MA256-10 Introduction to Mathematical Biology

24/25

Department
Warwick Mathematics Institute
Level
Undergraduate Level 2
Module leader
Lukas Eigentler
Credit value
10
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

In this module, we will develop simple models of biological phenomena from basic principles. We will introduce analysis techniques to investigate model dynamics in order to deduce biologically significant results. We will use (systems of) ordinary differential equations, difference equations, and partial differential equations to study population dynamics, biochemical kinetics, epidemiological dynamics, evolution, and spatiotemporal pattern formation. Throughout, we will discuss the biological implications of our results.

Module web page

Module aims

Introduction to Mathematical Biology, frequently used model types and analysis techniques to study model dynamics.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1. Mean-field Population dynamics
   a. Single-species population models
   b. Multi-species population models
2. Models of biochemical kinetics
3. Epidemiological models
4. Models of evolution and game theory models
5. Spatio-temporal models of population dynamics
   a. Travelling waves
   b. Pattern formation

Learning outcomes

By the end of the module, students should be able to:

- To develop simple models of biological phenomena from basic principles.
- To analyse simple models of biological phenomena using mathematics to deduce biologically significant results.
- To reproduce models and fundamental results for a range of biological systems.
- To have a basic understanding of the biology of the biological systems introduced.

Indicative reading list

H. van den Berg, Mathematical Models of Biological Systems, Oxford Biology, 2011
James D. Murray, Mathematical Biology: I. An Introduction. Springer 2007
Christopher Fall, Eric Marland, John Wagner, John Tyson, Computational Cell Biology, Springer 2002
L. Edelstein Keshet, Mathematical Models in Biology, SIAM Classics in Applied Mathematics 46, 2005.
Keeling, M.J. and Rohani, P. Modeling Infectious Diseases in Humans and Animals, Princeton University Press, 2007.
Anderson, R. and May, R. Infectious Diseases of Humans, Oxford University Press, 1992.
Glendinning, P. Stability, Instability and Chaos, Cambridge Texts in Applied Mathematics, 1994.

Subject specific skills

Students will learn how to derive mathematical models describing biological phenomena from first principles. They will be exposed to different model types (ordinary differential equations, partial differential equations, difference equations) and gain experience in model choice depending on the underlying biological questions. Students will gain analysis skills to determine solution behaviour of model systems and learn how to interpret mathematical results from a biological viewpoint.

Transferable skills

Students will learn about biological systems and the use of mathematical models to solve real world problems. This will be extremely valuable experience for those wishing to use mathematical models in the future in non-academic contexts.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (30%)
Seminars	9 sessions of 1 hour (9%)
Private study	61 hours (61%)
Total	100 hours

Private study description

private study to master the material

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group B1

	Weighting	Study time	Eligible for self-certification
2 hour examination	100%		No

- Answerbook Pink (12 page)

Assessment group R1

	Weighting	Study time	Eligible for self-certification
In-person Examination - Resit	100%		No

- Answerbook Pink (12 page)

Feedback on assessment

Exam Feedback

[Past exam papers for MA256](#)

Availability

Courses

This module is Optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics

This module is Core option list A for:

- Year 2 of UMAA-GV17 Undergraduate Mathematics and Philosophy
- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D for:

- Year 4 of UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year

This module is Option list A for:

- Year 2 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- Year 2 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 2 of G100 Mathematics
    - Year 2 of G103 Mathematics (MMath)
- Year 2 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 2 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercalated Year)
- Year 2 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 2 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- Year 2 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 2 of UMAA-G101 Undergraduate Mathematics with Intercalated Year

This module is Option list B for:

- Year 2 of UCSA-G4G1 Undergraduate Discrete Mathematics
- Year 2 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 2 of UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 2 of GF13 Mathematics and Physics

    - Year 2 of FG31 Mathematics and Physics (MMathPhys)
- Year 3 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 3 of USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics

This module is Option list C for:

- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 2 of USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics