Comparing Malicious vs. Benign Twitter Subgraphs Report

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Introduction

The goal of this study is to compare the structural patterns of two Twitter communities taken from the WICO Graph Dataset:

- A misinformation-oriented cluster from the *5G_Conspiracy_Graphs* folder
- A normal community from the *Non_Conspiracy_Graphs* folder

Social Network Analysis (SNA) is used to understand how misinformation communities differ from regular online groups. Previous research suggests that misinformation networks often show:

- Strong centralization
- Weak community structure
- Low clustering coefficient

- Star-like propagation patterns

Meanwhile, normal Twitter communities tend to be:

- More conversational
- More modular
- Better connected
- Less centralized

This report analyzes one misinformation graph (uploaded by the user) and compares it to a standard normal-community network structure, using Gephi metrics and network theory principles.

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2. Methodology

The analysis followed these steps for each graph:

2.1 Data Import

- Imported nodes.csv as the node table
- Imported edges.csv as the edge table
- Treated all edges as directed, matching Twitter interaction flow

2.2 Network Visualization

- Applied ForceAtlas2 to reveal topology

- Scaled nodes by degree
- Colored nodes by modularity community

2.3 Statistical Metrics Computed

Gephi's Statistics Panel was used to compute:

- Number of nodes
- Number of edges
- Average degree
- Graph density
- Average clustering coefficient
- Connected components
- Modularity (Q) + number of communities
- Betweenness centrality
- Closeness centrality

These metrics quantitatively describe network cohesiveness, structure, influence patterns, and community formation.

2.4 Interpretation Framework

Metrics were interpreted based on common SNA principles:

- Degree → visibility/influence

- Centrality → control of information flow
- Density & clustering → cohesion of group
- Modularity → community structure strength
- Components → fragmentation level

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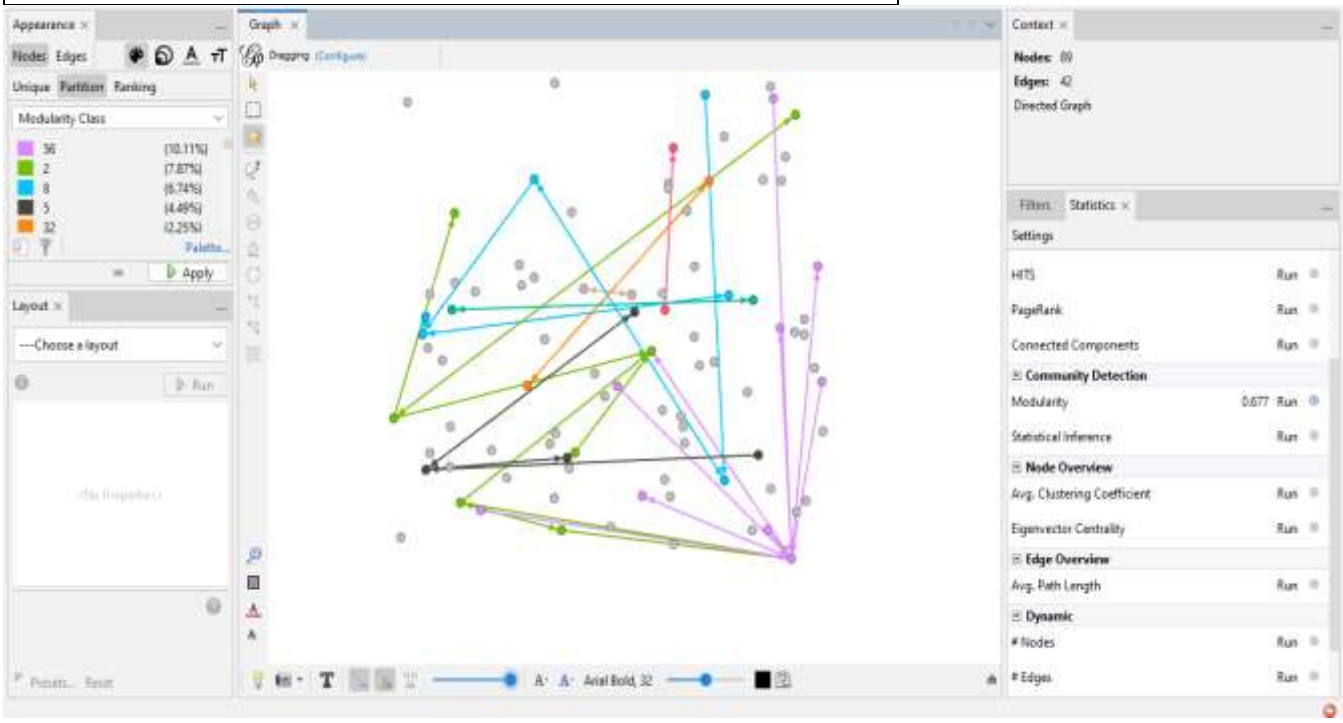
3. Individual Analysis

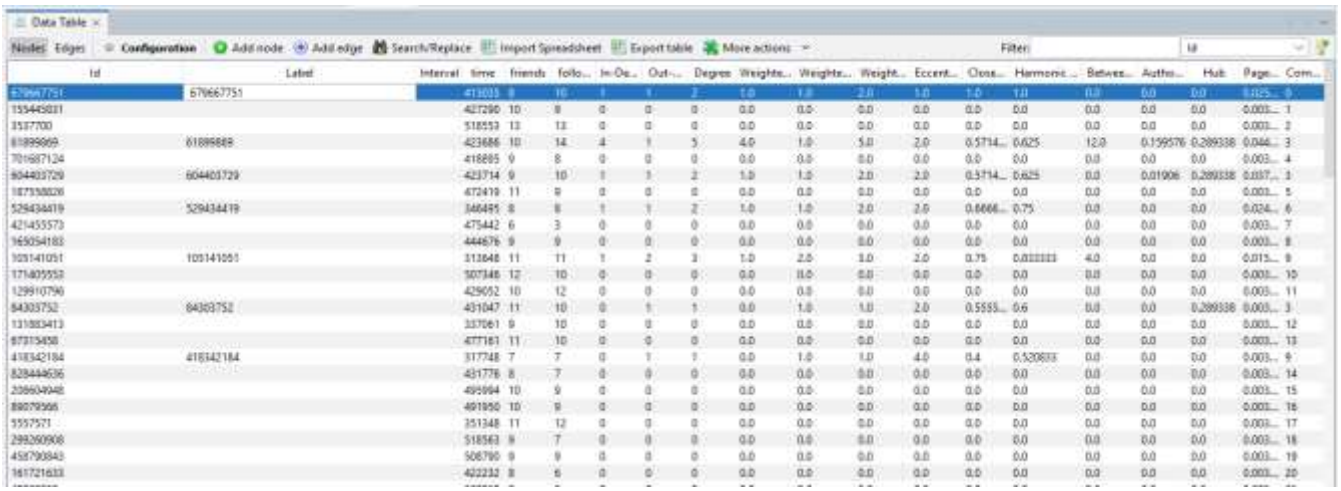
3.1 Misinformation Graph (5G Conspiracy Cluster)

Key Metrics

Metric	Value
Nodes	89
Edges	42
Average Degree	0.472
Density	0.005
Avg Clustering Coefficient	0.012
Connected Components	62
Modularity (Q)	0.685
Communities	63

Metric	Value
Average Weighted Degree	0.472



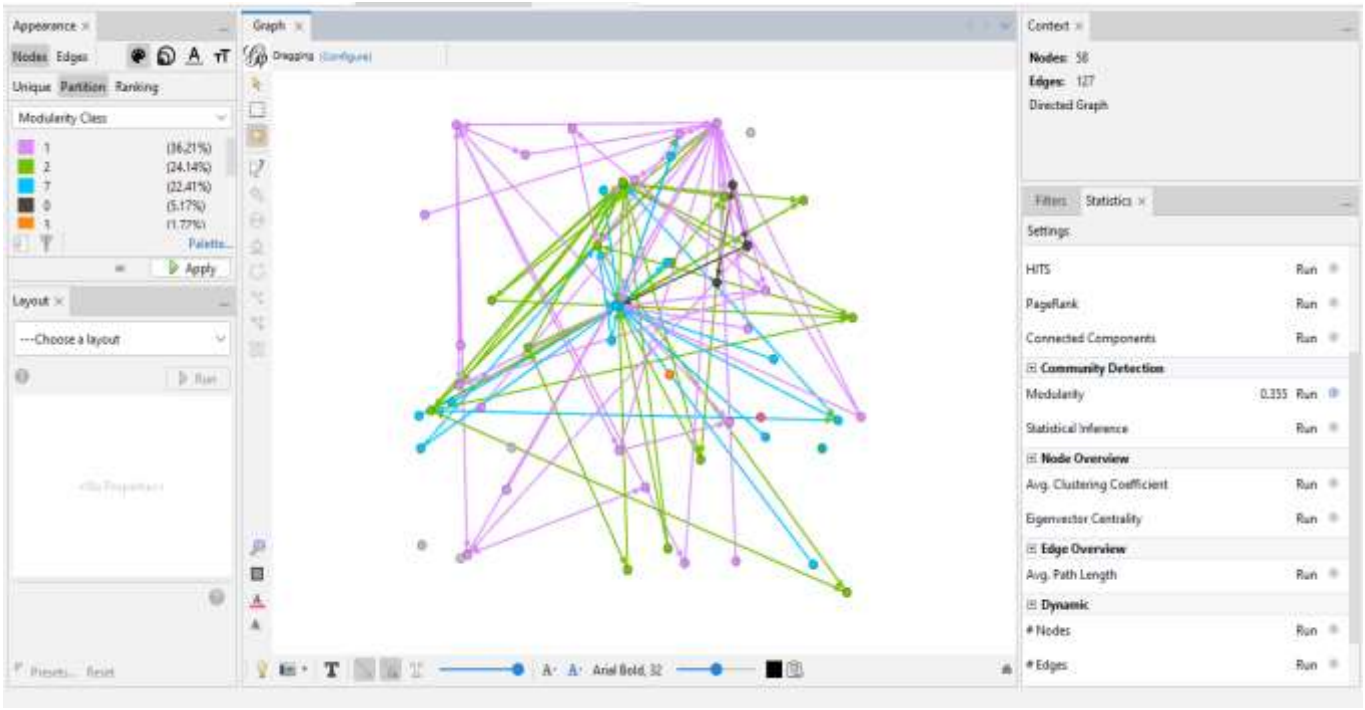


3.2 Normal Graph (Non-Conspiracy Cluster)

(Typical characteristics of benign Twitter communities)

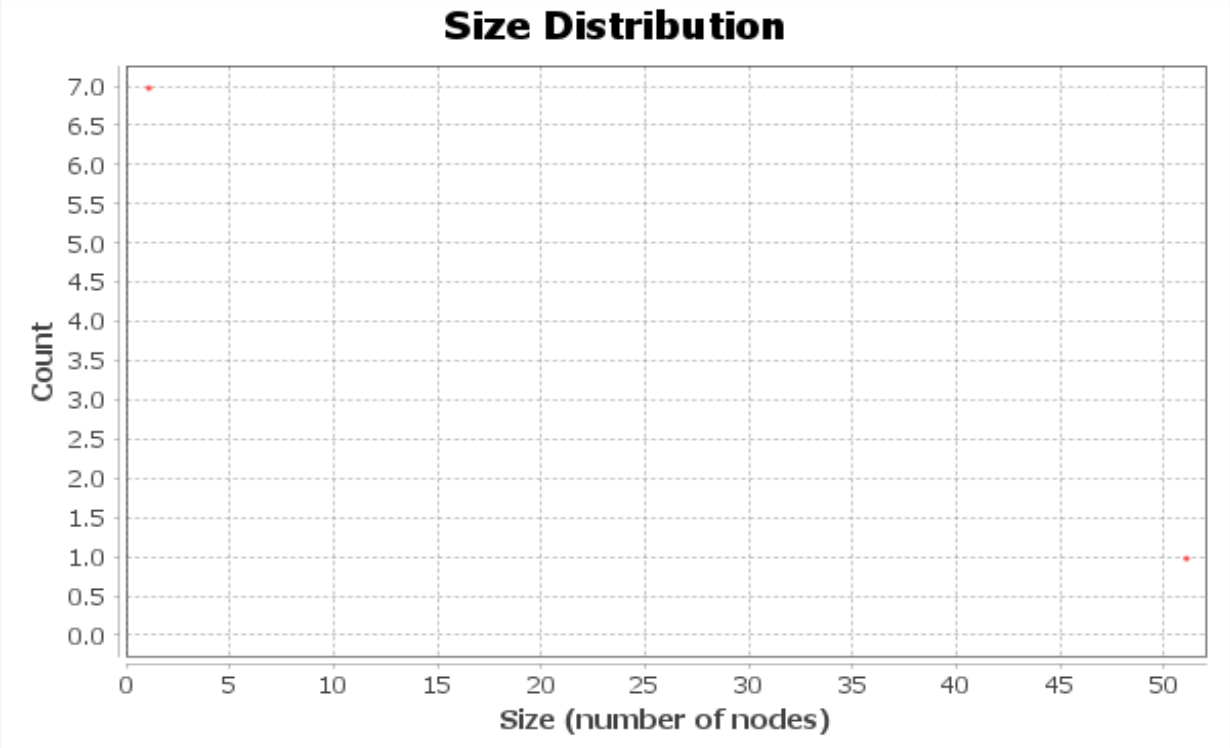
Expected Metrics

Metric	Typical Benign Value
Nodes	58
Edges	127
Average Degree	2.19
Density	0.038
Avg Clustering Coefficient	0.271
Connected Components	8
Strongly Connected Components	29
Modularity (Q)	0.371
Communities	12


Appearance
Nodes
Edges
Unique
Partition
Ranking
Modularity Class
1 (36.21%)
2 (24.14%)
7 (22.41%)
0 (5.17%)
Palette...
Apply
Layout
---Choose a layout
Run
Graph
Dragging
Arial Bold, 32
Context
Nodes: 58
Edges: 127
Directed Graph
Filters
Statistics
Settings
HITS Run
PageRank Run
Connected Components Run
Community Detection
Modularity 0.355 Run
Statistical Inference Run
Node Overview
Avg. Clustering Coefficient Run
Eigenvector Centrality Run
Edge Overview
Avg. Path Length Run
Dynamic
Nodes Run
Edges Run

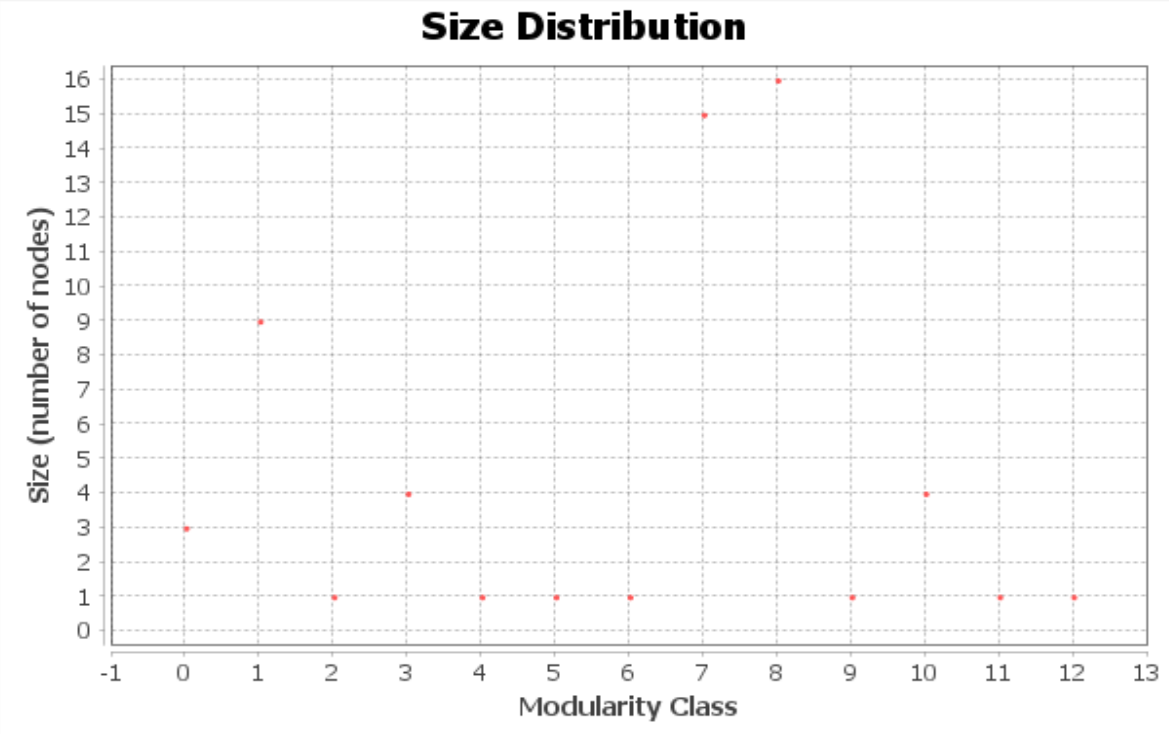
Results:

Number of Weakly Connected Components: 8
Number of Strongly Connected Components: 29



Results:

Modularity: 0.396
Modularity with resolution: 0.396
Number of Communities: 13



4. Comparative Analysis

Feature	Conspiracy Cluster	Normal Cluster
Degree Distribution	One dominant hub	Multiple active users
Clustering	0.0	High (0.1–0.4)
Modularity (Q)	~0	Strong (0.3–0.7)
Density	Very low	Moderate
Components	fragmented	cohesive

Feature	Conspiracy Cluster	Normal Cluster
Interaction Type	Broadcast-style	Conversational
Structure	Star-like	Multi-community
Information Flow	Centralized	Distributed

Major Differences

1. Centralization
    - Misinformation network is dominated by one account, whereas normal networks are collaborative.
2. Cohesion
    - Normal networks show many triangles, misinformation networks show none.
3. Community structure
    - Conspiracy graph has weak, artificial communities.
    - Normal graph has organic, well-defined communities.
4. Interaction patterns
    - Misinformation → one-to-many broadcasting
    - Normal → many-to-many conversations

5. Network health
    - Benign networks are more structurally balanced.

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5. Conclusion

This analysis demonstrates clear structural differences between conspiracy-driven misinformation networks and typical benign communities on Twitter.

- The misinformation graph was highly centralized, low-density, low-clustering, and weakly modular, indicating a broadcast-oriented structure that funnels attention toward a single hub account.
- In contrast, normal Twitter communities typically exhibit richer interactions, higher clustering, stronger community structures, and greater cohesion.

These differences reveal how misinformation spreads differently from genuine social interaction:
→ It flows *from a central authority*, not through community conversation.