MANCHESTER 1824
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MATH37012

Markov Processes

Unit code:	MATH37012
Credit Rating:	10
Unit level:	Level 3
Teaching period(s):	Semester 2
Offered by	School of Mathematics
Available as a free choice unit?:	N

Requisites

Prerequisite

- MATH20701 - Probability 2 (Compulsory)

Additional Requirements

MATH37012 pre-requisites

Aims

To develop the idea that processes evolving randomly in time can be modelled mathematically in terms of sequences or families of dependent random variables.

Overview

Markov chains are stochastic processes with the special property of "given the present, the future is independent of the past". Many real-life situations can be modelled by such processes and this course is concerned with their mathematical analysis. It by-passes the measure-theoretic considerations necessary for the development of a general theory of stochastic processes.

Assessment methods

- Other - 20%
- Written exam - 80%

Assessment Further Information

- Coursework: two hours weighting 20%
- End of semester examination: two hours weighting 80%

Learning outcomes

On successful completion of the course students will have a good grasp of basic concepts, techniques and results associated with the elementary theory of Markov processes.

Future topics requiring this course unit

The material of this course may be helpful in understanding the 4th year courses on stochastic calculus and Brownian motion.

Syllabus

1.Discrete time Markov chains:

Review of necessary probability theory. [2]

Definition of Markov chain. Homogeneity. (1-step) transition probabilities. Transition diagrams. Examples including Ehrenfest diffusion model. The Chapman-Kolmogorov equations. Matrix form. Accessibility. Closed/irreducible sets. Periodicity. Stationary distributions. Positive recurrence, null recurrence, transience. Random walk examples. Convergence to stationary distribution. Discussion of different methods of proof (e.g. Markov's method for finite state space; Doeblin's coupling; renewal type argument). [8]

2.Continuous time Markov chains:

Theoretical treatment at level of Karlin and Taylor (see below). Revision of Poisson process. Pure birth/birth death processes. [8]

3.Applications:

Queues. M/M/1. Queue length and waiting time distribution. M/M/s. Variable arrival and service rates. Machine interference. [4]

Recommended reading

- D. R. Stirzaker, Stochastic Processes and Models, Oxford University Press, 2005.
- A. N. Shiryaev, Probability, Springer-Verlag, 1996.
- S. Karlin and H. M. Taylor, A First Course in Stochastic Processes, Academic Press, 1975.

- D. R. Stirzaker, Elementary Probability, Cambridge University Press, 2003.
- G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, Oxford Univ. Press, 1992.

Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

Study hours

- Lectures - 22 hours
- Tutorials - 11 hours
- Independent study hours - 67 hours

Teaching staff

Jonathan Bagley - Unit coordinator