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 2265
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 2024 - 2025

LTCC

London Taught Course Centre

for PhD students in the mathematical sciences

7 October - 4 November 2024 (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.

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.

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.

11 November - 9 December 2024 (Block 2)

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.

Analytical Methods *Prof. Nick Ovenden, UCL*
We will study perturbation methods, alongside other analytical techniques, 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.

Symmetry Methods for Differential Equations
Prof. Peter Clarkson, University of Kent
This course is concerned with symmetry reductions of partial differential equations, which are obtained by seeking solutions in special forms or using group theoretical, highly algorithmic techniques. These symmetry reductions reduce the equation to a lower dimensional equation, often an ordinary differential equation.

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 the basic notions of manifold theory and will apply methods of Morse theory to obtain classification of configuration spaces of mechanical linkages.

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.

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.

13 January - 10 February 2025 (Block 3)

An introduction to the Finite Classical Groups
Dr Nick Gill, The Open University
The Classification of Finite Simple Groups is one of the most celebrated theorems in mathematics. It states that simple groups fall into a number of natural families, one of which is the classical groups. These groups are most easily understood as matrix groups. Our aim will be to define and study these groups using linear algebra and the theory of permutation groups.

Mathematical Biology *Dr Philip Pearce, UCL*
Course Description: 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).

Applications of Differential Geometry to Mathematical Physics
Dr Steffen Krusch, University of Kent
The course will illustrate how concepts in differential geometry arise naturally in different areas of mathematical physics. We will describe manifolds, fibre bundles, (co)tangent bundles, metrics and symplectic structures, and their applications to Lagrangian mechanics, field theory and Hamiltonian systems, including various examples related to integrable systems and topological solitons.

Theory of Linear Models
Dr Kalliopi Mylona, KCL
This course describes the theory behind the common methods of estimation and inference in linear models and extensions to related classes of models, such as transformed models, linear mixed models, generalised linear models, semiparametric regression models, machine learning models and nonlinear models.

Pseudo-differential Operators and applications to PDEs -
Prof. Michael Ruzhansky, 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).

17 February - 17 March 2025 (Block 4)

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.