School of Mathematics & Statistics

Head of School	Professor R A Cairns

Degree Programmes

Postgraduate Diploma:	Applied Statistics and Datamining Mathematics Statistics
M.Sc.:	Applied Statistics and Datamining Mathematics Statistics

Programme Requirements

Applied Statistics and Datamining

Postgraduate Diploma:	A total of 120 credits of MT modules, including MT5753, MT5756, MT5757, MT5758 and MT5759, in a programme of study approved by the Head of School.
M.Sc.:	120 credits as for Postgraduate Diploma together with a dissertation (MT5099) comprising three months' full-time study.

Mathematics

Postgraduate Diploma:	A total of 120 credits of MT modules, of which at least 90 credits should be a 5000 level, in a programme of study approved by the Head of School.
M.Sc.:	120 credits as for Postgraduate Diploma together with a 60 credit dissertation (MT5099) comprising three months' full-time study.

Statistics

Postgraduate Diploma:	A total of 120 credits of MT modules, of which at least 90 credits should be a 5000 level, in a programme of study approved by the Head of School.
M.Sc.:	120 credits as for Postgraduate Diploma together with a 60 credit dissertation (MT5099) comprising three months' full-time study.

Modules

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

ID5011 Geographic Information Systems for Environmental Management

Credits: 15 Semester: 1

Prerequisite: A basic ability in computer skills (Basic word processing, spread sheet analysis) gained through SALTIRE if not demonstrated

Anti-requisite: GE5005, ID5010, ID5012

Programme(s): Optional module for Environmental Biology M.Sc., Mathematics & Statistics, Economics, Management and Environmental History Taught Postgraduate Programmes.

Description: This module provides an introduction to Geographic Information systems and their use in environmental problem solving. The module will be taught through a series of lectures, tutorials, laboratory classes and individual projects. The module will be assessed through class exercises and the final, short individual project. Students will be introduced to methods of acquiring, storing, analysing and displaying (2D and 3D) spatial digital data using the ArcGIS data package. An introduction to data manipulation and statistical techniques on a variety of environmental examples will be given. The module is taught within the School of Geography & Geosciences but incorporates datasets and analysis techniques used in earth and environmental science, biology, archaeology, and mathematics.

Class Hour: To be arranged.

Teaching: Lectures, practicals and occasional tutorials.

Assessment: Continuous Assessment = 50%, Short Project = 50%

MT5099 Dissertation for M.Sc. Programme/s

Credits: 60

Prerequisite: An average grade of at least 13.5 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 Semester: 2

Availability: 2010-11

Programme(s): Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	2

Availability: 2009-10

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	1

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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 = 66%, Two Class Tests = 34%

MT5701 Advanced Statistical Inference

Credits:	20	Semester:	2

Availability: 2009-10

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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%

MT5751 Estimating Animal Abundance

Credits:	10	Semester:	2 (2 weeks)

Anti-requisite: MT5835

Programme(s): Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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: 2.00 pm

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

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

MT5752 Modelling Ecological Dynamics

Credits:	20	Semester:	2 (4 weeks)

Anti-requisite: MT5834

Programme(s): Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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: 2.00 pm.

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

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

MT5753 Statistical Modelling

Credits:	20	Semester:	1 (4 weeks)

Programme(s): Compulsory module for Applied Statistics and Datamining Taught Postgraduate Programme.

Optional module for Statistics Taught Postgraduate Programme.

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 R and S-plus Companion to Applied Regression* (Fox, 2002).

Class Hour: 2.00 pm.

Teaching: 4 1.5 hour lectures, one tutorial and 4 1.5 hour practical sessions each week for 4 weeks.

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

MT5756 Introductory Data Analysis

Credits: 20   Semester: 1 (4 weeks)

Programme(s):   Compulsory module for Applied Statistics and Datamining Taught Postgraduate Programme. An exemption may be granted to an appropriately qualified entrant.

Description: This module provides coverage of essential statistical concepts, data manipulation & analysis methods, and software skills in commercial analysis packages. Specifically: the different types of data and their numerical/graphical treatment; data entry/import/export, basic probability theory and concepts of inference; fundamental statistical concepts with particular emphasis on sampling issues; basic statistical models and tests; introductory computer-intensive inference. The widespread commercial statistical packages SAS, SPSS are introduced and utilized with Excel for most analyses. The statistical programming language R is also given brief attention. This module is a short intensive course and is a core, preliminary, requirement for the MSc in Applied Statistics and Datamining. It covers material essential for study of the more advanced statistical methods encountered in subsequent modules.

Class Hour: To be arranged.

Teaching: Lectures, tutorials and practicals.

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

MT5757 Advanced Data Analysis

Credits: 20   Semester: 1 (4 weeks)

Programme(s):   Compulsory module for Applied Statistics and Datamining Taught Postgraduate Programme.

                     Optional module for Statistics Taught Postgraduate Programme.

Description: This module covers modern modeling methods for situations where the data fails to meet the assumptions of common statistical models and simple remedies do not suffice. This represents a lot of real world data. Methods covered include: nonlinear models; basic splines & Generalized Additive Models; Ridge Regression and Principal Components Regression; models for non-independent errors. Pragmatic data imputation is covered with associated issues. Computer intensive inference is considered throughout. Practical applications build sought-after skills in the commercial package SAS.

Class Hour: 2.00 pm.

Teaching: Lectures, tutorials and practicals.

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

MT5758 Applied Multivariate Analysis

Credits: 15   Semester: 2

Anti-requisites: MT4609, MT5705

Programme(s):   Compulsory module for Applied Statistics and Datamining Taught Postgraduate Programme.

                     Optional module for Statistics Taught Postgraduate Programme.

Description: This module provides introductory and advanced training in the applied analysis of multivariate data. The module emphasis is upon practical analysis of data and the extraction of answers from real-life data. Basic theory is given covering matrix algebra, metrics and general measures of similarity. The most common and fundamental methods including dimension reduction and classification are covered e.g. Multivariate Analysis of Variance, Principal Components Analysis, multidimensional scaling, Factor Analysis, clustering methods. The practical component of the module focuses on analysis of real data using the commercial software tools Excel, SAS and SPSS.

Class Hour: 12.00 noon.

Teaching: Lectures, tutorials and practicals.

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

MT5759 Knowledge Discovery and Datamining

Credits:	15	Semester:	2

Programme(s): Compulsory module for Applied Statistics and Datamining Taught Postgraduate Programme.

Optional module for Statistics Taught Postgraduate Programme.

Description: Contemporary data collection can be automated and on a massive scale e.g. credit card transaction databases. Large databases potentially carry a wealth of important information that could inform business strategy, identify criminal activities, characterize network faults etc. These large scale problems may preclude the standard carefully constructed statistical models, necessitating highly automated approaches.

This module covers many of the methods found under the banner of "Datamining", building from a theoretical perspective but ultimately teaching practical application. Topics covered include: historical/philosophical perspectives, model selection algorithms & optimality measures, tree methods, bagging and boosting, neural nets, and classification in general. Practical applications build sought-after skills in the commercial packages SAS and SPSS.

Class Hour: 10.00 am.

Teaching: Lectures, tutorials and practicals.

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

MT5802 Advanced Analytical Techniques

Credits:	20	Semester:	2

Prerequisite: MT3503

Programme(s): Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	2

Prerequisite: one of either MT5611 or MT5612

Programme(s): Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	1

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	1

Anti-requisite: MT5804

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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%

MT5812 Global Capital Markets - Structured Derivatives, Analytics and Applications

Credits:	20	Semester:	Either

Prerequisite: MT4551

Co-requisite: EC5705

Description: The Global Capital Markets divisions of Investment Banks are now a significant employer of highly numerate graduates who have a rigorous training in both Economics and Mathematics. This module will provide a practical introduction to the theory and applications of the various different types of structured derivatives that currently exist across all the asset classes that constitute Capital Markets. Detailed examples of both the applications as well as the dynamics, valuation and risk-management of 'vanilla' and 'exotic' Interest Rate, Equity, Credit, FX and Commodity structured derivatives will be discussed and analysed.

The focus will be practical and there will be a bias towards developing a strong intuition through discussing and analyzing such questions as 'Why do structured derivatives exists?', 'Who are the participants (e.g. Asset Managers, Pension Funds, Hedge Funds, etc) in this market?', 'How are these structured derivatives valued, risk-managed and traded?', 'What type of models are used in their valuation?', 'What assumptions underlie the models and when do the assumptions break down?' to finally 'How do Banks make money from structured derivatives?' and 'How are the models actually used on the trading desks of Investment Banks?'

Class Hour: 12.00 noon

Teaching: Two lectures and one tutorial.

Assessment: Continuous Assessment = 60%, Two Hour Examination = 40%

MT5823 Semigroups

Credits:	20	Semester:	2

Availability: 2009-10

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	1

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	1

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	2

Availability: 2009-10

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	2

Availability: 2010-11

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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	Semester:	2

Availability: 2010-11

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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%

MT5829 Group Rings

Credits:	20	Semester:	2

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

Description: Group rings were introduced as a tool in the representation theory of groups, and then they became objects of independent study. A group ring combines a group and a ring, so it is natural to ask how the properties of the ring and the group determine the properties of the group ring, and vice versa. The main directions of current researches in group ring theory are their ring and Lie properties, the structure of the unit group and the isomorphism problem. After a revision of necessary facts from group theory and ring theory, we will give classical results in each of these four areas; we will also point out some very recent results and open questions.

Class Hour: To be arranged.

Teaching: Two or three lectures and one tutorial.

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

MT5831 Advanced Bayesian Inference

Credits:	20	Semester:	2

Availability: 2010-11

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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: 11.00 am

Teaching: Lectures, tutorials and practical classes

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

MT5990 Independent Study module

Credits:	20	Semester:	Either

Programme(s):   Optional module for all Postgraduate Taught Programmes within the School of Mathematics & Statistics.

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%

MT5991 Professional Skills for Mathematical Scientists

Credits:	30	Semester:	Whole Year

Programme(s):   Postgraduate Diplomas in Mathematics or, exceptionally, final year of MMath programme with the approval of the Head of School.

Description: This module encompasses a range of skills, both generic and topic specific, together with taught components aimed at providing an appreciation of both breadth and depth of research areas in Pure or Applied Mathematics. The precise programme of study, together with the identification of the relevant software expertise required, will be determined in consultation with the student's supervisor.

Class Hour: To be arranged.

Teaching: Lectures, Tutorials and Practical classes

Assessment: Continuous Assessment = 100%