Module Specification

Markov Chains

Version: 2024-25, v3.0, 08 Jul 2024

Contents

Part 1: Information

Module title: Markov Chains

Module code: UFMFSV-15-2

Level: Level 5

For implementation from: 2024-25

UWE credit rating: 15

ECTS credit rating: 7.5

College: College of Arts, Technology and Environment

School: CATE School of Computing and Creative Technologies

Partner institutions: None

Field: Computer Science and Creative Technologies

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: A Markov chain is a stochastic process, i.e., a sequence of random variables, for which, given the current state, the past contains no additional information concerning the future evolution of the system. In other words, the future states depend on the history of the process only via the current state. From a probabilistic viewpoint, Markov chains constitute a relatively simple class of stochastic processes, but, nevertheless, they provide a very important mathematical tool for modelling a wide variety of real-world situations. Markov chains have

applications in, for example, the following diverse areas: business; economics; engineering; finance; forecasting; manufacturing; music; technology; science; sociology; sport.

This module would be a good option for a student who wishes to develop their knowledge of probability theory, who wants to engage with applications to real-world problems, and who might contemplate a final year project in some area of probabilistic modelling.

Features: Not applicable

Educational aims: The aim of the module is to introduce the theory, application and simulation of discrete-time, homogeneous Markov chains on a countable state space.

Students will develop their understanding of Markov chains, both theoretical and in applications, through active problem-based learning.

Relevant probability theory and techniques will be introduced as necessary.

Outline syllabus: Probability spaces, random variables and conditional probability.
Definitions and basic properties of Markov chains.
Existence of Markov chains (statement only).
Calculation of n-step transition probabilities.
Communicating classes, closed classes, absorption, and irreducibility.
Classification of states.
Hitting times and stopping times.
Recurrence and transience.
Random walks on graphs.
Simulation of Markov Chains.

Part 3: Teaching and learning methods

Teaching and learning methods: The teaching and learning strategy will involve taught material that is interspersed with individual or group activities that develop

understanding of the theory and of its applications. The activities will include computations and simulations within a framework of problem-based learning. It is envisaged that a single multi-purpose room, e.g., a TEAL space, will be utilised for all the contact sessions.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Identify and compute features of Markov chains that have a finite or countable state space.

MO2 State the properties of Markov chains and related theorems clearly and precisely.

MO3 Use appropriate software to construct and to run simulation models based on Markov chains.

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/5525BE02-A50E-40BF-D3A5-0314884C15C6.html?lang=en-GB&login=1

Part 4: Assessment

Assessment strategy: The assessment portfolio consists of exactly one task, namely an end-of-module, 24-hour examination. This task, which involves a mixture of unseen and partially-seen questions, assesses the students' understanding of material and techniques from across the entire module, including both theoretical aspects and computer simulations. Preparation for the assessment involves the students' engaging with the scheduled classes, during which regular feedback is provided, and with the directed self-study activities.

The resit assessment has exactly the same format as that of the first sit.

Assessment tasks:

Examination (Online) (First Sit)
Description: Online Examination (24 hour window)
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3

Examination (Online) (Resit)
Description: Online Examination (24 hour window)
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Mathematics [Frenchay] BSc (Hons) 2023-24

Mathematics {Foundation} [Frenchay] BSc (Hons) 2022-23