MA4L5-15 Mathematics of Cancer

26/27

Department
Warwick Mathematics Institute
Level
Undergraduate Level 4
Module leader
Nigel Burroughs
Credit value
15
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module will cover the main mathematical techniques currently being used to understand cancer and analysis of cancer data. Cancer can be viewed as a dynamical system, an ecology or an evolutionary process. A number of cancer modelling frameworks have been used depending on the problem, including deterministic compartmental ODEs, probabilistic models (eg branching processes), spatial or structured populations (PDEs, agent based simulations), each having particular merits. This module will present various models and how these are used to design therapy.

Module aims

Principle aims are to 1) develop suitable models for cancer growth and mutation (branching process models), 2) modelling methods of the evolutionary of a cancer, 3) develop techniques to analyse intratumour heterogeneity, 4) use optimisation methods to determine optimal therapies, particularly chronotherapy, 5) spatial modelling techniques of tumour growth incorporating mechanisms such as nutrient limitation and angiogenesis, 6) analysis techniques of cancer data.

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. Mathematical models of evolution and mutation. (branching process models of mutation and applications to cancer).
2. Cancer growth models.
3. Spatial modelling/structured modelling of tumours.
4. Optimisation of therapy.
5. Data analysis for cancer data.

Learning outcomes

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

- Acquire an understanding of cancer as an evolutionary process and the mutation process dependencies.
- Use of branching processes to quantify risk of drug resistant mutations.
- Optimisation techniques to determine optimal therapy schedules.

Interdisciplinary

This is a mathematics focused module on the life science interface. Students will be taught the necessary biology.

Subject specific skills

Ability to translate biological mechanisms into mathematical framework, eg growth processes.
Ability to analyses and solve stochastic and deterministic models of cancer.
Ability to apply optimisation methods to ODEs.

Transferable skills

Ability to translate scientific ideas into mathematical language and back. Ability to think creatively. Ability to discern the validity of a proposed explanation.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (77%)
Seminars	9 sessions of 1 hour (23%)
Total	39 hours

Private study description

Homework problems.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B1

Assessment component	Weighting	Study time	Eligible for self-certification
Centrally-timetabled examination (On-campus) Standard 3 hour written exam.	100%	45 hours	No

---

- Answerbook Gold (24 page)

Reassessment component is the same

Feedback on assessment

Written feedback on the outcome of the exam.

Past exam papers for MA4L5

Availability

Courses

This module is Optional for:

- 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)

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:

- Year 4 of UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)

This module is Option list B for:

- 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 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