CSN 06 - Simulation of SIS model over networks

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1 Introduction

In this delivery we are asked to study the SIS model infection. To do so, we are asked to create a function that simulates an SIS infection on a given network.

After having our function implemented, then we have to check what the epidemic treshold is.

Theoretically speaking, it should be

$$\frac{1}{\lambda_1}$$

So we are going to check that among other things.

The graph models we are going to use in this study are five and always with size $n = 1000$:

1. Erdos-Renyi (ER) graph. 1.1. Probability of generating an edge between two nodes of 0.5.
2. A fully connected graph.
3. Barabasi-Albert (BA) graph. Power of preferential attachment $= 1$.
4. A star.
5. Watts-Strogatz (WS) Small world. 5.1. Dimension 1, neighborhood 4, rewiring probability of 0.4.

2 Spread of the disease

Let's first address Task 01. Having implemented the function that simulates the spread of an infection in a SIS model for a given graph, we are going to check the evolution of the infected nodes and susceptible ones.

Below are the evolution of the number of infectes nodes vs. the number of susceptible nodes, for a fixed
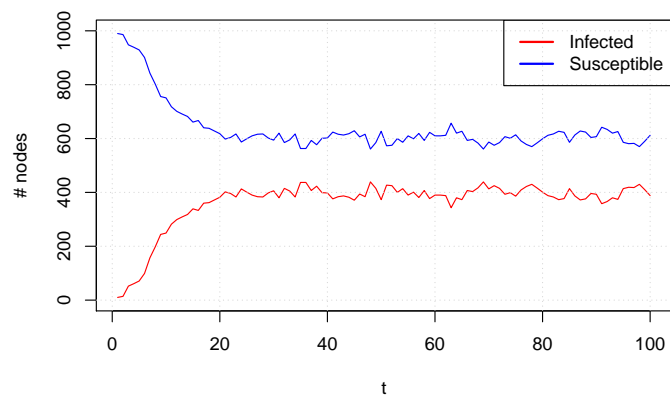
- $\beta = 0.5$
- $\gamma = 0.5$
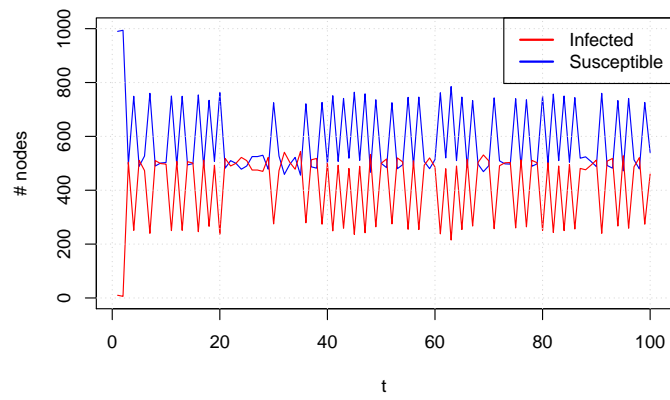- $p = 10$. 1% of the total nodes start on t_0 as infected.

Erdos–Renyi infected/susceptible evolution
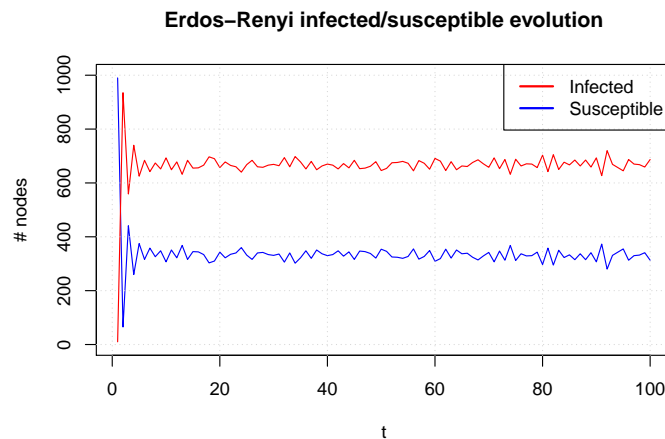
Fully connected g. infected/susceptible evolution
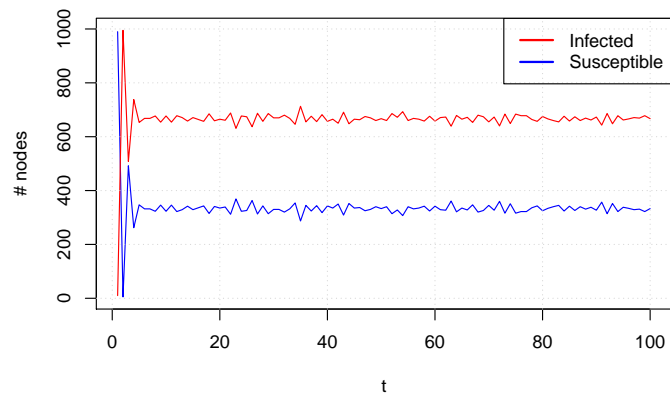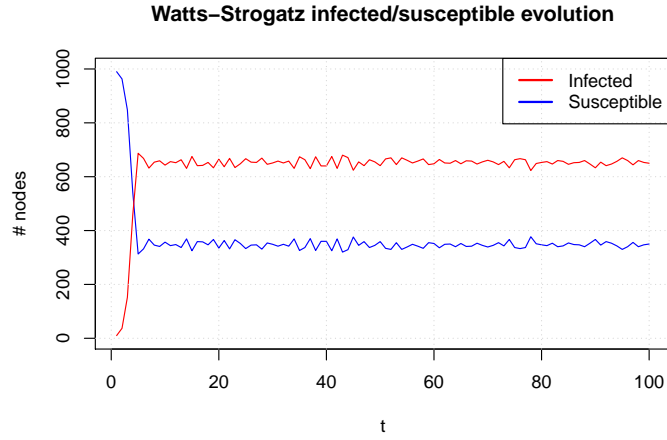

Barabasi−Albert infected/susceptible evolution

Star infected/susceptible evolution

Watts–Strogatz infected/susceptible evolution

We can see how on all of them, with the same probability of being infected and infecting others, the number of infected/susceptible stabilizes on the first 20 t_s on the ER, fully connected and BA models.

However, we can also see that it kind of stabilizes and at the same time it does not in the star graph.

Finally, we can see that the Watts-Strogatz stabilizes after the first 10 iterations, but the number of infected nodes is always above the number of susceptible ones. So we can say that Watts-Strogatz is more prone to an epidemic.