F71PM Probabilistic Methods

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
Additional Information:

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
F71PM Probabilistic Methods

- 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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