# MA933-15 Stochastic Modelling and Random Processes

## 20/21

**Department**
Warwick Mathematics Institute
**Level**
Taught Postgraduate Level
**Module leader**
Robert MacKay
**Credit value**
15
**Module duration**
10 weeks
**Assessment**
20% coursework, 80% exam
**Study location**
University of Warwick main campus, Coventry

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## Description

### Introductory description

N/A

Module web page

### Module aims

The main aims are to provide a broad background in theory and applications of complex networks and random processes, and related practical and computational skills to use these techniques in applied mathematical research and modelling. Students will become familiar with basic network theoretic definitions, commonly used network statistics, probabilistic foundations of random processes, some commonly studied Markov processes/chains, and the links between these topics through random graph theory.

### 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.

Review of important concepts from Probability
Discrete-time Markov chains
Continuous-time Markov chains
Stochastic models of interacting processes (including population dynamics, epidemics)
Basic network definitions and statistics
The Erdos-Renyi random graph and connection to percolation
Heterogeneous network models
Random processes on networks

### Learning outcomes

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

- Recall and apply standard network statistics such as degree distribution and clustering coefficient.
- Understand the probabilistic and combinatorial foundations of random processes and network theory, respectively.
- Work with standard stochastic models of population dynamics and epidemiology, such as branching and contact processes
- Mathematical modelling: Building a quantitative probabilistic model from a phenomenological description
- Work with popular random graph models such as Erdos-Renyi, Configuration Model and Preferential Attachment.
- Understand and implement simple algorithms to simulate random processes and networks

### Indicative reading list

Handbook of Stochastic Methods, CW Gardiner, Springer 2004.
Networks: An Introduction, MEJ Newman, OUP 2010.
Probability and Random Processes (3rd ed.), G Grimmett and D Stirzakek, OUP 2001.
Random Graph Dynamics, R Durrett, CUP 2007.

View reading list on Talis Aspire

### Subject specific skills

See learning outcomes.

### Transferable skills

Students will acquire key reasoning and problem solving skills which will empower them to address new problems with confidence.

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## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 10 sessions of 3 hours (20%) |
| Tutorials | 10 sessions of 1 hour (7%) |
| Private study | 110 hours (73%) |
| Total | 150 hours |

### Private study description

Review lectured material and work on set exercises.

## Costs

No further costs have been identified for this module.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group D

| | Weighting | Study time |
|---|---|---|
| Problem sets | 20% | |
| Problem sheets set and marked by module leader | | |
| Locally timetabled examination | 80% | |
| Class examination set by module leader. Not centrally timetabled. | | |

### Feedback on assessment

Marked script and opportunity for verbal feedback

Past exam papers for MA933

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## Availability

## Courses

This module is Core for:

- RMAA-G1PG Postgraduate Research Mathematics of Systems
    - Year 1 of G1PG Mathematics of Systems
    - Year 1 of G1PG Mathematics of Systems
- TMAA-G1PF Postgraduate Taught Mathematics of Systems
    - Year 1 of G1PF Mathematics of Systems
    - Year 1 of G1PF Mathematics of Systems

This module is Optional for:

- Year 2 of TPXA-F345 Postgraduate Taught Modelling of Heterogeneous Systems (PGDip)

This module is Option list B for:

- Year 1 of TPXA-F345 Postgraduate Taught Modelling of Heterogeneous Systems (PGDip)