2017-Byrne-FurtherMathBiology-Notes

Byrne, Helen. 2017. *Further Mathematics Biology*. Lecture notes. University of Oxford.

See https://www.maths.ox.ac.uk/system/files/attachments/MathBioNotes2017.pdf . Accessed 28 March 2023.

An outline for this course.

- We will observe that many phenomena in ecology, biology and biochemistry can be modelled mathematically.
- We will focus initially on systems where spatial variation is either absent or, at least,not important. In such cases only temporal evolution needs to be described, typically via ordinary differential equations.
- We are inevitably confronted with systems of ordinary differential equations, and thus we will study analytical techniques for extracting information from such equations.
- We will then consider systems where there is explicit spatial variation. The resulting models must also incorporate spatial effort.
- In ecological and biological applications the main physical phenomenon governing spatial variation is typically, but not exclusively, diffusion. Thus we invariably consider parabolic partial differential equations. Mathematical techniques will be developed to study such systems.
- These studies will be in the context of ecological, biological and biochemical applications. In particular we will draw examples from:

1. enzyme-substrate dynamics and other biochemical reactions;
2. Trans-membrane ion channels and nerve pulses;
3. epidemics;
4. the propagation of an advantageous gene through a population;
5. biological pattern formation mechanisms;
6. chemotaxis;
7. tumour growth.

Keywords: biology, enzyme-substrate, ion channels, nerve pulses, epidemics, gene propagation, chemotaxis, tumour