	(0.8, 0.1, 0.1)	—	(0.6, 0.3, 0.1)	(0.75, 0.15, 0.1)	(0.5, 0.2, 0.3)
U_3	(0.6, 0.2, 0.2)	(0.65, 0.25, 0.1)	—	(0.6, 0.2, 0.2)	(0.4, 0.3, 0.3)
U_4	(0.85, 0.1, 0.05)	(0.75, 0.15, 0.1)	(0.7, 0.2, 0.1)	—	(0.5, 0.3, 0.2)
U_5	(0.4, 0.3, 0.3)	(0.5, 0.25, 0.25)	(0.6, 0.25, 0.15)	(0.45, 0.35, 0.2)	—

Neutrosophic Excellent Domination Criteria:

A vertex U_i excellently dominates U_j if

- $T_{ij} \geq 0.8$ (high trust)
- $I_{ij} + F_{ij} \leq 0.2$ (low uncertainty and falsity)
- No other node dominates U_j with higher trust under the same criteria.

Dominator Set Calculation:

U_1 dominates U_2: (0.9, 0.05, 0.05) ,U_3: (0.85, 0.1, 0.05) and U_4: (0.88, 0.07, 0.05).

U_4 could also dominate U_3 and U_2, but U_1 has higher trust, so it's preferred.

U_5 doesn't meet any domination criteria due to low trust/high falsity.

Resultant Neutrosophic Excellent Dominator Set:

$\{U_1\}$ dominates U_2, U_3, U_4.

U_5 remains undominated—this user may be flagged for review or quarantined in the information graph.

Dynamic Update:

If later, U_1's trust drops due to incorrect statements, edge weights change:

- (U_1→U_2)=(0.7,0.2,0.1)

Now, U_4's edge to U_2 becomes dominant

- (0.75,0.15,0.1): $trust \geq 0.8\, fails$, but with adjustment, U_2 might shift to being dominated by U_4, if thresholds are relaxed or revised.

Results and Discussions for this section are:

Platforms like Twitter/X could implement this model behind the scenes to:

- Continuously highlight reliable users
- Adjust information visibility based on excellent domination
- Inform content moderation or warning labels dynamically

Such a model has significant practical implications. Social media platforms could use NED-based algorithms to dynamically adjust the visibility of posts, highlight consistently reliable users, and demote content from nodes identified as undominated or untrustworthy. This would not only promote more informed public discourse but also reduce the virality of harmful misinformation. Moreover, the adaptability of Neutrosophic Excellent Domination makes it suitable for integration with real-time machine learning systems. As algorithms process new data, Neutrosophic Weights can be recalibrated, ensuring that Dominating sets remain current and accurate.

By combining empirical learning with symbolic reasoning, this blended method provides a strong framework for handling influence in dynamic, complicated situations. Applying Neutrosophic Excellent Domination to Dynamic Social Networks offers a strategy for detecting and enhancing reliable influence that is both practically and mathematically sound. Neutrosophic Excellent Domination can be used to actively shape information flow as well as comprehend it in real-world situations like the COVID-19 epidemic, where fast and solid communication is essential. Neutrosophic approaches are a crucial component of the future of information management since our techniques for guaranteeing the integrity of digital communication must also transform as it does.

4.2. Numerical Illustration

The Neutrosophic Complete Graph in Dynamic Social Networks-Online Learning Forum (NPTEL-like Platform) is explained here. A course discussion forum allows all five students (designated A, B, C, D and E) in an online course to get in touch with one another. An online course has 5 students (labeled $A, B, C, D,$ and E), all of whom can communicate and interact through a course discussion forum. They:

- Ask questions
- Provide answers
- Upvote or downvote contributions

Every student is connected to every other student, forming a complete graph K_5.

This network evolves over time as trust is built or lost, based on post accuracy, helpfulness, and peer feedback. Edge weights are assigned as Neutrosophic values (T, I, F), representing:

- T: Degree of trusted influence (based on consistent helpful responses).
- I: Degree of indeterminacy (unclear or insufficient interaction).
- F : Degree of false or misleading influence (due to repeated incorrect or spammy posts).

This network is complete, as all pairs of students are connected.

Initial Neutrosophic Complete Graph: $G = K_5$

$Edge$	$Interaction\ Description$	$(T, I, F)\ Estimate$
$A - B$	$B\ consistently\ answers\ A's\ queries\ clearly$	$(0.9, 0.05, 0.05)$
$A - C$	$C\ occasionally\ responds, but\ unclearly$	$(0.4, 0.5, 0.1)$

$Edge$	$Interaction\ Description$	$(T, I, F)\ Estimate$
$A - D$	$D\ posted\ spam\ answers\ a\ few\ times$	$(0.2, 0.2, 0.6)$
$A - E$	$Helpful, but\ recently\ inactive$	$(0.6, 0.3, 0.1)$

Dynamic Update (After One Week)

- Student D improves quality → T for edges connected to D increase.
- Student C goes inactive → Indeterminacy I increases for all edges involving C.

Updated edge weights (partial view):

$Edge$	$Updated\ (T, I, F)$
$A - D$	$(0.5, 0.3, 0.2)$
$B - C$	$(0.4, 0.5, 0.1)$
$C - E$	$(0.3, 0.6, 0.1)$

To identify Neutrosophic Excellent Dominating Set (NEDS):

Choose 2 students (say, B and E) who are Highly trusted by the rest (high T from them to others).and all other connections are ambiguous or weak (low T, high I/F).

For applying this concepts, Use B and E to disseminate key course updates or assignments, ensuring high trust propagation and detect isolated or misleading nodes (e.g., high F) for moderation or review. It can be concluded that the Neutrosophic Complete graph structure captures dense interaction but enables fine-grained analysis of trustworthiness. This model adapts dynamically to behavioural data (post ratings, time, user feedback). It can be extended to recommend study partners, flag fake tutors, or route student questions to reliable peers.

5. Conclusions

The Neutrosophic Complete Graph offers a framework for modelling complex social interactions with uncertain, dynamic, and complicated relationships that is both mathematically valid and semantically expressive. The model involves the possibility for disinformation, ambiguity, and trustworthiness that exists in real world digital communication systems by offering each edge with a triplet of values. The model receives analytical power when it is expanded to include the phenomenon of Neutrosophic Excellent Domination. By identifying a select few individuals of influencers, a Neutrosophic Excellent Domination ensures independent and identifiable trust pathways by ensuring that each network participant is explicitly and significantly influenced by exactly one trusted leader and that influence from all other sources remains vague or inadequate. In dynamic platforms like NPTEL, where learners engage with peers and tutors on a regular basis, this frame is particularly useful. By combining the fine-grained relationship modeling of Neutrosophic Complete graph with the targeted dominance structure of Neutrosophic Excellent Domination, educational systems can enhance student engagement by recommending trustworthy peers and optimize content flow and moderation through reliable channels, to create adaptive, fair, and transparent trust-based ranking mechanisms. This data could feed into a Neutrosophic Model, where trust scores evolve based on the veracity of shared information, user feedback, and external verification. The result is a flexible, adaptive influence structure that supports informed decision-making and suppresses the viral spread of falsehoods. In essence, Neutrosophic Excellent Domination within a Neutrosophic Complete graph provides a powerful paradigm for structuring and managing influence and trust in highly connected, data-rich networks, paving the way for smarter, safer, and more inclusive social technologies. The outcomes will be a potential application in fake news suppression, education forums, and digital governance. A practical implementation might involve a platform using machine learning to assess the reliability of content in real time. Future work will integrate with deep learning for adaptive trust prediction and also apply to cybersecurity networks with evolving authentication data.

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