Tutorials: Mathematics and statistics

MATHEMATICIANS HAVE ALWAYS BEEN FASCINATED by numbers, but the subject is so much more. We can use maths to explain how a leopard gets its spots, to explore quantum theory and relativity, and to predict the movements of stock markets. Studying maths at Oxford will teach you to think mathematically and to provide you with the tools needed to construct theorems and proofs. You will be encouraged to ask questions and to find solutions for yourself. Above all, you will learn how to argue clearly and concisely as you solve problems. For some of you, this way of thinking or solving problems will be your goal. Others will want to see what further can be discovered. Either way, it is a subject we want you to enjoy.

Mathematicians at Oxford study in a new building named after perhaps the most famous current living mathematician, Sir Andrew Wiles, who famously proved Fermat's last Theorem and now lives in Oxford. Outside of the building you will find Penrose Paving, consisting of two different rhombus shaped granite tiles with inlaid stainless-steel arcs, which demonstrate the discoveries of Sir Roger Penrose, now emeritus professor at Oxford. In the Wiles building over 170 faculty, research fellows, and postdoctoral researchers work in fields ranging from number theory to understanding the mechanics of the human brain. The elegant building, in Oxford's new Radcliffe Observatory Quarter, is close to Wycliffe Hall, and has its own café to allow mathematicians to socialize with each other during breaks in study. Nearby the separate department of statistics specialises in computational statistics and statistical methodology, probability, bioinformatics and mathematical genetics.

Prerequisites: All students wanting to study mathematics and/or statistics at Oxford should have studied mathematics at their home universities for at least two years.

Teaching

Teaching for mathematics consists of University lectures, which play a key part in mathematics teaching, tutorials (one-to-one meetings with a specialist tutor), and, if appropriate and feasible, group tutorials with other Oxford undergraduates. For each tutorial, students will complete a set of questions from a problem sheet, submitting their solutions beforehand to be marked by the tutor. Full lecture notes and other supporting materials are available on the University's virtual learning platform to which students will have full access once they are in Oxford.

Further useful information on the tutorial options in mathematics and statistics can be found **here**. Please ignore information about how to apply, interviews, examinations etc. as this is intended only for matriculated students registered for degrees at Oxford. Also, please do not be put off by the fact that it is called a 'BA' in mathematics. Almost all first degrees at Oxford are BA degrees, whether the discipline is in humanities, social science, or science.

Choosing tutorials

Example courses available through Wycliffe Hall in the traditional Oxford tutorial system are listed below. Other options are possible with prior arrangement – please see the Maths Institute website for a full list of courses here. 'Prelims' refers to courses taught to first year maths undergraduates, 'Part A' second year, 'Part B' third year and 'Part C' fourth year. We strongly recommend choosing courses from 'Prelims' and 'Part A', although courses from 'Part B' and 'Part C' are possible with prior discussion.

SCIO does not take visiting students in Trinity Term, but we have included Trinity Term courses below as they may be chosen by students in Oxford in other terms/semesters on the understanding that no lectures will be available. We strongly recommend choosing courses where lectures are available, but we give students the option of taking these courses if they are subjects which they would otherwise be unable to take at all.

Submitting Your Course Selections

Prior to submitting your SCIO Course Selections within your application, please alert your Oxford advisor via phone or email and include the following information for each STEM tutorial you are requesting:

- The exact title of the tutorial
- Which courses you have done which you feel will enable you to do this tutorial
- Whether you will be taking this course to fulfil a specific requirement at your home institution. If so, please attach your institution's syllabus. If not, please list which specific topics you wish to cover.

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Note: All students take two tutorials—a primary (6 credits) and a secondary (3 credits)—and provide an alternative for each. Thus, if you want to take two STEM tutorials, you should provide details for four unique titles. Armed with the information you provide, the Oxford staff can search for the most appropriate tutor for each of your tutorial courses. They will contact you should any queries arise.

Tutorial list

Michaelmas term (fall semester)

Hilary term (spring semester)

Trinity term (April - June)

Michaelmas term (fall semester)

Geometry (intermediate)

Students will learn how to encode a geometric scenario into vector equations and meet the vector algebra needed to manipulate such equations. They will also meet the benefits of choosing sensible co-ordinate systems and appreciate what geometry is invariant of such choices.

Calculus (intermediate)

The course presents the tools needed to be able to solve a range of ordinary differential equations (ODEs) and introduces the notion of partial derivatives for use in a variety of applications.

Linear Algebra (intermediate)

This course introduces the general notions of a vector space, a subspace, linear independence and dependence, spanning sets and bases. It will also develop an understanding of matrices and their applications to systems of linear equations and linear maps between vector spaces.

Metric Spaces and Complex Analysis (advanced)

This course is split into two parts: metric spaces (10 lectures) and complex analysis (22 lectures). It begins with an introduction to point-set topology and the central importance of complex variables in analysis, before moving onto differentiation and integration in this setting. It then presents the tools and results of complex analysis including Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Laurent's expansion and the theory of residues.

Differential Equations (advanced)

Students will learn a range of different techniques and results used in the study of ordinary differential equations (ODEs) and partial differential equations (PDEs), such as: Picard's theorem proved both by successive approximation and the contraction mapping theorem; Gronwall's inequality; phase plane analysis; method of characteristics for first order semi-linear PDEs; classification of second order semi-linear PDEs and their reduction to normal form using characteristic variables; well-posedness; the maximum principle and some of its consequences.

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Hilary Term (Spring semester)

Multivariable Calculus (intermediate)

In this course students will be introduced to multi-dimensional vector calculus. They will be shown how to evaluate volume, surface and line integrals in three dimensions and how they are related via the divergence theorem and Stokes' theorem. Students will also learn how to perform calculations involving div, grad and curl, including appreciating their meanings physically and proving important identities.

Partial Differential Equations and Fourier Series (intermediate)

The course begins by introducing students to Fourier series, concentrating on their practical application and the conditions required for their convergence. They will then be shown how to derive the heat, wave and Laplace's equations in several independent variables and to solve them. Finally, they will begin the study of uniqueness of solution of these important partial differential equations (PDEs).

Differential Equations (advanced)

Students will acquire a range of techniques for solving second order ODE's and boundary value problems, including Frobenius solutions, Fredholm alternative and Bessel's functions. The course concludes with an introduction to asymptotic theory and how the presence of a small parameter can affect solution construction and form.

Integral Transforms (advanced)

Students will gain a range of techniques employing the Laplace and Fourier transforms in the solution of ordinary and partial differential equations. They will also have an appreciation of generalized functions and their calculus and applications.

Trinity term (April to June)

Constructive Maths (intermediate)

This course introduces the concept of an algorithm and explains how to construct simple algorithms for the solution of certain elementary problems. Students will make and run simple procedures in Matlab to demonstrate examples of applications in real analysis and implementation.

Mathematical Biology (advanced)

Students will develop a sound knowledge and appreciation of the ideas and concepts related to modelling biological and ecological systems using both discrete- and continuous-time non-spatial models. Techniques used include linear stability analysis and phase planes.

Variational Calculus (advanced)

In this course it is shown that such variational problems give rise to a system of differential equations, the Euler–Lagrange equations. Furthermore, the minimizing principle that underlies these equations leads to direct methods for analysing the solutions to these equations. These methods have far reaching applications and will help develop students' technique.