Complex Social Networks - lab 1

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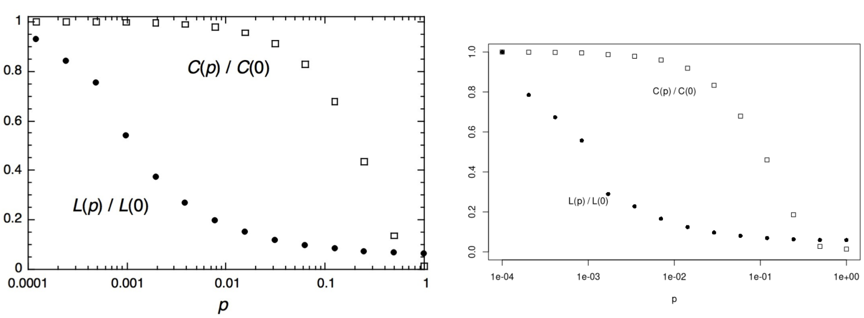
1 Problem 1

The goal of the problem was to plot the clustering coefficient and the average shortest path length as a function of the parameter p of the Watts-Strogatz model. The original and reproduced plots are shown in the Figure 1.



(a) Original plot

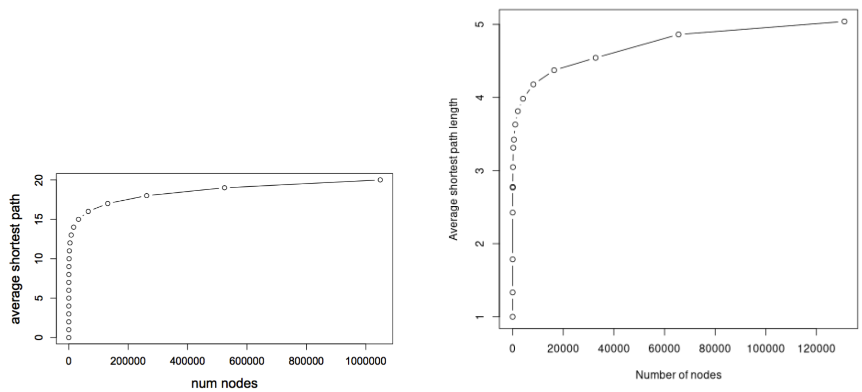
(b) Reproduced plot

Figure 1: Comparison of plots showing clustering coefficient and average shortest path length as a function of parameter p in Watts-Strogatz model

Values of the parameter p were generated from a logarithmic sequence P of length 14, starting from 0.0001 up to 1. Additionally, following values of graph size $N = (550, 650, \ldots, 1450)$ were used. For each Watts-Strogatz graph generated with size of lattice n and rewiring probability p, such that $(n, p) \in N \times P$, the average shortest path length and clustering coefficient (transitivity) were calculated. Then, the results for different values of n were averaged, and normalised to range $[0, 1]$ so that they can be shown on a single plot. We were not able, however, to graphically reproduce the scale present in the original plot.

2 Problem 2

The goal of the problem was to plot the average shortest path length as a function of the network size of the Erdos-Renyi model. The original and reproduced plots are shown in the Figure 2.



(a) Original plot

(b) Reproduced plot

Figure 2: Comparison of plots showing average shortest path length as a function of the network size in Erdos-Renyi model

Values of the graph size n (number of vertices) were generated from a sequence of 20 consecutive powers of 2, $N = (1, 2, 8, \ldots, 1048576)$. For bigger values of n, the computation time to generate a Erdos-Renyi graph become unbearable. Hence, the value p which represents the probability of having an edge between any vertices had to be adjusted accordingly. According to [1], if $p > \frac{(1-\epsilon)\ln n}{n}$ then a graph $G(n, p)$ will almost surely be connected. Based on this assumption, for a given size n, value of p was computed as $p = 1.1 * \frac{(1-\epsilon)\ln n}{n}$. This equation produces values small enough to result in a reasonable computation time, as well as large enough for the graph to be connected. Finally, $\forall n \in N$ an average shortest path length of graph $G(n)$ was calculated.

References

[1] Paul Erdos and Alfred Renyi. On the evolution of random graphs. *Publ. Math. Inst. Hungary. Acad. Sci.*, 5:17–61, 1960.