

ST227-10 Stochastic Processes

26/27

Department

Statistics

Level

Undergraduate Level 2

Module leader

Zorana Lazic

Credit value

10

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This module introduces stochastic processes in discrete time and space. It is core for students with their home department in Statistics. It is available as an option or unusual option for other students.

Pre-requisites:

- Statistics Students: ST119 Probability 2 AND (MA140 Mathematical Analysis 1 OR MA142 Calculus 1).
- Non-Statistics Students: ST120 Introduction to Probability AND (MA141 Analysis 1 or equivalent).

Leads to:

- ST333 Applied Stochastic Processes
- ST406 Applied Stochastic Processes with Advanced Topics.

and other third/fourth year modules.

[Module web page](#)

Module aims

To introduce the idea of a stochastic process, and to show how simple probability and matrix theory can be used to build this notion into a beautiful and useful piece of applied mathematics.

Loosely speaking, a stochastic or random process is any measurable phenomenon which develops randomly in time. Only the simplest models will be considered in this course, namely those where the process moves by a sequence of jumps in discrete time steps. We will focus on Markov chains, which use the idea of conditional probability to provide a flexible and widely applicable family of random processes. Such processes are common tools in economics, biology, psychology, and operations research, so they are very useful as well as attractive and interesting theories.

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.

This module introduces the study of random processes in time. The module covers

1. Introduction to Markov processes (definitions, Chapman-Kolmogorov equations, notions of recurrence, transience, reducible, periodic, ergodic, transition probability matrices).
2. Long-run behaviour of Markov Chains (hitting times and absorption, equilibrium distributions, convergence to equilibrium). Ergodic theorem.
3. Applications of Markov chains (e.g. branching processes).

Learning outcomes

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

- Describe the notion of a Markov chain, and know how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains.
- Analyse notions of long-time behaviour including transience, recurrence, and equilibrium.
- Know how to apply these ideas to answer basic questions in applied situations and to recognise where Markov chains are and are not appropriate models.
- Communicate solutions to problems accurately with structured and coherent arguments.

Indicative reading list

[Reading lists can be found in Talis](#)

[Specific reading list for the module](#)

Interdisciplinary

This module requires students to develop balanced facility of rigorous mathematical argument

together with appreciation of the over-riding relevance of statistical considerations.

Subject specific skills

Demonstrate facility with advanced mathematical and probabilistic methods.

Demonstrate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of mathematical problems.

Reason critically, carefully, and logically and derive (prove) mathematical results.

Create structured and coherent arguments communicating them in written form.

Analyse problems, abstracting their essential information formulating them using appropriate mathematical language to facilitate their solution.

Transferable skills

Problem solving skills: The module requires students to solve problems presenting their conclusions as logical and coherent arguments.

Written communication skills: Students complete written assessments that require precise and unambiguous communication in the manner and style expected in mathematical sciences.

Verbal communication skills: Students are encouraged to discuss and debate formative assessment and lecture material within small-group tutorial sessions. Students can continually discuss specific aspects of the module with the module leader. This is facilitated by statistics staff office hours.

Team working and working effectively with others: Students are encouraged to discuss and debate formative assessment and lecture material within small-group tutorial sessions.

Professionalism: Students work autonomously by developing and sustain effective approaches to learning, including time-management, organisation, flexibility, creativity, collaboration and intellectual integrity.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (20%)
Seminars	5 sessions of 1 hour (5%)
Tutorials	4 sessions of 1 hour (4%)
Private study	61 hours (61%)
Total	100 hours

Type	Required
Assessment	10 hours (10%)
Total	100 hours

Private study description

Weekly revision of lecture notes and materials, wider reading and practice exercises, working on problem sets and preparing for examination.

Other activity description

Revision support equivalent to approximately 2 hours.

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 D2

	Weighting	Study time	Eligible for self-certification
In term assessment	10%	8 hours	No
<p>There will be approximately weekly problem sets. Each problem set will contain a number of individual questions based on the material delivered in the lectures. Problem sheets are supported by seminars, including both analytical and computational tasks. Assessment is based on solutions to the problems and engagement with in-class problems.</p> <p>The preparation and completion time noted refers to the amount of time in hours that a well-prepared student who has attended lectures and carried out an appropriate amount of independent study on the material could expect to spend on this assessment.</p>			
Centrally-timetabled examination (On-campus)	90%	2 hours	No
<p>You will be required to answer all questions on this examination paper. The study time noted refers to the length of the exam in hours.</p> <hr/>			

Weighting

Study time

Eligible for self-certification

- Answerbook Pink (12 page)

Assessment group R2

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

You will be required to answer all questions on this examination paper.

- Answerbook Pink (12 page)

Feedback on assessment

Individual feedback will be provided on problem sheets by class tutors.

Solutions and cohort level feedback will be provided for the examination.

Students are actively encouraged to make use of office hours to build up their understanding, and to view all their interactions with lecturers and class tutors as feedback.

[Past exam papers for ST227](#)

Availability

Courses

This module is Core for:

- USTA-G302 Undergraduate Data Science
 - Year 2 of G302 Data Science
 - Year 2 of G302 Data Science
- Year 2 of USTA-G304 Undergraduate Data Science (MSci)
- USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
 - Year 2 of G30A Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream)
 - Year 2 of G30J Master of Maths, Op.Res, Stats & Economics (Data Analysis Stream)
 - Year 2 of G30B Master of Maths, Op.Res, Stats & Economics (Econometrics and Mathematical Economics Stream)
 - Year 2 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research

and Statistics Stream)

- Year 2 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)
- Year 2 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
- Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 2 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 2 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
 - Year 2 of GG14 Mathematics and Statistics
 - Year 2 of GG14 Mathematics and Statistics
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
 - Year 2 of Y602 Mathematics,Operational Research,Stats,Economics
 - Year 2 of Y602 Mathematics,Operational Research,Stats,Economics