Degree and clustering

Homework | Agent-based modelling, Konstanz, 2024

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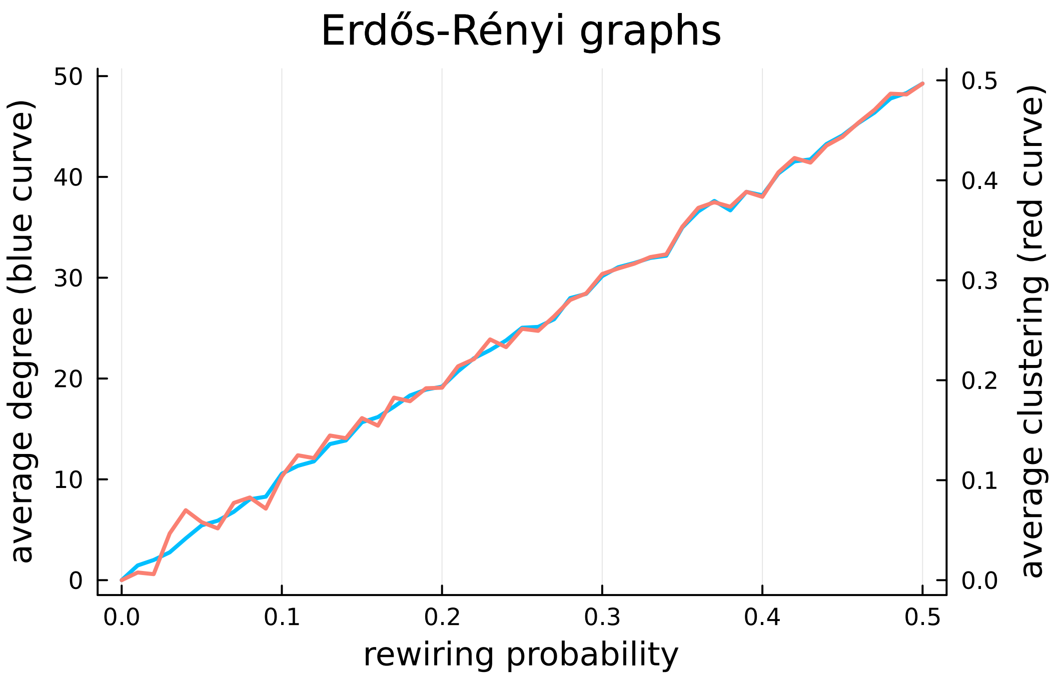
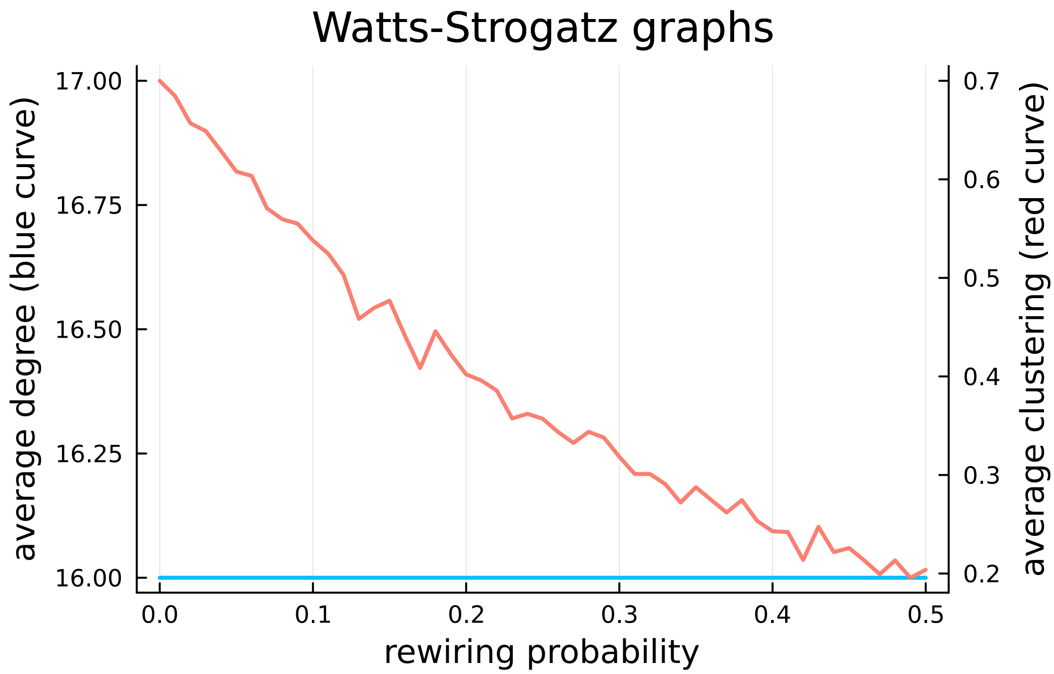
Many real-life social networks have the following properties simultaneously:

1. Low average degree – most people have a limited set of friends
2. High average clustering – most people are part of cliques

To study whether these conditions are satisfied by simple random graph models, the following little computational experiment was carried out. First, 51 Erdős-Rényi graphs were generated, one for each value of p, where p is the rewiring probability and ranges from 0.0 to 0.5 in equally-spaced steps (of size 0.01). (The number of nodes was set to $n = 100$.) Then, the (1) mean degree and (2) mean local clustering coefficient was calculated for each of these graphs. The results are:



Next, the same experiment was performed but this time with Watts-Strogatz (small-world) networks instead, again sweeping over different values of the rewiring probability. The other parameters were set to $n = 100$ (network size) and $k = 16$ (initial degree). The results are:



This demonstrates that the two conditions, low average degree and high average clustering, can be achieved in Watts-Strogatz networks but not in Erdős-Rényi graphs.

Your task is to replicate the above analysis, producing the plots in the end.

> **Tip**
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> You can make good use of array comprehensions, the `mean` function from *Statistics.jl*, and [this tip](#) on how to put two vertical axes in the same plot.

> **Bonus**
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> For even more fun, think about the following questions:
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> 1. Why is the average degree a linearly increasing function of p in the case of Erdős-Rényi graphs?
> 2. Why is it a constant function in the case of Watts-Strogatz graphs?
> 3. Why is the average degree function "wiggly" in the case of Erdős-Rényi graphs but not so in the case of Watts-Strogatz graphs?
> 4. Why is the average clustering wiggly in both cases?