

MA4E7-15 Population Dynamics: Ecology & Epidemiology

26/27

Department

Warwick Mathematics Institute

Level

Undergraduate Level 4

Module leader

Matt Keeling

Credit value

15

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This course deals with the mathematics behind the dynamics of populations; both populations of free-living organisms (from plants to predators) and those that cause disease. Once the basic models and concepts have been introduced attention will focus on understanding the many complexities that can arise, such as age-structure, spatial structure, temporal forcing and stochasticity. The focus of the course will be how mathematical models can help us both predict the future behaviour of populations and understand their dynamics.

[Module web page](#)

Module aims

Research into the dynamics of ecological populations allows us to understand the conservation of endangered species, make predictions about the effects of global climate change and understand the population fluctuations observed in the natural world. Work on infectious diseases clearly has important applications to public-health, allowing us to predict the spread of an epidemic (such as Foot-and-Mouth or SARS virus) and determine the effect of control measures.

Throughout, use will be made of examples in the recent literature, with a strong bias towards read-

world problems. Special attention will be given to the applied use of the models developed and the necessity of good quality biological data and understanding.

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.

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Learning outcomes

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

- At the end of the module, students will be able to: • Describe and analyse classical models in epidemiology and ecology and interpret the biological parameters and model structures. • Understand how to use these models to answer key questions relating to real-world applications; • Perform phase-plane analysis and analyse steady states and their stability to determine how models will behave in various parameter regimes; • Compute the basic reproduction number, R_0 , using first principles and the next generation matrix approach and use it to assess potential for control of infectious diseases using different intervention strategies. • Implement model analysis for select systems of ODEs, PDEs, and stochastic equations and interpret the results of the analyses; • Critique the modelling assumptions made and suggest ways to improve the models.

Subject specific skills

This module introduces students to applied mathematical epidemiology and ecology. Students will develop the ability to develop their own models of epidemiological and ecological systems, analyse these models and interpret the results in an applied context.

Transferable skills

The ability to model, analyse and interpret results is an important transferable skill that can be used in other applied contexts.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	9 sessions of 1 hour (6%)
Private study	111 hours (74%)
Total	150 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

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

Students can register for this module without taking any assessment.

Assessment group B1

	Weighting	Study time	Eligible for self-certification
Centrally-timetabled examination (On-campus) 3 hour exam, no books allowed	100%		No

- Answerbook Gold (24 page)

Assessment group R

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

- Answerbook Gold (24 page)

Feedback on assessment

Exam feedback

[Past exam papers for MA4E7](#)

Availability

Courses

This module is Optional for:

- TMAA-G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
 - Year 1 of G1PC Mathematics (Diploma plus MSc)
 - Year 2 of G1PC Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PF Postgraduate Taught Mathematics of Systems
- Year 4 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics

This module is Core option list F for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 1 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 2 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PF Postgraduate Taught Mathematics of Systems
- Year 4 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- Year 4 of UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 5 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list B for:

- TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 1 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 2 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 5 of UCSA-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)

This module is Option list C for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
 - Year 3 of G105 Mathematics (MMath) with Intercalated Year
 - Year 4 of G105 Mathematics (MMath) with Intercalated Year
 - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G103 Undergraduate Mathematics (MMath)
 - Year 3 of G103 Mathematics (MMath)
 - Year 4 of G103 Mathematics (MMath)
- Year 4 of UMAA-G107 Undergraduate Mathematics (MMath) with Study Abroad
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
 - Year 3 of G106 Mathematics (MMath) with Study in Europe
 - Year 4 of G106 Mathematics (MMath) with Study in Europe

This module is Option list E for:

- Year 5 of USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated