

School of Mathematics & Statistics

Head of School Professor K J Falconer

Degree Programmes

Graduate Diploma: Mathematics
Statistics

M.Sc.: Mathematics
Statistics

Programme Requirements

Mathematics

Graduate Diploma: A total of 120 credits from MT modules at 3000 level and above, including at least 60 credits at 5000 level, the course of study to be approved by the Head of School.

M.Sc.: 120 credits as for Graduate Diploma together with a dissertation (MT5099) comprising three months' full-time study, which will carry 60 credits.

Statistics

Graduate Diploma: A total of 120 credits from MT modules at 3000 level and above, including at least 60 credits at 5000 level, the course of study to be approved by the Head of School.

M.Sc.: 120 credits as for Graduate Diploma together with a dissertation (MT5099) comprising three months' full-time study, which will carry 60 credits.

Modules

The anti-requisite for each module is the corresponding 4000 level module.

The prerequisites for each module may be replaced by equivalent material from other institutions.

MT5099 Dissertation for M.Sc. Programme/s

Credits: 60.0

Prerequisite: An average grade of at least 14 in course work. Candidates whose average grade falls in the range 12-13 may be allowed to proceed at the discretion of the Head of School.

Programme(s): Compulsory module for Mathematics and Statistics M.Sc. Postgraduate Programmes

Description: Student dissertations will be supervised by members of the teaching staff who will advise on the choice of subject and provide guidance throughout the progress of the dissertation. The completed dissertation of not more than 15,000 words must be submitted by the end of August.

Class Hour: At times to be arranged with the supervisor

Teaching: Individual Supervision

Assessment: Dissertation = 100%

Mathematics and Statistics – 5000 Level Modules

MT5611 Advanced Symbolic Computation

Credits: 20.0 Semester: 2

Availability: 2004-05

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4111

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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: 2003-04

Prerequisites: (MT2001 or MT2101), MT2003

Anti-requisite: MT4112

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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%

Mathematics and Statistics – 5000 Level Modules

MT5701 Advanced Statistical Inference

Credits: 20.0 Semester: 1

Availability: 2003-04

Prerequisites: (MT2001 or MT2101), MT2004, (and MT3606 from 2003-04)

Anti-requisite: MT4606

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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 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%

MT5705 Advanced Multivariate Analysis

Credits: 20.0 Semester: 1

Availability: 2004-05

Prerequisites: MT2004, (MT2001 or MT3501)

Anti-requisite: MT4609

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4609 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 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: 9.00 am

Teaching: Two lectures and one tutorial.

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

Mathematics and Statistics – 5000 Level Modules

MT5751 Estimating Animal Abundance

Credits: 10.0 Semester: 1 (2 weeks)

Programme(s): Optional module for M.Res. Environmental Biology and M.Res. in Environmental Biology Conversion for Mathematical, Physical and Molecular Sciences Postgraduate Taught Programmes.

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%

MT5752 Modelling Ecological Dynamics

Credits: 20.0 Semester: 2 (4 weeks)

Prerequisite: BL5021 or substantial quantitative training

Programme(s): Compulsory module for M.Res. Environmental Biology and M.Res. in Environmental Biology Conversion for Mathematical, Physical and Molecular Sciences Postgraduate Taught Programmes.

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)

Programme(s): Compulsory module for M.Res. Environmental Biology and M.Res. in Environmental Biology Conversion for Mathematical, Physical and Molecular Sciences Postgraduate Taught Programmes. Also available to MMath candidates.

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” (Krzanowski, 1998), which closely matches what we believe to be an ideal course structure.

Class Hour: 2.00 pm

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

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

Mathematics and Statistics – 5000 Level Modules

MT5803 Advanced Interpolation and Approximation

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4503

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module covers the material of MT4503, 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%

MT5804 Advanced - The Sun

Credits: 20.0 Semester: 1

Prerequisite: MT2003 or MT3601 or MT4601

Anti-requisite: MT4504

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4504 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: Two-and-a-half Hour Examination = 100%

MT5806 Advanced Numerical Solution of Partial Differential Equations

Credits: 20.0 Semester: 2

Availability: 2004-05

Prerequisite: MT3504 or MT3605 or MT4605

Anti-requisite: MT4506

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4506 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%

Mathematics and Statistics – 5000 Level Modules

MT5808 Advanced Dynamical Systems

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3504

Anti-requisite: MT4508

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4508 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%

MT5809 Advanced Fluid Dynamics

Credits: 20.0 Semester: 2

Prerequisite: MT3601 or MT4601

Anti-requisite: MT4509

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of the module MT4509 with the addition of directed reading on more advanced aspects of the subject such as, compressible flow. Topics covered in MT3809 include: review of basic fluid properties, conservation laws, potential flows, free surface flows, vorticity evolution, fundamentals of atmosphere and ocean fluid dynamics.

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5813 Advanced Fractal Geometry

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisites: MT2001 or MT2101

Anti-requisite: MT4513

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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%

Mathematics and Statistics – 5000 Level Modules

MT5816 Advanced Finite Mathematics

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT1002

Anti-requisite: MT4516

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module includes and extends the contents of MT4516. Additional topics to be covered may include: Boolean algebras, further combinatorial structures.

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial

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

MT5820 Advanced Linear Algebra

Credits: 20.0 Semester: 1

Availability: 2003-04

Prerequisite: MT2001, MT2002

Anti-requisite: MT4520

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4520 with the addition of more advanced material. 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: Two-and-a-half Hour Examination = 100%

MT5822 Advanced Metric and Topological Spaces

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2002

Anti-requisite: MT4522

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4522 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: 12.00 noon

Teaching: Two lectures and one tutorial.

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

Mathematics and Statistics – 5000 Level Modules

MT5823 Advanced Semigroups

Credits: 20.0 Semester: 2

Availability: 2005-06

Prerequisite: MT2002

Anti-requisite: MT4523

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module will consist of MT4523, 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: Two-and-a-half Hour Examination = 100%

MT5824 Advanced Topics in Groups

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT4603

Anti-requisite: MT4524

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module will consist of MT4524 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%

MT5825 Advanced Topics in Modern Analysis

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3604 or MT4604

Anti-requisite: MT4525

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4525 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%

Mathematics and Statistics – 5000 Level Modules

MT5831 Advanced Bayesian Inference

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT3701 or MT3606 or MT4606

Anti-requisite: MT4531

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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. 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; computational Bayes methods.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial and practical classes.

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

MT5832 Advanced Mathematical Programming

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisites: MT1002, MT2001

Anti-requisite: MT4532

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4532 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%

Mathematics and Statistics – 5000 Level Modules

MT5834 Advanced Ecological Modelling

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2001 or MT2101

Anti-requisite: MT4534

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4534 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%

MT5835 Advanced Wildlife Population Assessment

Credits: 20.0 Semester: 2

Availability: 2003-04

Prerequisite: MT2004

Anti-requisite: MT4535

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

Description: This module consists of MT4535 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%

MT5998 Advanced Project in Mathematics/Statistics

Credits: 30.0 Semester: Whole Year

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

Anti-requisites: MT4998, MT4999, MT5999

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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%

MT5999 Advanced Project in Mathematics/Statistics

Credits: 40.0 Semester: Whole Year

Anti-requisites: MT4998, MT5998, MT4999

Programme(s): Optional module for Mathematics and Statistics Postgraduate Taught Programmes. The course of study must be approved by the Head of School.

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%