

## HW7: Models of Network Formation due December 3

For this assignment, submit your answers as problems as a single pdf file, alongside any code you may have written and required additional text files, using provide with the command:

```
homework% provide comp150ns hwk7 hwk7.pdf code-you-wrote
```

where code-you-wrote is replaced with any source files you may have written.

For this assignment, you will generate random networks under various models, and compare those random networks to those from Homework 2 (Karate Club, Prison, and Dolphins - all of which are available on the course website: note: make an undirected version of Prison by just assuming all the edges are bidirectional). You will consider graphs generated under 1) the Erdős-Rényi model, 2) the Watts and Strogatz model, 3) the configuration model, and 4) the Barabási-Albert preferential attachment model. These models are all described in your textbook (mostly clearly marked in the table of contents, except Watts and Strogatz which is on page 425).

1. What *parameters* does each model (1-4) take?
2. For each alternative random graph model, and for each of the three Homework 2 networks, to attempt to generate random networks under this model that “look” like these networks, how would you recommend setting the model parameters?
3. Using the settings you described above, for each random model/real network parameter pair generate 10 random networks (i.e. a total of 10 graphs for each of 12 experiments). For each experiment, calculate the mean and standard deviation of the following quantities: betweenness-centrality, mean shortest path length, average degree, percent of nodes with degree  $< 3$ , diameter, clustering coefficients, mean local clustering coefficient, and number of connected components for each network. Calculate these quantities as well (or copy them from HW2 if you have already computed them) for the three real networks.
4. What random graph model does each real network appear most similar to? Why?