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22.11.2021

Complex Network Analysis

Assignment 4 "Scale-Free Networks"

Problem 4-1 Power Laws

1. Network (b) is approximately scale-free.
In the log-log plot the data points of the degree distribution function p_k for network (b) follow a linear function, whereas the data points for network (a) have a plateau for small k at first ($k < 10^1$). p_k of network (b) can therefore be better described by the relation $p_k \sim k^{-\gamma}$ than (a), p_k follows a power law, which can always apply for scale-free networks.

2. Estimate γ using formula from slide 4-28:
$$\gamma = 1 + N\left[\sum_{i=1}^{N} \ln\left(\frac{K_i}{K_{min} - \frac{1}{2}}\right)\right]^{-1}$$
using $K_{min} = 10$, $N = 20$ (data from twenty nodes are available), and $K_i \in \{16, 17, \ldots, 22, 10\}$
$\rightarrow \underline{\gamma \approx 2.53}$
Calculate error of estimation σ:
$$\sigma = \frac{\gamma - 1}{\sqrt{N}} \approx \frac{2.53 - 1}{\sqrt{N}} \underline{\approx 0.34}$$