The LTCC fosters the training of doctoral research students in the Mathematical Sciences. Its courses cover the areas of Statistics, Applied Mathematics and Pure Mathematics, with the aim of providing students with an overview of these areas, and of acquiring a working knowledge of classical results and recent developments in their own broad research fields but outside the specialised domains of their individual research projects. There is a wide range of expertise among the staff of the institutions currently in the LTCC consortium:

- Departments of Mathematics and Statistical Science, UCL
- The School of Mathematical Sciences, Queen Mary University of London
- Department of Mathematics, Imperial College London
- Department of Mathematics, King's College London
- Departments of Mathematics and Statistics, LSE
- Departments of Mathematics, City, University of London
- SMSAS, University of Kent
- Department of Mathematics, Brunel University London
- Department of Mathematics, Royal Holloway University of London
- School of Mathematics and Statistics, Open University

The LTCC programme emphasises direct teaching and personal contact rather than distance learning, and includes modular lecture courses and short intensive courses.

Note: A fee is payable by students from non-LTCC departments.

Lecture venue:

De Morgan House
57-58 Russell Square
London WC1B 4HS

Office address:

LTCC
Department of Mathematics
University College London
Room 610, 25 Gordon Street
London WC1H 0AY

Phone: 020 3108 1551
E-mail: office@ltcc.ac.uk
www.ltcc.ac.uk

This course list is subject to change. Further information, venue details, full text syllabi, the registration form and timetable are available online at **www.ltcc.ac.uk** or contact us at office@ltcc.ac.uk

Basic Courses 2023 - 2024

LTCC

London Taught Course Centre

for PhD students in the mathematical sciences

9 October - 6 November 2023 (Block 1)

Stochastic Processes *Dr Terry Soo, UCL*
This course aims to introduce the main ideas and methods of simple applied probability, together with examples of a variety of applications. Main topics: Markov chains in discrete and continuous time, and Poisson-based processes.

Pseudo-differential operators and applications to PDEs
Dr Claudia Garetto, QMUL
In this course we will study the theory of pseudo differential operators. These integral operators are a generalisation of differential operators. They have interesting algebraic properties, such as the existence of a symbolic calculus, which are very useful when studying PDEs (elliptic equations and higher order PDEs).

Analytical Methods *Prof. Nick Ovenden, UCL*
We will study perturbation methods in the context of ordinary and partial differential equations. Topics covered will include matched asymptotics, steepest descents, conformal mappings, WKB expansions and multi-scale analysis.

Applied Bayesian Methods *Prof. Petros Dellaportas, UCL*
This course introduces the Bayesian approach to statistical inference and relevant theories, methodologies and computational techniques for its implementation.

13 November-11 December 2023 (Block 2)

Measure Theory *Dr Robert Simon, LSE*
We cover the basic structure of measures, starting with the algebra of sets on which a measure is defined. We explore the concept of outer measure and its most common application, the Lebesgue measure on Euclidean space. We end the course by applying measures to functions and their integration, including the monotone and dominated convergence theorems.

Morse theory, topology and robotics
Prof. Michael Farber, QMUL
Morse theory is a powerful tool which allows understanding topology of manifolds using information about critical points of smooth functions. We shall start with basic notions of manifold theory; we shall apply Morse theory to study topology of configuration spaces of mechanical linkages and will arrive at their combinatorial classification.

Fundamental Theory of Statistical Inference
Prof. Alastair Young, Imperial
This course describes the key aspects of Bayesian, Fisherian and frequentist approaches to statistical inference. The module will cover: statistical inference from a decision-theoretic perspective; Bayesian methods; exponential and transformation families of models; principles of statistical inference and data reduction; key elements of frequentist theory of point estimation and hypothesis testing.

Orthogonal Polynomials and Special Functions
Dr Ana Loureiro, University of Kent
The course aims to investigate the modern theory of orthogonal polynomials (OPs) and some special functions. We will also discuss about the connections with numerical methods, random matrices, operator theory, integrable systems, number theory and combinatorics. Extensions of the concept of orthogonality, in particular multiple orthogonality, will be considered.

15 January - 12 February 2024 (Block 3)

Graph Theory
Prof. Peter Allen, LSE
Our aims in this course are twofold. First, to discuss some of the major results of graph theory, and to provide an introduction to the language, methods and terminology of the subject. Second, to emphasise various approaches (algorithmic, probabilistic, etc.) that have proved fruitful in modern graph theory. These modes of thinking about the subject have also proved successful in other areas of mathematics, and the skills learnt in this course should be transferable to other areas of mathematics.

Mathematical Biology
Dr Philip Pearce, UCL
The course aims to provide an introduction to multiscale methods in mathematical biology, including a survey of relevant applications. Emphasis is placed on how realistic biological effects at the microscale (e.g. gene expression within cells) can be captured in macroscopic models (e.g. PDEs for whole cell populations).

Homological Algebra
Prof. Markus Linckelmann, City
The first half of this course will be a systematic introduction to the basic concepts and methods in homological algebra, such as chain complexes, cohomology, Ext and Tor, homotopy, long exact cohomology sequences, derived functors and categories. The second half of the course will focus on applications in group cohomology, Hochschild cohomology of algebras, deformation theory, algebraic topology, and time permitting some basics on functor cohomology.

Measure-theoretic Probability
Prof. Alexander Gnedin, QMUL
The course provides a measure-theoretic background for modern Probability Theory and introduces important stochastic processes. The selected topics include construction of measures, conditioning and martingales, types of convergence and limit theorems, construction and properties of Brownian motion, weak convergence of measures in application to Donsker's invariance principle. Each lecture is supplemented by a set of exercises of varying levels of difficulty.

19 February - 18 March 2024 (Block 4)

Time Series Analysis *Dr Yining Chen, LSE*
The aim of this course is to introduce students to the statistical analysis of time series data and simple models, and showcase what time series analysis can be useful for. Topics include: autocorrelation, stationarity, trend removal and seasonal adjustment, basic time series models (e.g. ARMA) and their estimation, introduction to financial time series and the GARCH models. R demonstrations will also be included.

Representation Theory of Finite Groups
Dr Yusra Naqvi, UCL
In this course, we study finite groups via their actions on vector spaces, which allows us to make use of methods from linear algebra. We will first discuss important results in the more general representation theory of associative algebras and then specialise to a closer examination of finite groups.