School of Mathematics & Statistics

Head of School

Professor E F Robertson

Degree Programmes

Single Honours Degrees (BSc, MA or MSci):	Applied Mathematics Mathematics Pure Mathematics Statistics
Single Honours Degrees (BSc)	Quantitative Ecology
Joint Honours Degrees (BSc):	Mathematics and Chemistry, Computer Science, Economics, Geography, Logic & Philosophy of Science, Management Science, Physics, Psychology, Statistics. Statistics and Computer Science, Economics, Geography, Logic & Philosophy of Science, Management Science, Mathematics.
Joint Honours Degrees (MSci):	Mathematics and Statistics Mathematics and Theoretical Physics
Joint Honours Degrees (MA)	Mathematics and Ancient History, Art History, Economics, Hebrew, Latin, Mediaeval History[A], Philosophy, Scottish History, Statistics, Theological Studies. Statistics and Economics, Mathematics, Philosophy.
Major Degree Programmes (BSc):	Mathematics with French[W] or Geography or German[W] Statistics with French[W] or German[W]

[W] available also as 'with Integrated Year Abroad Degrees'

[A] Timetable clash exists, therefore only Applied Mathematics can be studied in this combination

BSc Programme Prerequisites

Applied Mathematics

A pass at 11 or better in both MT2001 and MT2003

Mathematics

Mathematics:	A pass at 11 or better in MT2001 or MT2101 and in one of MT2002 or MT2003
Mathematics and Physics: the	Passes at 11 or better in either (MT2001 and MT2003) or MT2101 plus Physics requirements
All other Programmes:	A pass at 11 or better in MT2001 or MT2101 and in one of MT2002 or MT2003
Mathematics with French: in	As for Mathematics and also a pass in FR2011 and a pass at 11 or better FR2012
Mathematics with German:	As for Mathematics and also GM2005 and a pass at 11 or better in GM2006
Mathematics and Statistics: also	Passes at 11 or better in both (MT2001 or MT2101) and MT2004 and in one of MT2002, MT2003 or MT2005

Chemistry and Mathematics

Passes at 11 or better in CH2101, **either** CH2102 **or** CH2103, **either** MT2001 **or** MT2101, and one of MT2002 and MT2003

Pure Mathematics

Passes at 11 or better in both (MT2001 or MT2101) and MT2002

Quantitative Ecology

Passes at 11 or better in MT1006, MT2001, MT2004, BI2001 and either BI2004 or BI2005. It is recommended that students take BI2005.

Statistics

Passes at 11 or better in both (MT2001 or MT2101) and MT2004

Statistics with French: As for Statistics and also with a pass in FR2011 and a pass at 11 or better in FR2012

Statistics with German: As for Statistics and also GM2005 and a pass at 11 or better in GM2006

BSc Programme Requirements

Applied Mathematics

Single Honours Degree: 240 credits, of which at least 210 credits must be from MT3501 - MT3999 including:

(i) MT3501 - MT3504

(ii) MT3601, MT3602

(iii) at least one of MT3611, MT3612

(iv) MT3999

Mathematics

Single Honours Degree: 240 credits, of which at least 210 credits must be from MT3501 - MT3999 including:

(i) MT3501 - MT3504

(ii) at least two of MT3601, MT3602, MT3603, MT3604

(iii) at least one of MT3611, MT3612

(iv) MT3999

Mathematics with French or German: 240 credits, of which at least 180 credits must be from MT3501 - MT3999, including:

(i) at least three of MT3501 - MT3504

(ii) at least one of MT3601 - MT3604

(iii) at least one of MT3611, MT3612

(iv) MT3999

Mathematics and Physics: 240 credits, of which at least 120 credits must be from MT3501 - MT3999, excluding MT3805, but including:

(i) at least two of MT3501 - MT3504

(ii) at least one of MT3601 - MT3604

(iii) at least one of MT3611 and MT3612

(iv) MT3999

Mathematics and Statistics: 240 credits, of which at least 210 must be from MT3501 - MT3999 including:

(i) MT3501 and at least one of MT3502 - MT3504

(ii) MT3701 and at least two of MT3702 - MT3706

(iii) at least one of MT3601 - MT3604

(iv) At least one of MT3611, MT3612

(v) MT3999

Mathematics and any other subject: 240 credits, of which at least 120 credits must be from MT3501 - MT3999 including:

(i) at least two of MT3501 - MT3504

(ii) at least one of MT3601 - MT3604

(iii) at least one of MT3611, MT3612

(iv) MT3999

Pure Mathematics: 240 credits, of which at least 210 credits must be from MT3501 - MT3999 including:

(i) MT3501 - MT3504

(ii) MT3603, MT3604

(iii) at least one of MT3611, MT3612

(iv) MT3999

Quantitative Ecology: 240 credits including:

(i) 60 credits from MT3702, MT3834, MT3999

(ii) 40 credits from BE3001 and BE3002

(iii) At least 90 credits from MT3501, MT3504, MT3602, MT3611, MT3704, MT3705, MT3706, MT3802, MT3803, MT3808, MT3813, MT3828, MT3830, MT3835,MT3838

(iv) At least 40 credits from BE3004, BE3005, BE3006, BE3102, BE3105

Statistics

Single Honours Degree: 240 credits, of which at least 210 must be from MT3501 - MT3999 including:

(i) MT3501

(ii) MT3701 - MT3706

(iii) MT3999

Joint Honours Degree: 240 credits, of which 120 must be from MT3501 - MT3999 including:

(i) MT3501

(ii) MT3701 and at least two from MT3702 - MT3706

(iii) MT3999

In the case of Joint Honours in Management Science and Statistics at least 45 credits are required from MN3006 - MN3056.

Statistics with French or German: 180 credits from MT3501 - MT3999 including:

(i) MT3501

(ii) MT3701 and at least three from MT3702 - MT3706

(iii) MT3999

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

MSci Programme Prerequisites

Applied Mathematics

A pass at 17 or better in both MT2001 and MT2003

Mathematics

Mathematics:	Passes at 17 or better in (MT2001 or MT2101) and one of MT2002 or MT2003
Mathematics and Theoretical Physics:	Passes in either MT2101 or (MT2001 and MT2003) plus the Physics requirements, the Mathematics passes being at 17 or better and
the Physics	passes being at 15 or better
Mathematics and Statistics:	Passes at 17 or better in both (MT2001 or MT2101) and MT2004 and
also	in one of MT2002, MT2003 or MT2005

Pure Mathematics

Passes at 17 or better in both (MT2001 or MT2101) and MT2002

Statistics

Passes at 17 or better in both (MT2001 or MT2101) and MT2004

MSci Programme Requirements

Mathematics & Statistics - pathways

Applied Mathematics

300 credits from MT3501 - MT4999 including:

(i) MT3501 - MT3504

(ii) MT3601, MT3602

(iii) at least one of MT4611 and MT4612

(iv) MT4999

(v) at least 120 credits from MT4801 - MT4881

Mathematics

300 credits from MT3501 - MT4999 including:

(i) MT3501 - MT3504

(ii) at least two of MT3601, MT3602, MT3603, MT3604

(iii) at least one of MT4611, MT4612

(iv) MT4999

(v) at least 120 credits from MT4801 - MT4881

Mathematics and Statistics

300 credits from MT3501 - MT4999 including:

(i) MT3501 and at least one of MT3502 - MT3504

(ii) one of MT3601 - MT3604

(iii) (MT3701 or MT4701) and at least two of (MT3702 or MT4702), MT3706, (MT3704 or MT4704), (MT3705 or MT4705)

(iv) at least one of MT4611 or MT4612

(v) MT4999

(vi) at least 120 credits from MT4701 - MT4881

Mathematics and Theoretical Physics

305 credits comprising:

(i) MT3501 and MT3504

(ii) at least two modules from MT3501 - MT3837 other than MT3805 and those specified in (i)

(iii) at least four modules from MT4611 - MT4882 other than MT4805

(iv) either MT4998 or PH4102

(v) the theoretical physics requirements

Pure Mathematics

300 credits from MT3501 - MT4999 including:

(i) MT3501 - MT3504

(ii) MT3603, MT3604

(iii) at least one of MT4611 and MT4612

(iv) MT4999

(v) at least 120 credits from MT4801 - MT4881

Statistics

300 credits from MT3501 - MT4999 including:

(i) MT3501

(ii) (MT3701 or MT4701), (MT3702 or MT4702), MT3706, (MT3704 or MT4704), (MT3705 or MT4705)

(iii) MT4999

(iv) at least 140 credits from MT4701 - MT4881

Modules

MT1001 Introductory Mathematics

Credits: 20.0 Semester: 1

Prerequisites: Higher/A-Level Mathematics. Students with A at Highers and B at Paper I of CSYS or a C at A- level may bypass this module and proceed to MT1002.

Anti-requisite: MT1003

Description: This module is designed to give students a secure base in elementary calculus to allow them to tackle the mathematics needed in other sciences. Students wishing to do more mathematics will be given a good foundation from which they can proceed to MT1002. Some of the work covered is a revision and reinforcement of material in the Scottish Highers and many A-level syllabuses.

Class Hour: 9.00 am

Teaching: Five lectures, one tutorial and one laboratory.

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

Re-Assessment: 2 Hour Examination = 100%

MT1002 Mathematics

Credits: 20.0 Semester: Either

Prerequisites: MT1001 or Higher/A-level Mathematics (A at Higher and B at Paper I of CSYS, or C at A-level).

Description: This module is designed to introduce students to the ideas, methods and techniques which they will need for applying mathematics in the physical sciences or for taking the study of mathematics further. It aims to extend and enhance their skills in algebraic manipulation and in differential and integral calculus, to develop their geometric insight and their understanding of limiting processes, and to introduce them to complex numbers and matrices.

Class Hour: 9.00 am

Teaching: Five lectures, one tutorial and one laboratory.

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

Re-Assessment: 2 Hour Examination = 100%

MT1003 Pure and Applied Mathematics

Credits: 20.0 Semester: 2

Prerequisite: MT1002

Description: The aim of this module is to provide students with a taste of both pure and applied mathematics, to give them insight into areas available for study in later years and to provide them with the opportunity to broaden their mathematical experience.

Class Hour: 9.00 am

Teaching: Five lectures, one tutorial and one laboratory.

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

Re-Assessment: 2 Hour Examination = 100%

MT1006 Statistical Data Analysis

Credits: 20.0 Semester: 1

Prerequisites: Pass in Mathematics at SCE 'O' Grade or Standard Grade at Grade 1 or 2 (Credit Level) or GCSE at Grade A, B or C.

Description: This module will cover the following three main topics: (i) graphical and statistical data summary: introduction to statistics, ways of representing, viewing and summarising data, graphical fallacies and pitfalls. (ii) randomization and Monte Carlo methods: the idea of randomization tests, non-parametric tests based on this paradigm, Monte Carlo tests and the bootstrap. (iii) linear models: fitting straight lines to data, uncertainty in model parameters, analysis of variance, goodness of fit, multiple regression.

Class Hour: 11.00 am

Teaching: Four lectures, one tutorial and one laboratory.

Assessment: Continuous Assessment = 34%, 2 Hour Examination = 66%

Re-Assessment: Continuous Assessment = 17%, 3 Hour Examination = 83%

MT1007 Statistics in Practice

Credits: 20.0 Semester: 2

Prerequisites: MT1001 or Higher/A-level Mathematics (A at Highers and B at Paper I of CSYS, or C at A-level)

Description: The aims of the module are to demonstrate by means of topical case studies the relevance of statistics in providing answers to questions such as: should soft water have a government health warning?; are Antarctic whales heading for recovery or extinction?; is the universe evolving?; can you tell butter from marge?; was Quintus Curtis Snodgrass really Mark Twain?; how can we forecast future UK population size?; does a large brain indicate intelligence?; how can we discover what people think?; is one game of Russian roulette preferable to a lifetime of offshore fishing?

Class Hour: 11.00 am

Teaching: Four lectures, one tutorial and one laboratory.

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

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

MT2001 Mathematics

Credits: 30.0 Semester: 1

Prerequisite: MT1002

Anti-requisite: MT2101

Description: The aims of this module are to extend the knowledge and skills gained by students in the module Mathematics MT1002, and in particular to enhance their skills in the theory and application of: differential and integral calculus of several real variables; limiting processes; linear mathematics.

Class Hour: 12.00 noon.

Teaching: Five lectures, one tutorial and one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

MT2002 Algebra and Analysis

Credits: 30.0 Semester: 1

Prerequisite: MT1002

Description: The aims of this module are to encourage students' understanding of the logical structure of mathematics and the nature of proof, and to introduce students to some fundamental concepts of abstract algebra and of analysis.

Class Hour: 11.00 am

Teaching: Five lectures, one tutorial and one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

MT2003 Applied Mathematics

Credits: 30.0 Semester: 2

Prerequisite: MT1002

Anti-requisite: MT2101

Description: This module introduces students to applied mathematics through the construction, analysis and interpretation of mathematical models, and to the techniques of analysis used in mathematical modelling.

Class Hour: 12.00 noon.

Teaching: Five lectures, one tutorial and one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

MT2004 Statistics

Credits: 30.0 Semester: 2

Prerequisites: MT1002 and MT1004 [From 2001-02 only MT1002]

Description: This module introduces students to the mathematical models of randomness used as part of statistical modelling and analysis. The module is a mix of fundamental mathematical statistics and applied statistical analysis and provides the background necessary for the 3000 level modules in statistics.

Class Hour: 10.00 am

Teaching: Five lectures, one tutorial and one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

MT2005 Discrete Mathematics

Credits: 30.0 Semester: 2

Prerequisites: MT1002

Description: This module aims to introduce students to techniques and ideas in discrete mathematics, and to reinforce the idea of proof in mathematics.

Class Hour: 11.00 am

Teaching: Five lectures, one tutorial and one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

MT2006 Project in Statistics

Credits: 10.0 Semester: Either

Prerequisites: A grade of 11 or higher is required in one of MT1004, MT1006, MT1007

Description: The student will choose a project from a list published annually. A topic outwith this list may be approved. Weekly sessions with the supervisor will be scheduled, and a report must be submitted by the end of week 10 of the semester.

Assessment: Project = 100%

Re-Assessment: Resubmission of project and Oral Examination.

MT2101 Mathematical Methods

Credits: 30.0 Semester: 1

Prerequisite: MT1002

Anti-requisites: MT2001, MT2003

Description: The aims of this module are to extend the knowledge and skills gained by students in the module MT1002, and in particular enhance their skills in the theory and application of: limiting processes and differential and integral calculus in several real variables, methods of Fourier series and Laplace transforms, and vector calculus. The needs of Honours students in Physics and Astronomy are addressed. The module MT2101 may, with the permission of the Head of School, be acceptable as a alternative to MT2001 in the entry requirements for Honours courses involving mathematics or statistics. However, students wishing to retain the option of entry to Honours Mathematics or Statistics should normally take MT2001.

Class Hour: 12.00 noon

Teaching: Five lectures, one tutorial, one practical.

Assessment: Continuous Assessment = 30%, 3 Hour Examination = 70%

Re-Assessment: 3 Hour Examination = 100%

The prerequisite for each of the following Honours modules is entry to the Honours Programme(s) for which they are specified, save where a specific prerequisite is given.

MT3501 Linear Mathematics

Credits: 15.0 Semester: 1

Prerequisite: MT1002

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: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3502 Foundations of Calculus

Credits: 15.0 Semester: 2

Prerequisite: MT2001 or MT2101

Description: This module gives a rigorous treatment of topics in the calculus, some of which will already have been encountered from the point of view of calculation and application without considering questions of validity. Topics, which will be illustrated by many examples and counter-examples, may include: convergence of sequences and series, continuity, differentiability and applications to Taylor series, analysis in n dimensions, partial derivatives, the inverse function theorem.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

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; conformal mappings.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

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: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3601 Fundamentals of Applied Mathematics

Credits: 15.0 Semester: 1

Pre(Co)requisites: MT2001 or MT2003 or MT2101

Description: The object of the module is to introduce students to basic applied mathematical methods which can be applied to problems in fluid dynamics, plasma dynamics and solar magnetohydrodynamics. The module will include: a revision of the basic techniques of vector calculus; the basic equations of fluid mechanics, including the equations of continuity, Euler and Bernoulli; fluid motions accelerated by pressure gradients; general properties of incompressible flow; Maxwell's equations; solar MHD (observations and equations); equilibria; solution of Laplace's equation by separation of variables; the wave equation; characteristics; separable solutions; the heat diffusion equation; similarity solutions; linear perturbations; small-amplitude analysis; examples - sound waves; MHD waves.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3602 Applied Mathematical Methods

Credits: 15.0 Semester: 1

Prerequisites: MT2003, MT2001 or MT2101

Description: The aim of this module is to give students a modern analytical basis in the theory of ordinary and partial differential equations arising in applied mathematics. The module will include: phase plane methods for linear and nonlinear differential equations; the nonlinear pendulum; systems of equations; limit cycles; stability; chaos and strange attractors; the Lorenz equations; the Riccati equations, an introduction to nonlinear evolution equations: the method of characteristics in partial differential equations; the advection equations; diffusive and dispersive balance; Burger's equation; the Korteweg-de Vries equation; solitons and related equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial

Assessment: 2 Hour Examination = 100%

MT3603 Groups

Credits: 15.0 Semester: 1

Prerequisite: MT2002

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: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3604 Real Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2002

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: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3611 Symbolic Computation

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2001 or MT2101

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%

MT3612 Computing in Mathematics

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisites: (MT2001 or MT2101), MT2003

Anti-requisite: 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%

MT3701 Statistical Inference

Credits: 15.0 Semester: 1

Prerequisites: (MT2001 or MT2101), MT2004

Description: This module aims to show how the methods of estimation and hypothesis testing met in first and second year can be justified and derived; to extend those methods to a wider variety of situations; to show how different point estimators can be compared; to provide an introduction to the Bayesian approach to inference. The syllabus includes: distribution theory; point estimation; mean square error; unbiasedness; Fisher information; the Cramer-Rao lower bound; maximum likelihood estimation; hypothesis-testing; Bayesian inference.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3702 Generalized Linear Models and Data Analysis

Credits: 15.0 Semester: 1

Prerequisite: MT2004

Co- (or pre-)requisite:MT3501

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%

MT3704 Sampling Theory

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT1004 or MT1007

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, unequal probability sampling and questionnaire design.

Class Hour: 12.00 noon

Teaching: Two lectures, one tutorial and practical classes.

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

MT3705 Multivariate Analysis

Credits: 15.0 Semester: 1

Availability: 2000-01

Prerequisites: MT2004 and (MT2001 or MT3501)

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: 9.00 am

Teaching: Two lectures, one tutorial and practical classes.

Assessment: 2 Hour Examination = 100%

MT3706 Markov Chains and Processes

Credits: 15.0 Semester: 1

Availability: 2001-02

Prerequisite: MT2004

Description: This module provides an introduction to the theory of stochastic processes and to their use as models, including applications to population processes and queues. The syllabus includes the Markov property, the Chapman-Kolmogorov equations, classification of states of Markov chains, decomposition of chains, stationary distributions, random walks, branching processes, the Poisson process, birth-and-death processes and their transient behaviour, embedded chains, Markovian queues.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3801 Topics in the History of Mathematics

Credits: 15.0 Semester: 2

Prerequisite: MT1002

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: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3802 Numerical Analysis

Credits: 15.0 Semester: 1

Prerequisites: MT2001 or MT2101

Description: The module will introduce students to some topics in numerical analysis, including interpolation, best approximation, numerical integration, the numerical solution of ordinary differential equations, solution of systems of linear equations by elimination and by iterative methods.

Class Hours: 9.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3803 Interpolation and Approximation

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2001 or MT2101

Description: This module aims to present some of the key ideas in interpolation and approximation. Topics may include Chebyshev polynomials and optimal interpolation points; Peano's theorem; Bernstein polynomials and Bernstein's proof of the Weierstrass theorem, rational approximation and Gaussian quadrature.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3804 The Sun

Credits: 15.0 Semester: 1

Prerequisites: MT2003, MT3601

Description: This module is intended to introduce the basic observations and theories of solar physics, paying particular attention to solar magnetohydrodynamics. The syllabus includes: an outline of observational properties ranging from the solar interior to the Sun's outer atmosphere; theoretical aspects of solar magnetohydrodynamics; magnetic equilibria; MHD waves; coronal heating.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3805 Electromagnetism

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT3601

Description: This module is intended to introduce students to the properties of electromagnetic waves, including the propagation of plane waves and guided waves, and the generation of waves by antennas, and to give an introduction to the motion of charged particles in electric and magnetic fields and some applications to plasma physics.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3806 Numerical Solution to Partial Differential Equations

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT3504 or MT3602

Description: This module is intended to introduce 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. The module will include: convergence and stability of standard finite-difference schemes; the application of standard methods to two space dimensional problems; ADI methods; the CFL condition; dispersion, dissipation and stability; the Lax Wendroff method.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3807 Classical Mechanics

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2003

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%

MT3808 Dynamical Systems

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3504

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%

MT3809 Fluid Dynamics

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3601

Description: This module aims to develop an understanding of fluid movement through the application of relevant mathematical techniques to various situations. The module will include: the workings of Pitot tubes and Venturi meters; the concepts of Froude and Reynolds numbers; how to solve Laplace's equation for various velocity potential problems; Navier-Stokes equations; aerofoil theory; water wave theory.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3811 Aysmptotic Analysis and Perturbation Theory

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT3504

Description: This module is designed to introduce students to asymptotic and perturbation methods that give analytical approximations to integrals and solutions of differential equations. The module will include: definitions of asymptotic series and expansions; proof of Watson's lemma; Laplace's method; method of stationary phase; regular and singular perturbation methods for differential equations; boundary layer equations and the method of matched asymptotic expansions; WKB method.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3812 Nonlinear Partial Differential Equations

Credits: 15.0 Semester: 2

Availability: 2001-02

Pre(Co)requisite: MT3504

Description: The aim of this module is to give an insight into the role of nonlinear partial differential equations of the evolution type in modern applied mathematics. After an introduction to methods for linear equations, the module will deal with techniques for the analysis of applications in such areas as compressible fluid flow and the formation of shock waves, travelling waves, spread of thin films, solitons, traffic flow and other areas of the physical and biological sciences.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3813 Fractal Geometry

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2001 or MT2101

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%

MT3814 Graph Theory

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT1002

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%

MT3815 Functional Analysis

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

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%

MT3816 Finite Mathematics

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT1002

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: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3817 Rings and Fields

Credits: 15.0 Semester: 1

Availability: 2000-01

Prerequisite: MT2002

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%

MT3818 Topics in Geometry

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: The aim of this module is to introduce students to the field of Geometry and in particular to use the knowledge they have gained of Modern Algebra in other modules to elucidate both the areas of Euclidean and non-Euclidean geometry. The axiomatic approach to geometry originally introduced by the Ancient Greeks was modified in the 19th Century following the discovery of non-Euclidean geometries. A geometry can be regarded as being determined by its group of allowable transformations and in this module we will emphasise this approach. Topics to be covered may include: Euclidean geometry and the Euclidean group in R^2 and R^3, Projective geometry, Elliptic geometry, Hyperbolic geometry, an introduction to the topology of surfaces.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3819 Number Theory

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: The aim of this module is to introduce students to some topics in elementary number theory, ranging from problems first considered in ancient times to work stimulated by recent advances in computers. 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: 10.00am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3820 Linear Algebra

Credits: 15.0 Semester: 1

Availability: 2001-02

Prerequisite: MT2002

Description: This module extends the theory of vector spaces and linear mappings. The syllabus includes bases, the dimension theorem, eigenvalues and eigenvectors, the Cayley-Hamilton theorem, minimum polynomials, sums and direct sums of subspaces, the primary decomposition theorem, diagonalisation, similarity, various canonical forms.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3821 Modules and Categories

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3820

Description: The basic idea of a category and the fundamental notions of function and natural transformation are introduced with particular reference to the abelian category of modules. Universal constructions are used throughout. The syllabus includes morphisms, exact sequences, quotient modules, isomorphism theorems, free modules, products and coproducts, kernels and cokernels, binormal categories, groups of morphisms, additive categories, abelian categories, equivalent categories, adjoint functors.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3822 Metric and Topological Spaces

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2002

Description: This module extends ideas of convergence and continuity to the very general settings of metric spaces and topological spaces. Topics to be covered may include complete metric spaces and the contraction mapping theorem, compactness in metric spaces, topological spaces axiomatized via open sets, compactness and connectedness in topological spaces. Many examples and applications will be given.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3823 Semigroups

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: Semigroup theory is one of the newer algebraic disciplines, and is related to a number of fields of mathematics such as groups, theoretical computer science and universal algebra. In the first part of the module the students will learn fundamental concepts of semigroup theory, including those of subsemigroups, homomorphisms, congruences, as well as Green's structure theory. In the second part of the module this theory will be applied to study various kinds of semigroups such as: simple semigroups, inverse semigroups, regular semigroups, etc. Semigroup theory is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3824 Topics in Groups

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3603

Description: This module continues the study of groups begun in MT3603. The main aim of this module is for students to get a deeper understanding of the internal structure of groups, and of different ways the groups may appear. The module may include topics from: the theory of permutation groups, representations of groups by matrices, soluble and nilpotent groups, group presentations and computational group theory. Group theory is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3825 Topics in Modern Analysis

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3604

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. Topics to be covered may include: measure theory, the ergodic theorem, martingale theory, Fuchsian groups. Analysis is one of the active research areas in the School, and the choice of topics will reflect this.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3827 Forecasting

Credits: 15.0 Semester: 1

Availability: 2000-01

Prerequisite: MT2004

Description: This module is intended to compare the relative merits of 'classical' moving average and exponential smoothing techniques and the Box-Jenkins approach to forecasting time series. The syllabus includes: introduction to time series models; simple models; exponential smoothing; linear trend processes; seasonal models; moments for stochastic processes; stationary processes; white noise processes; mixed models; non-stationary models; partial autocorrelation (PACF); the estimation stage of ARMA modelling; diagnostic checking using residuals; point and interval predictions.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3828 Classification

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2001 or MT3501

Description: The aim of this module is to introduce students to the basic ideas of cluster analysis and graphical procedures for summarising and displaying relationships in multivariate data sets. It will illustrate these procedures by use of the CLUSTAN computer package. The syllabus includes: types of data; dissimilarity measures; partitioning algorithms; hierarchical classifications; principal coordinates analysis; non-metric multidimensional scaling; stages in a numerical classification; the CLUSTAN package.

Class Hour: 11.00 am

Teaching: Two lectures, one tutorial and practical classes.

Assessment: 2 Hour Examination = 100%

MT3830 Population Genetics

Credits: 15.0 Semester: 1

Availability: 2001-02

Prerequisite: MT1004 or MT2004

Description: This module aims to show how mathematical models may be used to study the evolution of populations and how statistical techniques may be used to investigate model validity. The syllabus includes: an introduction to Mendelian genetics; dominance; pairs of alleles; the Hardy-Weinberg principle; non-random mating populations; selfing; selection; mutation.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3831 Bayesian Inference

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3701

Description: This module is intended to offer a re-examination of standard statistical problems from a Bayesian viewpoint and an introduction to areas, such as sequential estimation and sequential hypothesis testing, to which the Bayesian decision theoretic approach is ideally suited. The syllabus includes: Bayes theorem (discrete and continuous cases); inference based on the normal distribution; statistical decision theory; Bayes actions and Bayes rules; Sequential Probability Ratio Test (SPRT).

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3832 Mathematical Programming

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT1001 or MT1002

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; non-linear programming; integer programming.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3833 Utilities, Decisions and Inventories

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT1004 or MT2004

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; maximum 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%

MT3834 Ecological Modelling

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2001 or MT2101

Description: This module is intended to introduce the key concepts in theoretical population biology through a series of case studies, in order to give students the tools with which to build and analyse their own models. Topics will be drawn from: differential equations, matrix models, individual-based models, cellular automata; equilibria and stability; linearisation; non-linear dynamics and chaos; model formulation; parameter estimation; validation and prediction; sensitivity analysis; inverse problems; demographic and environmental stochasticity; structured populations; spatially explicit models.

Class Hour: 10.00 am

Teaching: Two lectures and one laboratory.

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

MT3835 Wildlife Population Assessment

Credits: 15.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2004

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 final report. The syllabus includes: liklihood framework for distance sampling; general estimating equation; line and point transects; hazard-rate formulations; 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; cue-counting, trapping webs and migration counts; monitoring trends in abundance; mark-recapture and recovery methods; removal methods; catch per unit effort; change-in-ratio.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

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

MT3838 Robust Statistical Methods

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2004

Description: Classical and modern robust methods for data analysis are described. Permutation tests and intervals and Monte Carlo tests, which span both classical methods and modern, computer-intensive methods, are covered, as are some more recent computer-intensive methods, notably the bootstrap. Illustrations are given of the application of modern methods to standard statistical problems; the emphasis for classical methods is on order statistics and ranking methods.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

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

MT3850 Lattice Theory

Credits: 15.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Anti-requisite: MT4850

Description: The aim of the module is to introduce students to the basic ideas of ordered sets and lattices, with particular emphasis on various types of distributive lattices. The syllabus comprises: ordered sets and isotone mappings; infima and suprema; lattices and lattice morphisms; complete lattices; modular lattices, distributive lattices, and their Birkhoff characterisations; representation of a distributive lattice as a ring of sets; join-irreducible elements and finite duality; complementation and Boolean algebras; coonection with boolean rings; the Lindenbaum-Tarski theorem; congruences; principal congruences, the lattice of congruences; implicative lattices and pseudocomplemented lattices.

Class Hour: To be arranged.

Teaching: Two lectures and one tutorial.

Assessment: 2 Hour Examination = 100%

MT3999 Project in Mathematics/Statistics

Credits: 15.0 Semester: Whole Year

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 second semester.

Assessment: Project = 100%

The Prerequisite for each of the following 4000 modules is entry to the MSci Programme(s) for which they are specified, save where an additional prerequisite is given. The anti-requisite for each module is the corresponding 3000 module.

MT4611 Advanced Symbolic Computation

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2001 or MT2101

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 MT3611.

Class Hour: 9.00 am

Teaching: Two lectures, one tutorial

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

MT4612 Advanced Computing in Mathematics

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisites: (MT2001 or MT2101), MT2003

Description: This module consists of MT3612 with the addition of directed study on more advanced topics not covered in MT3612, 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 MT3612. 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%

MT4701 Advanced Statistical Inference

Credits: 20.0 Semester: 1

Prerequisites: (MT2001 or MT2101), MT2004

Description: This module consists of MT3701 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 will include: distribution theory – negative binomial, multinomial, gamma, beta, t and F distributions; point estimation – Mean square error; unbiasedness; sufficiency; the efficient score; Fisher Information; the Cramér-Rao lower bound; exponential families; attainment of the Cramér-Rao lower bound; multi-dimensional Cramér-Rao inequality; maximum likelihood estimation; consistency and asymptotic efficiency; hypothesis testing – Neyman-Pearson Lemma; uniformly most powerful tests; likelihood ratio tests; confidence sets – Pivotal quantities; Bayesian Inference – Bayes Theorem; highest posterior density intervals; Bayes estimators; prior distributions and subjective probability; conjugate priors.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4702 Advanced Generalized Linear Models and Data Analysis

Credits: 20.0 Semester: 1

Prerequisite: MT2004

Co-requisite: MT3501

Description: This module aims to demonstrate the power and elegance of unifying a large number of simple statistical models within the 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. As well as studying the material covered in MT3702, students will undertake a substantial piece of project work.

Class Hour: 11.00 am

Teaching: 2 lectures, 1 tutorial, practical classes and project related tutorials.

Assessment: Project = 40%, 2 Hour Examination = 60%

MT4704 Advanced Sampling Theory

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT1004 or MT1007

Description: This module comprises MT3704 but with a more advanced project which will require some or all of the following: supplementary reading, a literature review, a critique of a survey, questionnaire and survey design, survey implementation, and data analysis. The primary goal of the advanced project will be to have students investigate in greater depth one or more specific topics encountered in MT3704.

Class Hour: 12.00 noon

Teaching: Two lectures, one tutorial and practical classes.

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

MT4705 Advanced Multivariate Analysis

Credits: 20.0 Semester: 1

Availability: 2000-01

Prerequisites: MT2004, (MT2001 or MT3501)

Description: This module consists of MT3705 with the addition of directed reading on more advanced aspects of the subject and the requirement for students to analyse a data set. The syllabus includes: properties of the mutlivariate normal distribution; checking mutlivariate 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: 9.00 am

Teaching: Two lectures and one tutorial.

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

MT4803 Advanced Interpolation and Approximation

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2001 or MT2101

Description: This module covers the material of MT3803, with the addition of topics, covered by directed reading and/or additional lectures, requiring a much more mature understanding of analysis.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4804 Advanced - The Sun

Credits: 20.0 Semester: 1

Prerequisite: MT2003 or MT3601

Description: This module consists of MT3804 with the addition of directed reading on more advanced aspects of the subject and a requirement for students to carry out a detailed analytical investigation of a particular system or a detailed literature survey of a specific area. The syllabus includes: observations of the Sun and its magnetic phenomena; the equations of magnetohydrodynamics, their properties and application to solar magnetism; convection and diffusion of magnetic field; magnetic equilibria, force-free fields, magnetic flux tubes; MHD waves; waves in magnetic flux tubes, intense tubes, sunspots, coronal loops; coronal heating; prominences; Solar wind; helioseismology.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4805 Advanced Electromagnetism

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT3601

Description: This module is an extension of MT3805 to include (i) the application of particle orbit theory to plasmas, (ii) the propagation of waves in plasmas. The syllabus also includes: electric and magnetic fields and polarisation; Maxwell's equations; wave equation for fields, properties of plane waves and Fresnel's relations; Poynting's theorem and energy flow; scalar and vector potential and the inhomogeneons wave equation; Green's function solution and retarded potentials; radiation from dipole and half wave antennas, and arrays of antennas; wave guides; motion of charged particles, adiabatic invariants and guiding centre drifts; particle orbit theory and its use in plasma physics; wave propagation in plasmas, cold plasm dispersion relation, cut-offs and resonances, CMA diagram, warm plasma modifications of cold plasma theory.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4806 Advanced Numerical Solution of Partial Differential Equations

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT3504 or MT3602

Description: This module consists of MT3806 with the addition that students will be required to gain expertise in a programming language and undertake computational projects. The syllabus includes: convergence and stability of finite-difference approximations to initial value problems in one and two space dimensions; the investigation of dispersion and dissipation in the approximation of conservative laws.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4807 Advanced Classical Mechanics

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2003

Description: The module consists of MT3807 with the addition of directed reading on advanced topics. The students will be asked to complete extra tutorial sheets covering the advanced material. The following material will also be covered: Newton's laws of motion – dynamics of a particle; momentum and energy; conservative forces – energy conservation; central forces – angular momentum conservation – planetary orbits; non-inertial/accelerating frames of reference, principle of equivalence, coriolis and centrifugal forces; dynamics of a system of particles; mechanics of a rigid body, moments and products of inertia, principal axes, impulsive forces, Euler's equations; Lagrange's equations, principle of least action, generalised co-ordinates, Euler's angles, Hamilton's equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4808 Advanced Dynamical Systems

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3504

Description: This module consists of MT3808 with the addition of directed reading on more advanced or technical aspects of the subject and a requirement for students to carry out a detailed analytic and numerical investigation of a particular system. The syllabus includes: discrete and continuous dynamical systems; period doubling, intermittency, bifurcations and chaos in mappings and differential systems; homoclinic and heteroclinic points and orbits and their role in the development of chaos; the Smale horseshoe mapping and symbolic dynamics; the bifurcations of codimension one and the use of centre manifold theory; Melnikov's method; Strange attractors, dimension and Lyapunov exponents; Hamiltonian dynamics and the Kolmogorov-Arnold-Moser theorem.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4809 Advanced Fluid Dynamics

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3601

Description: This module consists of MT3809 with the addition of directed reading on more advanced aspects of the subject. By the end of the module students are expected to understand the various physical properties of fluids; the workings of Pitot tubes and Venturi meters; the concepts of Froude and Reynolds number; gas bubbles oscillations; how to solve Laplace's equation for various velocity potential problems; the concept of a stream function; Navier-Stokes equations and their solution in simple situations; application of complex variable theory to fluid flows and its use in predicting lift and drag round rotating bodies; aerofoil theory; water wave theory; comprehensible fluid theories; Mach number and shock lines; Prandtl-Meyr expansions; Rankine-Huguneot relationships.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4811 Advanced Asymptotic Analysis and Perturbation Theory

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisites: MT3503, MT3504

Description: This module consists of MT3811 with the addition of directed reading on more advanced topics in both Asymptotic Analysis and Perturbation Theory. The advanced topics may include, for example, the method of steepest descents, advanced boundary layer methods and the Langer transformation for two turning point problems in WKB theory. Students will be asked to complete more demanding tutorial sheets and carry out detailed calculations using these more advanced techniques. The syllabus will include that for MT3811 plus advanced asymptotic and perturbation methods. For example, additional methods could be chosen from (i) the method of steepest descents, (ii) advanced boundary layer methods and (iii) Langer transformations for turning point problems.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4812 Advanced Partial Differential Equations

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3504

Description: The aim of this module is to give an insight into the role of nonlinear partial differential equations of the evolution type in modern applied mathematics. After an introduction to methods for linear equations, the module will deal with techniques for the analysis of applications in such areas as compressible fluid flow and the formation of shock waves, travelling waves, spread of thin films, solitons, traffic flow and other areas of the physical and biological sciences. The particular focus of this module will be a description of the inverse scattering method for the solution of the Korteweg-de Vries equation.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4813 Advanced Fractal Geometry

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisites: MT2001 or MT2101

Description: This module consists of MT3813 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%

MT4814 Advanced Graph Theory

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT1002

Description: This module includes and extends the contents of MT3814. Additional topics to be covered may include: applications of graphs to groups and other algebraic structures, automorphism groups, further algorithms, complexity of algorithms.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4815 Advanced Functional Analysis

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: This module consists of MT3815 with additional advanced material leading to a project. The module will 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 topics such as spectral theory and the Hahn-Banach theorem.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4816 Advanced Finite Mathematics

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT1002

Description: This module includes and extends the contents of MT3816. Additional topics to be covered may include: Boolean algebras, further combinatorial structures.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4817 Advanced Rings and Fields

Credits: 20.0 Semester: 1

Availability: 2000-01

Prerequisite: MT2002

Description: This module consists of MT3817 together with additional advanced material, which is designed to give students a deeper understanding of the structure of rings and fields and their applications. It may include topics from radical theory, semisimplicity, Galois theory and primary ideals and decompositions.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4818 Advanced Topics in Geometry

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: This module includes and extends the contents of MT3818. Additional topics to be covered may include: crystallographic and frieze groups and their classification, an introduction to algebraic topology.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half hour examination = 100%

MT4819 Advanced Number Theory

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: This module includes and extends the contents of MT3819. Additional topics to be covered may include: quadratic reciprocity, quadratic forms, arithmetic functions, further Diophantine equations.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

Assessment: Two-and-a-half hour examination = 100%

MT4820 Advanced Linear Algebra

Credits: 20.0 Semester: 1

Availability: 2001-02

Prerequisite: MT2001

Description: This module consists of MT3820 with the addition of more advanced material. The syllabus includes bases, the dimension theorem, eigenvalues and eigenvectors, the Caley-Hamilton theorem, minimum polynomials, sums and direct sums of subspaces, the primary decomposition theorem, diagonalisation , similarity, various canonical forms.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4821 Advanced Modules and Categories

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3820 or MT4820

Description: This module consists of MT3821 with the addition of more advanced material. The basic idea of a category and the fundamental notions of functor and natural transformation are introduced with particular reference to the abelian category of modules. Universal constructions are used throughout. The syllabus includes morphisms, exact sequences, quotient modules, isomorphism theorems, free modules, products and coproducts, kernels and cokernels, binormal categories, groups of morphisms, additive categories, abelian categories, equivalent categories, adjoint functors.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4822 Advanced Metric and Topological Spaces

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2002

Description: This module consists of MT3822 with additional advanced material leading to a project. This module extends ideas of convergence and continuity to very general settings. Topics include metric spaces, completeness and the contraction mapping theorem, compactness, topological spaces axiomatized via open sets, compactness and connectedness.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4823 Advanced Semigroups

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2002

Description: This module will consist of MT3823, together with additional advanced material, designed to take students to the frontiers of current research in semigroup theory. It may contain topics from: semigroup presentations, decidability problems, finiteness conditions, amalgamation, matrix semigroups and semigroup varieties.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT4824 Advanced Topics in Groups

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3603

Description: This module will consist of MT3824 together with additional advanced material, in which the results from the basic part of the module will be used to obtain deeper information about finite groups of small orders, simple groups, solubility problems for finitely presented groups and Burnside type problems. This additional part of the module will be designed so as to give students a taste of the current research in group theory.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4825 Advanced Topics in Modern Analysis

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3604

Description: This module consists of MT3825 with additional advanced material leading to a project. 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, Fuchsian groups. Analysis is one of the active research areas at the school, and the choice of topics will reflect this.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4828 Advanced Classification

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2001 or MT3501

Description: This module consists of MT3828 with the addition of directed reading on more advanced or technical aspects of the subject and a requirement for students to apply the methodology in a detailed examination of data. The syllabus includes: types of data and classifications; construction of dissimilarity measures; partitioning algorithms; hierarchical classifications; principal co-ordinates analysis; non-metric multidimensional scaling; stages in numerical classification; analysis of data using the CLUSTAN package.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT4831 Advanced Bayesian Inference

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT3701

Description: This module consists of MT3813 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. Foundations include: Bayes theorem (discrete and continuous cases); summarising posterior distributions; prediction; sufficiency; non-informative priors. Inference based on the Normal distribution includes: inference and prediction for a Normal sample; inverse gamma and Normal-gamma distributions; univariate Normal linear regression; prediction of observations satisfying a fitted linear model. Statistical Decision Theory includes: Bayes actions and Bayes rules; sampling costs; initial determination of sample size; one-step-look-ahead rules; optimal bounded sequential procedures; unbounded decision problems; approximation of optimal procedures by bounded procedures; sequential Probability Ratio Test (SPRT).

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT4832 Advanced Mathematical Programming

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT1001 or MT1002

Description: This module consists of MT3832 with the addition of directed reading on more advanced aspects of the subject and a requirement for students to carry out a project. The syllabus includes: formulation of linear programming problems; solution graphically and by use of the simplex algorithm; sensitivity analysis; the dual problem and its relation to the primal problem; the transportation problem and its solution using the North West Corner method and Vogel's rule; the assignment problem and its solution; transshipment; nonlinear programming; integer programming.

Class Hour: 12.00 noon

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

MT4834 Advanced Ecological Modelling

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2001 or MT2101

Description: This module consists of MT3834 with the addition of an advanced project, in the form of a literature review or a project on some aspect of modelling.

Class Hour: 10.00 am

Teaching: Two lectures and one laboratory.

Assessment: Essay = 10%, Advanced Project Report = 25%, 2 Hour Examination = 65%

MT4835 Advanced Wildlife Population Assessment

Credits: 20.0 Semester: 2

Availability: 2001-02

Prerequisite: MT2004

Description: This module consists of MT3835 with the addition of an advanced project, which might cover any aspect of the module.

Class Hour: 11.00 am

Teaching: Two lectures and one laboratory.

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

MT4838 Advanced Robust Statistical Methods

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisite: MT2004

Description: This module consists of MT3838 with the addition of an advanced project, which might cover any aspect of the module.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 20%, Advanced Project = 25%, 2 Hour Examination = 55%

MT4850 Advanced Lattice Theory

Credits: 20.0 Semester: 2

Availability: 2000-01

Prerequisites: MT2002

Description: This module consists of MT3850 with the addition of more advanced material. The aim of the module is to introduce students to the basic ideas of ordered sets and lattices, with particular emphasis on various types of distributive lattices. The syllabus includes: ordered sets and isotone mappings; infima and suprema; lattices and lattice morphisms; complete, modular, and distributive lattices and their Birkhoff characterisations; representation of a distributive lattice as a ring of sets; join-irreducible elements and finite duality; complementation and Boolean algebras; connection with boolean rings; the Lindenbaum-Tarski Theorem; congruences, principal congruences, the lattice of congruences; implicative and pseudo-complemented lattices; introduction to Ockham algebras.

Class Hour: To be arranged.

Teaching: Two lectures and one tutorial.

Assessment: Two Hour Examination = 100%

MT4998 Advanced Project in Mathematics/Statistics

Credits: 30.0 Semester: Whole Year

Prerequisite: Entry to the MSci degree in Mathematics and Theoretical Physics

Anti-requisite: MT4999

Description: The project will be chosen from an approved list of topics and the credit rating will reflect the content and depth of an investigation involved.

Assessment: Project = 100%

MT4999 Advanced Project in Mathematics/Statistics

Credits: 40.0 Semester: Whole Year

Anti-requisite: MT4998

Description: This is a more substantial project which, for M.Sci. students will replace the existing Honours project. The project will be chosen from an approved list of topics. The student may be required to review current literature and investigate a topic in some depth.

Assessment: Project = 100%