Network Science
Spring 2024
Problem sheet 3

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1. Consider the G_{Np} random graph model with $N = 3$ nodes.

   (a) Draw all 8 graphs that can be generated by the model and determine the realization probability of each graph.

   (b) What is the probability a graph has at most one edge?

   (c) What is the probability that the graph is connected?

   (d) What is the expected number of connected triples?

   (e) What is the expected clustering coefficient of node i, $\langle C_i \rangle$?

2. Now, consider the G_{Np} model with general N.

   (a) Recall the degree distribution for the model. Explain what it means.

   (b) Let $i \sim j$ be a randomly chosen link from a graph G generated by G_{Np}, and let k_i^j be the degree of node i attached to this link. Find the probability distribution for k_i^j. In other words, find an expression for $P(k_i^j = k)$. Hint: first consider $P(k_i^j = 1)$.

3. What code would you use to draw a G_{Np} random graph with 10 nodes and with probability p with NetworkX. Solution:

4. Show that if we let $p(N) = N^{-z}$ with $z > 2$ then $G \in G_{Np}$ w.h.p. has no two edges with a common vertex (or equivalently the degree at each node is at most one).
   delayed to next problem sheet