

## The assignment of synthetic networks for Assignment number 1

1. Of your three real networks, select the one with the largest number of nodes  $N_{max}$ . Count its edges,  $E_{max}$ . Generate **random network** of the same number of nodes  $N_{max}$  and edges  $E_{max}$ .

Compare the real network and the corresponding random network in terms of properties listed in points 2 and 3 in the assignment 1:

(i) the diameter, (ii) the number of connected components (for directed graphs, weakly and strongly connected) and the range of their sizes, (iii) the node average degree;

and plots: (iv) the degree distribution (for directed graphs, also in-degree and out-degree distributions), (v) the path length distribution, (vi) the clustering coefficient distribution, (vii) the betweenness centrality distribution, (viii) the connected components size distribution;

and values: (ix) the average values, and (x) variances for each of the measurements (iv)-(viii).

2. Of your three real networks, select the one with the medium number of nodes  $N_{mid}$ . Generate scale-free network of the same number of nodes  $N_{mid}$ , with exponent of the power law function  $\gamma = 3$ .

You can use preferential attachment model starting with  $m_0 = 3$  nodes and with each new node attaching preferentially to  $m = 3$  nodes in each step of growth, or use one of the tools to generate it (then you lowest node degree is  $k_{min} = 3$ ).

Compare the real network and the corresponding scale-free network in terms of properties listed in points 2 and 3 in the assignment 1 as listed above.

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