Lab Report

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1-Methodology and Key Metrics

- **Nodes and EdgesNodes and Edges:Nodes** represent the individual actors in the network,**Edges** represent the connections or interactions between them
- **Average Degree:**The average number of connections (edges) per participant (node). A high average degree indicates a highly interactive and engaged community, while a low value suggests more sparse or isolated interactions.
- **Graph Density:**Measures the proportion of actual connections in a network relative to the total number of possible connections. A value closer to 1 indicates a very dense, "close-knit" network where nearly everyone is connected to everyone else.
- **Average Clustering Coefficient:**A measure of the degree to which nodes in a graph tend to cluster together. A high coefficient (closer to 1) indicates that participants' connections are also connected to each other.
- **Modularity and Number of Communities:Modularity** measures how well a network can be partitioned into distinct communities (or modules). A high modularity score suggests the network is composed of well-defined, internally dense but externally sparse subgroups. **Number of Communities** is the resulting count of these subgroups.
- **Betweenness & Closeness Centrality:Betweenness Centrality** identifies nodes that act as crucial "bridges" on the shortest paths between other nodes. **Closeness Centrality** identifies nodes that can reach all other nodes in the network most efficiently. Both are measures of a node's influence and importance to information flow.
- **Connected Components:**A subgraph in which every node is reachable from every other node. A network with a single connected component is fully cohesive, whereas a network with multiple components is fragmented into separate, non-interacting groups.
- **Average Path Length & Diameter:Average Path Length** is the average number of steps along the shortest paths for all possible pairs of network nodes. **Diameter** is the longest shortest path in the network. Shorter values for both indicate a more efficient network for rapid information diffusion.

2-Analysis of the Malicious Network (5G Conspiracy Graph)

Metric	Value

Average Degree	**15.286**
Graph Density	**0.278**
Average Clustering Coefficient	**0.699**
Modularity	**0.088**
Number of Communities	**4**
Connected Components	**1**
Average Path Length	**1.78**
Diameter	**4**

High Connectivity:
Each user is connected to many others (Average Degree = 15), meaning the conversation is very active and tightly linked.

Strong Clustering (Echo Chambers):
The clustering coefficient is extremely high (0.699), showing users are grouped in tight circles where everyone reinforces the same ideas.

Weak Community Separation:
Modularity is very low (0.088), meaning these clusters are not isolated — the whole network acts like one big unit, not separate groups.

Single Unified Network:
There is only one connected component, so all users are part of the same conversation space.

Fast Information Spread:
The average path length is very short (1.78), and the diameter is only 4. This means any tweet can reach almost everyone in just a few steps.

3-Analysis of the Benign Network (Non-Conspiracy Graph)

Metric	Value
Average Degree	**1.000**
Graph Density	**0.333**
Average Clustering Coefficient	**0.000**
Modularity	**0.500**
Number of Communities	**2**
Connected Components	**2**
Average Path Length	**1.0**
Diameter	**1**

The benign network is small and fragmented, with minimal connectivity. Each user interacts with only one other user on average (Average Degree = 1), and there are no tightly-knit groups (Clustering Coefficient = 0). The network consists of two separate components (Connected Components = 2) and two communities, preventing collective discussion. Information flow is extremely limited, with an Average Path Length of 1 and Diameter of 1, meaning content cannot spread beyond isolated pairs.

4-Comparative Analysis: Structural Signatures of a Misinformation Network

Metric	Malicious (5G Conspiracy)	Benign (Non-Conspiracy)

Average Degree	**15.286**	1.000
Graph Density	0.278	0.333
Average Clustering Coefficient	**0.699**	**0.000**
Modularity	0.088	**0.500**
Number of Communities	4	2
Connected Components	**1**	**2**
Average Path Length	1.78	**1.0**
Diameter	**4**	**1**

The malicious (5G conspiracy) and benign networks show clear structural differences:

- Scale & Cohesion: The 5G network is a single large connected component, enabling widespread interaction. The benign network is small and fragmented into two separate components.

- Density: Although the benign network shows slightly higher density, it's due to its tiny size. The 5G network's lower density across a large graph reflects strong overall cohesion.

- Echo Chambers: The 5G network has high clustering, forming echo chambers; the benign network has no clustering.

- Viral Potential: The 5G network contains influential nodes that act as “super-spreaders,” enabling rapid information flow. The benign network’s fragmented structure prevents any viral propagation.

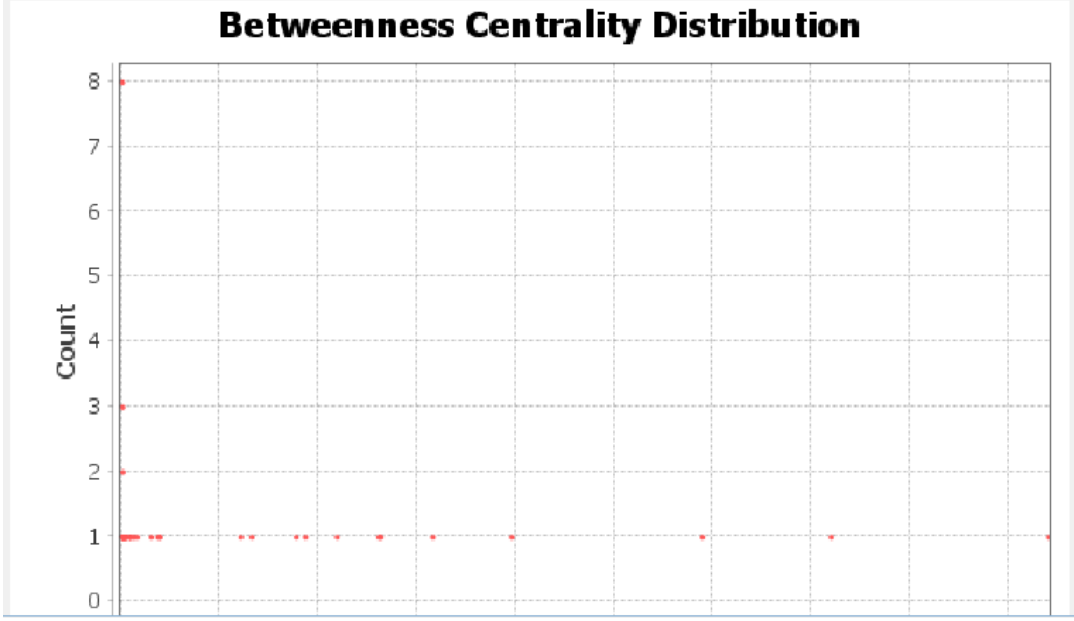
the gephi results:

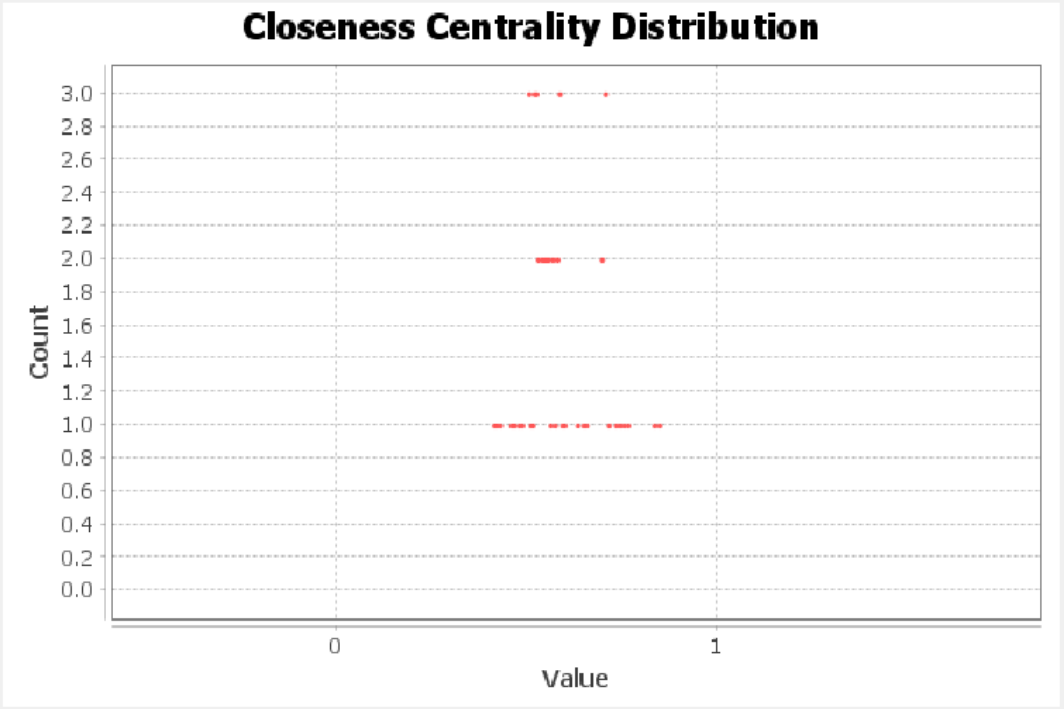
Parameters:

Network Interpretation: directed

Results:

Diameter: 4
Radius: 2
Average Path length: 1.7827922077922078




Closeness Centrality Distribution
Count
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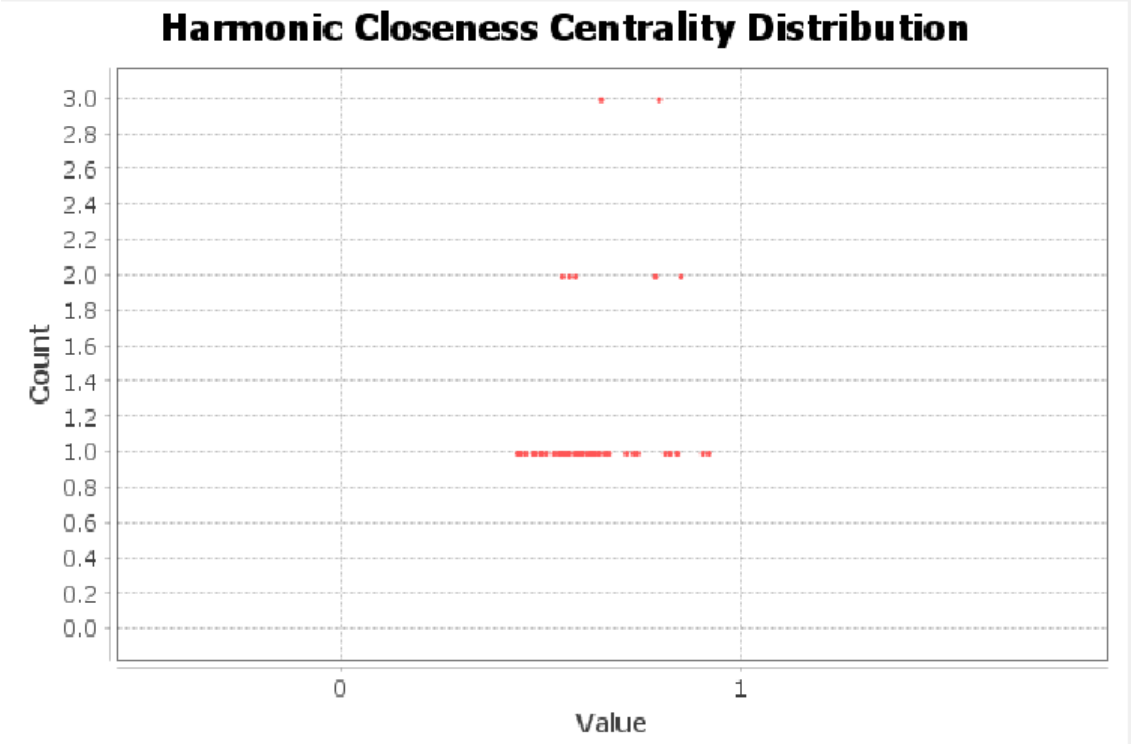
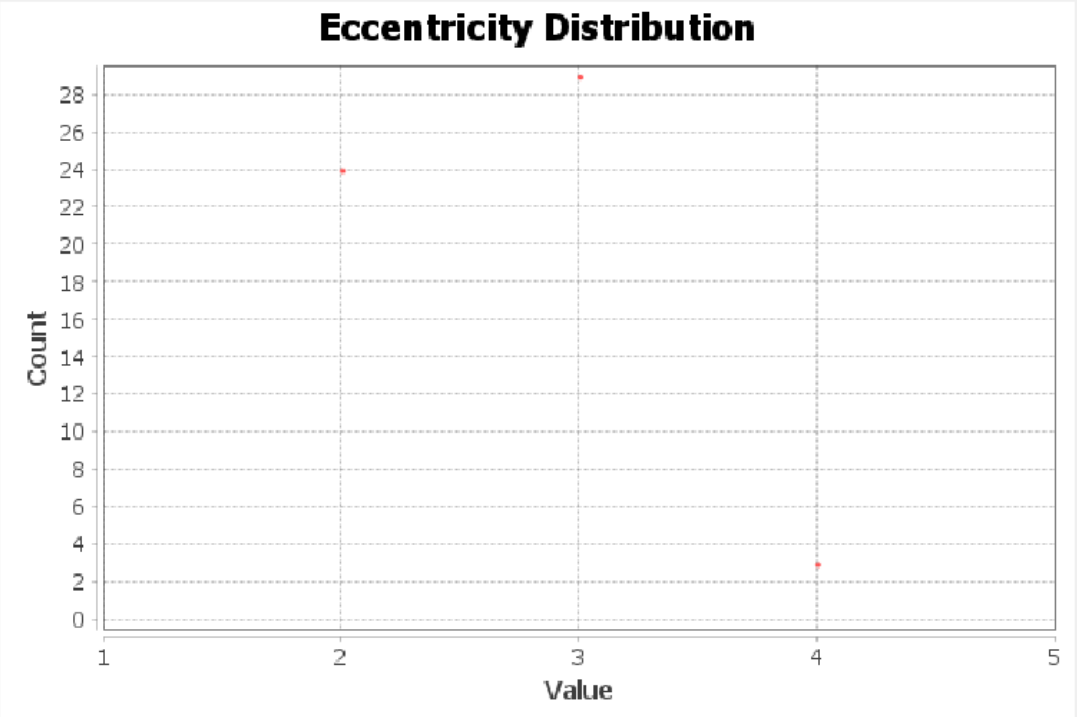
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
Value


Harmonic Closeness Centrality Distribution
3.0
2.8
2.6


Harmonic Closeness Centrality Distribution
Count
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
1
Value



Algorithm:

Ulrik Brandes, *A Faster Algorithm for Betweenness Centrality*, in Journal of Mathematical Sociology 25(2):163-177, (2001)

Id	Label	Interval	In-Degree	Out-Degree	Degree	Modularity Class	Clustering Coefficient	Eccentricity	Closeness Centrality	Harmonic Closeness Centrality	Betweenness Centrality
581006651	581006651		1	2	3	1	1.0	3.0	0.478261	0.49697	0.0
152501440	152501440		1	1	2	2	0.0	3.0	0.416667	0.439394	0.0
152655341	152655341		1	1	2	2	0.0	4.0	0.419847	0.443939	0.0
298831058	298831058		1	1	2	0	0.0	3.0	0.458333	0.475758	0.0
152734462	152734462		4	1	5	2	0.916667	3.0	0.413534	0.436364	0.0
152621724	152621724		3	3	6	1	1.0	3.0	0.486726	0.509091	0.0
52577515	52577515		1	1	2	0	0.0	4.0	0.429688	0.456061	0.0
263295349	263295349		1	1	2	1	0.0	4.0	0.462185	0.480303	0.0
44750463	44750463		10	10	20	0	0.977778	3.0	0.539216	0.584848	0.080515
170181978	170181978		3	6	9	0	0.933333	3.0	0.518868	0.548485	0.114286
44759578	44759578		4	8	12	3	0.910714	3.0	0.528846	0.566667	0.114286
152856397	152856397		4	3	7	0	0.9	3.0	0.466102	0.493939	0.114286
152931851	152931851		6	4	10	0	0.933333	3.0	0.504587	0.527273	0.181818
149526930	149526930		7	6	13	1	0.952381	3.0	0.518868	0.548485	0.190909
210249021	210249021		8	6	14	0	0.916667	3.0	0.504587	0.539394	0.222751
210262799	210262799		6	6	12	0	0.933333	3.0	0.509259	0.542424	0.286079
67979878	67979878		5	5	10	0	0.9	3.0	0.514019	0.539394	0.296104
152928776	152928776		7	7	14	0	0.952381	3.0	0.52381	0.557576	0.296104
109201365	109201365		8	9	17	0	0.866667	3.0	0.518868	0.566667	0.35366
59190567	59190567		5	6	11	2	0.904762	3.0	0.52381	0.551515	0.434035
57651675	57651675		10	8	18	0	0.936364	3.0	0.528846	0.566667	0.452896
300196388	300196388		8	14	22	2	0.928571	2.0	0.572917	0.627273	0.563056
152815652	152815652		9	9	18	0	0.944444	2.0	0.544554	0.581818	0.582183
155817470	155817470		7	8	15	0	0.857143	3.0	0.52381	0.563636	0.801231
152711652	152711652		9	9	18	2	0.902778	2.0	0.544554	0.581818	0.884203
210202302	210202302		8	7	15	2	0.805556	3.0	0.504587	0.545455	0.955868
144778767	144778767		10	13	23	3	0.865385	3.0	0.555556	0.612121	1.175023
210272036	210272036		11	10	21	2	0.903846	2.0	0.55	0.590909	1.262739
163897161	163897161		15	9	24	0	0.890476	3.0	0.539216	0.578788	1.568637
54228644	54228644		11	11	22	3	0.820513	3.0	0.55	0.59697	1.65049

Data Table

Nodes Edges Configuration Add node Add edge Search/Replace Import Spreadsheet Export table More actions Filter: Id

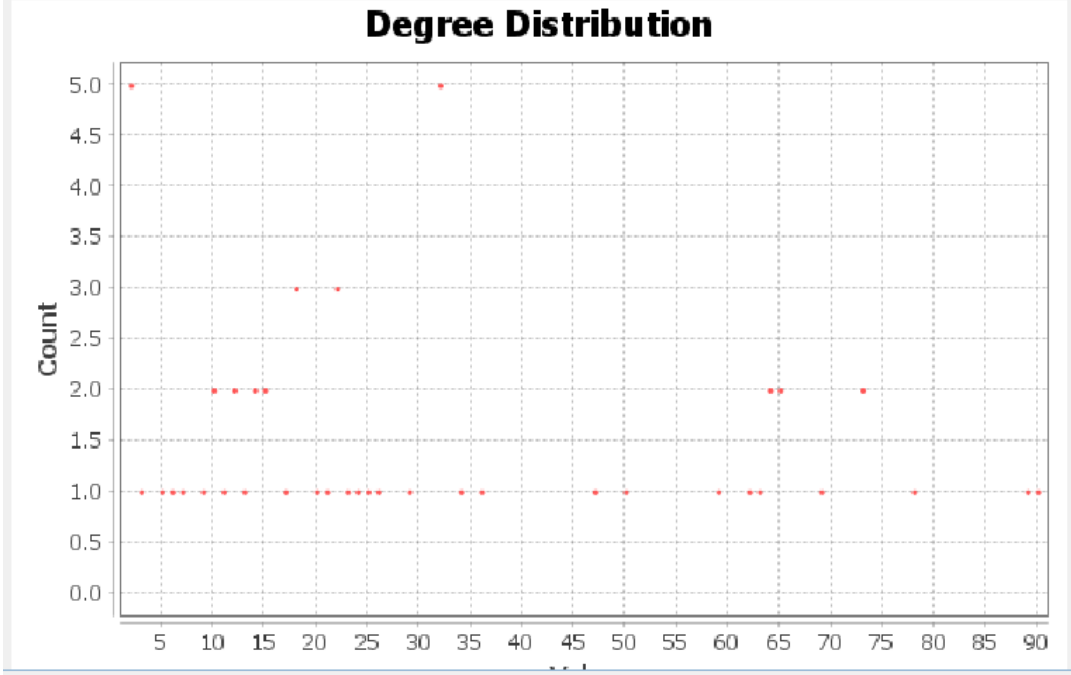
Id	Label	Interval	In-Degree	Out-Degree	Degree	Modularity Class	Clustering Coefficient	Eccentricity	Closeness Centrality	Harmonic Closeness Centrality	Betweenness Centrality
57643580	57643580		44	46	90	1	0.301573	3.0	0.846154	0.915152	470.230264
57645553	57645553		45	44	89	0	0.342995	2.0	0.833333	0.9	359.847184
57643905	57643905		35	38	73	2	0.406208	2.0	0.763889	0.845455	130.226227
9755306	9755306		36	37	73	0	0.448198	2.0	0.753425	0.836364	131.360728
36242770	36242770		39	39	78	0	0.315331	3.0	0.743243	0.845455	294.384244
85830732	85830732		30	35	65	0	0.503361	2.0	0.733333	0.818182	65.815196
57648470	57648470		35	34	69	2	0.446218	3.0	0.714286	0.806061	197.680043
26491764	26491764		32	32	64	2	0.53629	2.0	0.705128	0.790909	157.526367
74627839	74627839		33	32	65	0	0.479501	2.0	0.705128	0.790909	109.041859
19607432	19607432		32	32	64	0	0.52178	2.0	0.705128	0.790909	92.957464
26732858	26732858		32	31	63	2	0.503788	2.0	0.696203	0.781818	130.806275
12306271	12306271		31	31	62	3	0.54072	2.0	0.696203	0.781818	60.214636
126018634	126018634		33	26	59	0	0.440285	2.0	0.654762	0.736364	88.263348
21662712	21662712		25	25	50	2	0.701538	2.0	0.647059	0.727273	18.078328
57646845	57646845		24	23	47	3	0.650997	2.0	0.632184	0.709091	18.871743
152898768	152898768		18	18	36	0	0.754902	2.0	0.597826	0.663636	14.730946
57644453	57644453		17	17	34	3	0.886029	2.0	0.591398	0.654545	3.944332
8745272	8745272		16	16	32	1	0.779167	2.0	0.585106	0.645455	19.151199
57652163	57652163		16	16	32	2	0.871324	2.0	0.585106	0.645455	4.288577
44754940	44754940		16	16	32	2	0.908333	2.0	0.585106	0.645455	1.962677
152674464	152674464		16	16	32	0	0.849265	3.0	0.578947	0.642424	5.648645
101699474	101699474		17	15	32	2	0.819853	2.0	0.578947	0.636364	4.112902
300196388	300196388		8	14	22	2	0.928571	2.0	0.572917	0.627273	0.563056
210228384	210228384		13	13	26	2	0.788462	2.0	0.56701	0.618182	7.606588
52582608	52582608		11	14	25	2	0.796703	3.0	0.56701	0.624242	6.291865
45810687	45810687		15	14	29	0	0.87619	3.0	0.561224	0.621212	1.756174
44759999	44759999		11	11	22	2	0.836364	2.0	0.555556	0.6	3.621032
144778767	144778767		10	13	23	3	0.865385	3.0	0.555556	0.612121	1.175023
54228644	54228644		11	11	22	3	0.820513	3.0	0.55	0.59697	1.65049
210272036	210272036		11	10	21	2	0.903846	2.0	0.55	0.590909	1.262739

HTML Report

Degree Report

Results:

Average Degree: 15.286



Print Copy Save Close

HTML Report

Graph Density Report

Parameters:

Network Interpretation: directed

Results:

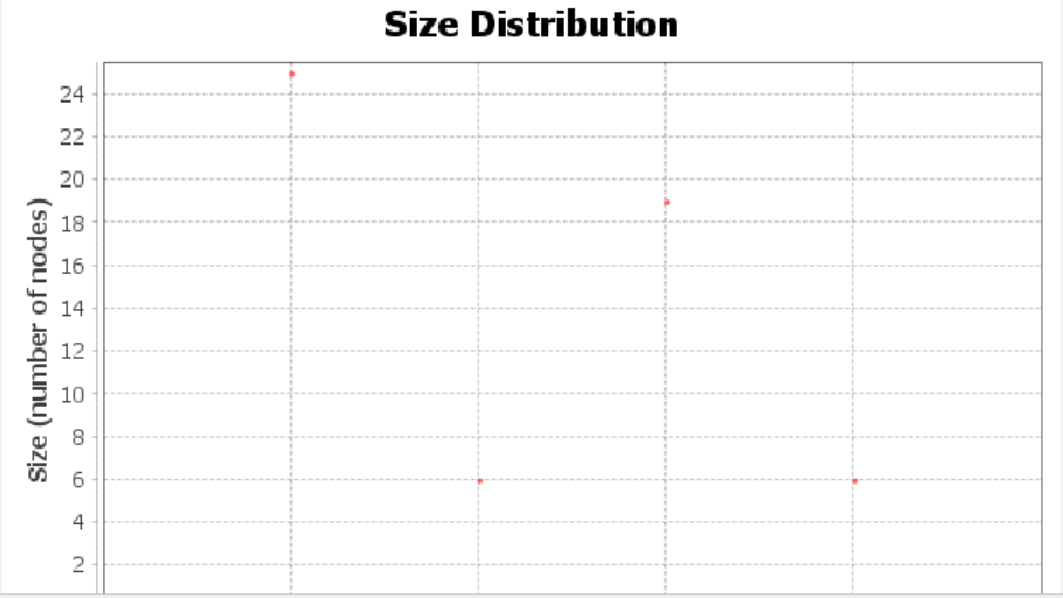
Density: 0.278

HTML Report

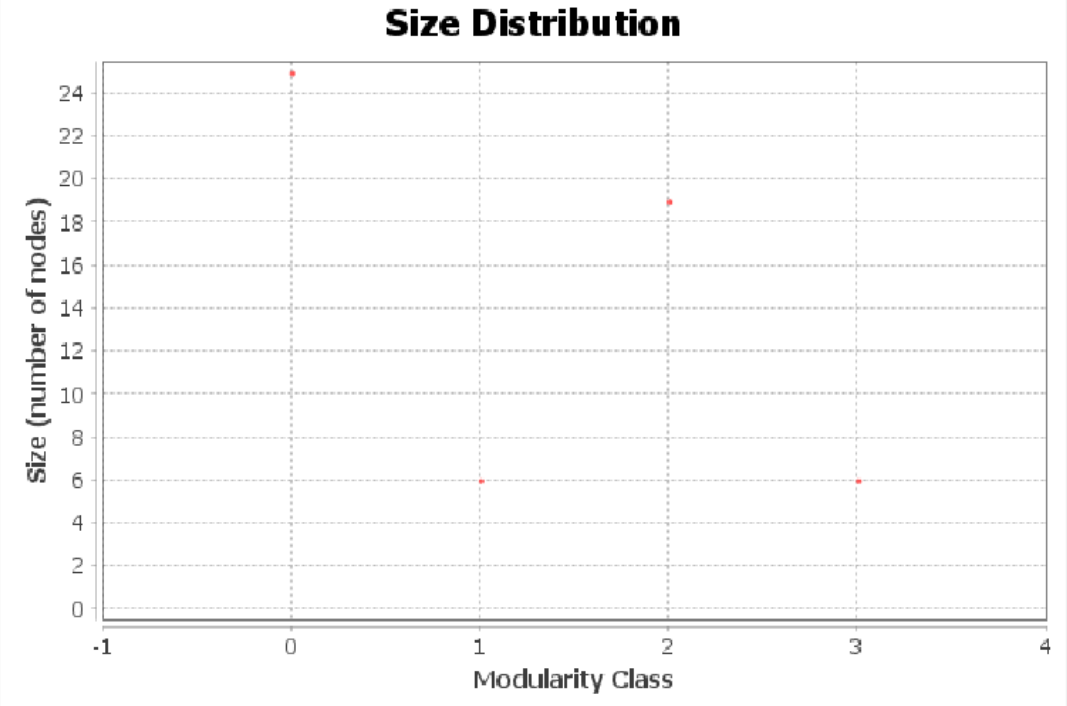
Randomize: On
Use edge weights: On
Resolution: 1.0

Results:

Modularity: 0.088
Modularity with resolution: 0.088
Number of Communities: 4



HTML Report



Algorithm:

Vincent D Blondel, Jean-Loup Guillaume, Renaud Lambiotte, Etienne Lefebvre, *Fast unfolding of communities in large networks*, in Journal of Statistical Mechanics: Theory and Experiment 2008 (10), P1000

Print Copy Save Close

HTML Report

Parameters:

Network Interpretation: directed

Results:

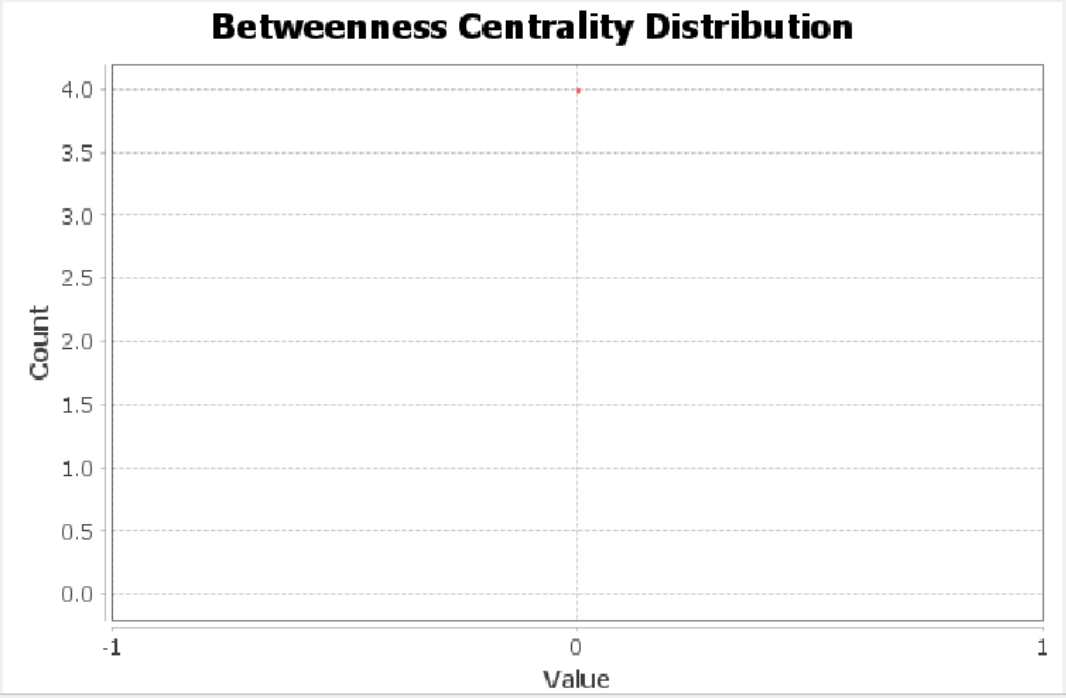
Average Clustering Coefficient: 0.699
The Average Clustering Coefficient is the mean value of individual coefficients.

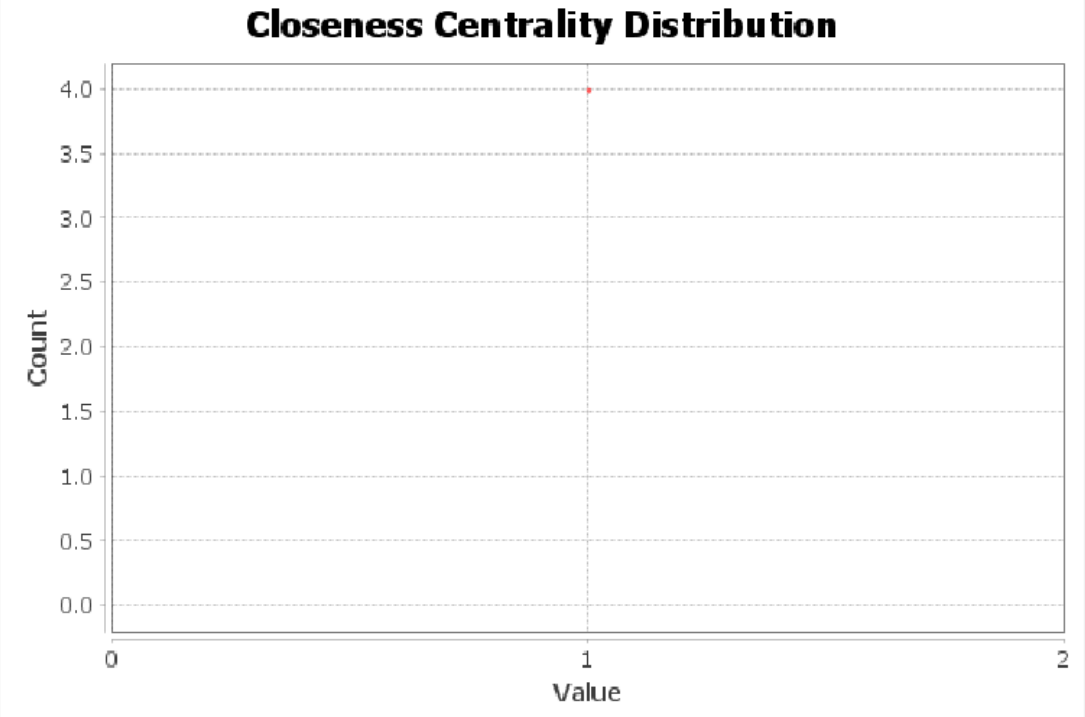
Print Copy Save Close

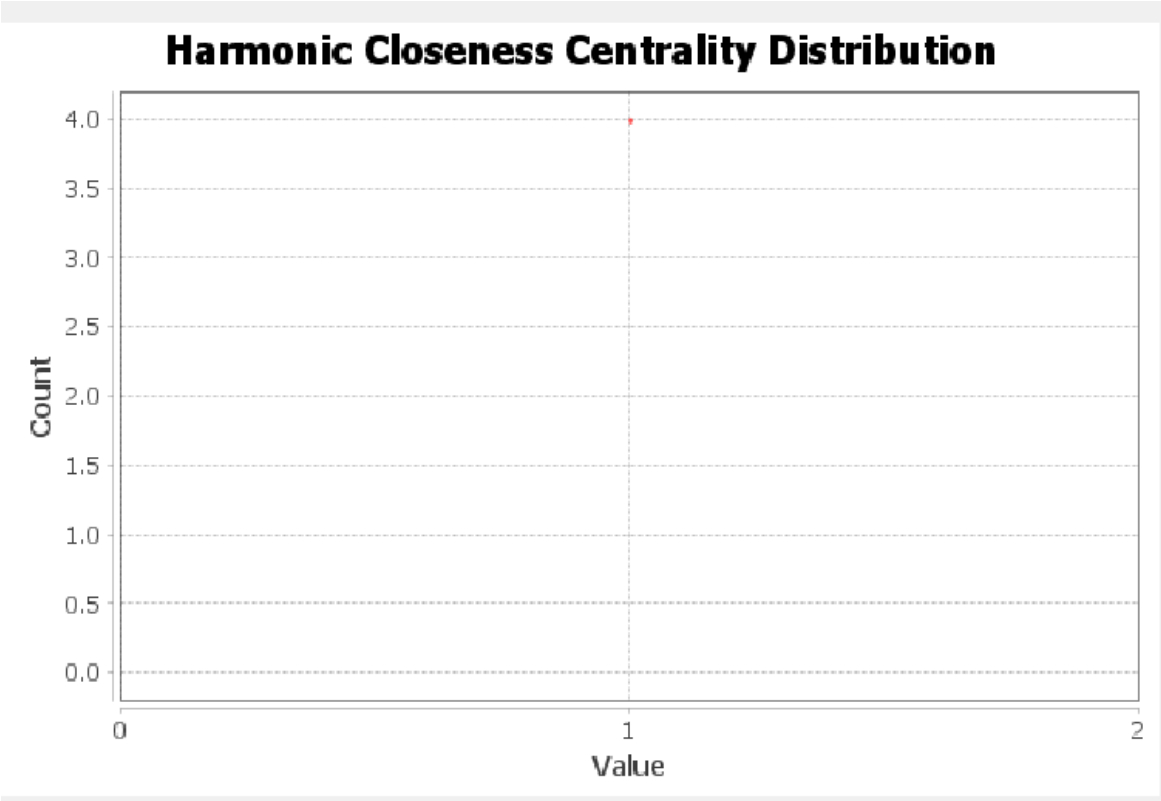
Network Interpretation: directed

Results:

Diameter: 1
Radius: 1
Average Path length: 1.0






Harmonic Closeness Centrality Distribution
Count
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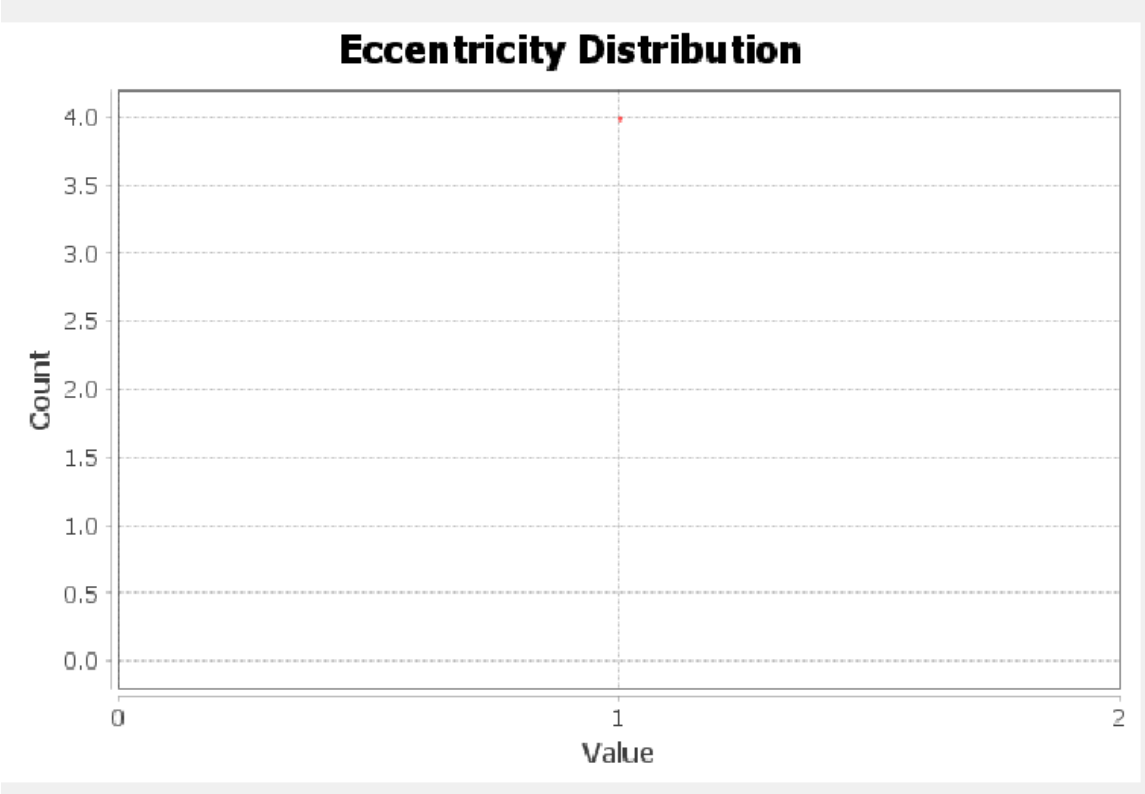
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
Value

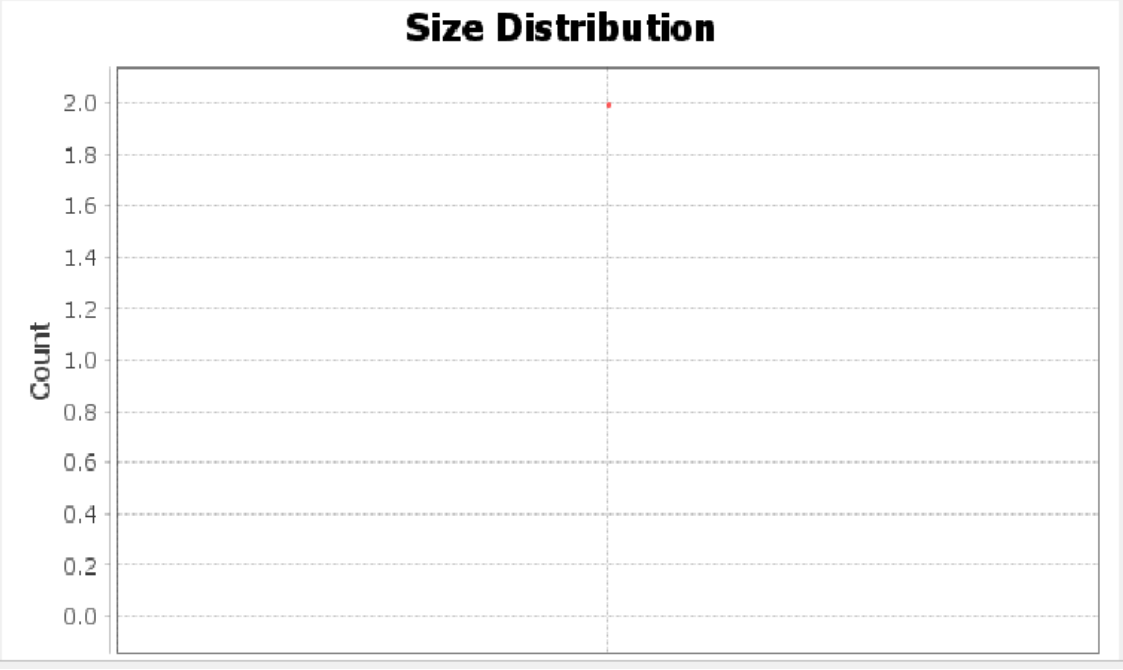

Eccentricity Distribution
Count
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
Value

Parameters:

Network Interpretation: directed

Results:

Number of Weakly Connected Components: 2
Number of Strongly Connected Components: 2



Nodes Edges | Configuration | Add node | Add edge | Search/Replace | Import Spreadsheet | Export table | More actions | Filter: | Id

Id	Label	Interval	In-Degree	Out-Degree	Degree	Clustering Coefficient	Modularity Class	Eccentricity	Closeness Centrality	Harmonic Closeness Centrality	Betweenness Centralit...	Component ID	Strongly-Connected ID
172468779	172468779		1	1	2	0.0	0	1.0	1.0	1.0	0.0	0	0
58015516	58015516		1	1	2	0.0	0	1.0	1.0	1.0	0.0	0	0
45222175	45222175		1	1	2	0.0	1	1.0	1.0	1.0	0.0	1	1
228453486	228453486		1	1	2	0.0	1	1.0	1.0	1.0	0.0	1	1

Parameters:

Network Interpretation: directed

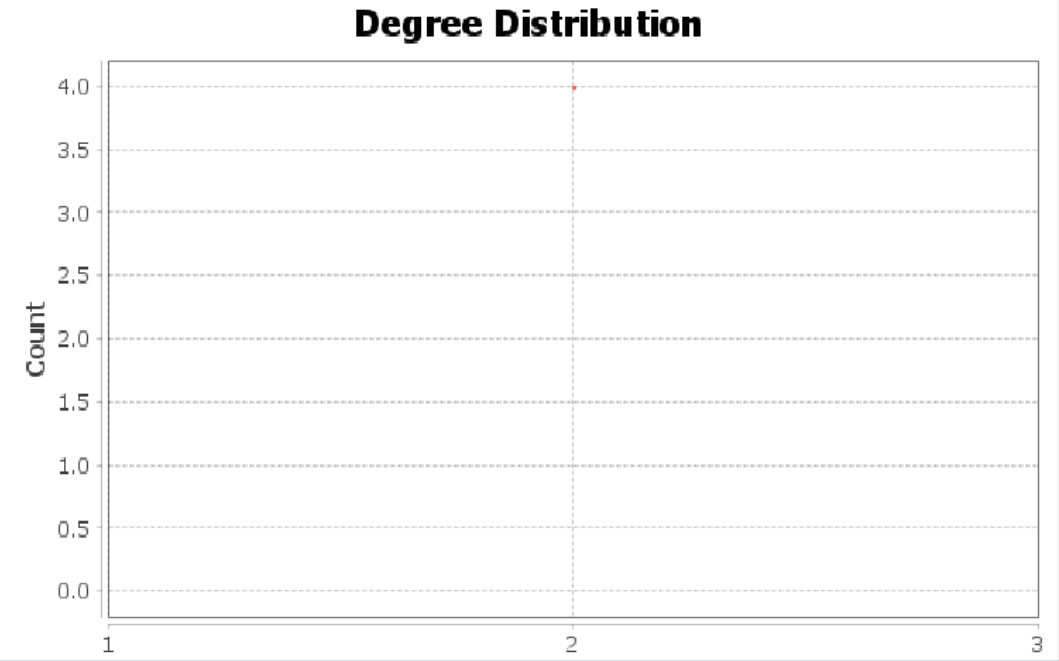
Results:

Number of Weakly Connected Components: 1
Number of Strongly Connected Components: 1

Degree Report

Results:

Average Degree: 1.000



Graph Density Report

Parameters:

Network Interpretation: directed

Results:

Density: 0.333

Parameters:

Network Interpretation: directed

Results:

Average Clustering Coefficient: 0.000
The Average Clustering Coefficient is the mean value of individual coefficients.

Parameters:

Randomize: On
Use edge weights: On
Resolution: 1.0

Results:

Modularity: 0.500
Modularity with resolution: 0.500
Number of Communities: 2