ST202-12 Stochastic Processes

23/24

Department Statistics Level Undergraduate Level 2 Module leader Nicholas Tawn Credit value 12 Assessment Multiple Study location University of Warwick main campus, Coventry

Description

Introductory description

This modules runs in Term 2.

This module 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: ST115 Introduction to Probability AND MA137 Mathematical Analysis Non-Statistics Students: ST111 Probability A AND ST112 Probability B AND (MA131 Analysis I OR MA137 Mathematical Analysis)

Leads to: ST333 Applied Stochastic Processes and ST406 Applied Stochastic Processes with Advanced Topics.

Module web page

Module aims

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 discuss: Markov chains, which use the idea of conditional probability to provide a flexible and widely applicable family of random processes; random walks, which serve as fundamental building blocks for constructing other processes as well as being important in their own right; and renewal theory,

which studies processes which occasionally "begin all over again." Such processes are common tools in economics, biology, psychology and operations research, so they are very useful as well as attractive and interesting theories.

The aims of this module are 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.

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. Brief review of fundamental probability notions.
- 2. Introduction to Markov processes (Definitions, Chapman-Kolmogorov equations, notions of recurrence, transience, positive recurrence, transition probability matrices,
- 3. Long-run behaviour of Markov Chains, (equilibirum distributions, convergence to equilibrium)
- 4. Some applications.
- 5. Discussion of extensions to continuous settings and if time permits to non-Markov settings.

Learning outcomes

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

- Understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains.
- Understand notions of long-time behaviour including transience, recurrence, and equilibrium.
- Be able to apply these ideas to answer basic questions in several applied situations including genetics, branching processes and random walks.

Indicative reading list

S.M. Ross, Introduction to Probability Models G.R. Grimmett and D.R. Stirzaker, Probability and Random Processes P.W. Jones and P. Smith, Stochastic Processes J.R. Norris, Markov Chains

View reading list on Talis Aspire

Subject specific skills

TBC

Transferable skills

TBC

Study

Study time

| Туре | Required |
|-----------|-----------------------------|
| Lectures | 30 sessions of 1 hour (88%) |
| Tutorials | 4 sessions of 1 hour (12%) |
| Total | 34 hours |

Optional 2 sessions of 1 hour

Private study description

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

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 D4

| | Weighting | Study time | | |
|--|--|--|--|--|
| Multiple Choice Quiz 1 | 3% | 4 hours | | |
| A multiple choice quiz which will tak | e place during the term that the r | nodule is delivered. | | |
| Multiple Choice Quiz 2 | 3% | 4 hours | | |
| A multiple choice quiz which will take place during the term that the module is delivered. | | | | |
| Multiple Choice Quiz 3 | 4% | 4 hours | | |
| A multiple choice quiz which will take place during the term that the module is delivered. | | | | |
| Written assignment | 10% | 12 hours | | |
| The assignment will contain a numb will be required. The preparation an hours that a well-prepared student w amount of independent study on the write your answers on paper and su | er of questions for which solution d completion time noted below re who has attended lectures and ca e material could expect to spend o bmit to the Statistics Support Off | ns and / or written responses efers to the amount of time in arried out an appropriate on this assignment. You will ice. | | |

Weighting

80%

In-person Examination

The examination paper will contain four questions, of which the best marks of THREE questions will be used to calculate your grade.

- Students may use a calculator
- Answerbook Pink (12 page)

Assessment group R2

Weighting

Study time

In-person Examination - Resit

100%

The examination paper will contain four questions, of which the best marks of THREE questions will be used to calculate your grade.

- Answerbook Pink (12 page)
- Graph paper
- Cambridge Statistical Tables (blue)

Feedback on assessment

Answers to problems sets will be marked and returned to you in a tutorial or seminar taking place the following week when you will have the opportunity to discuss it.

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

Past exam papers for ST202

Availability

Courses

This module is Core for:

- Year 2 of USTA-G305 Undergraduate Data Science (MSci) (with Intercalated Year)
- Year 2 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics

This module is Option list A for:

• Year 2 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe