

## Stochastic models in biology

Describing the real world in biology has been a challenge for a long time. Therefore, biology has been an important stimulus for mathematicians to propose models. To solve the problems, probabilists have developed many stochastic processes. In this series of lectures, we focus on stochastic models in biology, and we describe some of the stochastic processes which have been introduced over the last 50 years and applied in biology. More precisely, we give a quick overview in two domains.

- Modelling in biological populations. We first introduce usual discrete models, such as Galton–Watson when the size of the population varies, Wright–Fisher and Moran (and more generally, Canning’s models, and their associated discrete coalescent process, ) when the size of the population is fixed. Letting the size of the population tends to infinity, we study the convergence of these processes to their continuous–time limit. Finally, we give some statistical applications of these theory in biology.
- Modelling the spread of epidemic diseases. We present the standard SIR markovian model. First of all, we focus on the first step of the epidemic, and explain conditions of an epidemic outbreak. For large population, we explain how this model can be approximated, and give description of the epidemic. Finally, we explain how we can model epidemics when the population is structured. In particular, we give some recent results on SIR models on graphs.