

## LTCC Basic Statistics Course

- Title: **Stochastic Processes**
- Basic Details:
  - Core Audience: Statistics
  - Course Format: Core (10h)
- Syllabus: The course aims to introduce the main ideas and methods of simple applied probability, covering the following topics, together with examples of a variety of applications:
  1. A brief review of prerequisites (see below) and further discussion of Markov chains in discrete and continuous time; to include random walks, branching processes, reversibility, embedded chains, simulation and estimation. Examples of use of forward and backward decompositions, reversibility arguments and embedded chains.
  2. Point processes in time and space; to include complete and conditional intensities, superposition and thinning, Poisson-based processes, Markov and random fields.
  3. Epidemic models, to include thresholds, deterministic and moment closure approximations, population structure, host heterogeneity and heterogeneity of mixing, epidemics on networks.
- Recommended reading:
  - Hakan Andersson and Tom Britton (2000) *Stochastic Epidemic Models and their Statistical Analysis*. Springer Lecture Notes in Statistics no. 151,
  - D R Cox and Valerie Isham (1980) *Point Processes*, Chapman and Hall.
  - Geoffrey Grimmett and David Stirzaker (2001) *Probability and Random Processes*. 3<sup>rd</sup> ed. OUP.
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- Additional/Optional Reading:
  - Daryl Daley and David Vere-Jones (2003) *An Introduction to the Theory of Point Processes Volume 1: Elementary Theory and Methods*. Springer
  - Valerie Isham (2005) 'Stochastic models for epidemics: Current Issues and Developments' in *Celebrating Statistics*, eds A.C. Davison, Y. Dodge and N. Wermuth. OUP, pp.27-54.
  - Jesper Møller and Rasmus P Waagepetersen (2007) 'Modern Statistics for Spatial Point Processes (with discussion). *Scand. J. Statist.* 34: 643-711.
  - Sheldon Ross (1996) *Stochastic Processes*, Wiley.
- Prerequisites

Knowledge of Markov processes with discrete state spaces at a level typical of introductory undergraduate courses in applied probability – to include, in discrete time, transient and equilibrium behaviour, first passage times and classification of states; in continuous time, Poisson and birth-death processes.

Recommended texts:

- Sheldon M. Ross, *Introduction to Probability Models* (Academic Press, 2007, 9<sup>th</sup> ed.) sections: 4.1-4.4, 5.3, 6.1-6.5
  - David Stirzaker, *Stochastic Models and Processes* (OUP, 2005) sections 2.5, 3.1-3.6, 4.1-4.6.
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- Format:
    - No. of problem sheets: 4
    - Electronic lecture notes: yes
    - Necessary support facilities: none
    - Necessary software requirements for computing facilities: None
    - Proposed timing: late Spring 2010
    - Lecture/computer session/tutorial/discussion h split: 8/2. Part of each 2-hour session will be set aside to discuss issues arising from the current lecture or from the problems and/or reading set the previous week.
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- Lecture details:
    - Lecturer: Valerie Isham, UCL
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