Homework 2 — Networks

February 12, 2019

1. Degree sequences: Write a function to uniformly sample graphs with 5 nodes and a fixed degree sequence d. First enumerate all possible simple graphs on 5 nodes and then figure out if the degree sequence you put in is possible. Is this approach scalable?

2. Implement the sequential importance sampling algorithm of Blitstein and Diaconis and estimate the number of graphs with degree sequence given by the (unweighted) Karate Club network. Provide the estimate and Monte Carlo standard error. (Use the code from LAB and the "graphical.check" function you wrote to do this).

3. Also, test whether the degree sequence is sufficient to describe what's going on with this network. To do this, consider some statistics we have previously described (total number of triangles, diameter of the graph, etc.) and test whether the observed value in the Karate club network is "extreme". (This is in essence the same thing as counting the number of graphs with this degree sequence...)

   Blitzstein, Joseph, and Persi Diaconis. "A sequential importance sampling algorithm for generating random graphs with prescribed degrees." Internet mathematics 6.4 (2011): 489-522.

4. Based on your analysis above, fit an ERGM to the Karate Club network and interpret the output.