Abstract

Most natural networks are complex small world networks with three distinctive properties namely small characteristic path length, high clustering coefficient and scale-freeness. The small world concept in simple terms describes the fact that despite their often-large size, in most networks there is a relatively short path between any two nodes. The distance between two nodes is defined as the number of edges along the shortest path connecting them. In this dissertation, we have studied two areas, epidemiological network and transportation network.

For the epidemiological network, we identified the best strategy for presumptive treatment for malaria in a locality. Using ArcView GIS 3.2a software, the locality is mapped and all the houses are identified. From the data of incidence of malaria, we identify the graph of the spread of disease. Our aim has been to identify the best attack strategy through presumptive treatment to check the spread of the disease. We studied the New Station Lines of Ranichera Tea Garden in Jalpaiguri district, West Bengal, which we found to be a small world graph while running the presumptive treatment every 30 days for all the edge removal strategies and the maximal degree vertex removal strategy from day 69 to day 219. We observed that the spread of the disease is more like a technological or biological network than a social network, based on a parameter named assortativity. We worked on various spectral parameters of the parent subgraphs and observed that the average of eigenvalues and the percentage of zero eignevalues were the most resourceful parameters.

For the subgraphs with high average of eigenvalues it was noted:

1) With presumptive treatment every 30 days, the harmonic edge removal strategy was the best.
2) With presumptive treatment every 15 days, the highest degree sum edge removal strategy was the best.

For the subgraphs with low average of eigenvalues it was noted:

1) With presumptive treatment every 30 days, the degree sum and degree product edge removal strategies were equally best.
2) With presumptive treatment every 15 days, the highest degree vertex removal strategy was the best.

For the subgraphs with high percentage of zero eigenvalues it was noted:

1) With presumptive treatment every 10 days, the degree product edge removal strategies were the best.
2) With presumptive treatment every 5 days, the highest degree sum edge removal strategy was the best.

For the subgraphs with low percentage of zero eigenvalues it was noted:

With presumptive treatment every 10 days, the degree sum edge removal strategies were the best.

As an example of Transportation Network, we studied the Mumbai Bus Transportation Network. From the study it was evident that the Mumbai Bus Transportation Network is a small world since we can reach from any station to any other station on an average by less than 3 buses and around 61% of all neighbours of each vertex are also neighbours amongst themselves. It is also observed that the disassortativity of the network increases if the network is disconnected but the harmonic path length of the network is finite. The work on the Mumbai Transportation Network is indicative in the sense that in gives direction to the possible scope of Small World Network anlysis for the vulnerability study of various urban transportation networks in Indian metropolitan cities.