

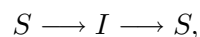
2. Exercise Sheet – Networks (with applications to neuroscience)

Due date: Fr. 17.06.2011 14:00

This exercise sheet is meant to provide help in order to recap the topics of this week's lectures. Solutions will be discussed during the Friday lecture.

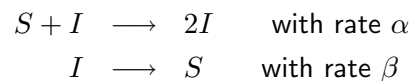
Problem 4: SI model

Consider the SI model for an infectious disease:



where S and I denote *susceptible* and *infected* nodes ($S + I = N$), respectively.

1. Determine a differential equation according to the following reaction kinetics:



for a normalized density $j = I/N$.

2. Calculate the stationary state of the system.
3. How can the model be generalized to a network with subpopulations including transitions between them?

Problem 5: SI model adapted

Models for an infectious disease are often considered on a static network. For a random network, for instance, the basic reproductive number, which denotes the secondary infections caused by a single infected node, is given by

$$R_0 = \frac{\alpha \langle k \rangle}{\beta}$$

with mean node degree $\langle k \rangle$, infection rate α , and recovery rate β .

1. What will change assuming that the network becomes adaptive, i.e., the topology varies?
2. What kind of adaptive rewiring law is plausible for a node in order to avoid infection?
3. How would the adaptation rule influence the node degree $k(t)$, which now becomes time dependent? Sketch $k(t)$ for a plausible rewiring law?