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

LOCATION AND ASSESSMENT METHODS

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