

The background features a dark, textured surface with torn white paper edges at the top and bottom. Dried, light-colored flowers with multiple small blossoms are arranged in clusters on the left and right sides.

MAMMALIA RACCOON PROXIMITY NETWORK ANALYSIS

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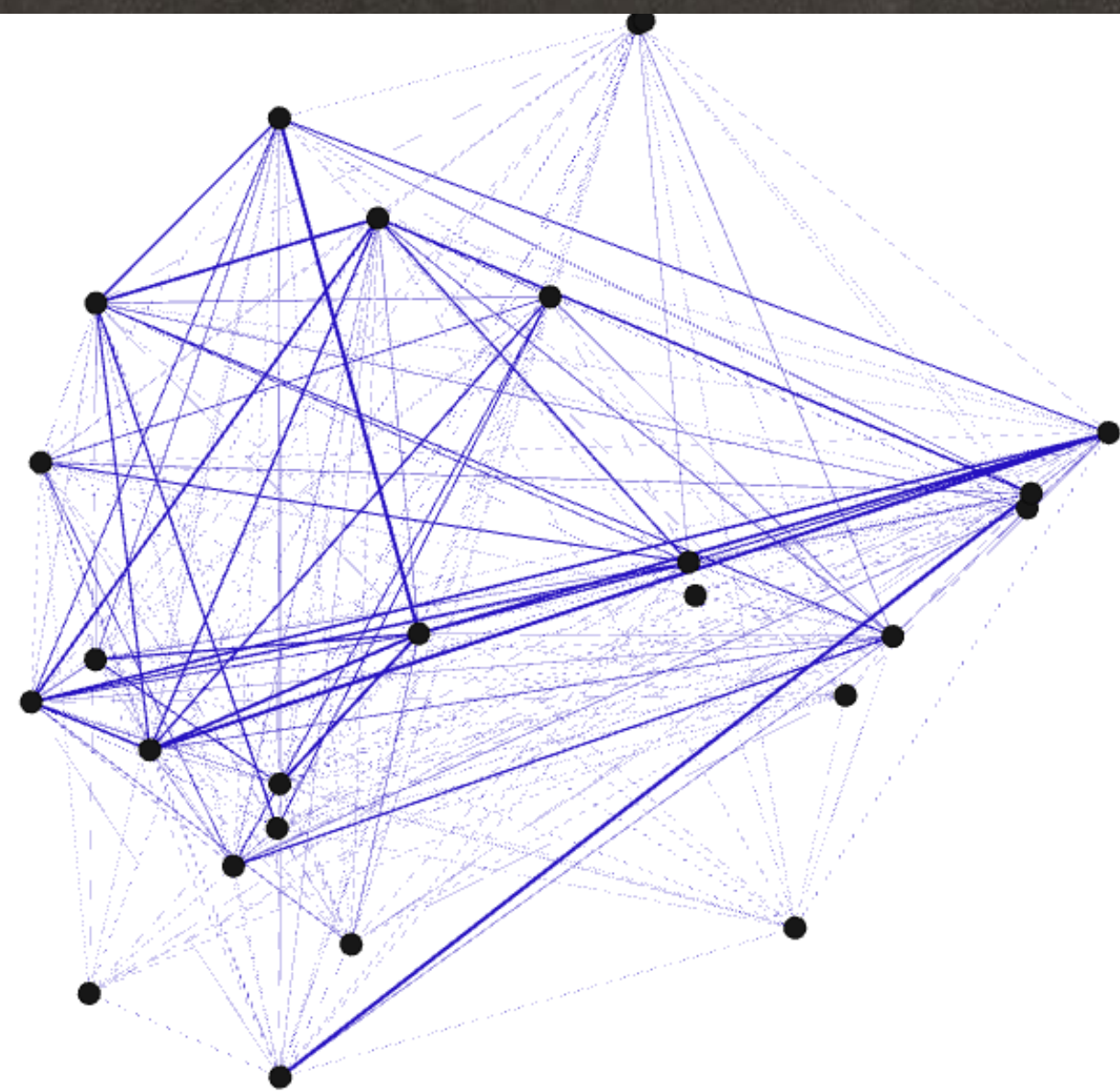
ABSTRACT

- Raccoons are an important vector of rabies and other pathogens.
- Because the spread of rabies in wild raccoon populations has been well documented across much of the US , rabies incidents are a particularly useful model for studying and understanding the spread of pathogens in wild raccoons.
- The degree to which these pathogens can spread through a raccoon population is closely linked to association rates between individual raccoons.
- By analysing this dataset we can calculate more precise transmission probabilities by infected individuals, and determine how disease infection changes normal social behaviors.

ABOUT THE NETWORK

- proximity detecting collars and social network metrics were used to calculate the degree of social connectivity in an urban raccoon population for purposes of estimating potential pathogen spread.
- the raccoon social networks based on the total amount of time spent in close proximity between two individuals per month was considered.
- Among these diseases, rabies is perhaps the most important from a human health perspective, and understanding how pathogens are transmitted in raccoon populations is important for devising effective management and disease abatement strategies

The raccoons are considered as nodes and the interaction between them are represented by weighted edge. the dataset contains 24 nodes and 2k edges. the connection between two raccoons means there is a short period interaction between them. the weight of the edge describes how close they are to each other.



CENTRALITY MEASURES

1. DEGREE CENTRALITY
2. CLOSENESS CENTRALITY
3. BETWEENNESS CENTRALITY
4. CLUSTERING CENTRALITY
5. EIGENVECTOR CENTRALITY
6. PAGERANK ALGORITHM

Date.

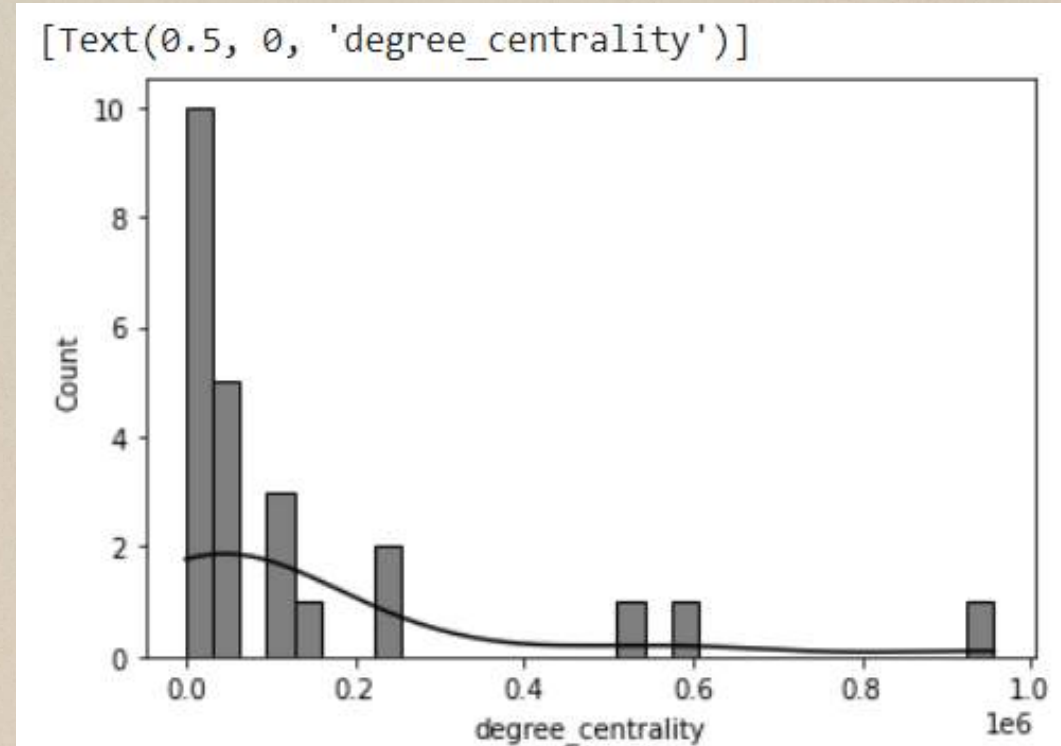
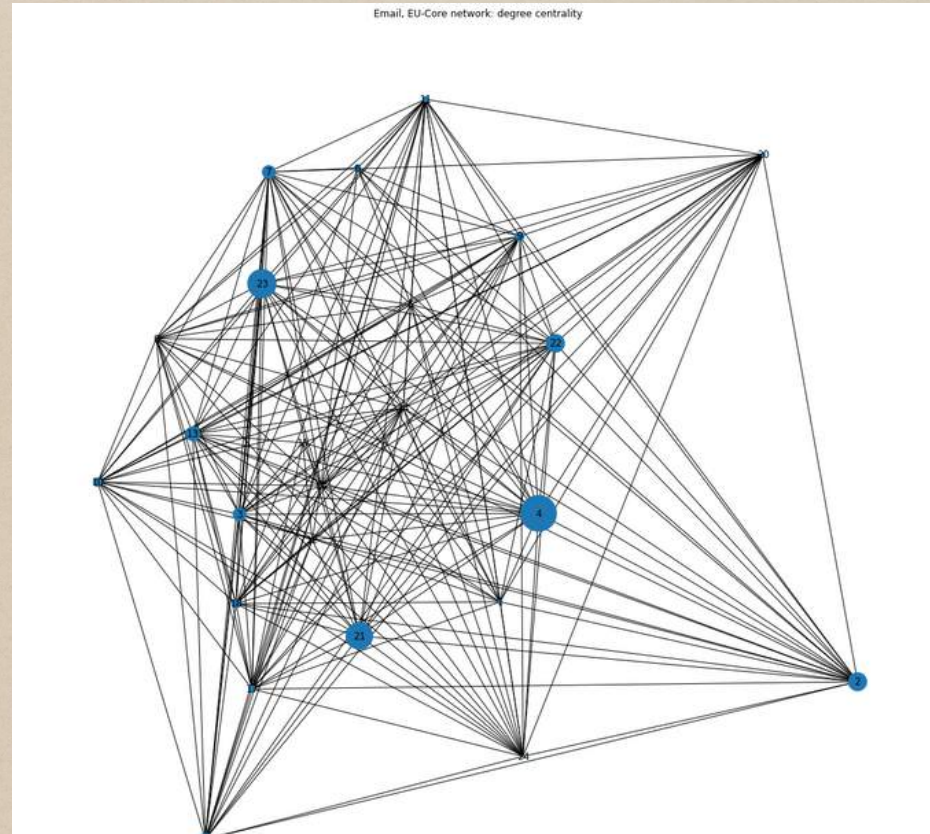
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DEGREE CENTRALITY

- The degree centrality of a node is simply its degree—the number of edges it has.
- The higher the degree, the more central or important the node is.
- This can be an effective measure, since many nodes with high degrees also have high centrality by other measures.



INFERENCE



```
[(4, 956341),  
(23, 599657),  
(21, 528234),  
(2, 244429),  
(22, 240324),  
(13, 147027),  
(7, 123597),  
(3, 123321),  
(19, 100806),  
(10, 57511),  
(9, 57236),  
(18, 51569),  
(17, 36498),  
(6, 32002),  
(11, 23524),  
(1, 11288),  
(20, 10730),  
(24, 6230),  
(8, 4579),  
(16, 3342),  
(5, 2156),  
(14, 1253),  
(12, 128),  
(15, 40)]
```

- The Racoon with highest number of interaction with other racoons is racoon no. 4, as we can see in the output from the code, which has the descending order of racoons with their number of interaction with other racoons.
- so raccoon number 4 is considered to be an important raccoon. so this raccoon plays an important part in the pathogen spreading across all other racoons

Date.

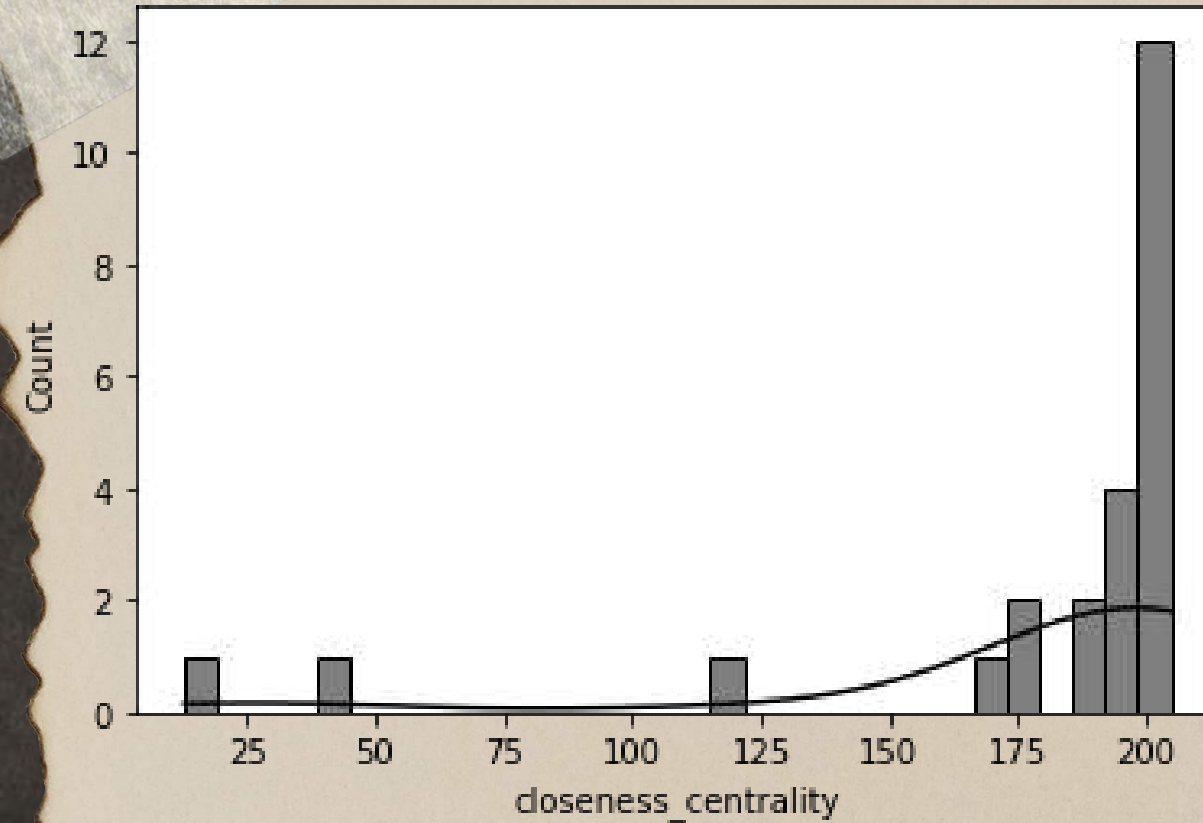
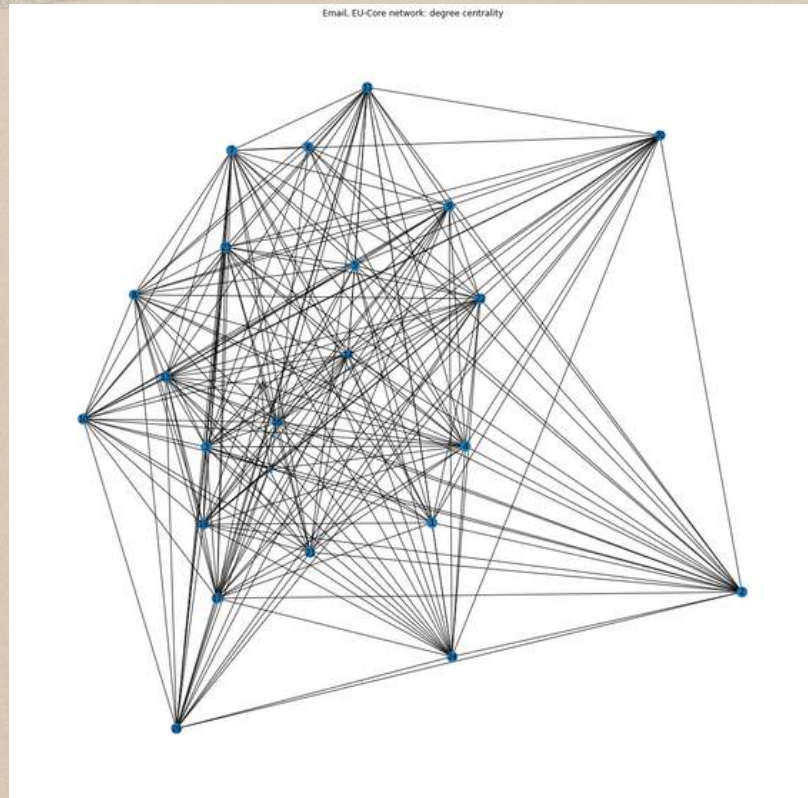
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CLOSENESS CENTRALITY

- Measure of the average shortest distance from each vertex to each other vertex.
- Way of detecting nodes that are able to spread information very efficiently through a graph.
- The closeness centrality of a node measures its average farness (inverse distance) to all other nodes.
- Nodes with a high closeness score have the shortest distances to all other nodes.



INFERENCE



```
sorted(closeness_centrality(), key=rank, reverse=True)[0:25]
```

Raccoon ID	Closeness Centrality
2	204.79366575112326
10	204.66118305511912
22	204.64535112414626
7	203.74531956134143
13	203.5282714440535
4	203.47081693127765
23	203.38559450695615
21	203.37482365757847
11	202.8703067188598
9	202.7427972482784
17	202.4741870296576
18	202.32878942286607
19	198.36661952225487
3	198.02600417277188
1	197.66252912032206
6	196.90820769123968
20	191.34156900456566
24	190.9768726039375
8	175.217800656248
16	173.41640289947222
5	170.92144369995498
14	121.26765394501324
12	38.600161105265826
15	12.942284756348759

- as we can see that raccoon number 2 with the closeness centrality of 204.79 is closer to all other raccoons, raccoon 2 has more probability of easily spreading the pathogens to all other raccoons
- if this raccoon has inhabited the pathogen then we can say that all others raccoons which are interacting with this have high probability of being infected by the rabies.

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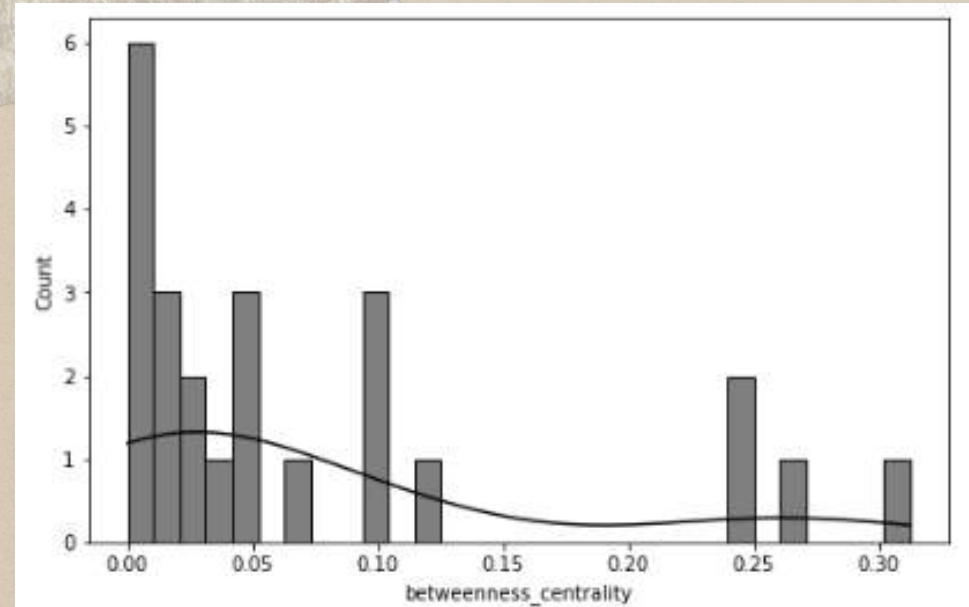
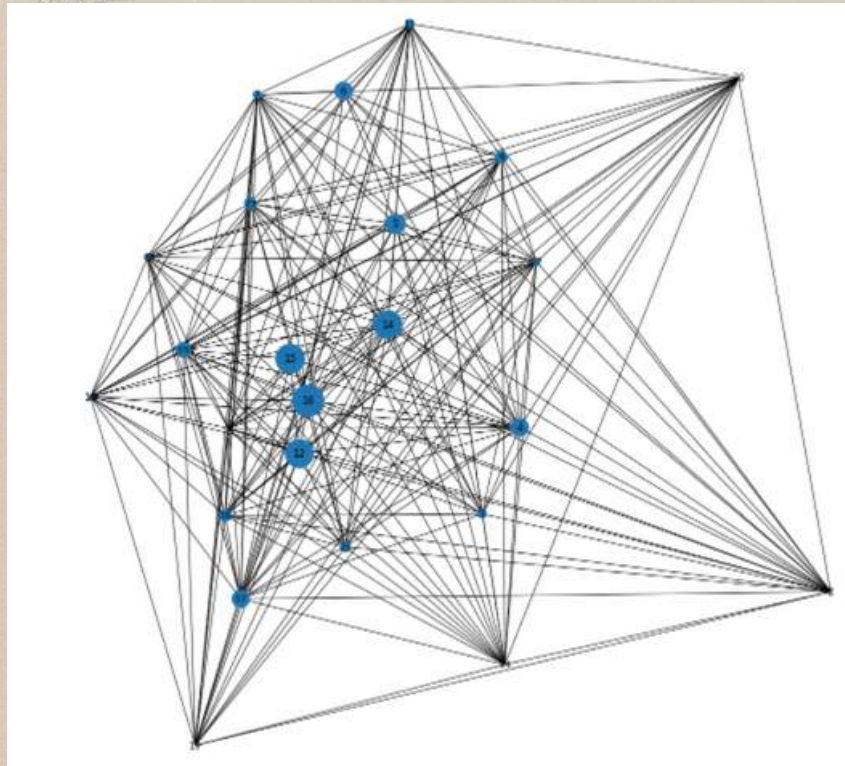
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BETWEENNESS CENTRALITY



- It quantifies how many times a particular node comes in the shortest chosen path between two other nodes.
- Vertices with high betweenness may have considerable
- Way of detecting the amount of influence a node has over the flow of information in a graph.
- It is often used to find nodes that serve as a bridge from one part of a graph to another.

INFERENCE



16	0.31225296442687744
15	0.2628458498023715
12	0.24703557312252963
14	0.24703557312252963
5	0.11857707509881422
4	0.09683794466403162
6	0.09683794466403162
17	0.09486166007905138
13	0.06916996047430829
9	0.04545454545454545
18	0.043478260869565216
23	0.043478260869565216
21	0.03359683794466403
1	0.023715415019762844
11	0.023715415019762844
7	0.01976284584980237
22	0.015810276679841896
8	0.01383399209486166
10	0.003952569169960474
2	0.0
3	0.0
19	0.0
20	0.0
24	0.0

- Through Betweenness Centrality, we can find those areas which act as a key bridge for pathogen transfer across the racoon population. The Centrality values and the important areas inferred from the distribution are depicted above:
- we can see that raccoon number 16 has more influence over the flow of information in this network
- so we can infer that the probability for the spread of pathogen through raccoon 16 is high.

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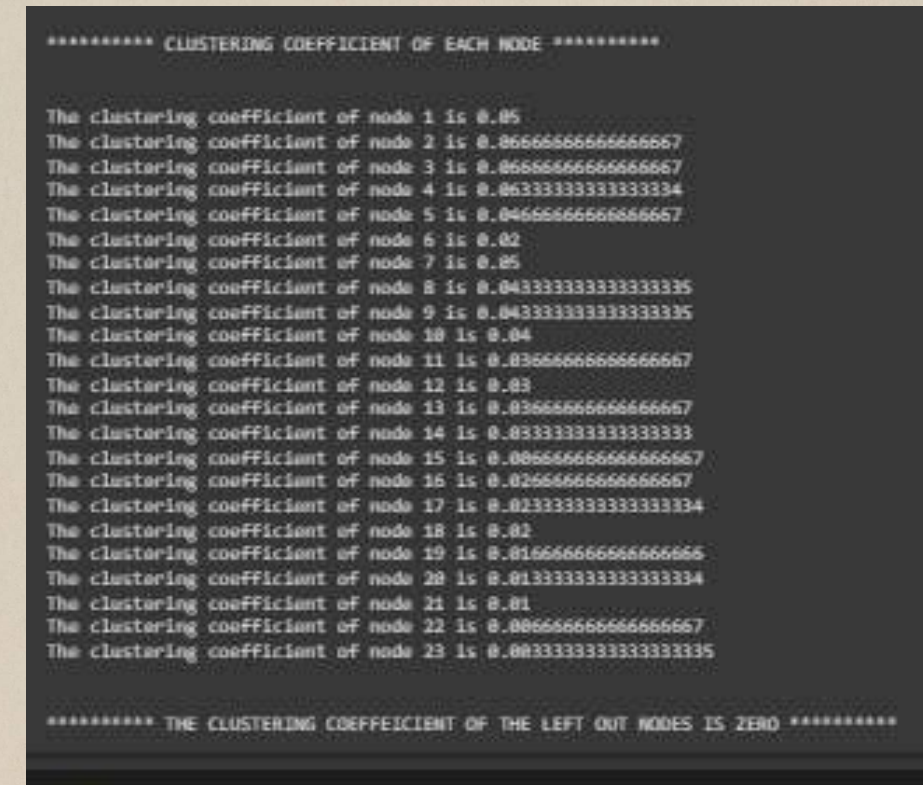
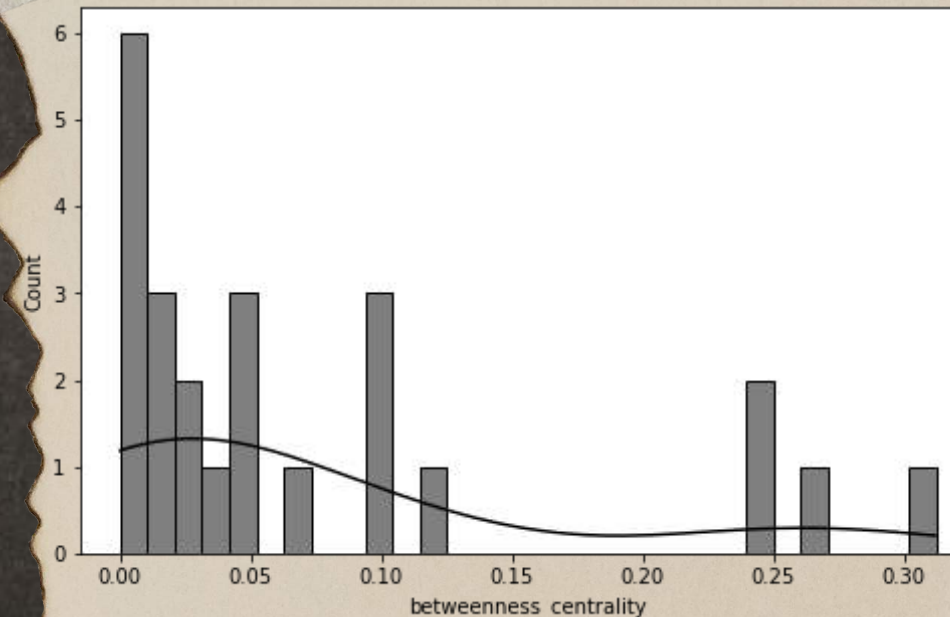
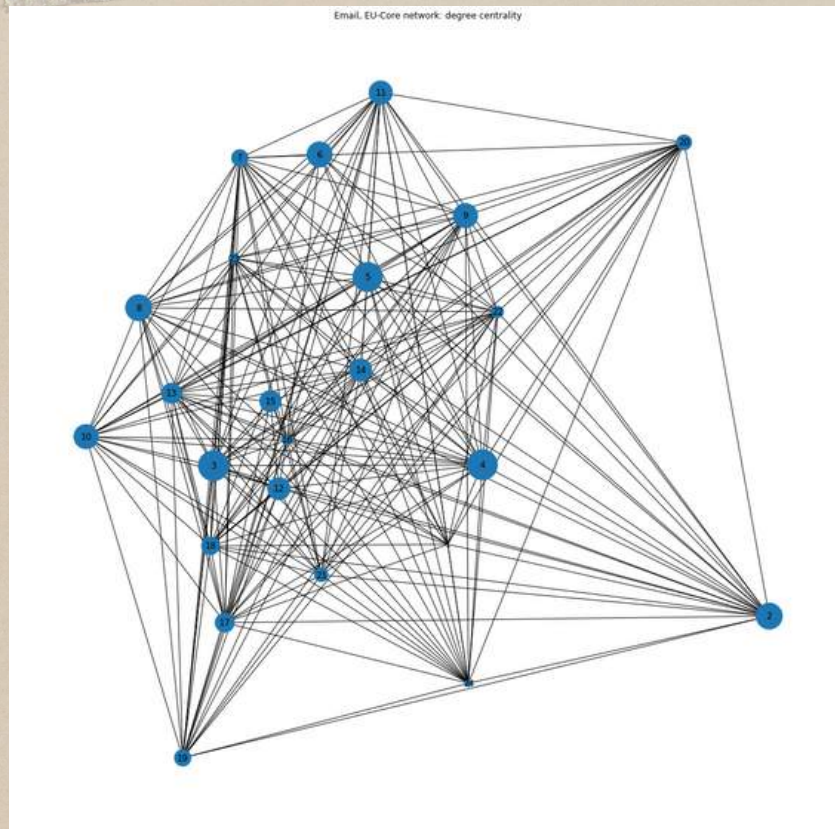
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CLUSTERING CENTRALITY



- Clustering is a process of partitioning a set of data into meaningful subsets so that all data in the same group are similar and the data in different groups are dissimilar in some sense
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- A clustering coefficient is a measure of the degree to which nodes in a graph tend to cluster together.
- Clustering has wide applications in social science, biology, chemistry, and information sciences.

INFERENCE



the maximum clustering coefficient is given by: 0.06666666666666667 for the node 2

- since raccoon 2 has the most clustering coefficient of about 0.0667 we can infer that it has more probability for becoming a part of a family.
- and we can also see that being a part of the family and if it has been infected by rabies and the probability for that particular raccoon family

Date.

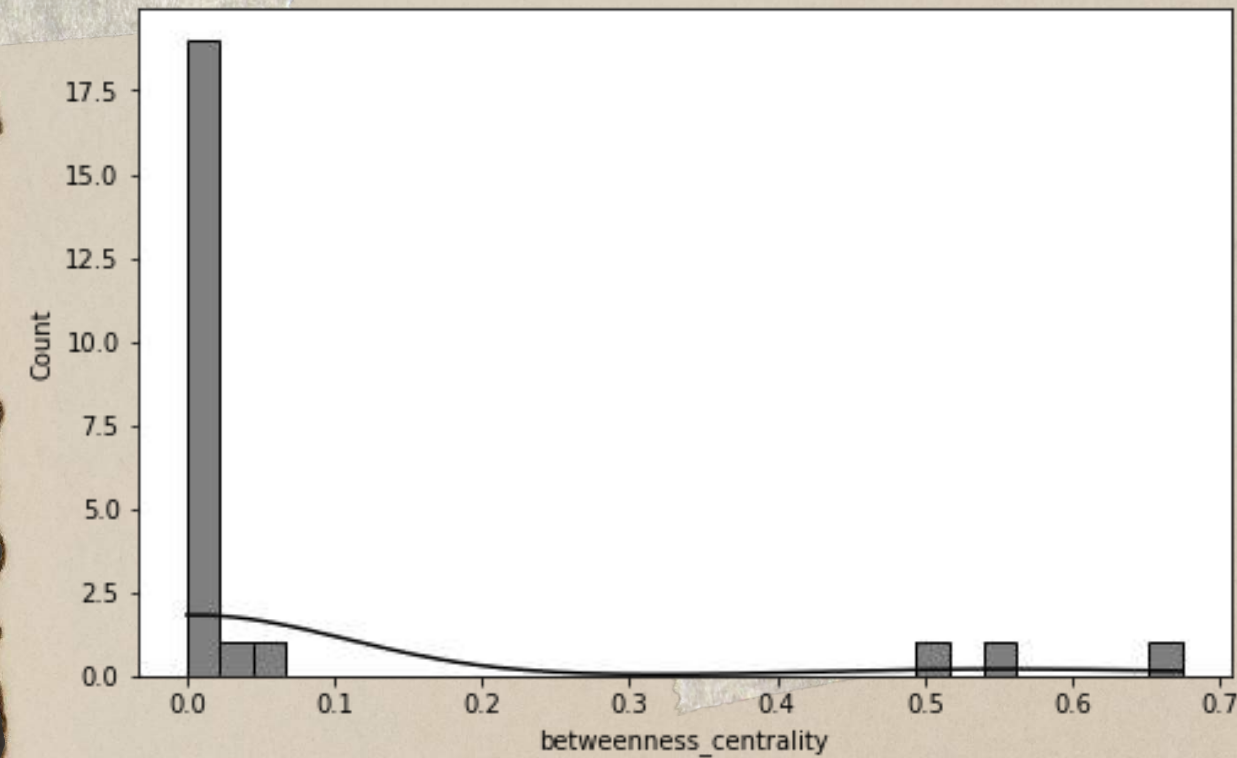
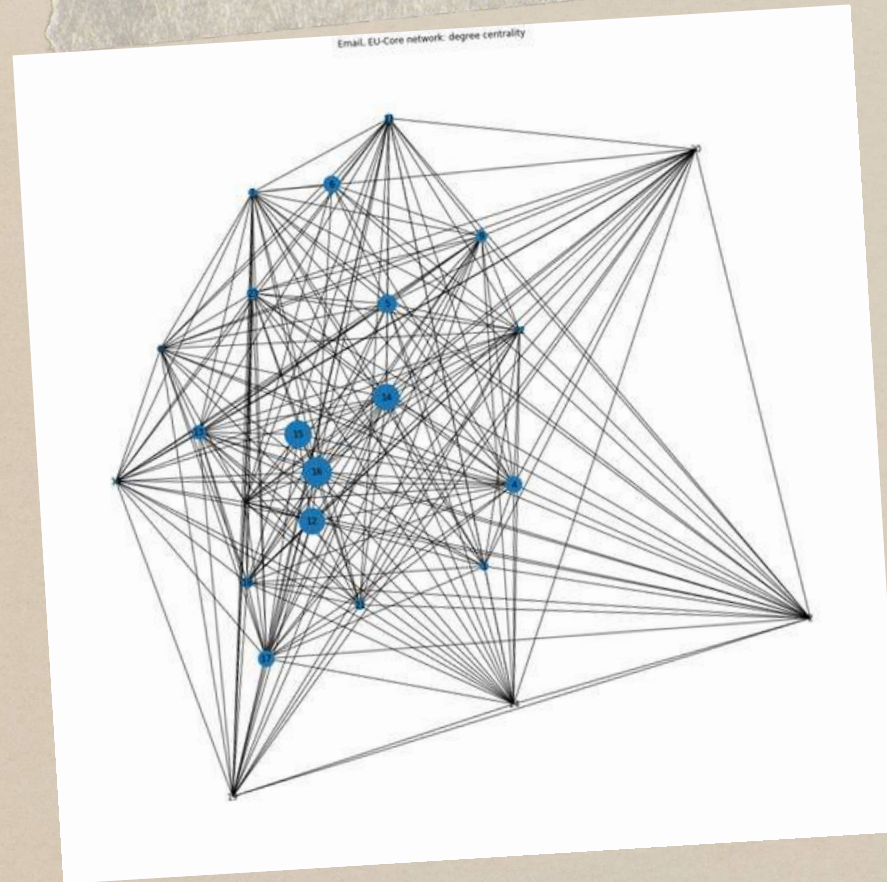
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EIGENVECTOR CENTRALITY

- Eigenvector centrality is a measure of the influence a node has on a network.
- Relative scores are assigned to all nodes in the network based on the concept that connections to high-scoring nodes contribute more to the score of the node in question than equal connections to low-scoring nodes.
- A high eigenvector score means that a node is connected to many nodes who themselves have high scores



INFERENCE



4	0.6742021857338013
23	0.5422080529538386
21	0.49741553208343736
9	0.05368098326768007
10	0.03383647349874086
19	0.0017725477113193183
22	0.0015719912344405534
24	0.0012934786931137223
3	0.0010881750747848253
5	0.0010758674576531613
2	0.0010638096766298032
20	0.0007727249697573776
17	0.000747386018979088
11	0.0007188951278298675
7	0.0004365908814012529
16	0.00039601727210943543
18	0.00038559600679239015
13	0.000310136862716165
6	0.0001789736201727748
1	9.650582550869021e-05
8	8.570189255685156e-05
14	2.314101006596197e-05
12	7.4714500871929645e-06
15	5.940408652058897e-06

- from the graph we can infer that raccoon number 4 has interaction with other raccoons which also has more number of interaction with other raccoons.
- so if this raccoon number 4 is being infected by rabies then the other raccoons with large number of interaction with other raccoons can also be infected.



THANK YOU

These findings demonstrate that raccoon populations are much more tightly connected than would have been predicted based on previous studies