

Network Science (Mini Project)

Analysis of airport network of USA and the spread of covid19 due to movement of passengers from one state to another state by flights movement

Anuj Sharma
MT19061



Introduction:

In this mini-project, following analysis has been done:

- the analysis of airport network of USA
- Visualization of mapping between airports, states and covid 19 cases
- Analysis of effect of movement of passengers from one place to another on covid19 cases

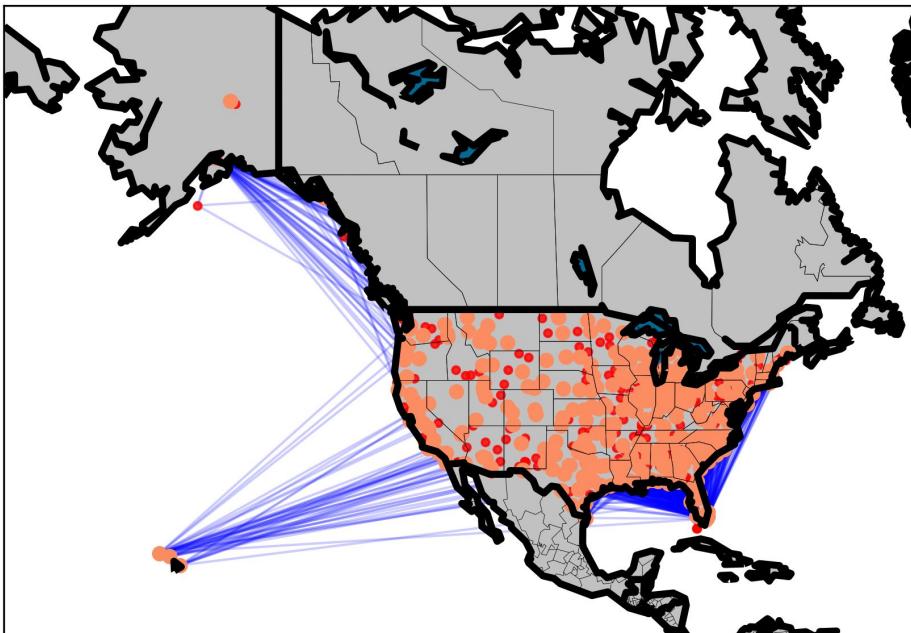


Modules Implemented:

1. Flightmap (Visualization of airport network of USA on terrain)
2. Graph visualization, Degree Distribution
3. Basic Network Properties
4. CC vs K plot
5. Knn vs K plot
6. Strength vs k plot
7. Cumulative Probability Distribution
8. Cumulative weight Distribution
9. Shortest Path length (number of stops vs count)
10. Compute shortest path (airports in between) and its visualization on terrain
11. Creation and comparison of Airport network with its corresponding random network
12. Creation and Visualization of State and Airport network without covid cases mapped with states
13. Creation and Visualization of State and Airport network with covid cases mapped with states
14. Creation and analysis of states connectivity network which are connected by direct flights between them
15. Displaying the effect of covid19 with time on number of states and on number of people
16. preprocessing of data to generate the result of dependency in spread of covid19 cases due to flights from one place to another in USA
17. Predicting dependency of spread of covid19 cases from the movement of flights from one place to another



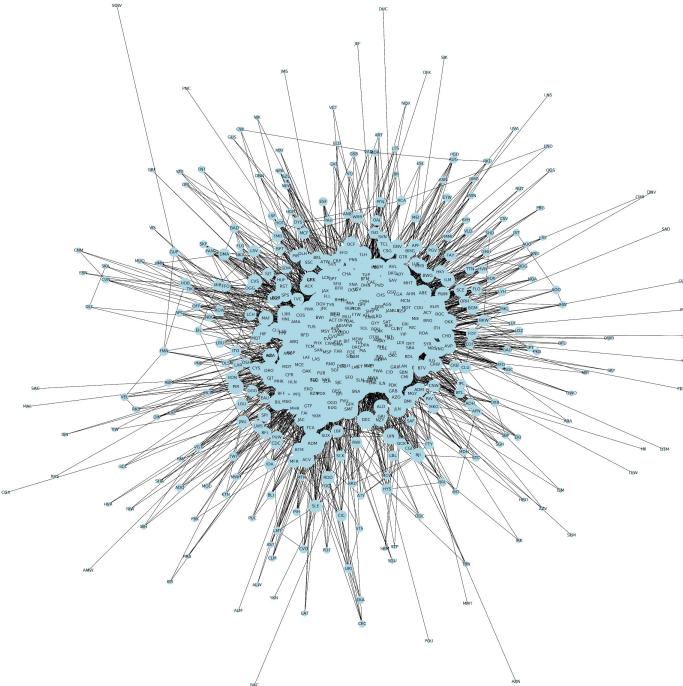
FlightMap



- Visualisation of airport network at USA terrain using longitude and latitude data of airports
- **Orange** color nodes are airports which are busy(or heavy traffic)
- **Red** color nodes are airports which are less busy(or less traffic)



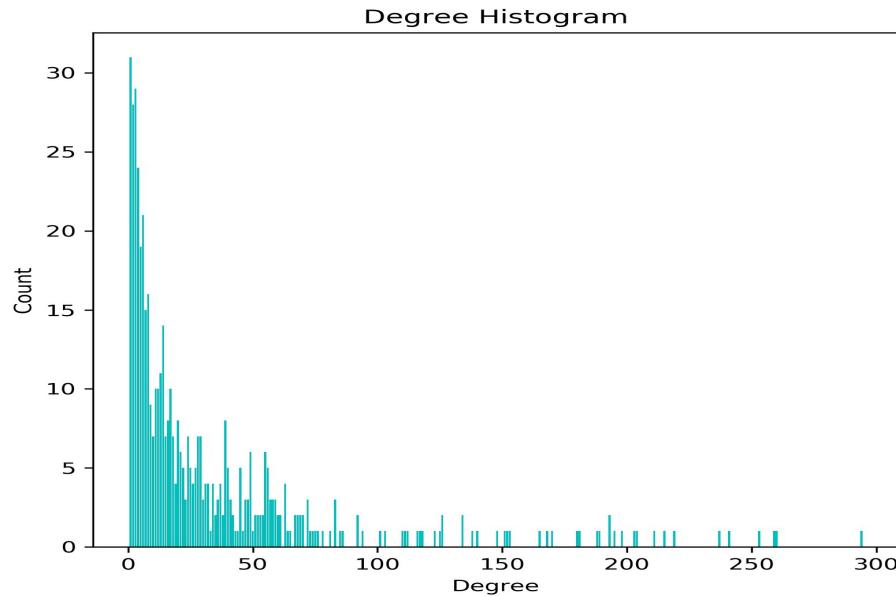
Flight Network Visualization



- Nodes are labelled by the names of airport.
- Node size represent the degree of the node i.e. the airport direct connectivity with other airports.



Degree Distribution of flight Network





Basic Network Properties

Number of nodes: 508

Number of edges: 8656

Average degree: 34.07

Node: MHK, Degree= 25, clustering coefficient= 0.53

Node: AMW, Degree= 1, clustering coefficient= 0

Node: EUG, Degree= 83, clustering coefficient= 0.29

.....

Average Clustering coefficient = 0.57

Average Shortest Path Length = 2.21



Comparison of Airport Network with its corresponding random network

Real graph:

Number of nodes: 508

Number of edges: 8656

Average degree: 34.07

Clustering coefficient = 0.57

Average Shortest Path Length = 2.21

Random graph: (100 instances)

Number of nodes: 508

Number of edges: min: 427 max: 124923 mean value: 64704.3

Average degree: 100.62 , range(70,400)

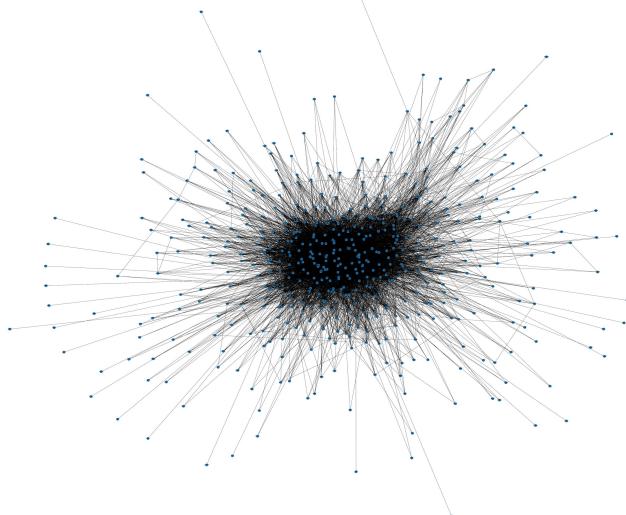
Clustering coefficient = min: 0 max: 0.99 mean value: 0.50

Average Shortest Path Length = min: 0.19 max: 3.57
mean value: 1.50

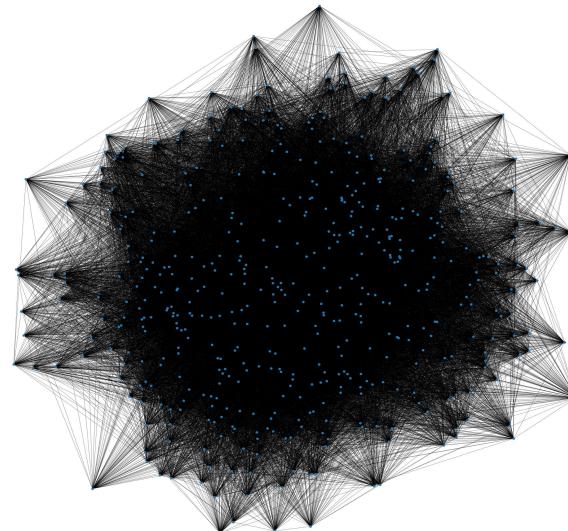


Comparison of Airport Network with its corresponding random network

Real graph



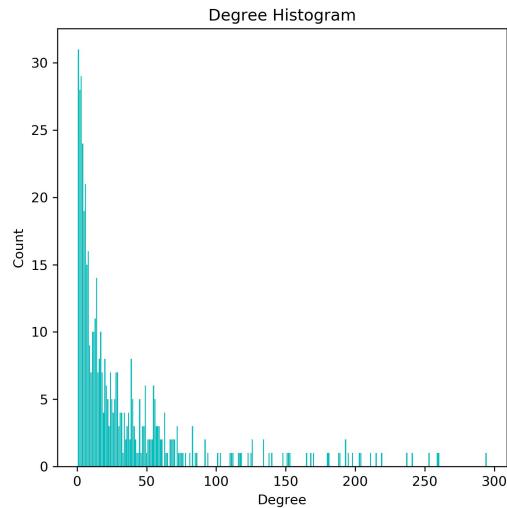
Random graph



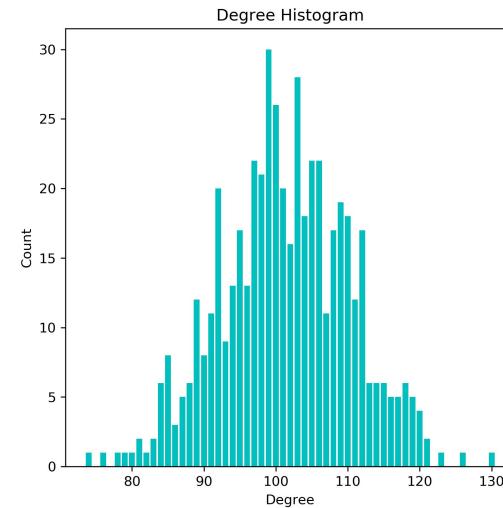


Comparison of Airport Network with its corresponding random network

Real Graph

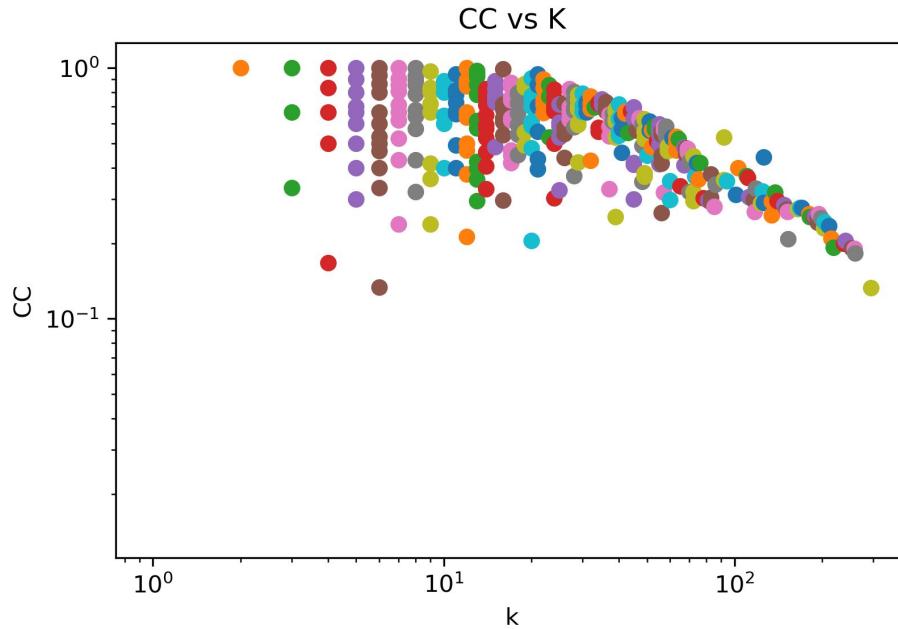


Random Graph



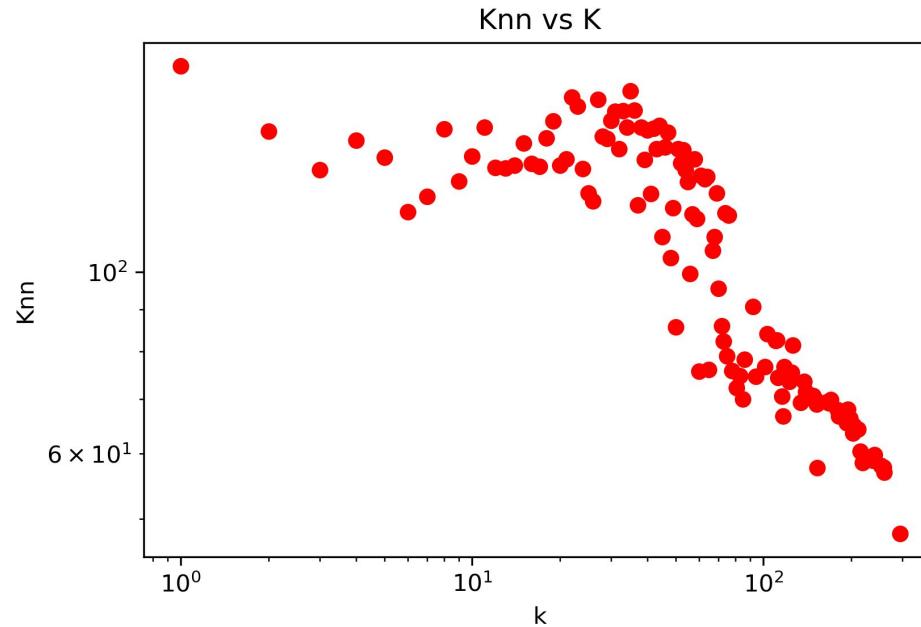


CC vs K



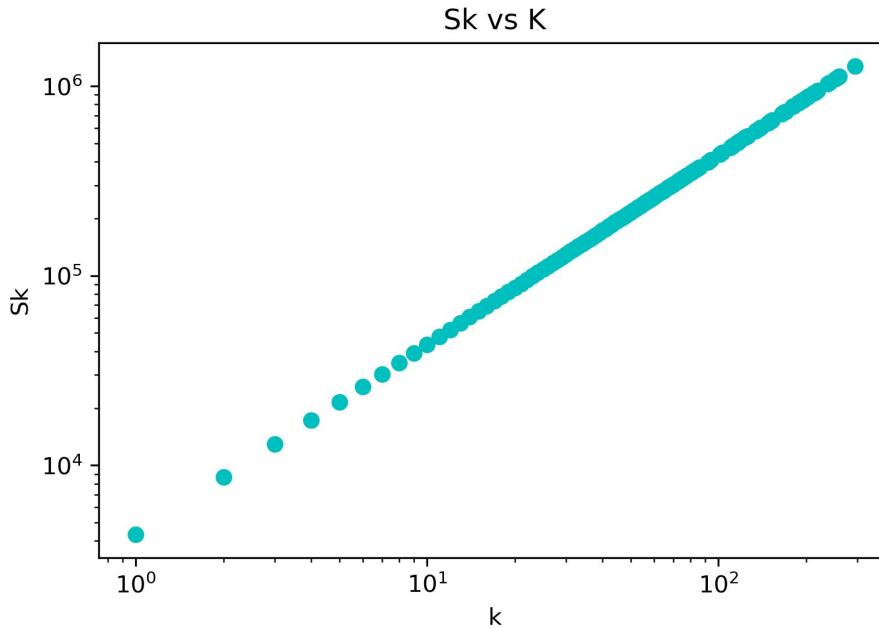


Knn vs k



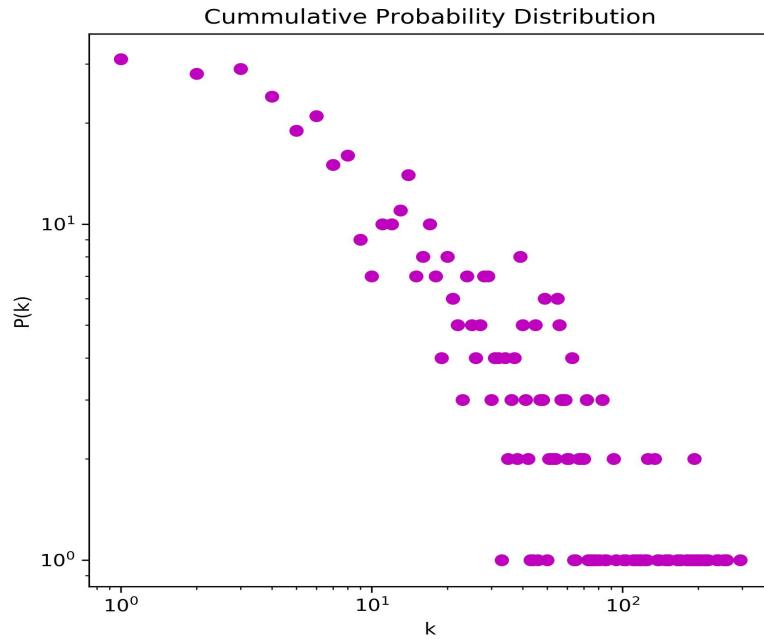


Strength vs K



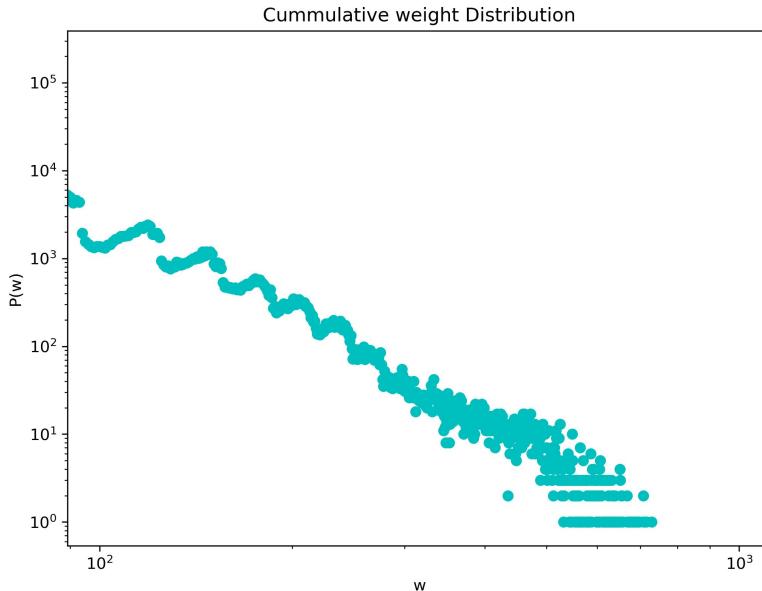


Cumulative Probability Distribution



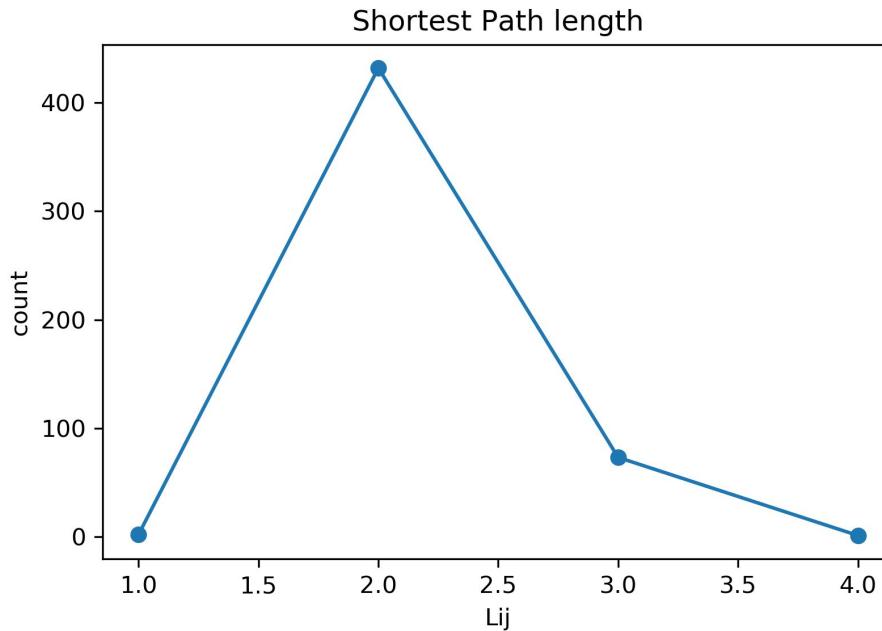


Cumulative Weight Distribution



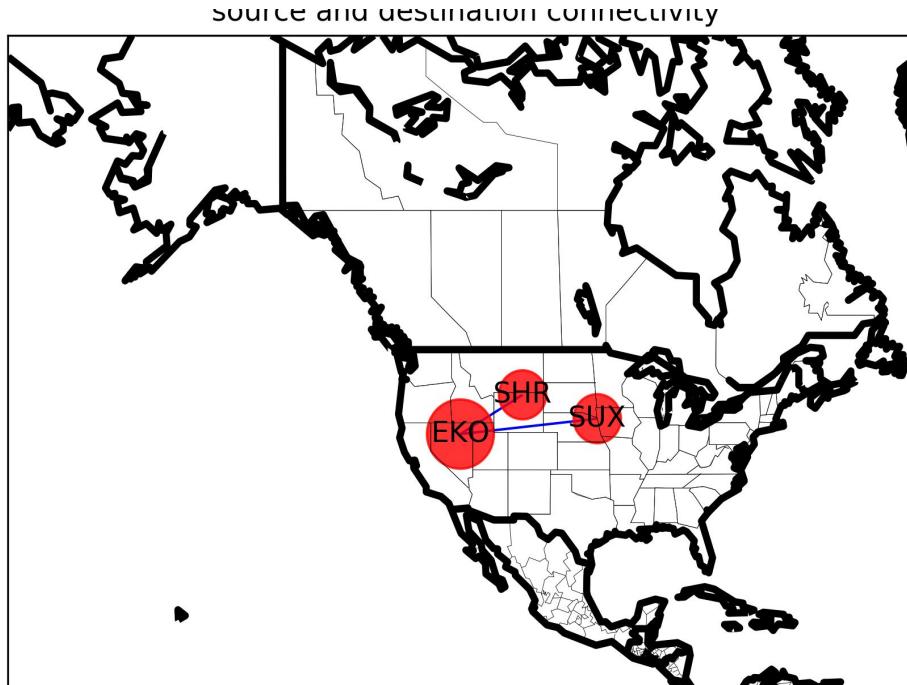


Shortest Path Length (number of stops) vs count

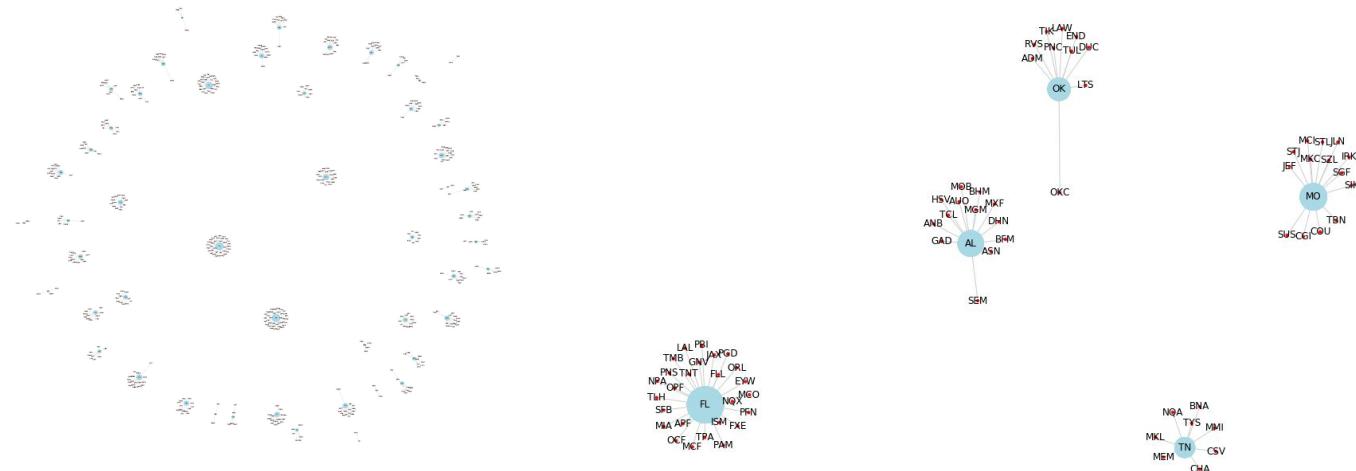




Shortest path visualization



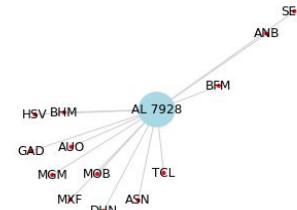
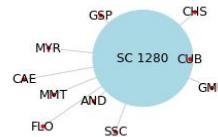
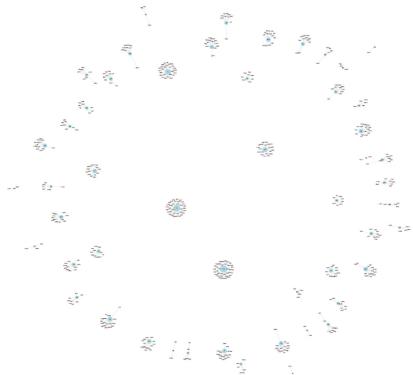
State and Airport network Visualization



Light blue color nodes are states and the red nodes connected to it are airports in that state



State and Airport network Visualization with covid19 positive cases



- State Node is labelled by the name of state and the number of positive covid19 cases in that state
- Size of state node represent the number of positive covid19 cases in that state



Analysis of State connectivity network that are connected by direct flights

Name: State connectivity network

Number of nodes: 51

Number of edges: 979

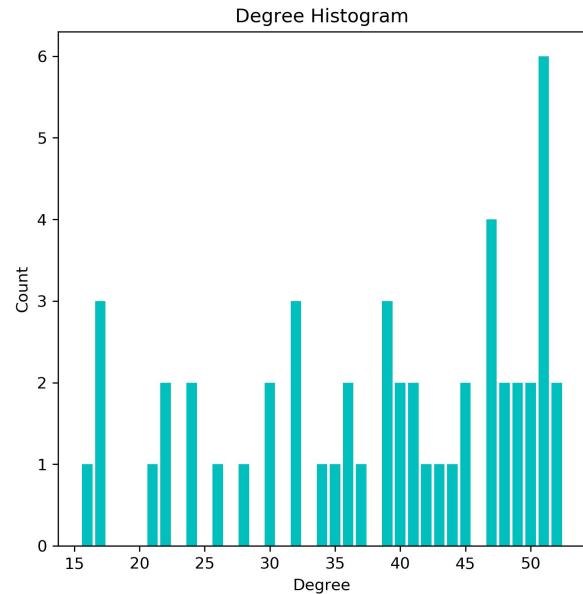
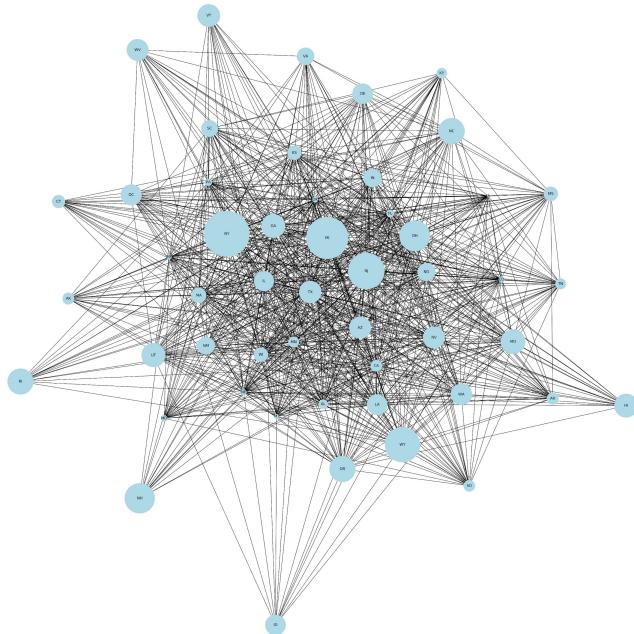
Average degree: 38.39

Clustering coefficient = 0.86

Average Shortest Path Length = 1.26

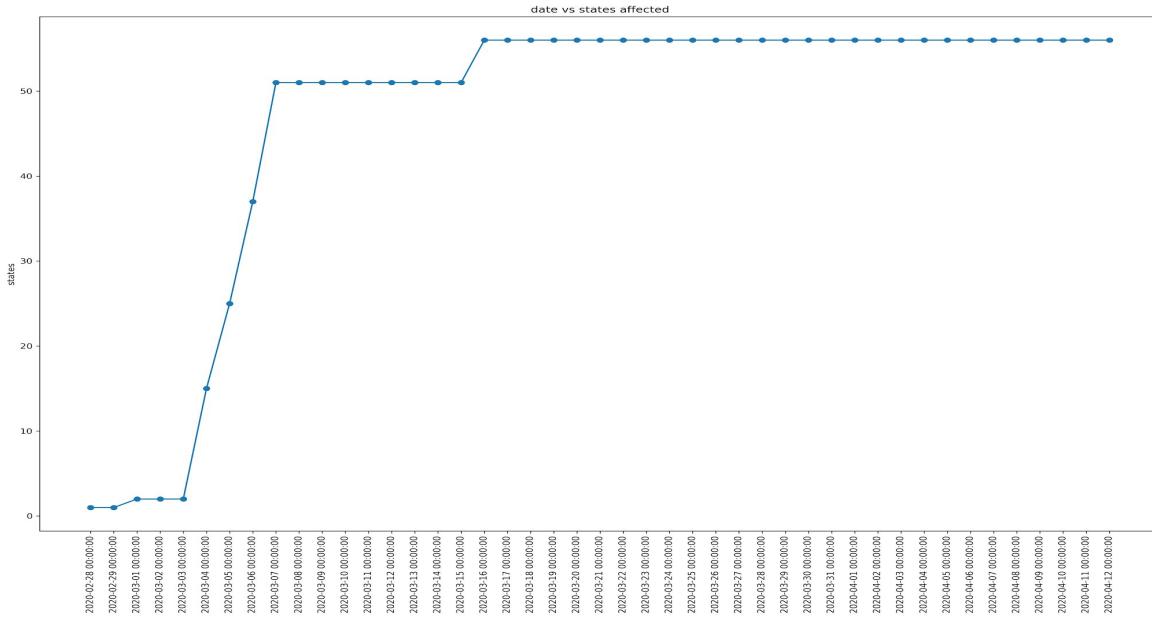


Visualization of State connectivity network



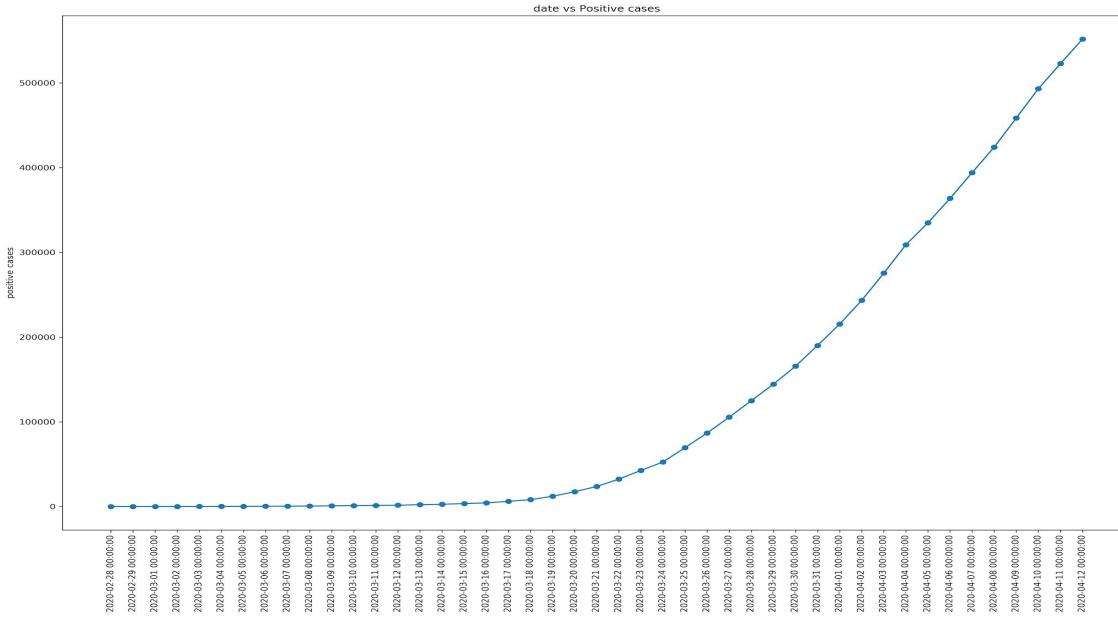


Analysing the timeline increase in covid19 cases with number of states





Analysing the timeline increase in covid19 cases in USA



Predicting dependency of spread of covid19 cases due to movement of flights from one place to another

Input:

1. Airport network graph
2. Source airport = ADQ
3. Destination airport = APF

Output:

Path to travel from source to destination with intermediate airports.

['ADQ', 'ANC', 'MIA', 'APF']

AK AK (source airport state, Destination airport state)

ADQ ANC (source airport, Destination airport)

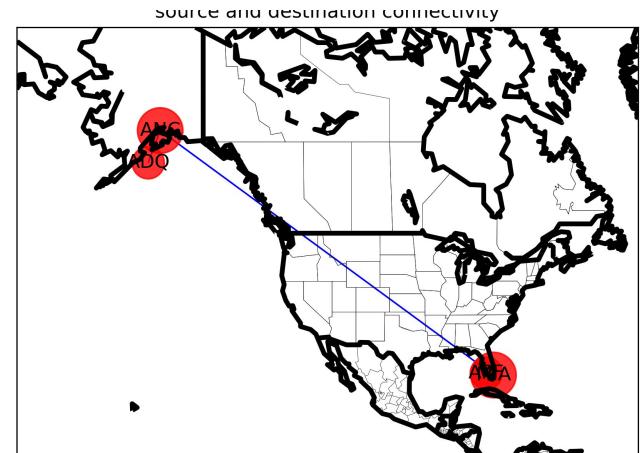
number of positive cases at source state 272

number of positive cases at destination state 285

Dependency factor: 0.06

Result:

NO, Movement of passengers from ADQ to APF by flights has not responsible in spread of Covid19 cases. If cases are there, it is due to rapid internal spread at that state or by local transport



Predicting dependency of spread of covid19 cases due to movement of flights from one place to another

Input:

1. Airport network graph
2. Source airport = SHR
3. Destination airport = SUX

Output:

Path to travel from source to destination with intermediate airports.
['SHR', 'EKO', 'SUX']

WY NV (source airport state, Destination airport state)

SHR EKO (source airport, Destination airport)

number of positive cases at source state 275

number of positive cases at destination state 3088

Dependency factor: 0.34

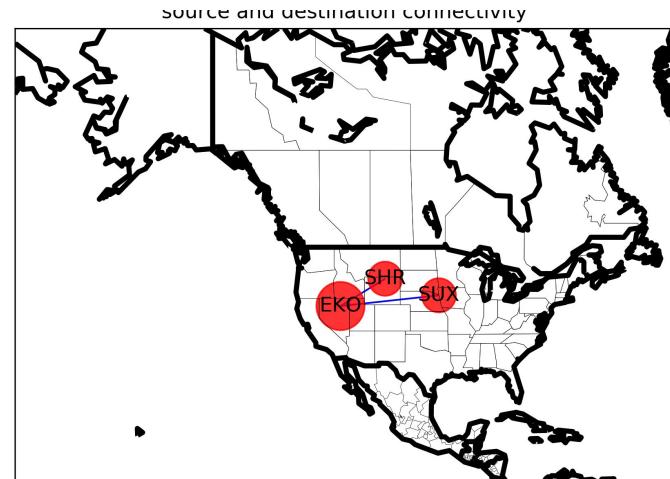
NV IA (source airport state, Destination airport state)

EKO SUX (source airport, Destination airport)

number of positive cases at source state 3088

number of positive cases at destination state 1899

Dependency factor: 3.86



Result:

YES, Movement of passengers from SHR to SUX by flights might responsible in spread of Covid19 cases