

School of Mathematics & Statistics

Important Degree Information:

B.Sc./M.A. Honours

The general requirements are 480 credits over a period of normally 4 years (and not more than 5 years) or part-time equivalent; the final two years being an approved honours programme of 240 credits, of which 90 credits are at 4000 level and at least a further 120 credits at 3000 and/or 4000 (H) levels. Refer to the appropriate Faculty regulations for lists of subjects recognised as qualifying towards either a B.Sc. or M.A. degree.

B.Sc./M.A. Honours with Integrated Year Abroad

The general requirements are 540 credits over a period of normally 5 years (and not more than 6 years) or part-time equivalent; the final three years being an approved honours programme of 300 credits, of which 60 credits are gained during the integrated year abroad, 90 credits are at 4000 level and at least a further 120 credits at 3000 and/or 4000 (H) levels. Refer to the appropriate Faculty regulations for lists of subjects recognised as qualifying towards either a B.Sc. or M.A. degree.

M.Math. Honours

General requirements are 600 credits over a period of normally 5 years or 4 years with Advanced Standing (and in no circumstances more than 6 years) or part-time equivalent; an approved honours programme of at least 330 credits of which 120 credits are at 5000 level and at least a further 210 are at 3000 level and above.

Other Information: In the case of students who spend part of the BSc/MA Honours Programme abroad on a recognised Exchange Scheme, the Programme Requirements will be amended to take into account courses taken while abroad.

Degree Programmes	Programme Requirements at:
(M.Math.Honours): Applied Mathematics (M.Math. Honours)	<p>Single Honours M.Math. Applied Mathematics Degree:</p> <p>Level 1: At least 20 credits comprising MT1002</p> <p>Level 2: At least 60 credits comprising at least grade 15 in MT2001 and MT2003 (or MT2101 and PH2011)</p> <p>Level 3: At least 60 credits comprising MT3501, MT3503, MT3504, MT3601</p> <p>Level 4: At least 45 credits comprising MT4005, MT4509 and MT4510. In addition at least one of MT4111, MT4112, MT5611 and MT5612</p> <p>Level 5: At least 120 credits overall which must include MT5999 and at least 60 credits from MT5802, MT5806, MT5809, MT5810, MT5990</p>

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Degree Programmes	Programme Requirements at:
<p>(M.Math Honours): Mathematics (M.Math. Honours)</p>	<p>Single Honours M.Math Mathematics Degree: Level 1: At least 20 credits including MT1002</p> <p>In addition credit in one of MT1007, MT1008, MT2004 must normally be gained at some stage.</p> <p>Level 2: At least 90 credits including at least grade 15 in MT2001 (or MT2101), and at least grade 15 in two of MT2002, MT2003, MT2004 and MT2005</p> <p>Level 3: At least 60 credits including MT3501, MT3503, MT3504 and at least one of MT3600, MT3601 and MT3606</p> <p>Level 4: At least 30 credits including at least 2 of MT4003, MT4004, MT4510, MT4509, MT4606. In addition at least one of MT4111, MT4112, MT5611 and MT5612</p> <p>Level 5: At least 120 credits overall which must include MT5999 and at least 60 credits from MT5752, MT5753, MT5802, MT5806, MT5809, MT5810, MT5823-8, MT5835, MT5990.</p>
<p>(M.Math Honours): Pure Mathematics (M.Math. Honours)</p>	<p>Single Honours M.Math Pure Mathematics Degree: Level 1: At least 20 credits including MT1002</p> <p>Level 2: At least 60 credits including a pass at 15 or better in MT2001 and MT2002</p> <p>Level 3: At least 60 credits including MT3501, MT3503, MT3504 and MT3600</p> <p>Level 4: At least 30 credits including MT4003 and MT4004. In addition at least one of MT4111, MT4112, MT5611 and MT5612.</p> <p>Level 5: At least 120 credits overall which must include MT5999 and at least 60 credits from MT5823-MT5828, MT5990</p>
<p>(M.Math. Honours): Statistics (M.Math Honours)</p>	<p>Single Honours Statistics M.Math. Degree: Level 1: At least 20 credits including MT1002</p> <p>Level 2: At least 60 credits including a pass at 15 or better in MT2001 (or MT2101) and MT2004</p> <p>Level 3: At least 45 credits including MT3501, MT3606 and MT3607</p> <p>Level 4 & Level 5: The programme must include:</p> <ul style="list-style-type: none"> - at least one of MT4527 and MT4608; - at least one of MT5701 and MT5831; - at least one of MT5705 and MT5835; - MT5753; - A project MT5999 on a statistical topic; - At least 120 credits at level 5.

Degree Programmes	Programme Requirements at:
<p>(B.Sc. Honours or M.A. Honours): Mathematics</p>	<p>Single Honours Mathematics Degrees: Level 1: At least 20 credits comprising MT1002</p> <p>In addition credit in one of MT1007, MT1008 or MT2004 must normally be gained at some stage.</p> <p>Level 2: At least 60 credits comprising a pass at 11 or better in MT2001 (or MT2101) and a pass at 11 or better in at least one of MT2002, MT2003, MT2004 and MT2005. (An alternative route is MT2101 and PH2011)</p> <p>Level 3 and 4:</p> <ul style="list-style-type: none"> - 45 credits comprising MT3501, MT3503 and MT3504; - at least one of MT3600, MT3601 and MT3606 - MT4599; - at least one of MT3607, MT4111, MT4112.
<p>(B.Sc. Honours): Mathematics and Chemistry, Computer Science, Economics, Geography, Internet Computer Science, Logic & Philosophy of Science, Management Science, Physics, Psychology.</p> <p>(M.A. Honours): Mathematics and Ancient History, Art History, Biblical Studies, Classical Studies, Economics, Hebrew, International Relations, Latin, Mediaeval History, Modern History, Philosophy, Psychology, Scottish History, Spanish[^], Theological Studies.</p> <p>[^] available also as 'With Integrated Year Abroad Degrees'</p>	<p>Mathematics element of Joint Honours Degrees: Level 1: 20 credits comprising MT1002</p> <p>Level 2: 60 credits comprising Passes at 11 or better in MT2001 (or MT2101) and one of MT2002 or MT2003 (or PH2011)</p> <p>Level 3 and level 4: Normally a total of 120 credits which must include:</p> <ul style="list-style-type: none"> - at least two of MT3501, MT3503 and MT3504; - at least one of MT3600 and MT3601; - at least one of MT4111, MT4112; - MT4599. <p>Note The total number of MT credits at level 3 and 4 may be reduced to no less than 90 with the permission of the Director of Teaching.</p>
<p>(B.Sc. Honours): Mathematics with French[^] or Geography or German[^] or Russian[^] or Spanish[^]</p> <p>[^] available also as 'With Integrated Year Abroad Degrees'</p> <p>(M.A. Honours) Mathematics with Russian[^] or Spanish[^]</p>	<p>Mathematics element of Major Degree with a Modern Language: Level 1: 20 credits comprising MT1002</p> <p>Level 2: 60 credits comprising a pass at 11 or better in MT2001 (or MT2101) and in one of MT2002 or MT2003</p> <p>Level 3 and level 4: Normally a total of 180 credits which must include:-</p> <ul style="list-style-type: none"> - at least two of MT3501, MT3503, MT3504; - at least one of MT3600 and MT3601; - at least one of MT4111, MT4112; - MT4599.

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Degree Programmes	Programme Requirements at:
<p>(M.Phys. Honours): Mathematics and Theoretical Physics</p>	<p>Mathematics element of Joint M.Phys. Degree: Level 1: 20 credits comprising MT1002</p> <p>Level 2: 30 - 60 credits comprising MT2101 or (MT2001 and MT2003)</p> <p>Level 3: 30 credits comprising MT3501 and MT3504</p> <p>Level 4: At least 45 credits comprising at least three modules from MT4000 level.</p> <p>Level 5: A project (either MT5999 or PH5102) together with a further 40 credits in MT5000 level modules.</p> <p>Note Normally the Honours programme will comprise either 180 credits in MT modules at level 3 and above, or 150 credits in MT modules at level 3 and above together with a 30 credit MT module at level 2.</p>
<p>(B.Sc. or M.A. Honours): Statistics</p>	<p>Single Honours Statistics Degrees: Level 1: At least 20 credits including MT1002</p> <p>Level 2: At least 60 credits including a pass at 11 or better in MT2001 and MT2004</p> <p>Level 3 and level 4:</p> <ul style="list-style-type: none"> - MT3501 - MT3606 - At least one of MT3607, MT4111, MT4112 - MT4606 - MT4607 - At least two of MT4531, MT4608, MT4609 - MT4599
<p>(B.Sc. Honours): Statistics and one of Computer Science, Economics, Geography, Internet Computer Science, Logic & Philosophy of Science, Management Science.</p> <p>(M.A. Honours): Statistics and one of Economics, Philosophy</p>	<p>Statistics element of Joint Honours Degrees: Level 1: At least 20 credits including MT1002</p> <p>Level 2: At least 60 credits comprising passes at 11 or better in MT2001 (or MT2101) and MT2004</p> <p>Level 3 and level 4: Normally 120 credits which must include</p> <ul style="list-style-type: none"> - 30 credits comprising MT3501, MT3606; - at least two from MT3703, MT4531, MT4606 - MT4609; - MT4599.
<p>(B.Sc. Honours): Statistics with French[^] or German[^] or Spanish[^]</p> <p>[^] available also as 'With Integrated Year Abroad Degrees'</p>	<p>Statistics element of a Major Degree with a Modern Language: Level 1: At least 20 credits comprising MT1002</p> <p>Level 2: At least 60 credits comprising passes at 11 or better in MT2001 (or MT2101) and MT2004</p> <p>Level 3 and level 4: Normally a total of 180 credits which must include</p> <ul style="list-style-type: none"> - 30 credits comprising MT3501, MT3606; - at least one of MT4531, MT4606; - at least two of MT3703, MT4607, MT4608, MT4609; - MT4599.

Students completing any other degree programmes (as defined in previous Course Catalogues) should discuss their module selections with one of the School's Honours Advisers.

Modules

Normally the prerequisite for each of the following Honours modules is entry to the Honours Programme(s) for which they are specified, as well as any additional specific prerequisite(s) given.

General degree students wishing to enter 3000 modules and non-graduating students wishing to enter 3000 or 4000 level modules must consult with the relevant Honours Adviser within the School before making their selection.

The prerequisite for each of the following 5000 modules is entry to the MPhys or MMath Programme(s) for which they are specified, as well as any additional specific prerequisite(s) given.

MT3501 Linear Mathematics

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: This module aims to show the importance of linearity in many areas of mathematics ranging from linear algebra through to geometric applications to linear operators and special functions. The main topics covered are: linear dependence and independence; change of basis; inner product spaces; inequalities; convergence in Euclidean spaces; Fourier series and adjoint and self-adjoint operators.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3503 Complex Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: This module aims to introduce students to analytic function theory and applications. The topics covered include: analytic functions; Cauchy-Riemann equations; harmonic functions; multivalued functions and the cut plane; singularities; Cauchy's theorem; Laurent series; evaluation of contour integrals; fundamental theorem of algebra; Argument Principle; Rouché's Theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

MT3504 Differential Equations

Credits: 15.0 Semester: 1

Prerequisite: MT2001 or MT2101

Description: The object of this module is to provide a broad introduction to analytical methods for solving ordinary and partial differential equations and to develop students' understanding and technical skills in this area. This module is a prerequisite for several other honours options. The syllabus includes: existence and uniqueness of solutions to initial-value problems; series solutions of second-order o.d.e.'s; examples including Bessel, Legendre and Airy equations; nonlinear o.d.e.'s; classification of second order linear p.d.e.'s; method of separation of variables; eigenvalues for boundary conditions of mixed type; characteristics and reduction to canonical form.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 10%, 2 Hour Examination = 90%

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MT3600 Fundamentals of Pure Mathematics

Credits: 15.0 Semester: 1
Prerequisite: MT2002 or (MT2001 and MT1003)
Description: The aim of this module is to introduce the fundamental algebraic and analytic concepts in pure mathematics in the context of the number systems.
Class Hour: 10.00 am
Teaching: Two lectures and one tutorial.
Assessment: 2 Hour Examination = 100%

MT3601 Fundamentals of Applied Mathematics

Credits: 15.0 Semester: 1
Prerequisites: (MT2001 and MT2003) or MT2101
Anti-requisite: MT4601
Description: This module is designed to introduce students to the mathematical methods which are needed to go on to further study of fluid mechanics, magnetohydrodynamics and electromagnetism. It consists of a revision of the techniques of vector calculus, followed by a discussion of the basic equations of fluid dynamics and electromagnetism. The properties of these equations are then illustrated by considering some basic properties of fluid flow and of magnetohydrodynamics.
Class Hour: 10.00 am
Teaching: Two lectures and one tutorial.
Assessment: 2 Hour Examination = 100%

MT3606 Statistical Methods

Credits: 15.0 Semester: 1
Prerequisite: MT2004
Description: This module provides a bridge between second year and Honours modules in statistics. Topics covered include nonparametric methods, analysis of Poisson data, distribution theory, introduction to Bayesian methods, likelihood-based methods. The module covers some of the basic tools used by statisticians to develop a wide range of statistical methods.
Class Hour: 11.00 am
Teaching: Two lectures and one tutorial.
Assessment: 2 Hour Examination = 100%

MT3607 Computing in Statistics

Credits: 15.0 Semester: 2
Availability: 2007-08
Prerequisites: MT2004 or both MT1008 and MT2001
Description: Students will gain experience with the software package SAS and the statistical language and environment R. Statistical computing exercises include using and writing software to (1) extract and organize electronically stored data, (2) search for patterns and meaningful relationships, (3) fit mathematical models to characterize relationships succinctly, (4) produce useful graphical and numerical summaries.
Class Hour: 9.00 am
Teaching: Two lectures and one practical class.
Assessment: Continuous Assessment = 30%, 2 Hour Examination = 70%

MT3703 Stochastic Modelling

Credits: 15.0 Semester: 1
Availability: 2007-08
Prerequisite: MT2004

Description: The object of this module is to introduce students to the basic ideas of stochastic models of systems, to enable them to formulate and analyse stochastic models (in terms of Markov chains or appropriate continuous-time stochastic processes) for various systems, and to explain how simulation may be of use in understanding such models. The syllabus includes: Markov chains; Chapman-Kolmogorov equations; basic properties of random walks; queues; idea of a Poisson process in terms both of events and inter-event times; the concept of simulation of stochastic processes; how to formulate an appropriate stochastic model of a system.

Class Hour: 9.00 am
Teaching: Two lectures and one tutorial.
Assessment: 2 Hour Examination = 100%

MT3802 Numerical Analysis

Credits: 15.0 Semester: 1
Prerequisites: MT2001 or MT2101
Anti-requisite: MT4502

Description: The module will introduce students to some topics in numerical analysis, which may include methods of approximation, numerical integration, solution of systems of linear equations by elimination and by iterative methods.

Class Hours: 11.00 am
Teaching: Two lectures and one tutorial.
Assessment: Continuous Assessment = 20%, 2 Hour Examination = 80%

MT3832 Mathematical Programming

Credits: 15.0 Semester: 2
Availability: 2007-08
Prerequisites: MT2001 (or MT1002 and MN2002)
Anti-requisite: MT4532

Description: The aim of this module is to introduce students to the formulation and solution of various linear programming problems. The subject matter will be illustrated by applying the methods of solution to real examples. The syllabus includes: formulation of linear problems; solution graphically and by simplex algorithm; sensitivity analysis; duality; transportation and transshipment; the assignment problem.

Class Hour: 12.00 noon
Teaching: Two lectures and one tutorial.
Assessment: 2 Hour Examination = 100%

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MT3833 Utilities, Decisions and Inventories

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT2004

Anti-requisite: MT4533

Description: This module is intended to provide an introduction to the formulation and solution of problems of decision-taking and problems in the management of inventory systems for a single item, to motivate the need for utility functions, and to explain how they are assessed and employed. The syllabus includes: decision theory; maximin and Bayesian approaches; Bayes theorem; Bellman's optimality principle; utility theory; utility functions; inventory theory.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4003 Groups

Credits: 15.0 Semester: 2

Prerequisite: MT3600 or (MT2002 and MT3501)

Anti-requisites: MT3603, MT4603

Description: This module introduces students to group theory, which is one of the central fields of the 20th century mathematics. The main theme of the module is classifying groups with various additional properties, and the development of tools necessary in this classification. In particular, the students will meet the standard algebraic notions, such as substructures, homomorphisms, quotients and products, and also various concepts peculiar to groups, such as normality, conjugation and Sylow theory. The importance of groups in mathematics, arising from the fact that groups may be used to describe symmetries of any mathematical object, will be emphasised throughout the module.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4004 Real Analysis

Credits: 15.0 Semester: 2

Prerequisite: MT3600 or (MT2002 and MT3501)

Anti-requisites: MT3604, MT4604

Description: This module continues the development of real analysis started in MT2002. Topics that will be treated from a rigorous point of view may include: differentiation, Riemann integration, uniform convergence, function spaces.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4005 Linear and Nonlinear Waves

Credits: 15.0 Semester: 1

Prerequisites: MT2003 and (MT3503 or MT3504)

Anti-requisites: MT3605, MT4605

Description: This module gives an introduction to wave motion and its importance in many areas of applied mathematics. It begins with a discussion of the linear approximation for small amplitude waves and discusses properties of these such as dispersion relations, phase and group velocities, dissipation and dispersion. Some nonlinear effects such as wave steepening are then treated and an introduction given to some of the equations, for example Burger's and Korteweg de Vries, which are used to model nonlinear wave propagation.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4111 Symbolic Computation

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3501 or MT3503 or MT3504

Anti-requisite: MT3611, MT5611

Description: This module aims to enable students to use Maple as a tool in their other modules and to turn naturally to such a package when solving mathematical problems. The module aims to illustrate the following points: a symbolic computation package allows one to conduct mathematical experiments; a symbolic computation package allows one to collect data about a problem being studied. This is similar to the way other scientists work. It is easier to try several different approaches to a problem and see which works. The machine is stupid. Intelligence comes from the user. The user thinks, the user interprets, the computer calculates.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 30%, 2 Hour Examination = 70%

MT4112 Computing in Mathematics

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisites: MT3503 or MT3504

Anti-requisites: MT3612, MT5612, Honours or Joint Honours Programme in Computer Science.

Description: This module is intended to introduce students to FORTRAN and the writing of computer codes to implement mathematical algorithms. The module includes a basic introduction to FORTRAN, and the implementation of mathematical algorithms in a well-documented FORTRAN program. Students are required to complete a project in addition to sitting the examination.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 30%, 2 Hour Examination = 70%

MT4501 Topics in the History of Mathematics

Credits: 15.0 Semester: 1

Prerequisite: one of MT3501, MT3503, MT3504, MT3606

Anti-requisite: MT3801, MT5613

Description: The aim of this module is to give students an insight into the historical development of mathematics. Topics to be covered may include some of: the development of algebra, the origins of the calculus, the history of logarithms, the work of some individual mathematicians.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment: Project = 34%, Two Class Tests = 66%

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MT4507 Classical Mechanics

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT2003 and (MT3503 or MT3504)

Anti-requisite: MT3807

Description: The object of this module is to introduce students to some of the ideas and mathematical techniques used in understanding the behaviour of dynamical systems that obey Newton's Laws. These notions are arguably the foundations of physics and applied mathematics. The module will include: Newton's laws of motion; conservative forces; central forces; non-inertial/accelerating frames of reference; dynamics of a system of particles; mechanics of a rigid body; Euler's equations; Lagrange's equations; Hamilton's equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4508 Dynamical Systems

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisite: MT3504

Anti-requisite: MT3808

Description: This module aims to introduce students to the basic ideas of the modern theory of dynamical systems and to the concepts of chaos and strange attractors. The module will include: period doubling; intermittency and chaos; geometrical approach to differential equations; homoclinic and heteroclinic orbits; Poincaré sections; the Smale horseshoe mapping; centre manifold theory.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4509 Fluid Dynamics

Credits: 15.0 Semester: 2

Prerequisite: MT3601 (or MT4601)

Description: This module provides an introduction to the theory of incompressible fluid dynamics, which describes the motion of liquids and gases at speeds small compared to the sound speed. Special attention is paid to a precise foundation of the various conservation laws that govern fluid dynamics, as this provides a convenient framework in which to study specific examples as well as extensions of the basic theory.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4510 Solar Theory

Credits: 15.0 Semester: 2

Prerequisite: MT3601

Anti-requisites: MT4504, MT5804

Description: The object of this module is to describe the basic dynamic processes at work in the Sun, a subject which is being enlivened by dramatic new results from space missions.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4511 Asymptotic Methods

Credits: 15.0 Semester: 1

Availability: 2006-07

Prerequisite: MT3504

Anti-requisite: MT3811

Description: This module is designed to introduce students to asymptotic methods used in the construction of analytical approximations to integrals and solutions of differential equations.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4513 Fractal Geometry

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisite: MT3501 or MT3503 or MT3504

Anti-requisite: MT3813, MT5813

Description: The aim of this module is to introduce the mathematics used to describe and analyse fractals and to show how the theory may be applied to examples drawn from across mathematics and science. The module discusses the philosophy and scope of fractal geometry; and may include topics such as dimension, representation of fractals by iterated function systems, fractals in other areas of mathematics such as dynamical systems and number theory, Julia sets and the Mandelbrot set.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4514 Graph Theory

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3501 or MT3503 or MT3504

Anti-requisite: MT3814

Description: The aim of this module is to introduce students to the study of Graph Theory as a tool for representing connections between data. Topics to be covered may include: basic theory and applications, Eulerian graphs, Hamiltonian graphs, planar graphs, spanning trees and applications, networks, matching problems.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4515 Functional Analysis

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3600 or (MT2002 and MT3501)

Anti-requisite: MT3815

Description: This object of this module is to familiarise students with the basic notions of functional analysis, that is analysis on normed spaces and Hilbert space. The module will cover normed spaces, convergence and completeness, operators, Hilbert spaces and may include topics such as spectral theory and the Hahn-Banach theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

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MT4516 Finite Mathematics

Credits: 15.0 Semester: 1

Availability: 2007-08

Prerequisites: one of MT3501, MT3503, MT3504, MT3606

Anti-requisite: MT3816

Description: The aim of this module is to introduce students to some topics in the mathematics of combinatorial structures. This theory has wide applications, both in classical mathematics and in theoretical computer science. Topics to be covered may include: coding theory, finite geometries, Latin squares, designs.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4517 Rings and Fields

Credits: 15.0 Semester: 1

Availability: 2006-07

Prerequisite: MT3600 or (MT2002 and MT3501)

Anti-requisite: MT3817

Description: Historically, rings have appeared as generalisations of number systems (integers, in particular) with the intention of gaining deeper insight into number systems themselves. This will be reflected in this module, where students will study familiar concepts, such as factorisation, primeness, divisibility etc., in a new, more general, setting of commutative rings. In addition, the module may include topics from: rings of quotients, finite fields and extensions of fields.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4519 Number Theory

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisite: one of MT3501, MT3503, MT3504

Anti-requisite: MT3819

Description: The aim of this module is to introduce students to some important topics in number theory. Topics to be covered may include: prime numbers, cryptography, continued fractions, Pell's equation, the Gaussian integers and writing numbers as sums of squares.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4521 Geometry and Topology

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisite: MT2002, (MT3600 or MT3501 or MT4003)

Description: The aim of this module is to elucidate the ancient subject of geometry with the modern algebraic insights of group theory and vector spaces, and show how the more recent subject of topology can be fitted into this framework.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4527 Forecasting

Credits: 15.0 Semester: 1

Availability: 2006-07

Prerequisites: MT2004 and one of MT3501, MT3503, MT3504, MT3606

Anti-requisite: MT3827

Description: This module provides an introduction to the forecasting of time series using both 'classical' moving average and exponential smoothing techniques and the Box-Jenkins approach. The syllabus includes: forecasting using moving average and exponential smoothing methods for constant mean and trend models, Holt-Winters method for seasonal models, the ARIMA class of models, fitting and forecasting for Box-Jenkins models.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4530 Population Genetics

Credits: 15.0 Semester: 1

Availability: 2007-08

Prerequisites: MT2004 and one of MT3501, MT3503, MT3504, MT3606

Anti-requisite: MT3830

Description: This module aims to show how the frequencies of characteristics in large natural populations can be explained using mathematical models and how statistical techniques may be used to investigate model validity. The syllabus includes: Mendel's First and Second Laws, random mating and random union of gametes, Hardy-Weinberg equilibrium, linkage, inbreeding, assortative mating, X-linked loci, selection and mutation.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4531 Bayesian Inference

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3606

Anti-requisite: MT3831, MT5831

Description: This module is intended to offer a re-examination of standard statistical problems from a Bayesian viewpoint and an introduction to recently developed computational Bayes methods. The syllabus includes Bayes' theorem, inference for Normal samples; univariate Normal linear regression; principles of Bayesian computational, Markov chain Monte Carlo – theory and applications.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial and practical classes.

Assessment: Continuous Assessment = 20%, 2 Hour Examination = 80%

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MT4536 Stochastic and Spatial Processes

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisite: MT3703

Description: This module develops further the theory of Markov chains which was introduced in MT3703, looking at absorption problems for finite reducible chains. An introduction is given to branching processes, which were first developed to explain the survival or extinction of surnames, considering in particular the criticality theorem of the Galton-Watson process. Birth-and-death population models are used to introduce Markov processes in continuous time. Probabilistic and inferential problems for spatial processes are also studied, looking at models in geostatistics, spatial models for lattice data and at spatial point patterns.

Class Hour: 11.00 am

Teaching: Weekly practical class and five lectures and one tutorial per fortnight.

Assessment: 2 Hour Examination = 100%

MT4551 Financial Mathematics

Credits: 15.0 Semester: 2

Prerequisites: MT2001 and (MT3503 or MT3504)

Anti-requisite: MT3851

Description: Students are introduced to the application of mathematical models to financial instruments. The course will include an overview of financial markets and the terminology in common usage but the emphasis will be on the mathematical description of risk and return as a means of pricing contracts and options.

Class Hour: 10.00 am

Teaching: 2 lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4599 Project in Mathematics/Statistics

Credits: 15.0 Semester: Whole Year

Anti-requisite: MT3999

Description: The student will choose a project from a list published annually although a topic outwith the list may be approved. Students will be required to report regularly to their supervisor and a report of no more than 5,000 words must be submitted by the end of the April.

Assessment: Project = 100%

MT4606 Statistical Inference

Credits: 15.0 Semester: 2

Availability: 2007-08

Prerequisites: MT3606

Anti-requisite: MT3701, MT5701

Description: This module aims to show how the methods of estimation and hypothesis testing met in MT2004 and MT3606 can be justified and derived; to extend those methods to a wider variety of situations. The syllabus includes: comparison of point estimators; the Rao-Blackwell Theorem; distribution theory; Fisher information and the Cramér-Rao lower bound; maximum likelihood estimation; hypothesis-testing; confidence sets.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT4607 Generalized Linear Models and Data Analysis

Credits: 15.0 Semester: 1

Availability: 2006-07

Prerequisite: MT2004

Co-(or pre-)requisite: MT3501

Anti-requisite: MT5753

Description: This module aims to demonstrate the power and elegance of unifying a large number of simple statistical models within the general framework of the generalized linear model. It will train students in the interpretation, analysis and reporting of data, when a single response measurement is interpreted in terms of one or a number of other variables.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial and practical classes.

Assessment: Project = 20%, 2 Hour Examination = 80%

MT4608 Sampling Theory

Credits: 15.0 Semester: 1

Availability: 2006-07

Prerequisite: MT2004

Co-(or pre-)requisite: one of MT3501, MT3503, MT3504, MT3606

Anti-requisite: MT3704

Description: The aims of this module are to introduce students to and interest them in the principles and methods of design-based inference, to convince them of the relevance and utility of the methods in a wide variety of real-world problems, and to give them experience in applying the principles and methods themselves. By the end of the module students should be able to recognise good and poor survey design and analysis, to decide upon and implement the main types of survey design in relatively straightforward settings, and analyse the resulting survey data appropriately. The syllabus includes fundamentals of design based *vs* model-based inference, simple random sampling, sampling with replacement, ratio and regression estimators, stratified sampling, cluster sampling and unequal probability sampling.

Class Hour: 10.00 am

Teaching: Two lectures, one tutorial and practical classes.

Assessment: Project = 15%, 2 Hour Examination = 85%

MT4609 Multivariate Analysis

Credits: 15.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3606

Anti-requisite: MT3705, MT5705

Description: This module aims to introduce students to the ideas and techniques of multivariate statistical analysis. The syllabus includes mean vectors, covariance matrices, correlation matrices; basic properties of multivariate normal distributions; checking multivariate normality; the likelihood ratio and union-intersection principles for constructing multivariate tests; the one-sample and two-sample Hotelling's T-squared tests; tests on covariance matrices, tests of independence; linear discriminant analysis; principal components analysis; canonical correlation.

Class Hour: 11.00 am

Teaching: Two lectures, one tutorial and practical classes.

Assessment: 2 Hour Examination = 100%

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MT5611 Advanced Symbolic Computation

Credits: 20.0 Semester: 2

Availability: 2006-07

Prerequisite: at least one MT4000 level module

Anti-requisite: MT4111

Description: This module aims to enable students to use Maple as a tool in their other modules and to turn naturally to such a package when solving mathematical problems. The module aims to illustrate the following points: a symbolic computation package allows one to conduct mathematical experiments; a symbolic computation package allows one to collect data about a problem being studied. This is similar to the way other scientists work. It is easier to try several different approaches to a problem and see which works. The machine is stupid. Intelligence comes from the user. The user thinks, the user interprets, the computer calculates. Students will undertake a more substantial project than that required for MT4111.

Class Hour: 9.00 am

Teaching: Two lectures, one tutorial

Assessment: Project = 45%, 2 Hour Examination = 55%

MT5612 Advanced Computing in Mathematics

Credits: 20.0 Semester: 2

Availability: 2007-08

Prerequisite: at least one MT4000 level module

Anti-requisite: MT4112

Description: This module consists of MT4112 with the addition of directed study on more advanced topics not covered in MT4112, for example, the use of NAG libraries and graphics packages plus aspects of Fortran 90 like dynamic allocatable arrays. In addition, the computing project will be more demanding than the project for MT4112. The syllabus includes: an introduction to good programming style through examples; the construction of a well documented Fortran program that implements a numerical algorithm; use of the advanced features of Fortran to, for example, (i) manipulate matrices, (ii) read and write to data files, (iii) implement library routines and (iv) use graphics packages. The students will also complete an advanced project that contributes up to 35% of the final marks for the module.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 35%, 2 Hour Examination = 65%

MT5613 Advanced Topics in the History of Mathematics

Credits: 20.0 Semester: 1

Prerequisites: one of MT4003, MT4004, MT4005 (or MT4603 – MT4605)

Anti-requisite: MT4501

Description: The overall aim of the module is to give students an insight into the historical development of mathematics and an opportunity to research into one particular topic in some depth. This module is taught in parallel with MT4501.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment: Project = 50%, Two Class Tests = 50%

MT5701 Advanced Statistical Inference

Credits: 20.0 Semester: 2

Availability: 2007-08

Prerequisites: MT3606 and any MT4000 level module

Anti-requisite: MT4606

Description: This module consists of MT4606 with the addition of directed reading on more advanced aspects of the subject and a requirement to write a review essay on an aspect of the subject. The syllabus includes: comparison of point estimators; the Rao-Blackwell Theorem; distribution theory; Fisher information and the Cramér-Rao lower bound; maximum likelihood estimation; hypothesis-testing; confidence sets.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5705 Advanced Multivariate Analysis

Credits: 20.0 Semester: 2

Availability: 2006-07

Prerequisites: MT3606 and any MT4000 level module

Anti-requisite: MT4609

Description: This module consists of MT4609 with the addition of directed reading on more advanced aspects of the subject or the analysis of a data set. The syllabus includes: properties of the multivariate normal distribution; checking multivariate normality; hypothesis testing; the likelihood ratio and union-intersection principles; one-sample and two-sample Hotelling T^2 tests; tests on covariance matrices; tests of independence; discriminant analysis; principal components analysis; canonical correlation; analysis of data using a computer package.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5751 Estimating Animal Abundance

Credits: 10.0 Semester: 2 (2 weeks)

Prerequisites: MT3606 and any MT4000 level module

Antirequisite: MT4535, MT5835

Description: The module will introduce students to the main types of survey method for wildlife populations. It will cover simple methods in some detail and provide students with a conceptual framework for building understanding of more advanced methods. By the end of the course, students will be able to identify an appropriate assessment method for a given population, be able to design a simple survey to assess the population, and perform simple analyses of survey data. Students will get experience in using the methods via computer practical sessions involving design and analyses of surveys conducted by computer simulation.

Class Hour: To be arranged.

Teaching: 4 lectures, one tutorial and two practical classes each week for 2 weeks.

Assessment: Continuous Assessment = 33%, 2 Hour Examination = 67%

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MT5752 Modelling Ecological Dynamics

Credits: 20.0 Semester: 2 (4 weeks)

Prerequisites: at least one MT4000 level module

Anti-requisites: MT4534, MT5834

Description: This module is designed to provide practical training in the construction and use of mathematical models of ecological dynamic systems. The module will start by covering basic dynamical concepts and mathematical tools, and will then cover modelling of individuals, single species populations, interacting populations and ecosystems. At all stages students will be expected to build and analyse models, with a combination of pencil and paper and computer software.

Class Hour: To be arranged.

Teaching: 4 lectures, one tutorial and 3 practicals each week for 4 weeks.

Assessment: Continuous Assessment = 33%, 2 Hour Examination = 67%

MT5753 Statistical Modelling

Credits: 20.0 Semester: 1 (4 weeks)

Prerequisites: at least one MT4000 level module

Anti-requisite: MT4607

Description: This course will introduce the main ideas of linear and generalised linear statistical modelling and will provide training in applied statistical modelling. The course structure is as follows: what statistical models are and what they are for; distributions, point and interval estimation and hypothesis testing; simple linear regression models for normal data; multiple regression; multiple regression with qualitative explanatory variables; less linear models for non-normal data; generalized linear models. Lectures will be built around the book “An Introduction to Statistical Modelling” (Krzysztof, 1998), which closely matches what we believe to be an ideal course structure.

Class Hour: To be arranged.

Teaching: 4 lectures, one tutorial and 3 practicals each week for 4 weeks.

Assessment: Continuous Assessment = 50%, 2 Hour Examination = 50%

MT5802 Advanced Analytical Techniques

Credits: 20.0 Semester: 2

Prerequisite: MT4508 or MT4511 or MT4005 (or MT4605)

Description: This module introduces students to some further important applied analytic techniques such as Variational Calculus, Integral equations and transforms, and the theory of Steepest Descent.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5806 Advanced Computational Techniques

Credits: 20.0 Semester: 2

Prerequisite: MT3802 (or MT4502) and one of either (MT4111 or MT5611) or (MT4112 or MT5612)

Anti-requisite: MT4506

Description: This module introduces students to some of the ideas, techniques and constraints that underpin modern approaches to the numerical modelling of physical processes that may be described by partial differential equations. Students will gain expertise in implementing standard methods and will submit a short dissertation together with a portfolio of computational work.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Project = 25%, 2 Hour Examination = 75%

MT5809 Advanced Fluid Dynamics

Credits: 20.0 Semester: 1

Prerequisite: MT4509

Description: This module will examine current research in fluid dynamics, with a particular focus on meteorology and oceanography. The large-scale atmosphere and oceans behave quite unlike a ‘classical’ fluid owing to the presence of stable density stratification and rotation. As a result, the fluid motion is dominated by slow, ‘vortical’ or eddying motions (like cyclones) which generally spin slower than the Earth. Superimposed on this slow motion are relatively fast wave-like motions analogous to surface waves on a pond. These lectures describe the mathematical basis of these fundamentally different types of motion, and furthermore illustrate the increasingly important role of computer modelling in this research.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5810 Advanced Solar Theory

Credits: 20.0 Semester: 1

Prerequisite: MT4510

Anti-requisites: MT4504, MT5804

Description: The object of this module is to describe the magnetohydrodynamic processes at work in the Sun, using modern techniques of applied mathematics, and to discuss the latest theories in relation to aspects of current research within the School.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Examination = 100%

MT5813 Advanced Fractal Geometry

Credits: 20.0 Semester: 2

Availability: 2007-08

Prerequisites: one of MT4003, MT4004, MT4005

Anti-requisite: MT4513

Description: This module consists of MT4513 with the addition of tutorials and directed reading on extensions of the subject and more sophisticated mathematical analysis. The aim of this module is to introduce the mathematics used to describe and analyse fractals and to show how the theory may be applied to examples drawn from across mathematics and science. The module discusses the philosophy and scope of fractal geometry; and covers concepts such as dimension, representation of fractals by iterated function systems, fractals in other areas of mathematics such as dynamical systems and number theory, Julia sets and the Mandelbrot set.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5823 Semigroups

Credits: 20.0 Semester: 2

Availability: 2007-08

Prerequisites: MT4003 (or MT4603) or MT4517

Anti-requisite: MT4523

Description: The general aim of this module is to introduce students to semigroup theory, which is the study of sets with one associative binary operation defined on them. In the process, the common aims and concerns of abstract algebra will be emphasised and illustrated by drawing comparisons between semigroups, groups and rings.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 25%, 2 Hour Examination = 75%

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MT5824 Topics in Groups

Credits: 20.0 Semester: 1

Prerequisite: MT4003 (or MT4603)

Description: The overall aim of this module is to build on the foundations established in MT4003/MT4603, and take the students further into this important and beautiful branch of mathematics. More specifically, through a selection of topics, some of which will be of current research interest in St Andrews, it will introduce students to advanced techniques of handling groups and classifying them.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5825 Measure and Ergodic Theory

Credits: 20.0 Semester: 1

Prerequisite: MT4004 (or MT4604)

Anti-requisite: MT4525

Description: This module introduces some of the powerful techniques and ideas of modern mathematical analysis that are important both in analysis in its own right and in its many applications in mathematics and science. The module will include topics such as: measure theory, the ergodic theorem, martingale theory. Analysis is one of the active research areas within the School, and the choice of topics will reflect current activity.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Project =25%, 2 Hour Examination = 75%

MT5826 Finite Fields

Credits: 20.0 Semester: 2

Availability: 2007-08

Prerequisite: MT4516 or MT4517

Description: Fields are an important part of modern algebra. Introduced as a generalization of number systems (in particular the rational and the real numbers), fields are the setting for some of the most fascinating results in pure maths, such as the insolubility of the quintic, and ruler and compass constructions. The theory of finite fields came to prominence in the last 50 years due to its applications in combinatorics, coding theory and cryptography. This module will begin by investigating the theory of fields in general, before specializing to finite fields in particular. Applications of field theory, to topics such as geometry and finite mathematics, will also be explored.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5827 Lie Algebras

Credits: 20.0 Semester: 2

Availability: 2006-07

Prerequisite: MT3501 and (MT4003/MT4603 or MT4517)

Description: The aim of this module is to classify the semi-simple Lie algebras over an algebraically closed field. Lie algebra has important applications to theoretical physics and is used in the classification of finite simple groups.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half Hour Examination = 100%

MT5828 Hyperbolic Geometry

Credits: 20.0 Semester: 2
Availability: 2006-07
Prerequisite: MT4004 (or MT4604)
Description: This module introduces some of the techniques and ideas of hyperbolic geometry including Fuchsian groups, Kleinian groups, Riemann surfaces, fractal geometry.
Class Hour: 9.00 am
Teaching: Two lectures and one tutorial.
Assessment: Two-and-a-half Hour Examination = 100%

MT5831 Advanced Bayesian Inference

Credits: 20.0 Semester: 2
Availability: 2006-07
Prerequisite: MT3701 or MT4606
Anti-requisite: MT4531
Description: This module consists of MT4531 with an additional project which will give consideration to some more advanced aspects of the theory or to the application of Bayesian techniques. This may involve either directed reading or the use of the computer for simulation or data-based analyses. The syllabus includes Bayes' theorem, inference for Normal samples; univariate Normal linear regression; principles of Bayesian computational, Markov chain Monte Carlo – theory and applications.
Class Hour: 10.00 am
Teaching: Two lectures and one tutorial and practical classes.
Assessment: Project = 40%, 2 Hour Examination = 60%

MT5835 Wildlife Population Assessment

Credits: 20.0 Semester: 2
Prerequisites: MT3606 and any MT4000 level module
Anti-requisites: MT4535, MT5751
Description: This module is intended to enable students to design appropriate surveys for assessing abundance of an animal population, to formulate simple statistical models for survey data and derive estimators, to analyse data competently, and to conduct a small survey from conception to the production of a final project report. The syllabus includes: likelihood framework for distance sampling; general estimating equation; line and point transects; clustered populations and size-biased sampling; stratification and covariates; variance and interval estimation; the bootstrap; estimation when detection at the line or point is not certain; survey design; field methods; related methods; including strip transects, quadrat counts; monitoring trends in abundance; mark-recapture and recovery methods; removal methods; catch per unit effort; change-in-ratio.
Class Hour: To be arranged.
Teaching: Two lectures and one laboratory.
Assessment: Advanced Project Report = 45%, 2 Hour Examination = 55%

MT5990 Independent Study module

Credits: 20.0 Semester: Either
Prerequisite: Permission of the Head of School
Description: This module provides the opportunity for a student to study an Advanced topic as a reading course under the supervision of a member of staff. The topic will be disjoint from those available in other modules.
Assessment: Two-and-a-half Hour Examination = 100%

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MT5999 Advanced Project in Mathematics/Statistics

Credits: 40.0 Semester: Whole Year

Prerequisite: Entry to an MPhys or MMath programme

Description: This is a more substantial project which, for MMath students, will replace the existing Honours project. The project will be chosen from an approved list of topics. The student will be required to investigate a topic in some depth, submit a report by the end of April and give a presentation.

Assessment: Project = 100%