Project

Task 1

Anchorage becomes infected at: 1229290800

Task 2

A close up of a map

Description generated with high confidence

P =0.01 Does not reach the whole network fully infected

P = 0.05 Does not reach the whole network fully infected

P = 0.1 Does not reach the whole network fully infected

P = 0.5 reaches the whole network fully infected

P = 1 reaches the whole network fully infected

The nearly periodic steps are due to changes in flight frequencies during days and nights. This causes the probability to jump more during daytime when flights are arriving to destinations and the probabilities increase less during nights when flights do not arrive to destinations as frequently.

Task 3

a)

A close up of a map

Description generated with high confidence

b)

Differences are visible straight from the beginning since the infection of next node is sensitive to the amount of flights leaving from the infected node. For example nodes 4, 41 and 100 seem to be far more trafficked than nodes 0 or 200 because infection spreads a lot faster from those nodes. The air travel is structured so that there are some very large hubs that have a lot of flight both leaving and coming while many airports are quieter in terms of traffic.

c)

If the results were not averaged over many seed nodes. The results would be highly affected by the seed so that the results would not be generalizable for the whole network. For example a vulnerability of certain node could be exaggerated or underestimated if the seed node happened to be either strongly or weakly linked to the single seed node.

Task 4

a)

K-shell

A screenshot of a cell phone

Description generated with very high confidence

Clustering coefficient (c)

A screenshot of a cell phone

Description generated with very high confidence

Degree (k)

A screenshot of a cell phone

Description generated with very high confidence

Betweennes

A screenshot of a cell phone

Description generated with very high confidence

Closeness:

A screenshot of a cell phone

Description generated with high confidence

b)

Spearman test outputs:

Closeness: SpearmanrResult(correlation=-0.8664937094257209, pvalue=1.4494114518227346e-85)

Betweenness: SpearmanrResult(correlation=-0.67378614903087697, pvalue=2.8344016642122774e-38)

Degree: SpearmanrResult(correlation=-0.84057476649312679, pvalue=1.0122681251300255e-75)

Clustering coefficient: SpearmanrResult(correlation=-0.144065747648911, pvalue=0.016033839196139234)

K-shell: SpearmanrResult(correlation=-0.84818017205401652, pvalue=2.0384407130492527e-78)

🡪 Closeness is the best predictor from the centrality measures

c)

Task 5

a)

A close up of a map

Description generated with high confidence

b)

The best immunization strategies include betweenness, degree, closeness and strength. Especially betweenness seems to overachieve as an immunization strategy compared to its performance in spreading speed measurements. Whereas, Kshell seems to perform worse as an immunization strategy compared to its performance in spreading speed measurements.

Why does betweenness perform better? Why k-shell worse?

c)

The probability of picking a random node with degree k in any given network is the amount of nodes with degree k divided by the total number of nodes in the network kj / n.

The probability of picking a node with degree k by the social net immunization strategy is the amount of options there are to pick a neighbor of a k-degree divided but the total number of nodes in the network. So k\*kj / n.

Thus, the social net immunization has higher probability of picking higher degree nodes.

d)

Other immunization methods perform better since they are able to locate the high centrality nodes that are very high degree and crucial for the network

Task6

a)

A close up of a map

Description generated with high confidence

A close up of a map

Description generated with high confidence

b)