COURSE DETAILS

Course Code: F71PM  
Full Course Title: Probabilistic Methods  
SCQF Level: 11  
SCAF Credits: 15  
Available as Elective: No

DELIVERY LEVEL

Undergraduate: No  
Postgraduate Taught: Yes  
Postgraduate Research: No

COURSE AIMS

To introduce fundamental stochastic processes which are useful in stochastic modelling and data science

LEARNING OUTCOMES – SUBJECT MASTERY

After studying this course, students should be able to:

- Use large deviation theory to estimate the probability of rare events
- Understand and use the Markov property
- Write down equations for the stationary distribution of a Markov chain and use, wherever possible, additional structure to solve them
- Write down first step equations and use them to compute the time to death, probability of absorption etc.
- Apply Markov chain modelling in several problems
- Understand long term behaviour and stationarity of a Markov chain
- Use renewal process to model various situations
- Calculate statistical properties for various renewal processes
- Define martingales
- Use main properties of martingales

LEARNING OUTCOMES – PERSONAL ABILITIES

At the end of the course, students should be able to:

- Demonstrate the ability to learn independently
- Manage time work to deadlines and prioritise workloads
- Present results in a way which demonstrates that they have understood the technical and broader issues of stochastic processes

SYLLABUS
Random walks and Large Deviations

- definition of a random walk
- introduction to large deviations theory
- introduction to rare event simulation
  - Conditional expectation
  - Markov chain

Sequences of random variables and the Markov property

Using the Markov property

Absorbing Markov chains with finite state space

First step (backwards) equations

Basic examples

Stationarity problem for finite state space chains

Convergence to stationarity

Markov chains with infinite but countable state space
  - Simple point processes, Poisson and compound Poisson processes
  - Continuous-time Markov processes
  - Renewal theory

Elementary renewal theory

Properties of the renewal function
F71PM Probabilistic Methods

- discrete renewal theory
  - Martingales

COURSE RELATIONSHIPS
N/A

LOCATION AND ASSESSMENT METHODS

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