B5.1: Stochastic Modelling of Biological Processes

**Lecturer:** Dr Murad Banaji   **Course Term:** Hilary 2024

Lectures: Wednesdays 12 noon, Fridays 11am, in L3 (16 lectures)

Course text: The course will be based heavily on the material in:

R. Erban and S. J. Chapman, "*Stochastic Modelling of Reaction-Diffusion Processes*", Cambridge Texts in Applied Mathematics, CUP (2020).

Some college libraries have physical copies of the course text. The Radcliffe Science Library and some college libraries have multiple copies. Graduate students can also borrow physical copies of the course text from the Whitehead Library in the Mathematical Institute. The online version is available at all times through SOLO.
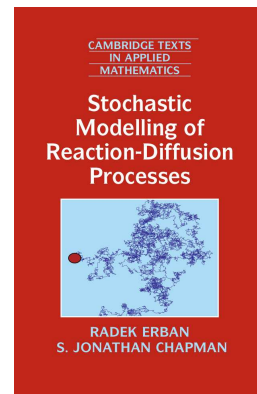
Additional lecture notes. Some further notes, supplementing the material in the course text, will also be posted on Moodle as we progress through the course. The purpose of these notes is to help provide background and explanation for some of the more complicated material in the book.

Prerequisites: This course builds on ten Prelims and Part A courses. Students taking this course should have a good understanding of the material in the following courses:

   Prelims: Probability, Computational Mathematics, Introductory Calculus, Multivariable Calculus, Fourier Series and PDEs, and Constructive Mathematics

   Part A: Differential Equations 1, Probability, Integral Transforms and Complex Analysis

Supplementary video lectures: The Hilary 2021 version of this course was given by Prof. Radek Erban using pre-recorded videos. Versions of these are available on YouTube where you will find 21 videos (labelled as Lectures 0-20 and available to the general public). The first video is at

   `https://www.youtube.com/watch?v=KPhMMnIocR0`

from where it is easy to find the rest. You will find these videos a valuable additional resource for this course.

Problem sheets and exams: The course is accompanied by four Problem Sheets, which will be discussed in your classes. Three classes, covering Problem Sheets 1, 2 and 3, are scheduled in Hilary Term. Your last class will be in Trinity Term and will cover Problem Sheet 4, your vacation work. In amongst the problems on the problem sheets will also be example exam questions. What material is examinable will be made clear throughout the course.

Algorithms and computer code: Although some simple stochastic models can be analyzed using only a pen and paper, more complicated examples require the help of computers. Moreover, there is a close link between theory and algorithms underpinning this course. The algorithms in the course text are all written in a general pseudocode. Some exercises will be computer-based, and you are welcome to implement these in any language of your choosing. Prof Erban's MATLAB codes to compute all illustrative simulations and figures presented in the course text are available at http://people.maths.ox.ac.uk/erban/cupbook/