Syllabus – Reading Seminar: Mathematics & Biology

- **Main goal:** The aim of this reading seminar is to provide an overview of some ongoing research topics in the modeling of the life sciences through a mathematical point of view.

- **Contents:** This year's reading seminar will mainly focus on two mathematical approaches: random models and PDE models with applications in ecology, population dynamics, evolution, cancer modeling and neuroscience. The probabilistic part of the reading seminar can be partly joint with the reading seminar on *Random Models* and will discuss models such as Galton-Watson, Moran, and Wright-Fischer. For the deterministic part, the reading seminar will build on parabolic equations such as reaction-diffusion equations and discuss for examples traveling waves, Turing instabilities, and pattern formation.

- **Prerequisite:** There is no real prerequisite for the reading seminar. However, we (strongly) encourage students to take the courses: *Introduction to partial differential equations* and *Stochastic calculus and Markov processes*.

- **References:** We suggest three references:
  B. Perthame, *Parabolic Equations in Biology, Growth, Reaction, Movement and Diffusion*, Lecture Notes on Mathematical Modelling in the Life Sciences, Springer.
  L. Roques, *Reaction-diffusion models for spatial ecology*, Editions Quae.
  S. Méléard and V. Bansaye, *Some stochastic models for structured populations : scaling limits and long time behavior*, cours de M2 de l'Ecole Polytechnique.

- **Key-words:** random models, PDE, ecology, evolution, reaction-diffusion, Turing instability, traveling waves.

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