School of Mathematics & Statistics

Head of School   Professor A W Hood

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%

MT5611 Advanced Symbolic Computation

Credits:	20.0	Semester:	2

Availability: 2006-07

Prerequisite: at least one MT4000 level module

Anti-requisite: MT4111

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

Class Hour: 9.00 am

Teaching: Two lectures, one tutorial

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

MT5612 Advanced Computing in Mathematics

Credits:	20.0	Semester:	2

Availability: 2007-08

Prerequisite: at least one MT4000 level module

Anti-requisite: MT4112

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

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

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

MT5613 Advanced Topics in the History of Mathematics

Credits:	20.0	Semester:	1

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

Anti-requisite: MT4501

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

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5701 Advanced Statistical Inference

Credits:	20.0	Semester:	2

Availability: 2007-08

Prerequisites: MT3606 and any MT4000 level module

Anti-requisite: MT4606

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

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT5705 Advanced Multivariate Analysis

Credits:	20.0	Semester:	2

Availability: 2006-07

Prerequisites: MT3606 and any MT4000 level module

Anti-requisite: MT4609

Description: This module consists of MT4609 with the addition of directed reading on more advanced aspects of the subject or the analysis of a data set. The syllabus includes: properties of the 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: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT5751 Estimating Animal Abundance

Credits:	10.0	Semester:	2 (2 weeks)

Prerequisites: MT3606 and any MT4000 level module

Antirequisite: MT4535, MT5835

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

Class Hour: To be arranged.

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

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

MT5752 Modelling Ecological Dynamics

Credits: 20.0   Semester: 2 (4 weeks)

Prerequisites: at least one MT4000 level module

Anti-requisites: MT4534, MT5834

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

Class Hour: To be arranged.

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

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

MT5753 Statistical Modelling

Credits: 20.0   Semester: 1 (4 weeks)

Prerequisites: at least one MT4000 level module

Anti-requisite: MT4607

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

Class Hour: To be arranged.

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

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

MT5802 Advanced Analytical Techniques

Credits: 20.0   Semester: 2

Prerequisite: MT4508 or MT4511 or MT4005 (or MT4605)

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

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5806 Advanced Computational Techniques

Credits: 20.0   Semester: 2

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

Anti-requisite: MT4506

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

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5809 Advanced Fluid Dynamics

Credits:	20.0	Semester:	1

Prerequisite: MT4509

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

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT5810 Advanced Solar Theory

Credits:	20.0	Semester:	1

Prerequisite: MT4510

Anti-requisites: MT4504, MT5804

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

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5813 Advanced Fractal Geometry

Credits:	20.0	Semester:	2

Availability: 2007-08

Prerequisites: one of MT4003, MT4004, MT4005

Anti-requisite: MT4513

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

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

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

MT5823 Semigroups

Credits:	20.0	Semester:	2

Availability: 2007-08

Prerequisites: MT4003 (or MT4603) or MT4517

Anti-requisite: MT4523

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

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

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

MT5824 Topics in Groups

Credits:	20.0	Semester:	1

Prerequisite: MT4003 (or MT4603)

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

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT5825 Measure and Ergodic Theory

Credits:	20.0	Semester:	1

Prerequisite: MT4004 (or MT4604)

Anti-requisite: MT4525

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

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial.

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

MT5826 Finite Fields

Credits:	20.0	Semester:	2

Availability: 2007-08

Prerequisite: MT4516 or MT4517

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

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT5827 Lie Algebras

Credits:	20.0	Semester:	2

Availability: 2006-07

Prerequisite: MT3501 and (MT4003/MT4603 or MT4517)

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

Class Hour: 11.00 am

Teaching: Two lectures and one tutorial.

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

MT5828 Hyperbolic Geometry

Credits:	20.0	Semester:	2

Availability: 2006-07

Prerequisite: MT4004 (or MT4604)

Description: This module introduces some of the techniques and ideas of hyperbolic geometry including Fuchsian groups, Kleinian groups, Riemann surfaces, fractal geometry.

Class Hour: 9.00 am

Teaching: Two lectures and one tutorial.

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

MT5831 Advanced Bayesian Inference

Credits:	20.0	Semester:	2

Availability: 2006-07

Prerequisite: MT3701 or MT4606

Anti-requisite: MT4531

Description: This module consists of MT4531 with an additional project which will give consideration to some more advanced aspects of the theory or to the application of Bayesian techniques. This may involve either directed reading or the use of the computer for simulation or data-based analyses. The syllabus includes Bayes' theorem, inference for Normal samples; univariate Normal linear regression; principles of Bayesian computational, Markov chain Monte Carlo – theory and applications.

Class Hour: 10.00 am

Teaching: Two lectures and one tutorial and practical classes.

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

MT5835 Wildlife Population Assessment

Credits:	20.0	Semester:	2

Prerequisites: MT3606 and any MT4000 level module

Anti-requisites: MT4535, MT5751

Description: This module is intended to enable students to design appropriate surveys for assessing abundance of an animal population, to formulate simple statistical models for survey data and derive estimators, to analyse data competently, and to conduct a small survey from conception to the production of a final project report. The syllabus includes: likelihood framework for distance sampling; general estimating equation; line and point transects; clustered populations and size-biased sampling; stratification and covariates; variance and interval estimation; the bootstrap; estimation when detection at the line or point is not certain; survey design; field methods; related methods; including strip transects, quadrat counts; monitoring trends in abundance; mark-recapture and recovery methods; removal methods; catch per unit effort; change-in-ratio.

Class Hour: To be arranged.

Teaching: Two lectures and one laboratory.

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

MT5990 Independent Study module

Credits:	20.0	Semester:	Either

Prerequisite: Permission of the Head of School

Description: This module provides the opportunity for a student to study an Advanced topic as a reading course under the supervision of a member of staff. The topic will be disjoint from those available in other modules.

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

MT5999 Advanced Project in Mathematics/Statistics

Credits: 40.0   Semester: Whole Year

Prerequisite: Entry to an M.Phys. or M.Math. programme

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

Assessment: Project = 100%