

# MA653 Network Science Assignment-1

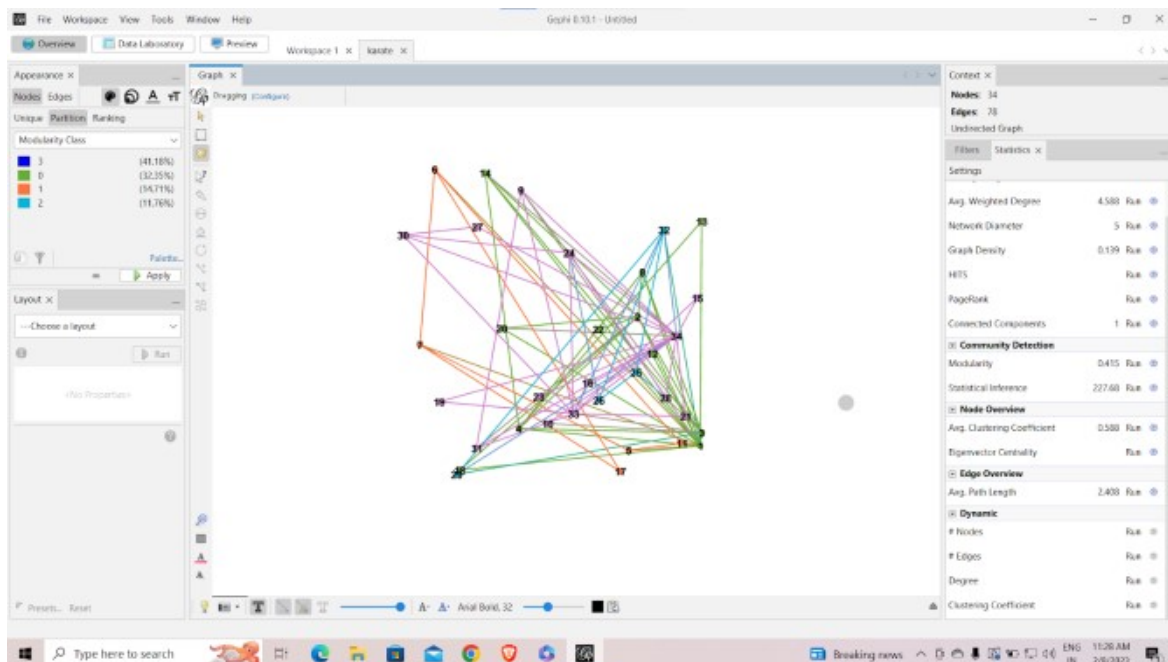
Name – Arti Sahu  
Roll No. – 200123011

Dataset used : [Zachary's karate club](#)

**Zachary's karate club:** a social network of friendships between 34 karate club members at a US university in the 1970s. Please cite W. W. Zachary, An information flow model for conflict and fission in small groups, *Journal of Anthropological Research* 33, 452-473 (1977)

## 1. Undirected Graph

Overview :



# Data laboratory :

FileWorkspaceViewToolsWindowHelp

Gephi 0.10.1 - Untitled

OverviewData LaboratoryPreview

Workspace 1 xkarate x

Data Table x

NodesEdgesConfigurationAdd nodeAdd edgeSearch/ReplaceImport SpreadsheetExport tableMore actions

Filter: id

Id	Label	Interval	Degree	Weighted De.	Eccentricity	Closeness Centr.	Harmonic Closeness Centr.	Betweenness Centr.	Authority	Hub	PageRank	Component...	Modularity CL	Inferred CL	Clustering Coeffi...	Number of trian...	Eigenvector Centr...
1	1	16	16.0	3.0	0.568966	0.70202		231.071429	0.355001	0.355484	0.097001	0	0	0	0.15	18	0.95754
2	2	9	9.0	3.0	0.485294	0.580800		28.478571	0.265964	0.265957	0.052872	0	0	0	0.333333	12	0.70159
3	3	10	10.0	3.0	0.559322	0.636164		75.850794	0.317193	0.317192	0.057075	0	0	0	0.244444	11	0.83354
4	4	6	6.0	3.0	0.464789	0.353554		6.288095	0.211179	0.21118	0.035062	0	0	0	0.666667	10	0.556486
5	5	3	3.0	4.0	0.37931	0.444444		0.333333	0.075967	0.07597	0.021986	0	1	0	0.666667	2	0.213923
6	6	4	4.0	4.0	0.383721	0.459596		15.833333	0.079481	0.079484	0.029123	0	1	0	0.5	3	0.227546
7	7	4	4.0	4.0	0.383721	0.459596		15.833333	0.079481	0.079484	0.029123	0	1	0	0.5	3	0.227546
8	8	4	4.0	4.0	0.44	0.497475		0.0	0.170956	0.170962	0.024495	0	0	0	1.0	6	0.45043
9	9	5	5.0	3.0	0.515625	0.560606		29.529365	0.227397	0.227409	0.029768	0	3	0	0.5	5	0.602076
10	10	2	2.0	4.0	0.434211	0.472222		0.447619	0.10267	0.102677	0.01431	0	3	0	0.0	0	0.271522
11	11	3	3.0	4.0	0.37931	0.444444		0.333333	0.075967	0.07597	0.021986	0	1	0	0.666667	2	0.213923
12	12	1	1.0	4.0	0.366667	0.499091		0.0	0.052853	0.052857	0.009567	0	0	0	0.0	0	0.143296
13	13	2	2.0	4.0	0.370787	0.424242		0.0	0.084252	0.084256	0.014648	0	0	0	1.0	1	0.224862
14	14	5	5.0	3.0	0.515625	0.560606		24.215873	0.226465	0.226477	0.029542	0	0	0	0.6	6	0.590325
15	15	2	2.0	5.0	0.370787	0.430303		0.0	0.101398	0.101407	0.014538	0	3	0	1.0	1	0.271269
16	16	2	2.0	5.0	0.370787	0.430303		0.0	0.101398	0.101407	0.014538	0	3	0	1.0	1	0.271269
17	17	2	2.0	5.0	0.284483	0.336164		0.0	0.023636	0.023635	0.01679	0	1	0	1.0	1	0.073452
18	18	2	2.0	4.0	0.375	0.429293		0.0	0.092396	0.092402	0.014562	0	0	0	1.0	1	0.246237
19	19	2	2.0	5.0	0.370787	0.430303		0.0	0.101398	0.101407	0.014538	0	3	0	1.0	1	0.271269
20	20	3	3.0	3.0	0.5	0.530303		17.146825	0.147905	0.147917	0.019609	0	0	0	0.333333	1	0.395132
21	21	2	2.0	5.0	0.370787	0.430303		0.0	0.101398	0.101407	0.014538	0	3	0	1.0	1	0.271269
22	22	2	2.0	4.0	0.375	0.429293		0.0	0.092396	0.092402	0.014562	0	0	0	1.0	1	0.246237
23	23	2	2.0	5.0	0.370787	0.430303		0.0	0.101398	0.101407	0.014538	0	3	0	1.0	1	0.271269
24	24	5	5.0	5.0	0.392857	0.485859		9.3	0.150114	0.150122	0.031521	0	3	0	0.4	4	0.406733
25	25	3	3.0	4.0	0.375	0.421717		1.166667	0.057055	0.057051	0.021072	0	2	0	0.333333	1	0.158697
26	26	3	3.0	4.0	0.375	0.421717		2.027778	0.059209	0.059205	0.021001	0	2	0	0.333333	1	0.165242
27	27	2	2.0	5.0	0.362637	0.427272		0.0	0.075577	0.075582	0.015041	0	3	0	1.0	1	0.201735
28	28	4	4.0	4.0	0.458333	0.512626		11.792063	0.133474	0.13348	0.025638	0	3	0	0.166667	1	0.358689
29	29	3	3.0	4.0	0.452055	0.497475		0.947619	0.131076	0.131079	0.019572	0	2	0	0.333333	1	0.349596
30	30	4	4.0	5.0	0.383721	0.465657		1.542857	0.134957	0.134964	0.026286	0	3	0	0.666667	4	0.364045

Add columnMerge columnsDelete columnClear columnCopy data to other columnFill column with a valueDuplicate column

Create a boolean column from regex matchCreate column with list of regex matching groupsNegate boolean valuesConvert column to dynamic

Type here to search

24°C Sunny11:29 AM2/8/2023

# Statistics :

Context X

Nodes: 34  
Edges: 78  
Undirected Graph

Filters Statistics X

Settings

Network Overview		
Average Degree	4.588	Run
Avg. Weighted Degree	4.588	Run
Network Diameter	5	Run
Graph Density	0.139	Run
HITS		Run
PageRank		Run
Connected Components	1	Run
Community Detection		
Modularity	0.415	Run
Statistical Inference	227.68	Run
Node Overview		
Avg. Clustering Coefficient	0.588	Run
Eigenvector Centrality		Run
Edge Overview		
Avg. Path Length	2.408	Run
Dynamic		
# Nodes		Run

## Average clustering coefficient Distribution :

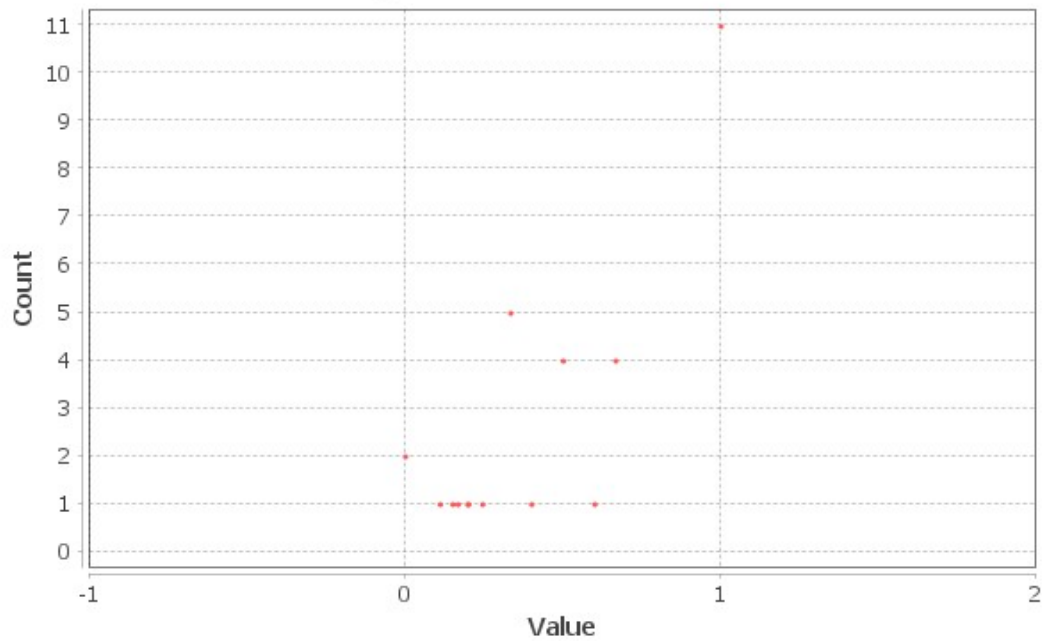
### Results:

Average Clustering Coefficient: 0.588

Total triangles: 45

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

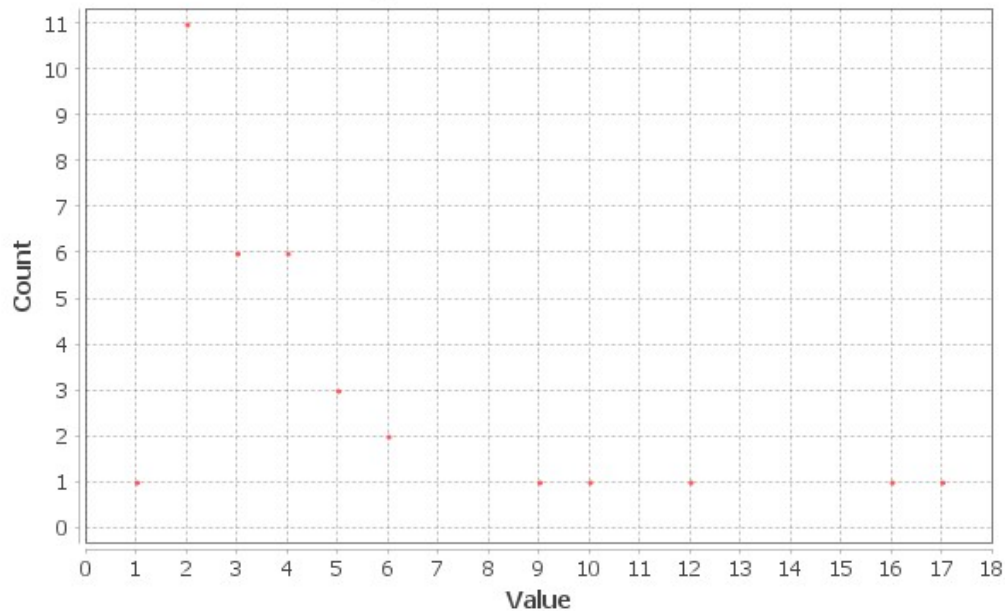
### Clustering Coefficient Distribution



## Degree Distribution :

1. Average degree = 4.588

### Degree Distribution



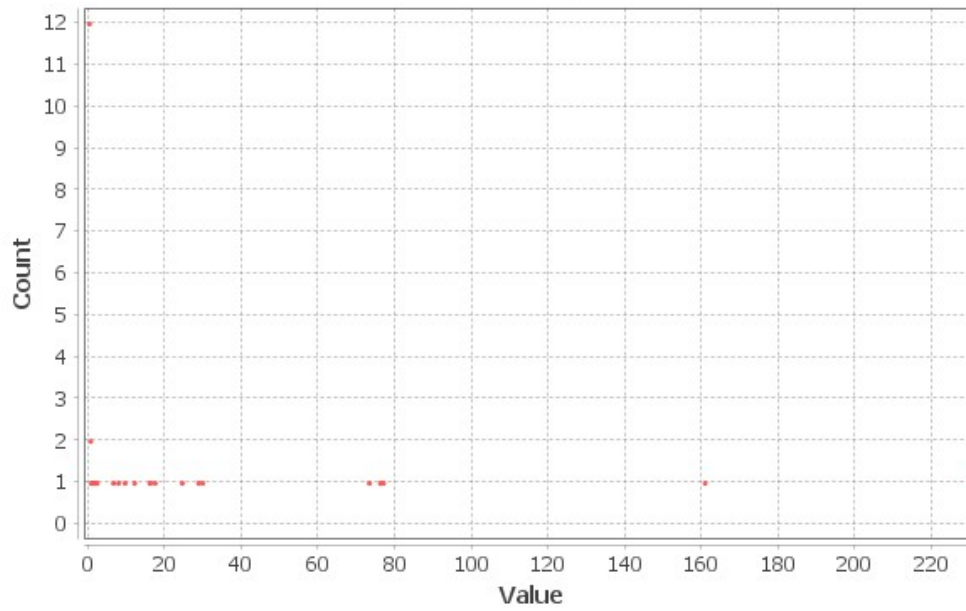
## Results:

Diameter: 5

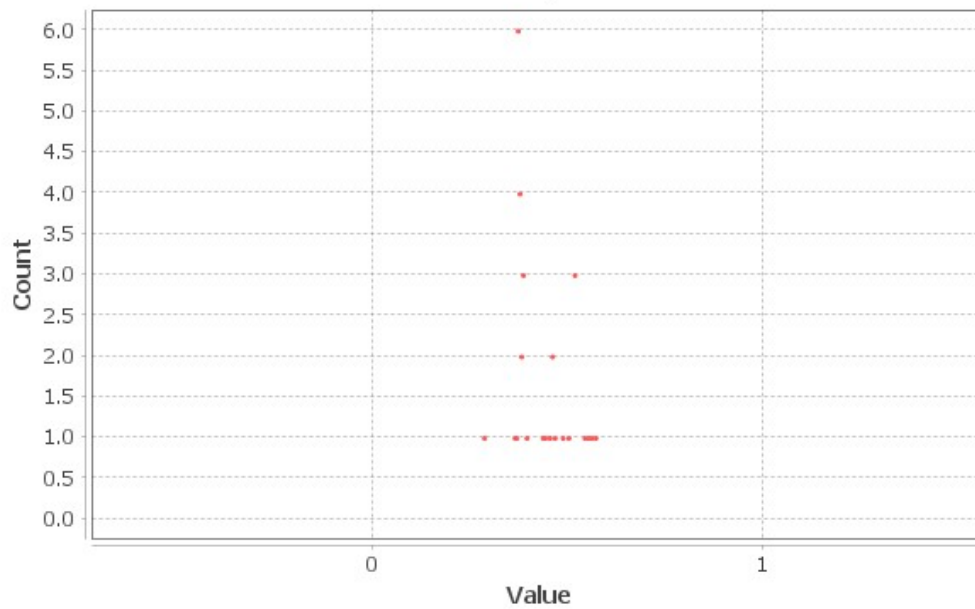
Radius: 3

Average Path length: 2.408199643493761

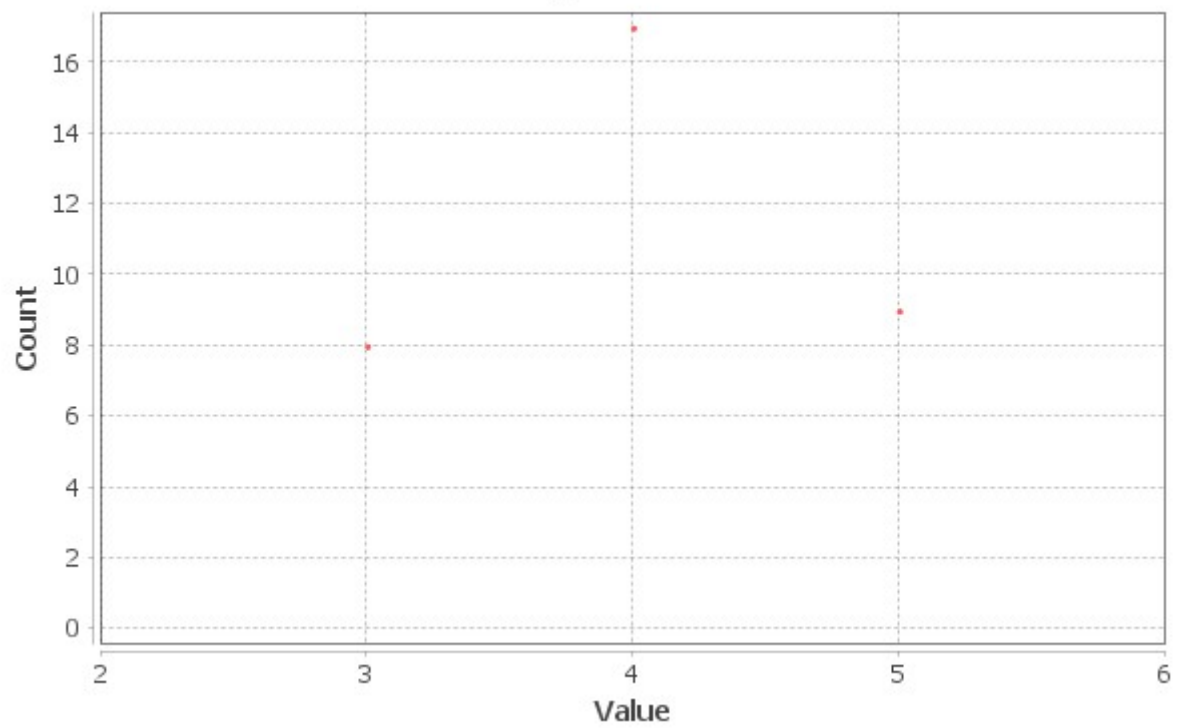
### Betweenness Centrality Distribution



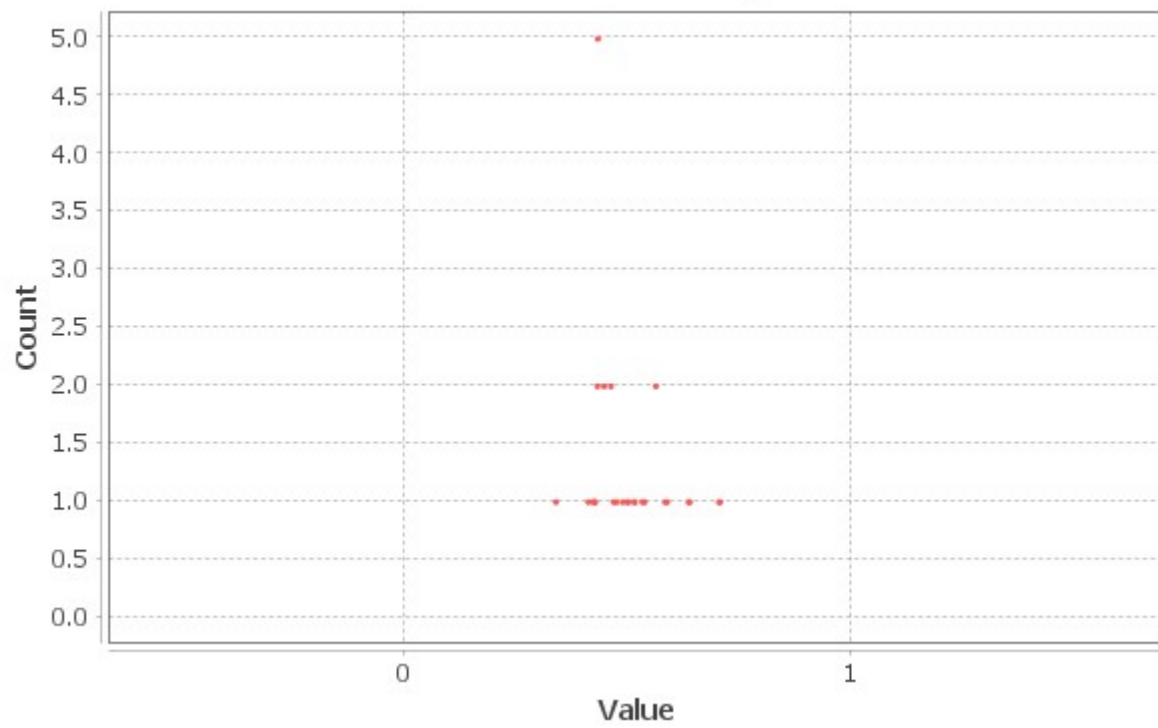
### Closeness Centrality Distribution



### Eccentricity Distribution

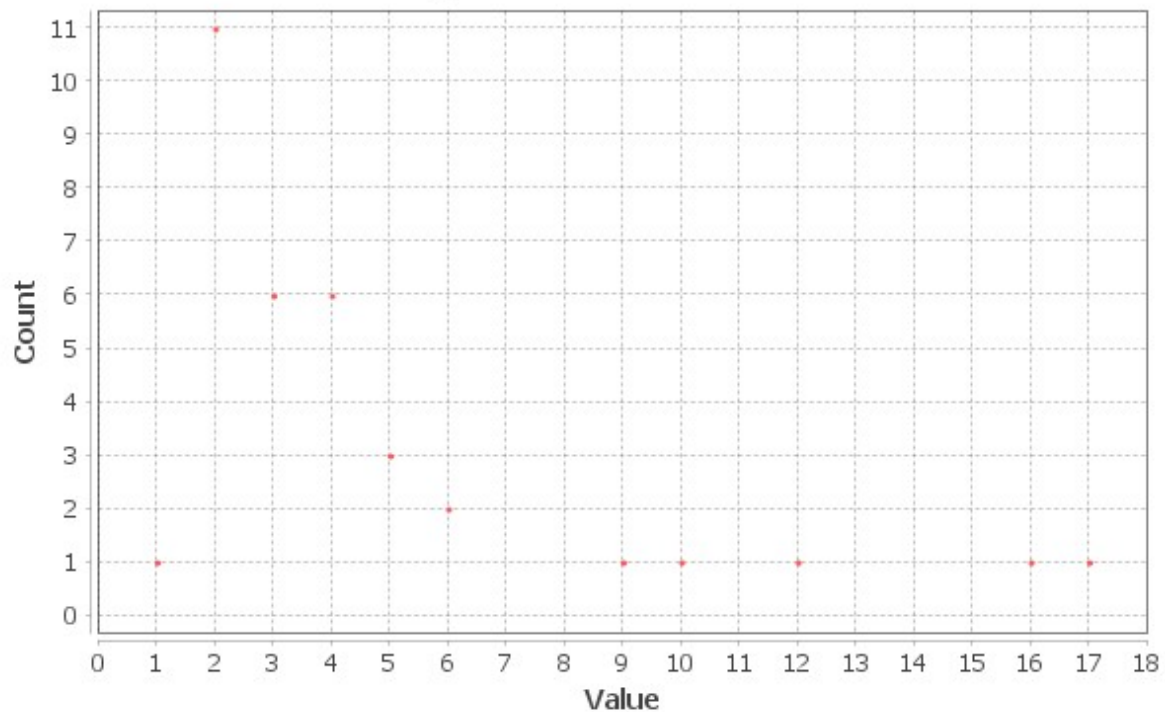


### Harmonic Closeness Centrality Distribution



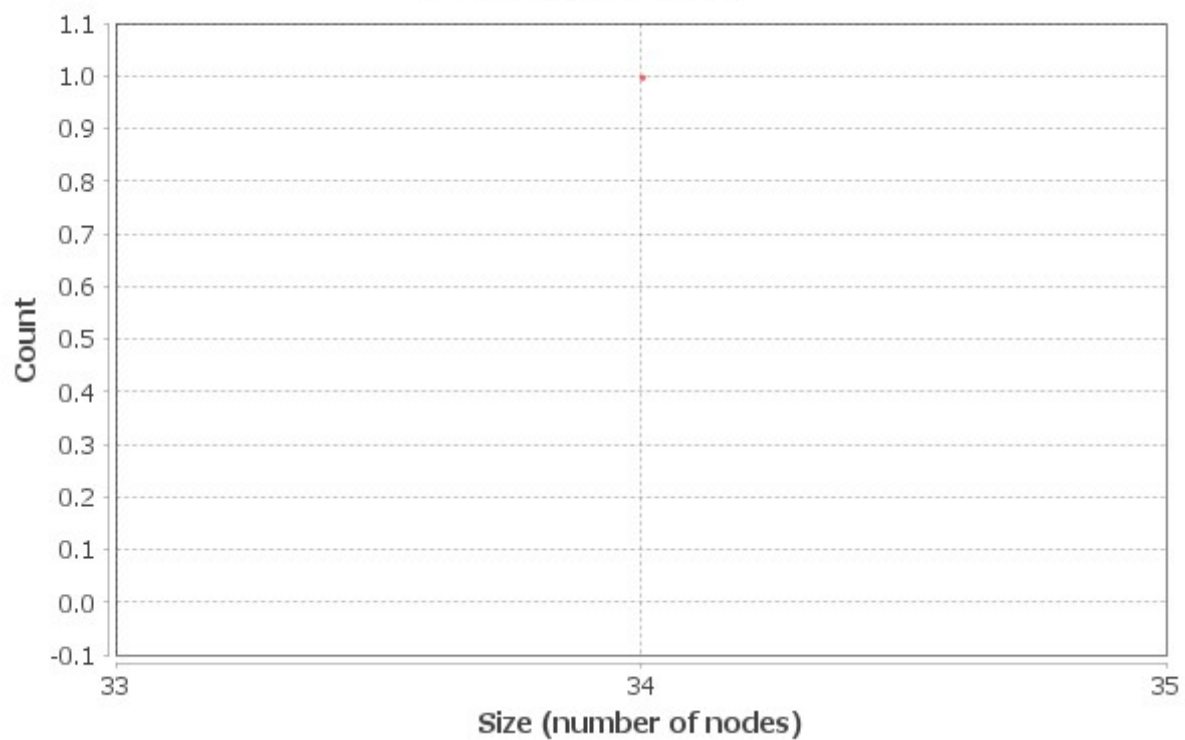
**Average weighted degree = 4.588**

**Degree Distribution**



**Number of weakly connected components = 1**

**Size Distribution**



## Eigenvector centrality

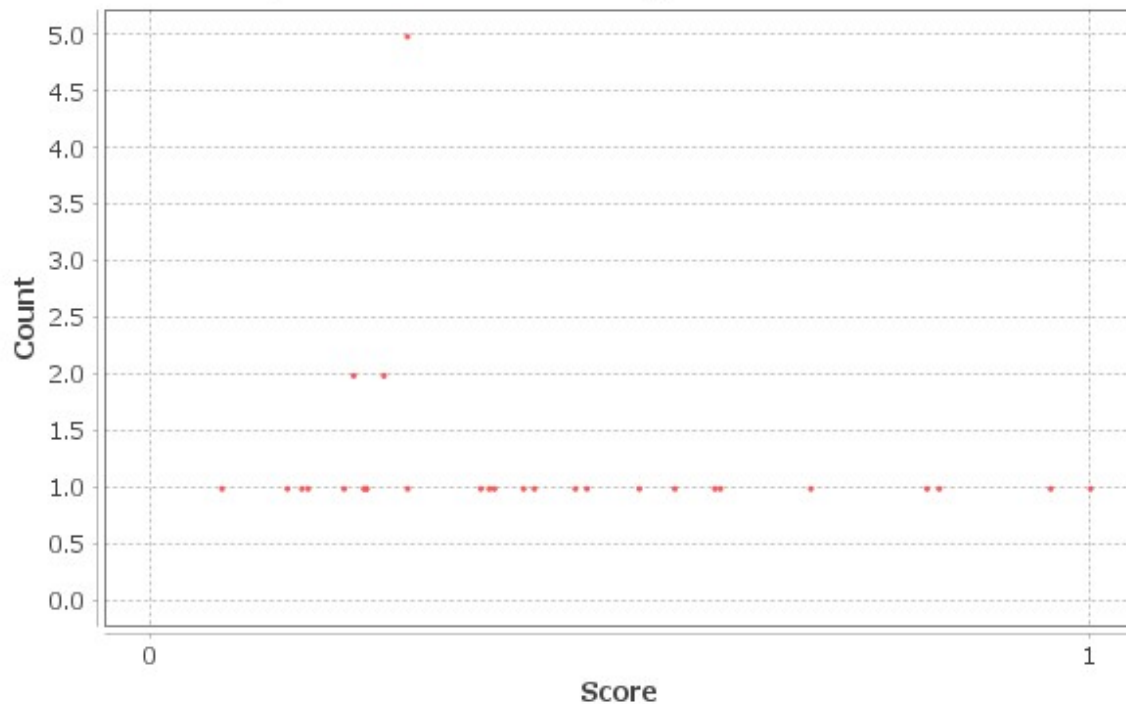
### Parameters:

Network Interpretation: undirected

Number of iterations: 100

Sum change: 9.783386901414531E-4

### Eigenvector Centrality Distribution



## Graph density :

HTML Report

### Graph Density Report

#### Parameters:

Network Interpretation: undirected

#### Results:

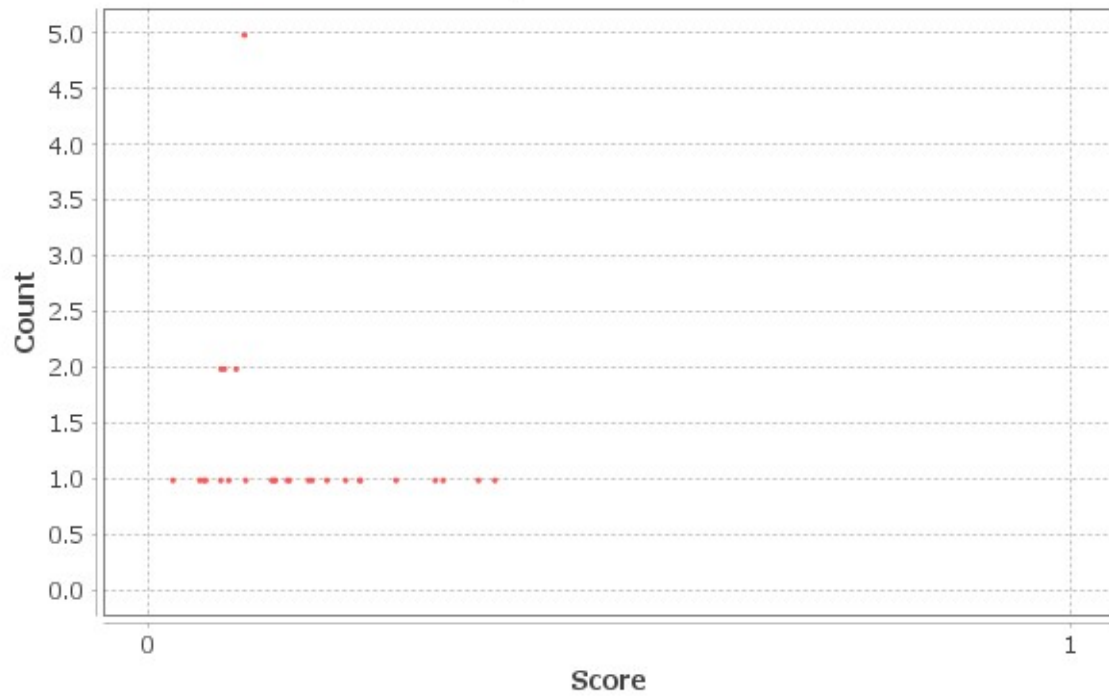
Density: 0.139

Hits :

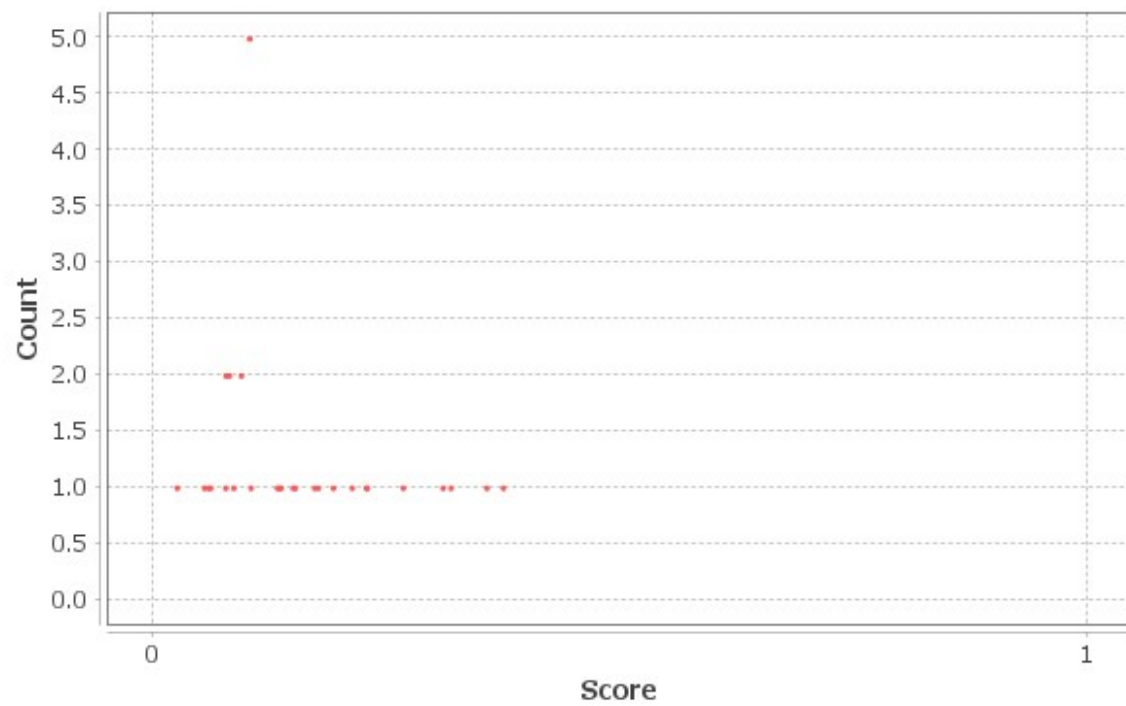
Parameters:

$E = 1.0E-4$

### Authority Distribution



### Hubs Distribution





## Modularity :

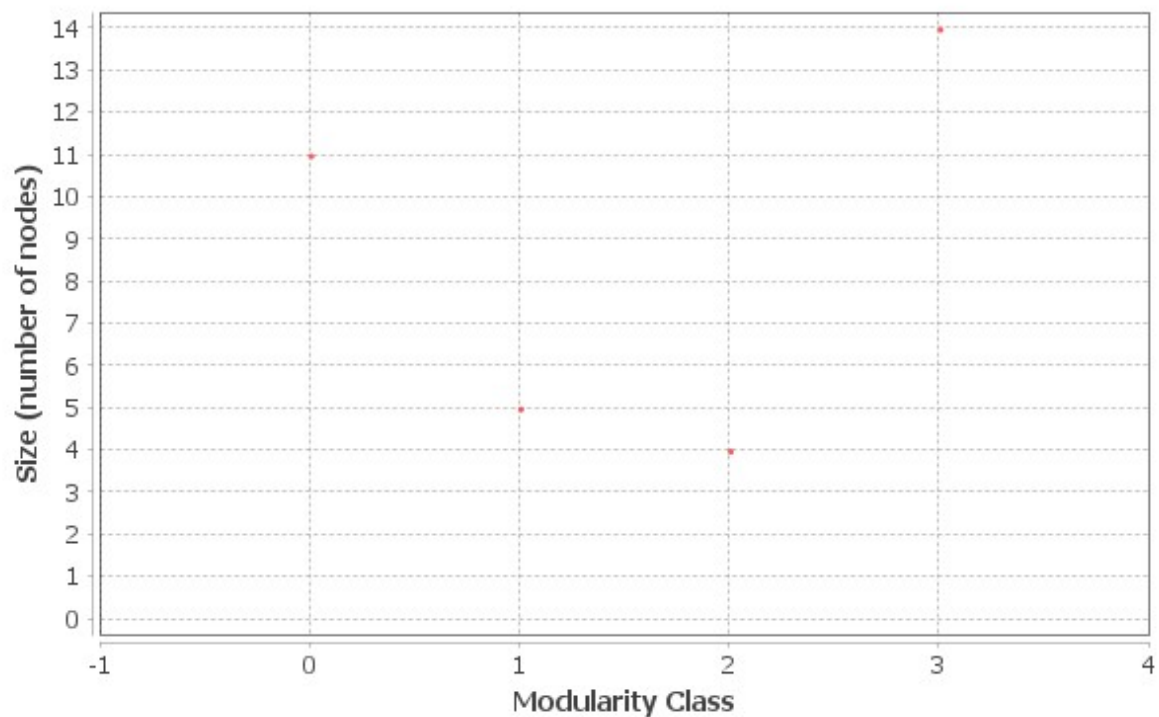
### Parameters:

Randomize: On  
Use edge weights: On  
Resolution: 1.0

### Results:

Modularity: 0.389  
Modularity with resolution: 0.389  
Number of Communities: 4

## Size Distribution

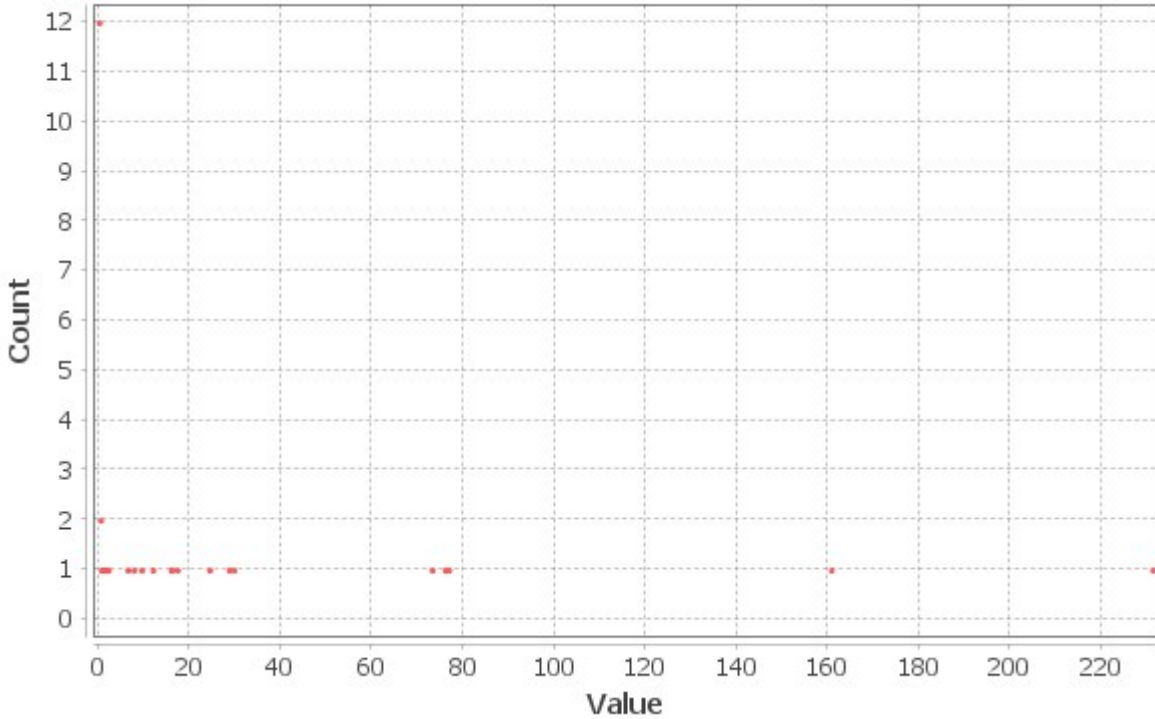


## Network diameter:

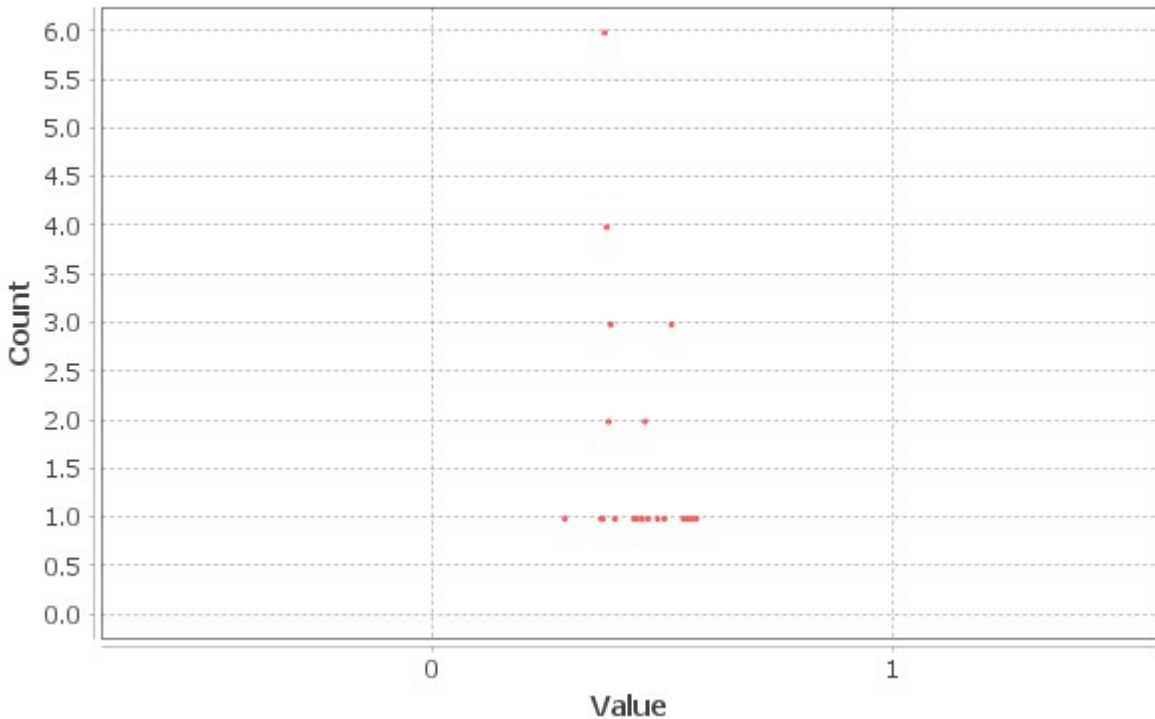
### Results:

Diameter: 5  
Radius: 3  
Average Path length: 2.408199643493761

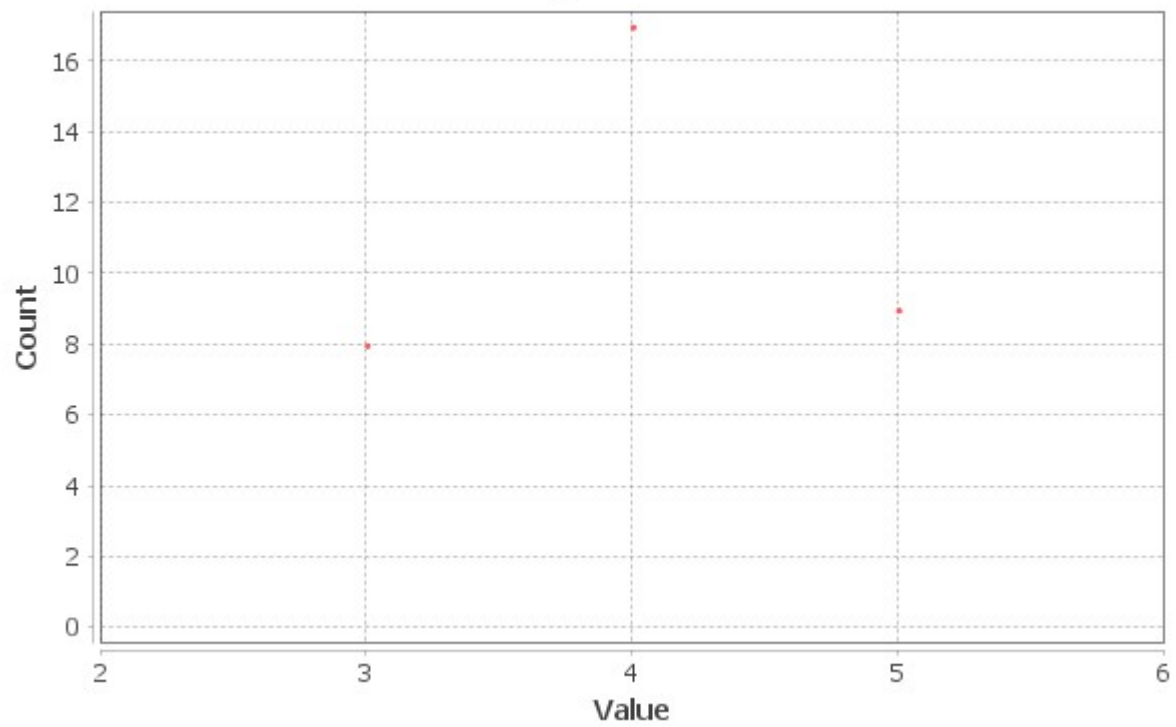
## Betweenness Centrality Distribution



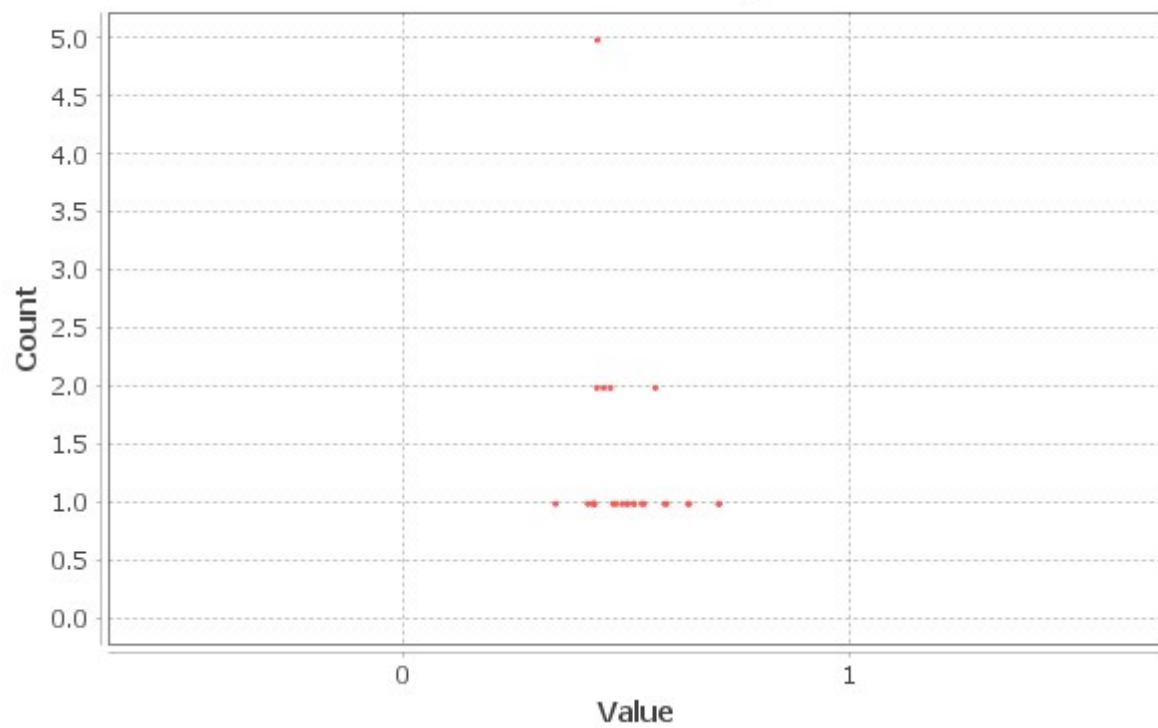
### Closeness Centrality Distribution



## Eccentricity Distribution



## Harmonic Closeness Centrality Distribution

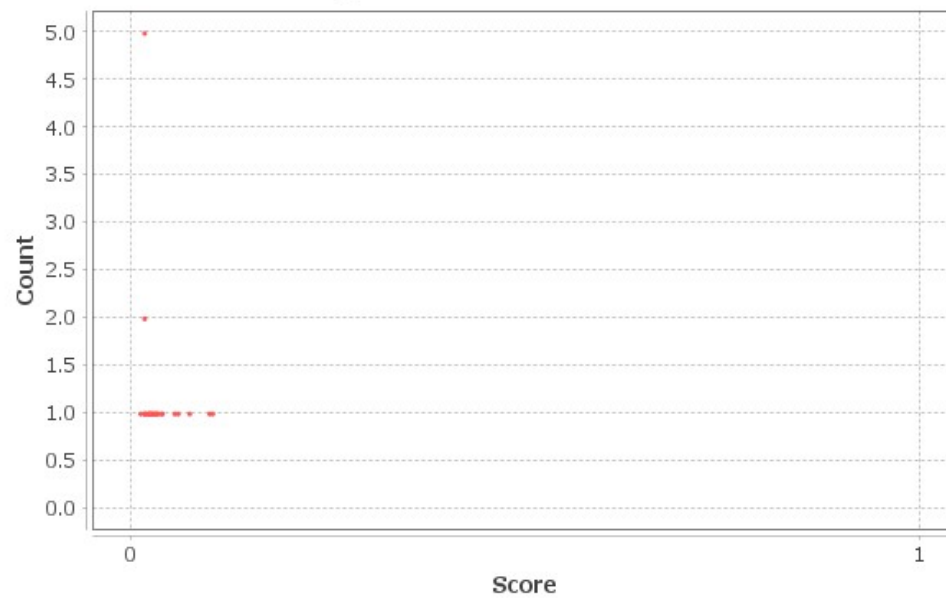


**Page rank :**

### Parameters:

Epsilon = 0.001  
Probability = 0.85

### PageRank Distribution

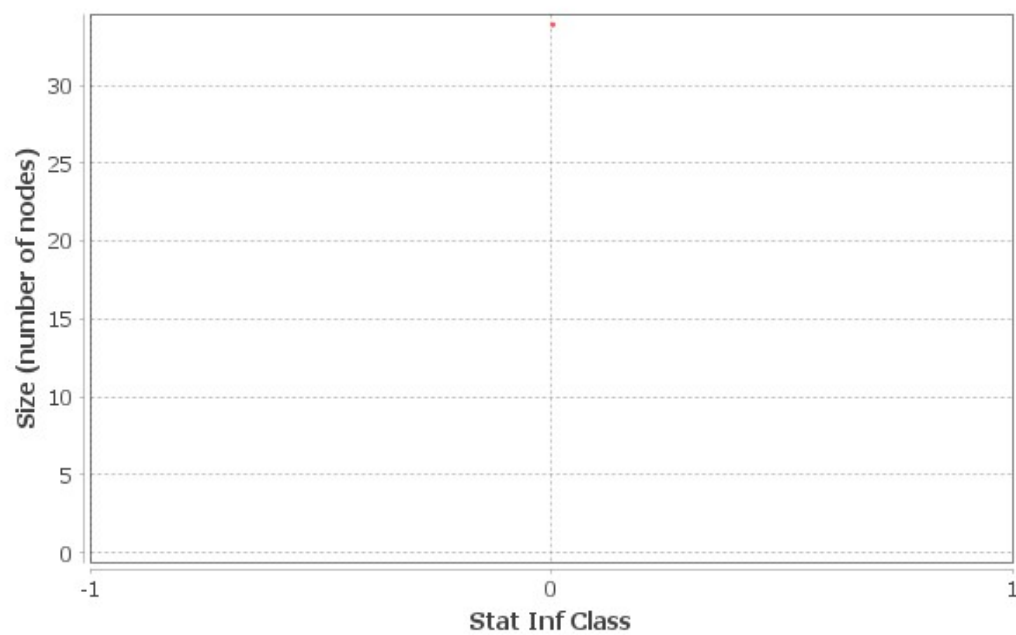


## Statistical inference

### Results:

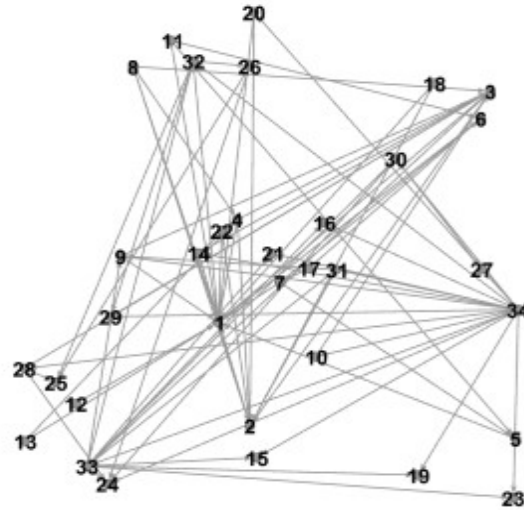
Description Length: 227.680  
Number of Communities: 1

### Size Distribution



# 1. Directed Graph

**Overview :**



**Data laboratory :**

FileWorkspace View Tools Window Help

OverviewData LaboratoryPreview

Workspace 1 xkarate xkarate x

Data Table x

NodesEdgesConfigurationAdd nodeAdd edgeSearch/ReplaceImport SpreadsheetExport tableMore actions

Filterid

	Id	Label	Interval	In-Degree	Out-Deg.	Degree	Weighted In-D.	Weighted Out-D.	Weighted D.	Eccentric...	Closeness Cent.	Harmonic Closeness Ce.	Betweenness Cen.	Authority	Hub	PageRank	Component...	Strongly-Connec...	Modularity ...	Inferred C
1	1		16	0	16	16.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	0.311463	0.0	0.246433	0	0	0	0
2	2		8	1	9	8.0	1.0	9.0	1.0	1.0	1.0	0.5	0.192766	0.061341	0.087712	0	1	0	0	0
3	3		8	2	10	8.0	2.0	10.0	1.0	1.0	1.0	8.833333	0.273729	0.099305	0.074938	0	2	0	0	0
4	4		3	3	6	3.0	3.0	6.0	1.0	1.0	1.0	2.0	0.081973	0.153214	0.027796	0	3	0	0	0
5	5		2	1	3	2.0	1.0	3.0	1.0	1.0	1.0	0.0	0.028712	0.061341	0.025203	0	4	1	0	0
6	6		3	1	4	3.0	1.0	4.0	1.0	1.0	1.0	0.5	0.029919	0.061341	0.031553	0	5	1	0	0
7	7		1	3	4	1.0	3.0	4.0	1.0	1.0	1.0	1.5	0.001207	0.072888	0.021287	0	6	1	0	0
8	8		0	4	4	0.0	4.0	4.0	1.0	1.0	1.0	0.0	0.0	0.169358	0.014937	0	7	0	0	0
9	9		3	2	5	3.0	2.0	5.0	2.0	0.75	0.833333	2.25	0.262114	0.11525	0.024079	0	8	3	0	0
10	10		1	1	2	1.0	1.0	2.0	2.0	0.6	0.666667	0.166667	0.136167	0.053909	0.015684	0	9	0	0	0
11	11		0	3	3	0.0	3.0	3.0	1.0	1.0	1.0	0.0	0.0	0.072888	0.014937	0	10	1	0	0
12	12		0	1	1	0.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.061341	0.014937	0	11	0	0	0
13	13		0	2	2	0.0	2.0	2.0	2.0	0.666667	0.75	0.0	0.0	0.077485	0.014937	0	12	0	0	0
14	14		1	4	5	1.0	4.0	5.0	1.0	1.0	1.0	1.75	0.136167	0.169358	0.015684	0	13	0	0	0
15	15		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.244471	0.0	0.016896	0	14	3	0	0
16	16		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.244471	0.0	0.016896	0	15	3	0	0
17	17		0	2	2	0.0	2.0	2.0	2.0	0.666667	0.75	0.0	0.0	0.00613	0.014937	0	16	1	0	0
18	18		0	2	2	0.0	2.0	2.0	1.0	1.0	1.0	0.0	0.0	0.099305	0.014937	0	17	0	0	0
19	19		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.244471	0.0	0.016896	0	18	3	0	0
20	20		1	2	3	1.0	2.0	3.0	1.0	1.0	1.0	0.583333	0.136167	0.099305	0.015684	0	19	0	0	0
21	21		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.244471	0.0	0.016896	0	20	3	0	0
22	22		0	2	2	0.0	2.0	2.0	1.0	1.0	1.0	0.0	0.0	0.099305	0.014937	0	21	0	0	0
23	23		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.244471	0.0	0.016896	0	22	3	0	0
24	24		5	0	5	5.0	0.0	5.0	0.0	0.0	0.0	0.0	0.300691	0.0	0.0364	0	23	3	0	0
25	25		3	0	3	3.0	0.0	3.0	0.0	0.0	0.0	0.0	0.059936	0.0	0.030849	0	24	2	0	0
26	26		1	2	3	1.0	2.0	3.0	1.0	1.0	1.0	0.0	0.021343	0.071023	0.018528	0	25	2	0	0
27	27		2	0	2	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.153795	0.0	0.022867	0	26	3	0	0
28	28		1	3	4	1.0	3.0	4.0	2.0	0.714286	0.8	0.666667	0.136167	0.124932	0.015684	0	27	3	0	0
29	29		2	1	3	2.0	1.0	3.0	2.0	0.6	0.666667	2.166667	0.157511	0.053909	0.019275	0	28	2	0	0
30	30		2	2	4	2.0	2.0	4.0	1.0	1.0	1.0	1.0	0.244471	0.089508	0.016896	0	29	3	0	0

Add columnMerge columnsDelete columnClear columnCopy data to other columnFill column with a valueDuplicate columnCreate a boolean column from regex matchCreate column with list of regex matching groupsNegate boolean valuesConvert column to dynamic

Type here to search

18°C Haze2/8/20239:06 PM

# Statistics :

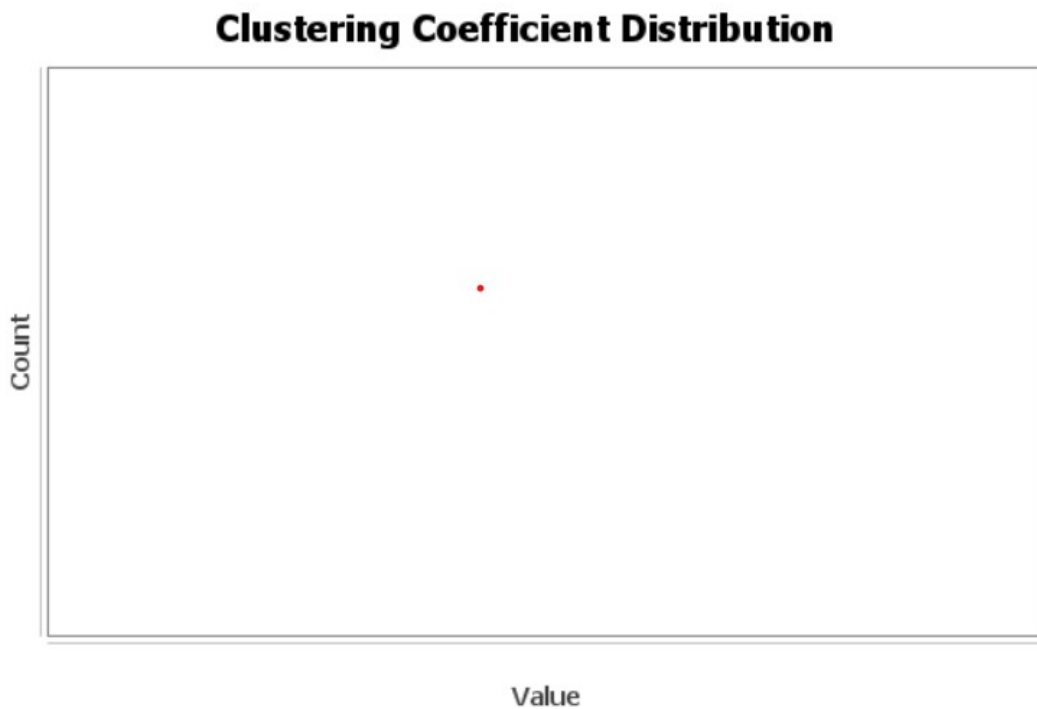
Context x			
Nodes: 34			
Edges: 78			
Directed Graph			
Filters Statistics x			
Settings			
Network Overview			
Average Degree	2.294	Run	
Avg. Weighted Degree	2.294	Run	
Network Diameter	3	Run	
Graph Density	0.07	Run	
HITS		Run	
PageRank		Run	
Connected Components	1	Run	
Community Detection			
Modularity	0.416	Run	
Statistical Inference	227.68	Run	
Node Overview			
Avg. Clustering Coefficient	0.285	Run	
Eigenvector Centrality		Run	
Edge Overview			
Avg. Path Length	1.274	Run	

## Average clustering coefficient Distribution :

### Results:

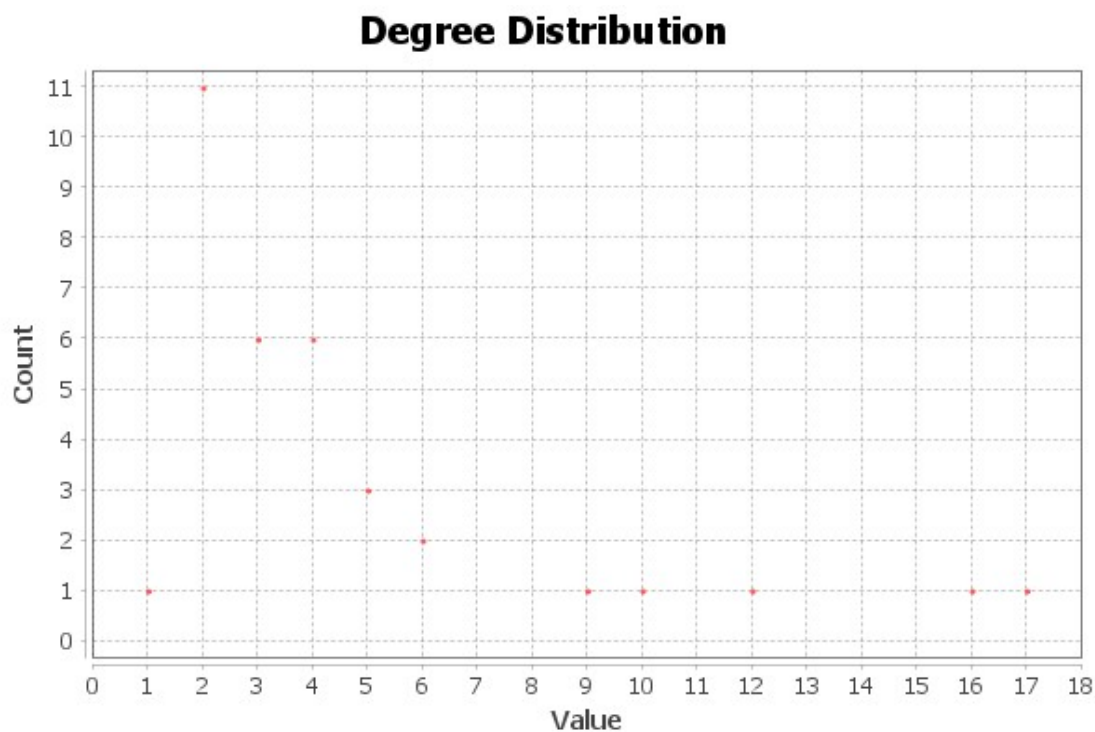
Average Clustering Coefficient: 0.285

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

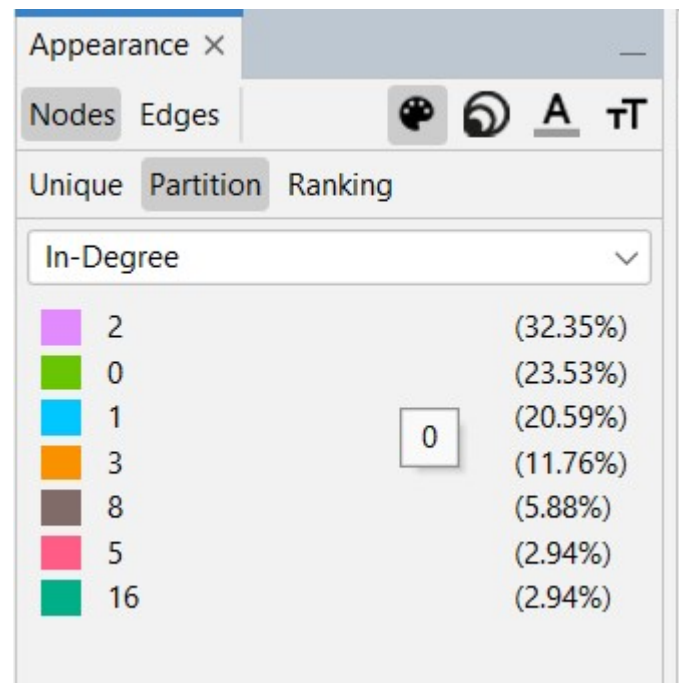
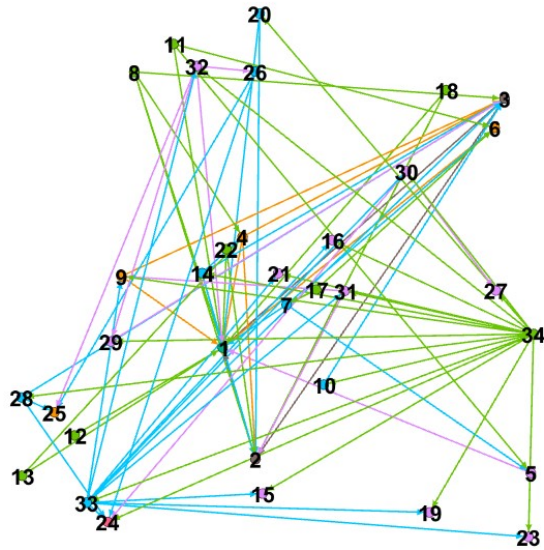


## Degree Distribution :

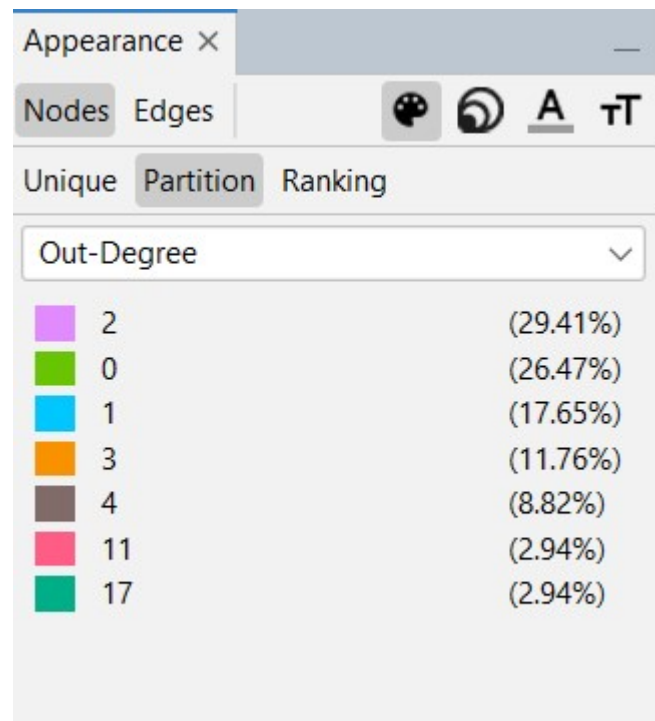
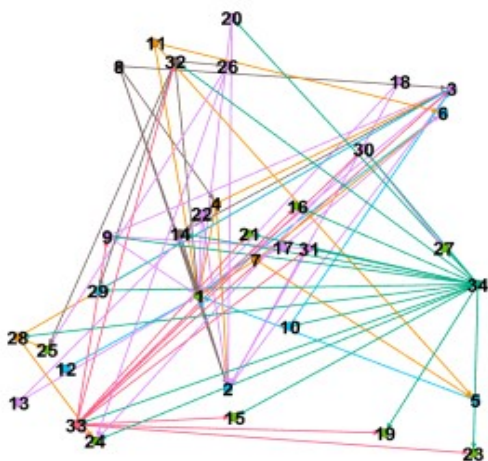
1. Average degree = 2.294



## Indegree :



## Outdegree :





**Average path length :**

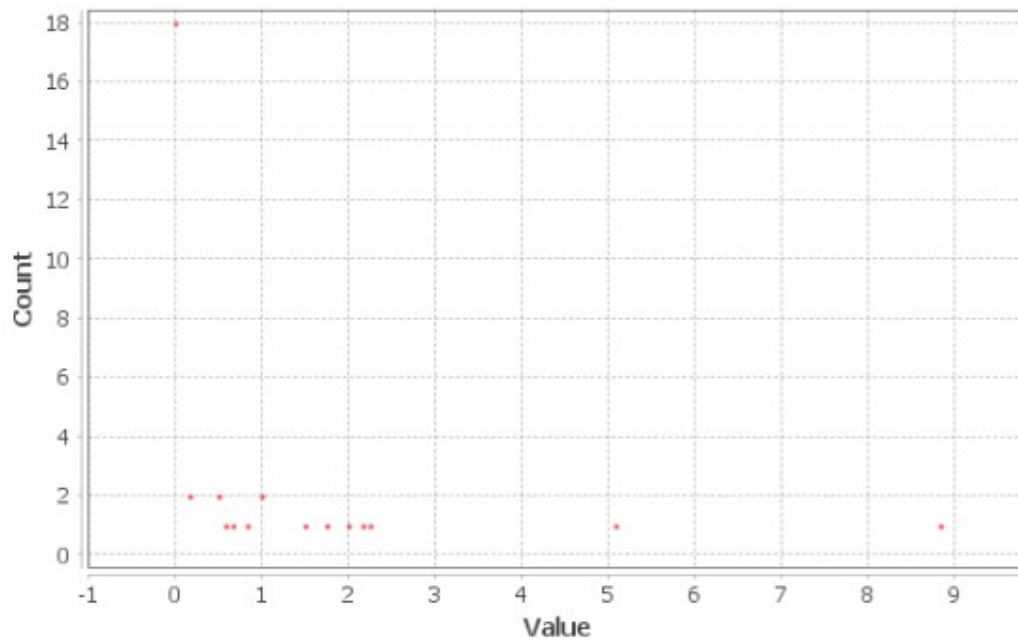
**Results:**

Diameter: 3

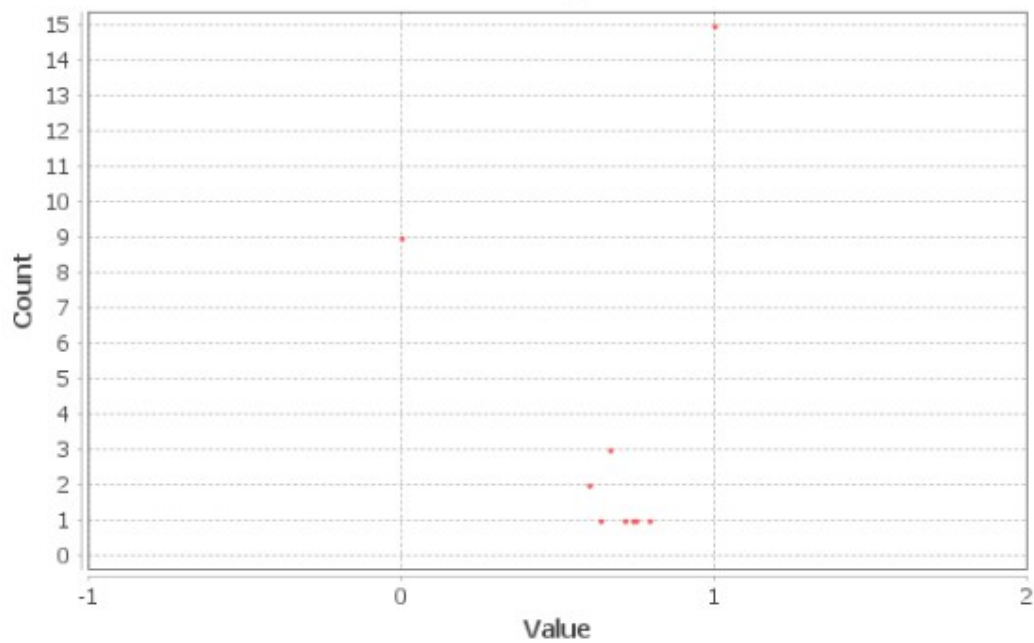
Radius: 0

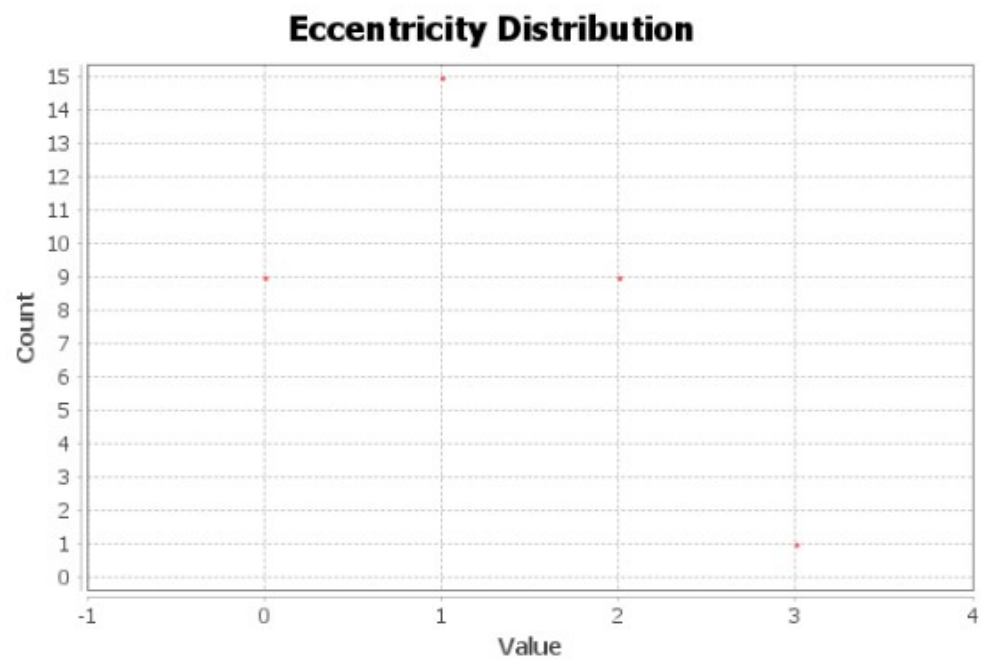
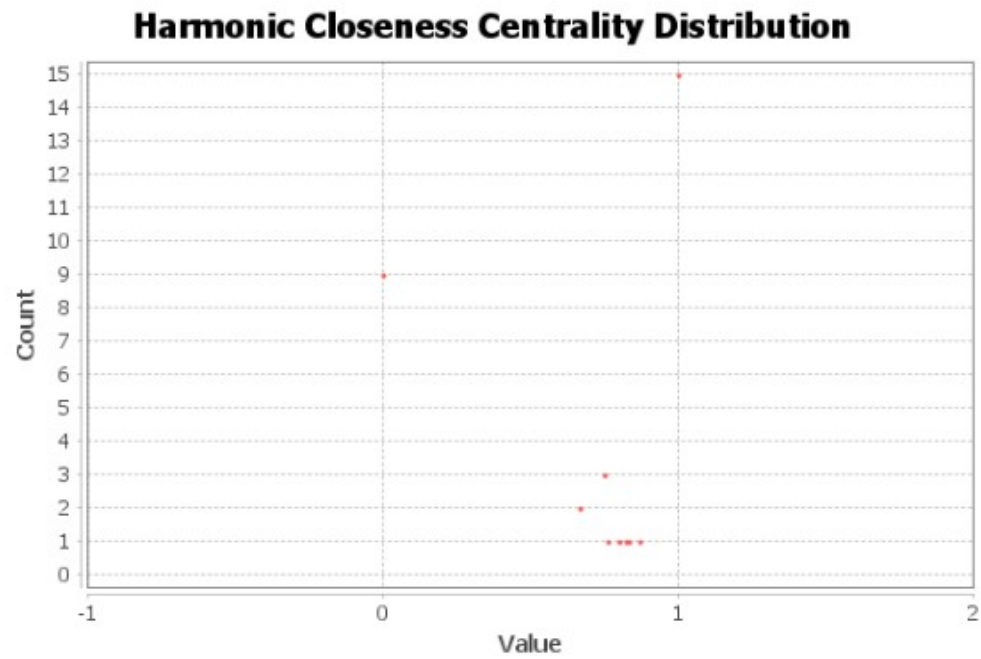
Average Path length: 1.2735849056603774

### **Betweenness Centrality Distribution**



### **Closeness Centrality Distribution**



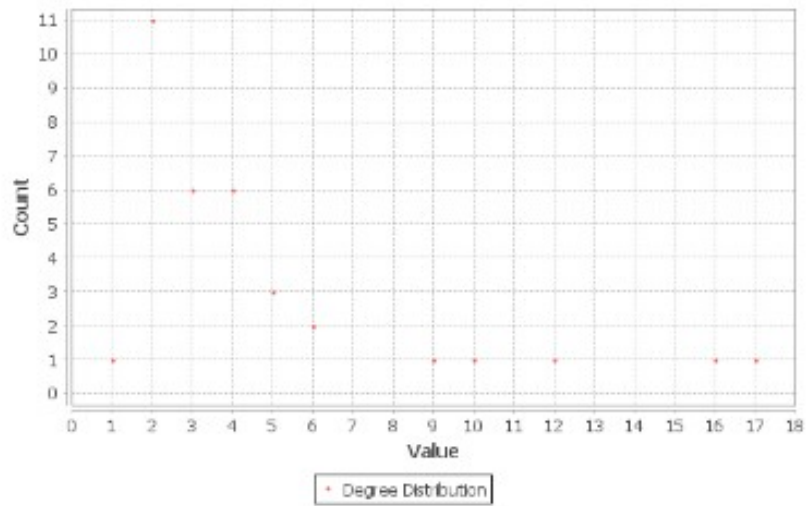


**Average weighted degree :**

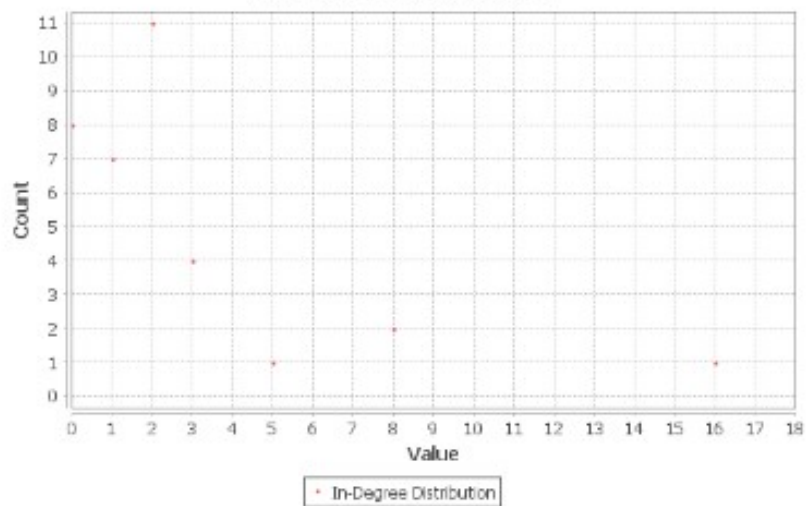
## Results:

Average Weighted Degree: 2.294

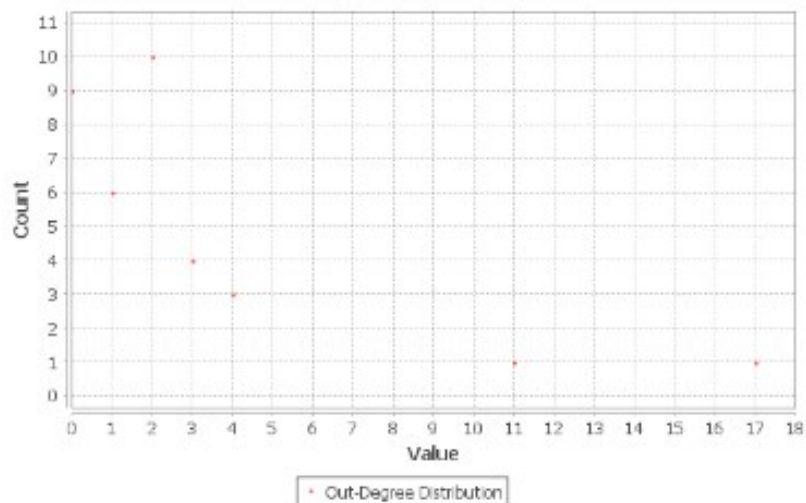
### Degree Distribution



### In-Degree Distribution



### Out-Degree Distribution

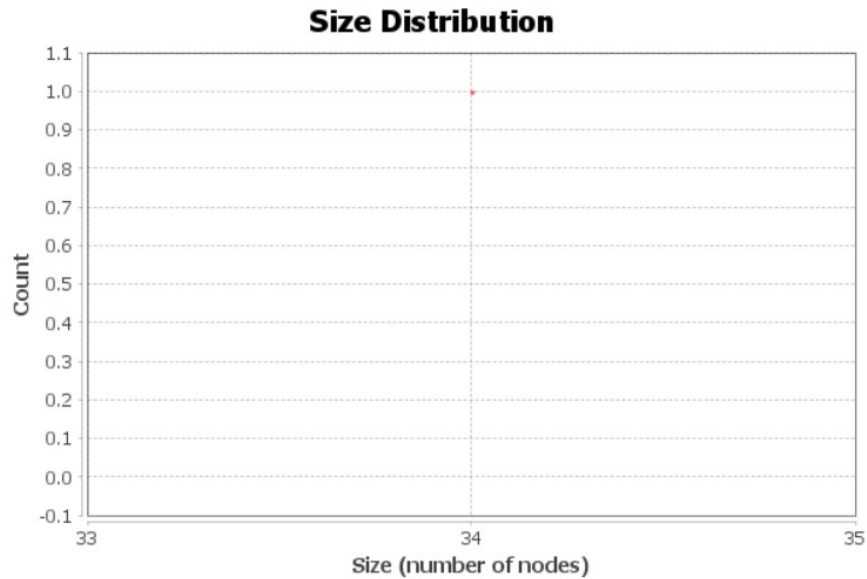


## Connected components :

### Results:

Number of Weakly Connected Components: 1

Number of Strongly Connected Components: 34



## Eigenvector centrality :

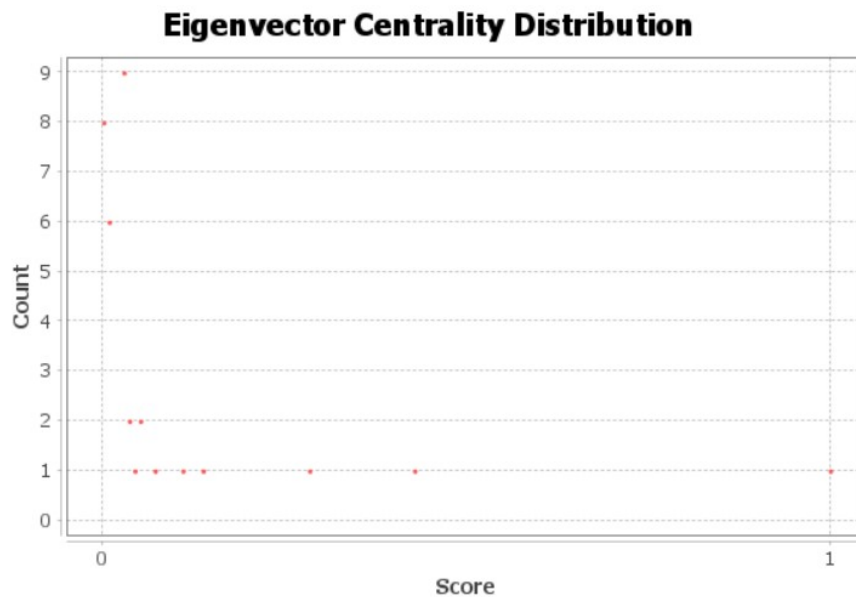
### Parameters:

Network Interpretation: directed

Number of iterations: 100

Sum change: 0.003985081431127474

### Results:



Graph density :

Graph Density Report

Parameters:

Network Interpretation: directed

Results:

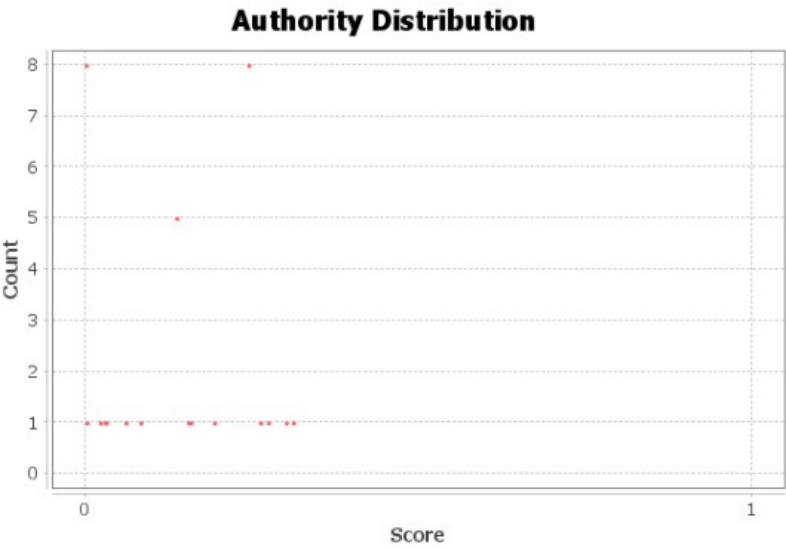
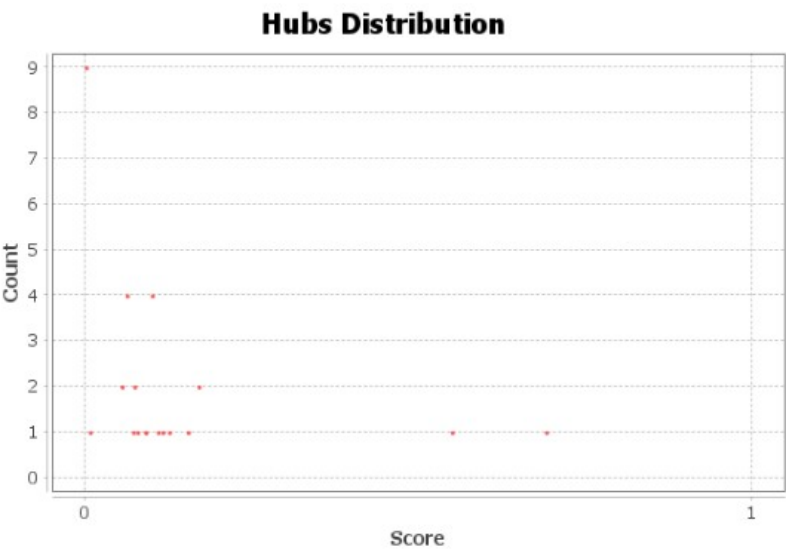
Density: 0.070

Hits :

Parameters:

E = 1.0E-4

Results:



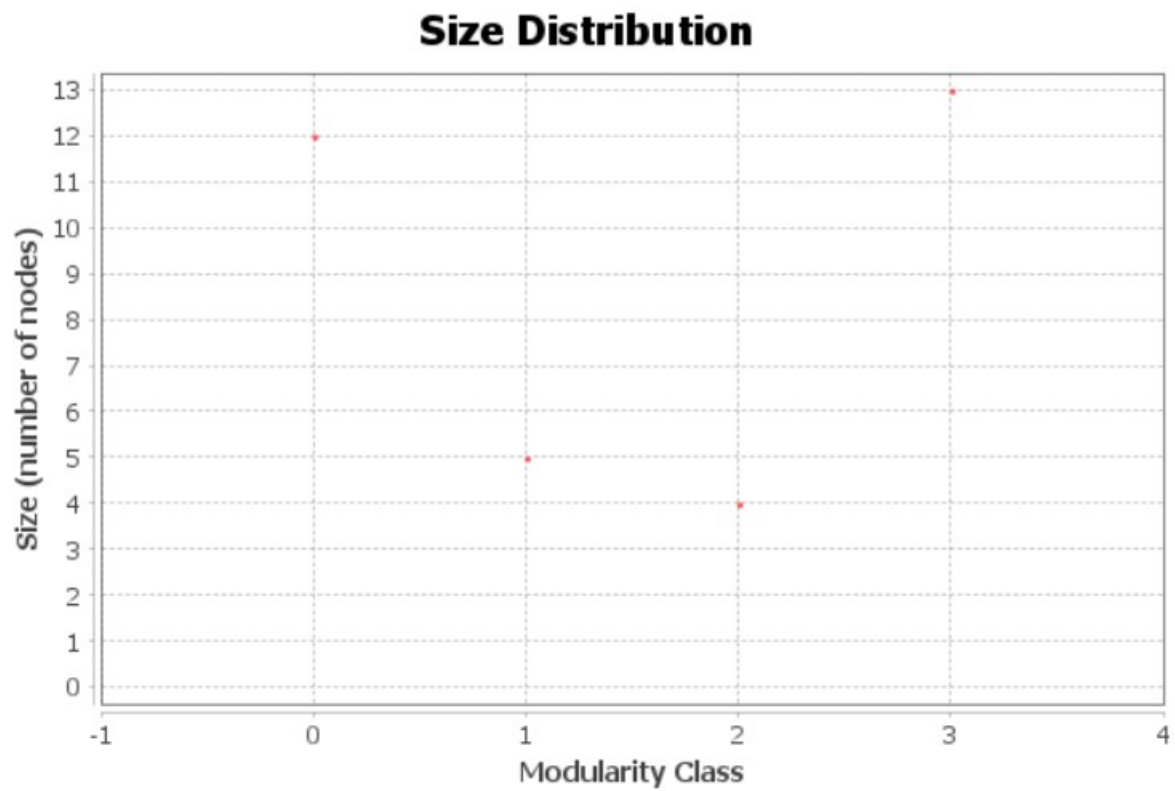
## Modularity :

## Parameters:

Randomize: On  
Use edge weights: On  
Resolution: 1.0

## Results:

Modularity: 0.416  
Modularity with resolution: 0.416  
Number of Communities: 4

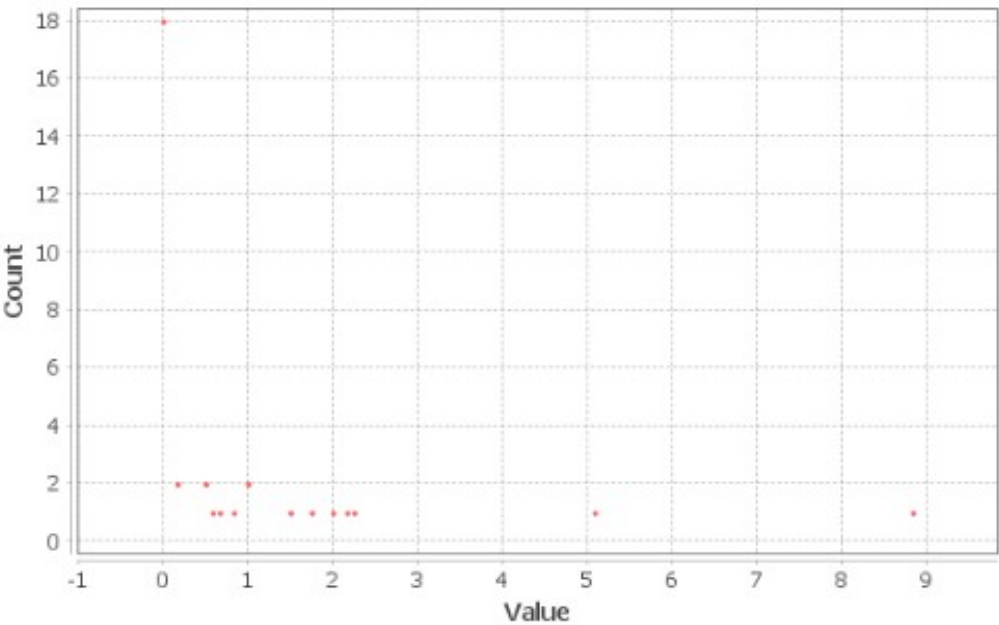


## Network diameter :

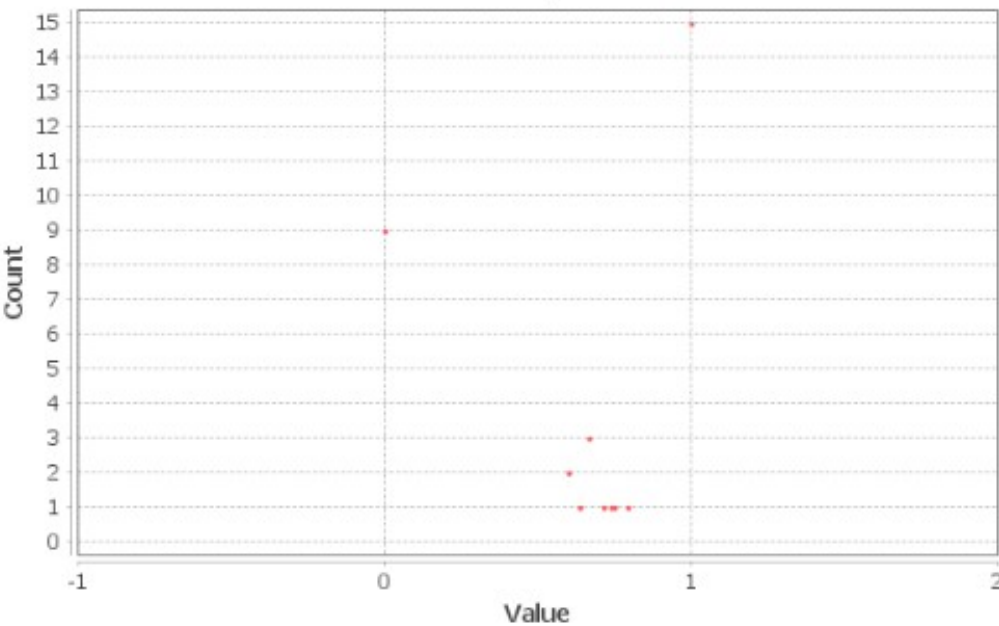
**Results:**

Diameter: 3  
Radius: 0  
Average Path length: 1.2735849056603774

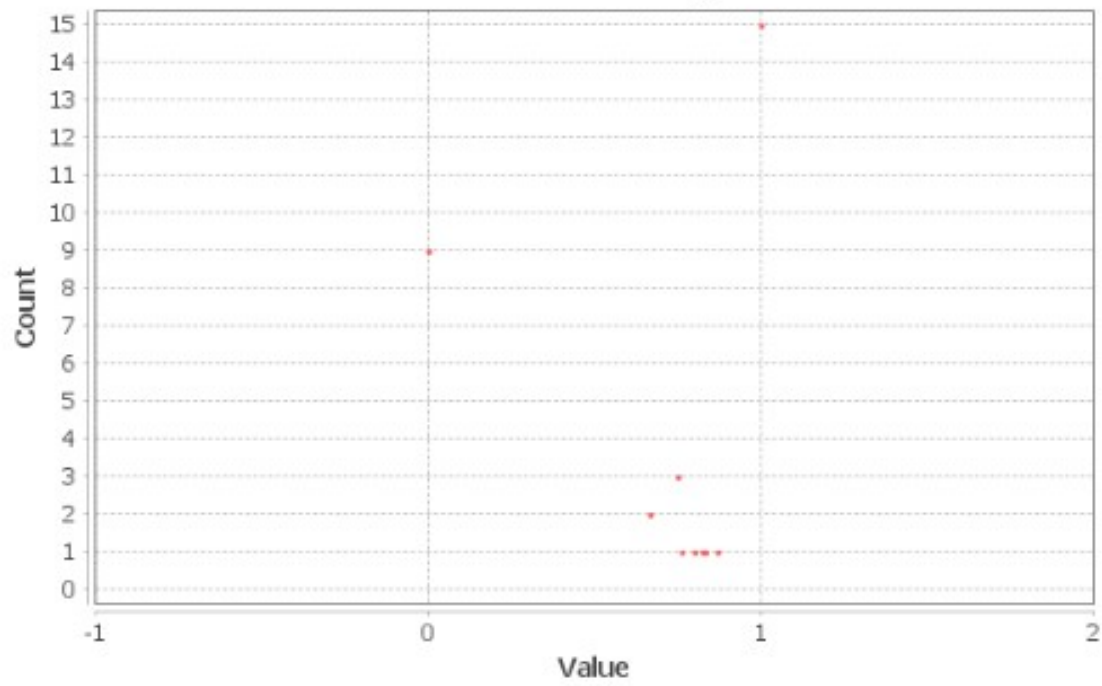
**Betweenness Centrality Distribution**



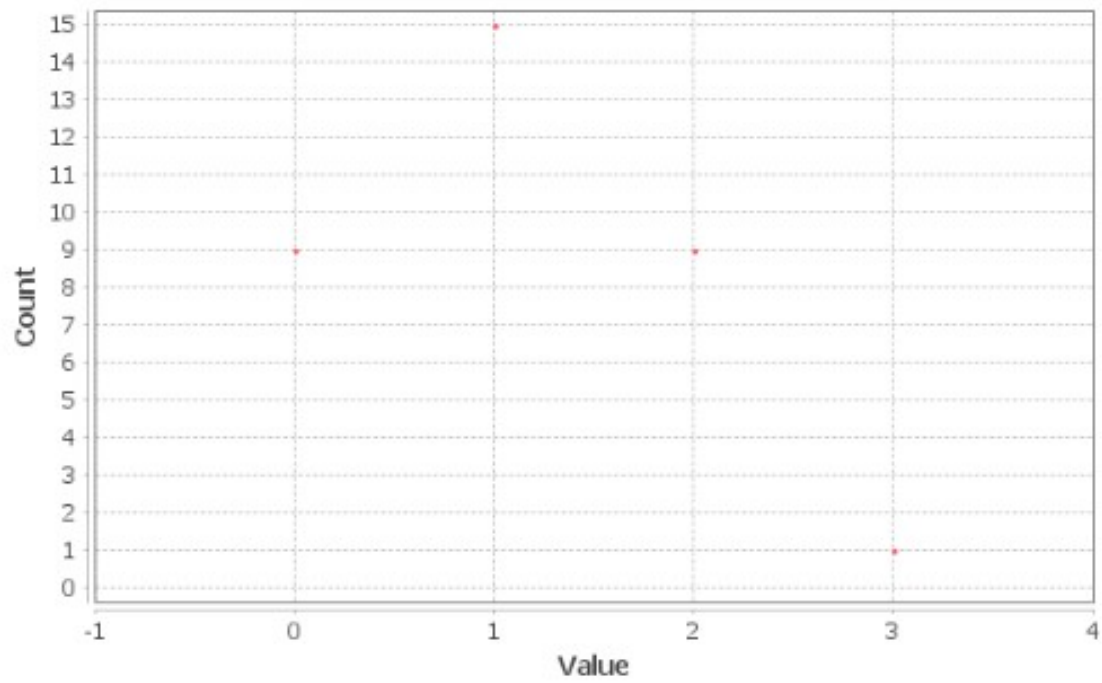
**Closeness Centrality Distribution**



**Harmonic Closeness Centrality Distribution**



**Eccentricity Distribution**



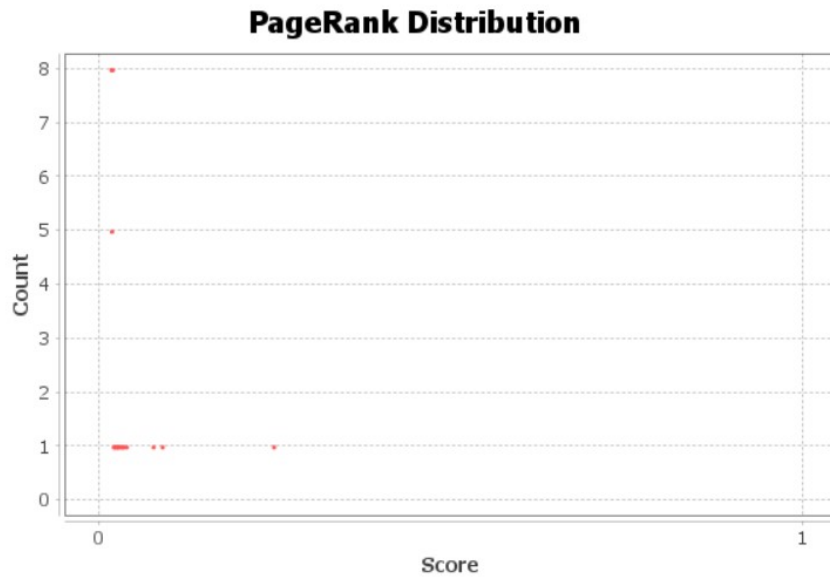


## Page rank :

### Parameters:

Epsilon = 0.001  
Probability = 0.85

### Results:



## Statistical inference :

### Results:

Description Length: 227.680  
Number of Communities: 1

