

Simulation of epidemics

Take inspiration from Wikipedia on SIR models to formulate a stochastic model of the development of diseases. With the covid-19 disease it is natural to think of this disease, however, disease modeling has a long tradition. The models applied by the expert group under SSI (Statens Serum Institut) used models of this type to support decisions by politicians on closing and partial opening of the Danish society during the epidemic. In reality the expert group did not rely on the classical models formulated by differential equations but rather simulated scenarios.

This project is about modeling infectious diseases and their spread in populations. The project is open but there are a number of tracks you could pursue and you should definitely pursue at least a handful of them.

Part I Basic modeling

In this part we suggest that you model a couple of the classical scenarios like the original SIR model with three compartments. You should experiment with different parameter settings. You can search the literature to find parameter values that reflects those of real diseases. A number of questions that could be addressed is

- (a) What is the likelihood that the disease will disappear
- (b) Can the disease exhibit cyclical behaviour
- (c) For a highly deadly disease can the population be extinguished?
- (d) For which population sizes and parameter values are deterministic models based on differential equations of sufficient precision

Part II - some ideas for further studies

- (a) Include more states, like states where individuals are infected but don't yet show symptoms with different rates for contagion

- (b) Model subgroups like families, workplaces and public transportation with different levels of exposure.
- (c) Model spatial distribution of persons, including moving patterns that depend on the state.
- (d) Model the effect of vaccination for different effectiveness of the vaccines.