

## Mathematics & Statistics (MT) Modules

MT3501 Linear Mathematics 2			
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Planned timetable:</b>	12.00 noon Mon (even weeks), Tue and Thu		
This module continues the study of vector spaces and linear transformations begun in MT2501. It 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 include: diagonalisation and the minimum polynomial; Jordan normal form; inner product spaces; orthonormal sets and the Gram-Schmidt process; adjoint and self-adjoint operators.			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2501		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).		
	<b>Scheduled learning:</b> 35 hours	<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework = 10%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Prof J D Mitchell		
<b>Module teaching staff:</b>	Prof James Mitchell		

MT3502 Real Analysis			
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue & Thu		
This module continues the study of analysis begun in the 2000-level module MT2502 Analysis. It considers further important topics in the study of real analysis including: integration theory, the analytic properties of power series and the convergence of functions. Emphasis will be placed on rigorous development of the material, giving precise definitions of the concepts involved and exploring the proofs of important theorems. The language of metric spaces will be introduced to give a framework in which to discuss these concepts.			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2502		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5-hours of lectures and 1 tutorial.		
	<b>Scheduled learning:</b> 35 hours	<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Class Test = 10%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Prof K J Falconer		
<b>Module teaching staff:</b>	Prof Kenneth Falconer		

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT3503 Complex Analysis				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12.00 noon Mon (odd weeks), Wed and Fri			
This module aims to introduce students to analytic function theory and applications. The topics covered include: analytic functions; Cauchy-Riemann equations; harmonic functions; multivalued functions and the cut plane; singularities; Cauchy's theorem; Laurent series; evaluation of contour integrals; fundamental theorem of algebra; Argument Principle; Rouché's Theorem.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2502 or pass MT2503			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 34 hours		<b>Guided independent study:</b> 116 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework = 10%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr M Quick			
<b>Module teaching staff:</b>	Dr Martyn Quick			

MT3504 Differential Equations				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	9.00 am Mon (odd weeks), Wed and Fri			
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; non-linear ODE's; Green's functions for ODE's; Sturm-Liouville problems; first order PDE's; method of characteristics; classification of second order linear PDE's; method of separation of variables; characteristics and reduction to canonical form.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2503			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 examples class (x 10 weeks).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> Written Examination = 100% (2-hour final exam = 90%, class test = 10%)			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof D G Dritschel			
<b>Module teaching staff:</b>	Prof David Dritschel, Dr Antonia Wilmot-Smith			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT3505 Algebra: Rings and Fields				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	11.00 am Mon (odd weeks), Wed & Fri			
This module continues the study of algebra begun in the 2000-level module MT2505 Abstract Algebra. It places emphasis on the concept of a ring and their properties, which give insight into concepts of factorisation and divisibility. Important examples such as polynomial rings will be used to motivate and illustrate the theory developed.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2505			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures and 1 tutorial.			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework = 10%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr S Huczynska			
<b>Module teaching staff:</b>	Dr Sophie Huczynska			

MT3506 Techniques of Applied Mathematics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12.00 noon Mon (odd weeks), Wed & Fri			
Differential equations are of fundamental significance in applied mathematics. This module will cover important and common techniques used to solve the partial differential equations that arise in typical applications. The module will be useful to students who wish to specialise in Applied Mathematics in their degree programme.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2506 and pass MT3504			
<b>Anti-requisite(s)</b>	You cannot take this module if you take PH3081			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures and 1 tutorial.			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework = 10%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr R K Scott			
<b>Module teaching staff:</b>	Dr Richard Scott, Dr David Rees-Jones			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT3507 Mathematical Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	11.00 am Mon (odd weeks), Wed & Fri			
<p>Together with MT3508, this module provides a bridge between second year and Honours modules in statistics. It will provide students with a solid theoretical foundation on which much of more advanced statistical theory and methods are built. This includes probability generating functions and moment generating functions, as well as widely used discrete distributions (binomial, Poisson, negative binomial and multinomial) and continuous distributions (gamma, exponential, chi-squared, beta, t-distribution, F-distribution, and multivariate normal). It will also provide a foundation in methods of statistical inference (maximum likelihood and Bayesian) and model selection methods based on information theory (AIC and BIC).</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures and 1 tutorial.			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Class Test = 10%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof S T Buckland			
<b>Module teaching staff:</b>	Prof Steve Buckland			

MT3508 Applied Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12.00 noon Mon (even weeks), Tue & Thu			
<p>Together with MT3507, this module provides a bridge between second year and Honours modules in statistics. It deals with the application of statistical methods to test hypotheses and draw inferences from data. This includes a number of nonparametric methods and statistical tests (goodness-of-fit tests and tests of independence). Inference methods include model fitting by least squares and maximum likelihood, and variance estimation by means of the information matrix and the bootstrap. The framework of the generalised linear model is presented covering parameter estimation, deviance, model selection and diagnostics. Further applications include multiple regression, analysis of variance and the (normal) linear model.</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures and 1 tutorial.			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework (Project) = 10%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof D L Borchers			
<b>Module teaching staff:</b>	Prof David Borchers			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT3802 Numerical Analysis				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	10.00 am Mon (odd weeks), Wed and Fri			
The module will introduce students to some topics in numerical analysis, which may include methods of approximation, iterative methods for solving systems of linear equations, numerical techniques for differential equations.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2501			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 70%, Practical Examinations = 0%, Coursework = 30%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 70%, Coursework = 30%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr A Naughton			
<b>Module teaching staff:</b>	Dr Aidan Naughton			

MT3832 Mathematical Programming				
<b>SCOTCAT Credits:</b>	15	SCQF Level 9	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12.00 noon Mon (odd weeks), Wed and Fri			
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.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2501 or ( pass MT1002 and pass MN2002 )			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 0.5 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr I B J Goudie			
<b>Module teaching staff:</b>	Dr Ian Goudie			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4003 Groups				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	9.00 am Mon (even weeks), Tue and Thu			
	<p>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.</p>			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2505			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10), 1 tutorial and 1 examples class (weeks 2 - 11).			
	<b>Scheduled learning:</b> 45 hours		<b>Guided independent study:</b> 105 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof N Ruskuc			
<b>Module teaching staff:</b>	Prof Nikola Ruskuc			

MT4004 Real and Abstract Analysis				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue and Thu			
	<p>This module continues the development of real analysis that was begun in MT2502 and continued through MT3502. Topics covered will include limits and continuity in metric spaces, differentiation in higher dimensions and the theoretical underpinning of Fourier series. This module will present some of the highlights of the study of analysis, such as Baire's Category Theorem, the Contraction Mapping Theorem, the Weierstrass Approximation Theorem, and the Inverse Function Theorem.</p>			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3502			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10), 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof L O R Olsen			
<b>Module teaching staff:</b>	Prof Lars Olsen			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4005 Linear and Nonlinear Waves			
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	Not automatically available to General Degree students		
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue and Thu		
	This module gives an introduction to wave motion and its importance in many areas of applied mathematics. It begins with a discussion of the linear approximation for small amplitude waves and discusses properties of these such as dispersion relations, phase and group velocities, dissipation and dispersion. Some nonlinear effects such as wave steepening are then treated and an introduction given to some of the equations, for example Burger's and Korteweg de Vries, which are used to model nonlinear wave propagation.		
<b>Pre-requisite(s):</b>	Before taking this module you must ( pass MT2506 or pass PH3081 ) and ( pass MT3503 or pass MT3504 )		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).		
	<b>Scheduled learning:</b> 35 hours	<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Dr A N Wright		
<b>Module teaching staff:</b>	Dr Andrew Wright		

MT4112 Computing in Mathematics			
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	Not automatically available to General Degree students		
<b>Planned timetable:</b>	9.00 am Mon (even weeks), Tue and Thu		
	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.		
<b>Pre-requisite(s):</b>	Either pre- or co-requisites MT3501, MT3503 or MT3504		
<b>Anti-requisite(s)</b>	In taking this module you must not be on a single or joint honours programme in the school of computer science		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks).		
	<b>Scheduled learning:</b> 0 hours	<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 70%, Coursework: Project = 30%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Prof D H Mackay		
<b>Module teaching staff:</b>	Prof Duncan Mackay		

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4113 Computing in Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	12.00 noon Mon (odd weeks) and Wed, 12.00 noon - 2.00 pm Fri			
The aim of this module is to teach computer programming skills, including principles of good programming practice, with an emphasis on statistical computing. Practical work focusses on the widely-used statistical language and environment R. Practical skills are developed through a series of computing exercises that include (1) modular programming; (2) manipulating data; (3) simulating data with specific statistical properties, (4) investigating behaviour of statistical procedures under failure of statistical assumptions.				
<b>Pre-requisite(s):</b>	Undergraduate - before taking this module you must pass MT2508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 1.5-hour lectures (x 10 weeks), 2-hour practical classes (x 10 weeks)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 40%, Practical Examinations = 0%, Coursework = 60%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 40%, Coursework = 60%			
<b>Re-assessment pattern:</b>	1-hour 40 minute Written Examination = 40%, Coursework (4 new programming assignments) = 60%			
<b>Module coordinator:</b>	Mr R Glennie			
<b>Module teaching staff:</b>	Mr Richard Glennie			

MT4501 Topics in the History of Mathematics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	12.00 noon Mon (odd weeks), Wed and Fri			
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.				
<b>Pre-requisite(s):</b>	If not already passed you must take 1 module from {MT3501, MT3502, MT3503, MT3504, MT3505, MT3506, MT3507, MT3508}			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5613			
<b>Co-requisite(s):</b>	If not already passed you must take 1 module from {MT3501, MT3502, MT3503, MT3504, MT3505, MT3506, MT3507, MT3508}			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> Written Examination = 50% (2 x 1-hour class tests), Coursework: Project = 50%			
<b>Re-assessment pattern:</b>	Coursework (new project) = 100%			
<b>Module coordinator:</b>	Dr I J Falconer			
<b>Module teaching staff:</b>	Dr Isobel Falconer, Prof Colva Roney-Dougal, Prof Mark Chaplain			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4508 Dynamical Systems				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (even weeks), Tue and Thu			
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.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr V Archontis			
<b>Module teaching staff:</b>	Dr Vasilis Archontis			

MT4509 Fluid Dynamics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue and Thu			
This module provides an introduction to the theory of incompressible fluid dynamics, which describes the motion of liquids and gases at speeds small compared to the sound speed. Special attention is paid to a precise foundation of the various conservation laws that govern fluid dynamics, as this provides a convenient framework in which to study specific examples as well as extensions of the basic theory.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2506 and pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> Written Examination = 100% (2-hour final exam = 90%, class test = 10%)			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr J N Reinaud			
<b>Module teaching staff:</b>	Dr Jean Reinaud			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4510 Solar Theory				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	11.00 am Mon (odd weeks), Wed and Fri			
The object of this module is to describe the basic dynamic processes at work in the Sun, a subject which is being enlivened by dramatic new results from space missions.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2506 and pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof I De Moortel			
<b>Module teaching staff:</b>	Prof Ineke De Moortel, Dr Andrew Wright			

MT4513 Fractal Geometry				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	12.00 noon Mon (even weeks), Tue and Thu			
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.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2503 and ( pass MT3501 or pass MT3502 or pass MT3503 or pass MT3504 )			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5813			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof K J Falconer			
<b>Module teaching staff:</b>	Prof Kenneth Falconer			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4516 Finite Mathematics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (even weeks), Tue and Thu			
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.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2504 or pass MT2505			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 1 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof C M Roney-Dougal			
<b>Module teaching staff:</b>	Prof Colva Roney-Dougal, Dr James Belk			

MT4519 Number Theory				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (even weeks), Tue and Thu			
The aim of this module is to introduce students to some important topics in number theory. Topics to be covered may include: prime numbers, cryptography, continued fractions, Pell's equation, the Gaussian integers and writing numbers as sums of squares.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2505 and ( pass MT3501 or pass MT3502 or pass MT3503 or pass MT3504 or pass MT3505 )			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr T D H Coleman			
<b>Module teaching staff:</b>	Dr Thomas Coleman			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4526 Topology				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (odd weeks), Wed and Fri			
<p>This module introduces the ideas of metric and topological spaces. A metric space is simply a set together with a 'distance' between any two points. This idea is pervasive in mathematics: from situations such as the usual distance in n-dimensional space, to the Hamming distance between words in an error-correcting code and the distance between functions approximating a given function. Metric spaces can be thought of as particular instances of topological spaces, where the fundamental concept is that of points being 'close' to each other rather than the precise distance between points. Topological spaces are a powerful generalisation of metric spaces, and have had a profound influence in the development of mathematics. Many examples of metric spaces and topological spaces will be introduced and fundamental ideas within topology will be discussed, including separation axioms, compactness and connectedness.</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3502			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr L S Theran			
<b>Module teaching staff:</b>	Dr Louis Theran			

MT4528 Markov Chains and Processes				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue and Thu			
<p>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, 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 and hidden Markov models.</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 8 tutorials over the semester.			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr S C Drasco			
<b>Module teaching staff:</b>	Dr Steven Drasco			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4530 Population Genetics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	9.00 am Mon (even weeks), Tue and Thu			
This module aims to show how the frequencies of characteristics in large natural populations can be explained using mathematical models and how statistical techniques may be used to investigate model validity. The syllabus includes: Mendel's First and Second Laws, random mating and random union of gametes, Hardy-Weinberg equilibrium, linkage, inbreeding, assortative mating, X-linked loci, selection and mutation.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks) and 0.5 tutorial (x 10 weeks).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr G Minas			
<b>Module teaching staff:</b>	Dr Giorgos Minas, Dr Michael Papatthomas			

MT4531 Bayesian Inference				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (even weeks), Tue and Thu			
This module is intended to offer a re-examination of standard statistical problems from a Bayesian viewpoint and an introduction to recently developed computational Bayes methods. The syllabus includes Bayes' theorem, inference for Normal samples; univariate Normal linear regression; principles of Bayesian computational, Markov chain Monte Carlo - theory and applications.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3507 or pass MT3508			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5731 or take MT5831			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 24 lectures and 7 practical classes over the semester.			
	<b>Scheduled learning:</b> 31 hours		<b>Guided independent study:</b> 119 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 80%, Practical Examinations = 0%, Coursework = 20%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 80%, Coursework = 20%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr M Papatthomas			
<b>Module teaching staff:</b>	Dr Michail Papatthomas, Dr Giorgos Minas			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4537 Spatial Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (even weeks), Tue and Thu			
This module will study the practical analysis of spatial data. It commences with a discussion on different types of spatial data. Spatial point processes, random fields and spatial models for lattice data are discussed. There is a strong focus on the practical and computational aspects of model fitting and modern, computationally efficient model fitting software is introduced.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3507 or pass MT3508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 4 tutorials over the semester.			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 80%, Practical Examinations = 0%, Coursework = 20%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 80%, Coursework = 20%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr M Papathomas			
<b>Module teaching staff:</b>	Dr Michail Papathomas			

MT4539 Quantitative Risk Management				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	12.00 noon Mon (odd), Wed, Fri, and 2.00 pm Fri			
The module introduces the concept of financial risk and discusses the importance of its regulation. The emphasis is laid on the popular risk measure Value at Risk (VaR). After a brief discussion on asset returns, various modelling techniques - ranging from the simple Historical Simulation to the more advanced ARMA and GARCH models - are presented and applied for the calculation of VaR using real financial data. The aim of this module is to provide a solid basis in risk management for those students considering a career in finance.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2504 and pass MT2508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 5 tutorials and 5 practical sessions.			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 80%, Practical Examinations = 0%, Coursework = 20%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 80%, Coursework = 20%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr V M Popov			
<b>Module teaching staff:</b>	Dr V Popov			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4551 Financial Mathematics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (odd weeks), Wed and Fri			
Students are introduced to the application of mathematical models to financial instruments. The course will include an overview of financial markets and the terminology in common usage but the emphasis will be on the mathematical description of risk and return as a means of pricing contracts and options.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2503 and ( pass MT1007 or pass MT2504 or pass EC2203 ) and pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof D H Mackay			
<b>Module teaching staff:</b>	Professor Duncan Mackay			

MT4552 Mathematical Biology 1				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	9.00 am Mon (even weeks), Tue and Thu			
This module will explore real world applications of mathematics to biological problems e.g. harvesting of fish stocks, host-parasitoid systems, predator-prey dynamics, molecular interactions. The mathematical techniques used in the modelling will be nonlinear difference equations and ordinary differential equations. The module will be useful to students who wish to specialise in Applied Mathematics in their degree programme.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 1 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 90%, Coursework (Class Test) = 10%			
<b>Re-assessment pattern:</b>	Take-Home Examination = 100%			
<b>Module coordinator:</b>	Prof M A J Chaplain			
<b>Module teaching staff:</b>	Prof Mark Chaplain, Team taught			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4599 Project in Mathematics / Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	Full Year
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students in the final year of a BSc/MA Honours degree programme in the School			
<b>Planned timetable:</b>	none			
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, produce a substantial written report, submitted by the end of April, and give a presentation.				
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Typically and on average, 20 mins of project supervisions per week over whole year.			
	<b>Scheduled learning:</b> 8 hours		<b>Guided independent study:</b> 142 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 20%, Coursework = 80%			
	<b>As used by St Andrews:</b> Coursework = 100%: Project = 80%, Presentation = 20%			
<b>Re-assessment pattern:</b>	Resubmission of project = 100%			
<b>Module coordinator:</b>	Prof N Ruskuc			
<b>Module teaching staff:</b>	Prof Nikola Ruskuc			

MT4606 Classical Statistical Inference				
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10.00 am Mon (odd weeks), Wed and Fri			
This module aims to show how the methods of estimation and hypothesis testing met in 2000- and 3000-level Statistics modules can be justified and derived; to extend those methods to a wider variety of situations. The syllabus includes: comparison of point estimators; the Rao-Blackwell Theorem; Fisher information and the Cramer-Rao lower bound; maximum likelihood estimation; theory of Generalized Linear Models; hypothesis-testing; confidence sets.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3507			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5701			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and 0.5 tutorial (weeks 2 - 11).			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr G Minas			
<b>Module teaching staff:</b>	Dr Giorgos Minas			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4614 Design of Experiments			
<b>SCOTCAT Credits:</b>	15	SCQF Level 10	<b>Semester</b> 2
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	Not automatically available to General Degree students		
<b>Planned timetable:</b>	9.00 am Mon (odd weeks), Wed and Fri		
<p>This module introduces a wide range of features that occur in real comparative experiments. The applications include trials of potential new medicines by the pharmaceutical industry; comparisons of new varieties of wheat for bread-making; evaluating different machine settings in industry. Issues include whether and how to partition the experimental material into blocks (for example, do old and young people respond to this drug differently?); how much replication to use (too much experimental material may be a waste of resources, but too little will not give meaningful results); as well as type of design. The module includes enough about the analysis of data from experiments to show what has to be considered at the design stage. It also includes considerations of consultation with the scientist and interpretation of the results.</p>			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT2508 and pass MT3501		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10) and either tutorial or practical (weeks 2 - 11).		
	<b>Scheduled learning:</b> 35 hours	<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 80%, Practical Examinations = 10%, Coursework = 10%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 80%, Presentation = 10%, Coursework = 10%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Prof R A Bailey		
<b>Module teaching staff:</b>	Prof R Bailey		

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4794 Joint Dissertation (30cr)				
<b>SCOTCAT Credits:</b>	30	SCQF Level 10	<b>Semester</b>	Full Year
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students in the Second year of the Honours Programme, who have completed the Letter of Agreement, downloadable from <a href="https://www.st-andrews.ac.uk/coursecatalogue/">https://www.st-andrews.ac.uk/coursecatalogue/</a> . No student may do more than 60 credits in Dissertation or Project modules.			
<b>Planned timetable:</b>	To be arranged.			
The dissertation must consist of approximately 6,000 words of English prose on a topic agreed between the student and two appropriate members of staff (who act as supervisors). The topic does not have to relate to work covered in previous Honours modules, though it may be helpful to the student if it builds on previous work. The topic and range of sources should be chosen in consultation with the supervisors in order to determine that the student has access to sources as well as a clear plan of preparation. (Guidelines for printing and binding dissertations can be found at: <a href="http://www.st-andrews.ac.uk/printanddesign/dissertation/">http://www.st-andrews.ac.uk/printanddesign/dissertation/</a> )				
<b>Pre-requisite(s):</b>	The student requires a letter of agreement			
<b>Anti-requisite(s)</b>	Cannot take more than 30 credits in other dissertation/project modules			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> As per Letter of Agreement.			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> As per Letter of Agreement.			
<b>Re-assessment pattern:</b>	As per Letter of Agreement.			
<b>Module coordinator:</b>	Prof N Ruskuc			
<b>Module teaching staff:</b>	Prof Nikola Ruskuc			
<b>Additional information from Schools:</b>	See also the guidelines within the general BSc/MA Honours project handbook for MT students, available at <a href="https://www.st-andrews.ac.uk/maths/current/ug/information/projects/">https://www.st-andrews.ac.uk/maths/current/ug/information/projects/</a>			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT4796 Joint Project (30cr)				
<b>SCOTCAT Credits:</b>	30	SCQF Level 10	<b>Semester</b>	Full Year
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students in the Second year of the Honours Programme, who have completed the Letter of Agreement, downloadable from <a href="https://www.st-andrews.ac.uk/coursecatalogue">https://www.st-andrews.ac.uk/coursecatalogue</a> . No student may do more than 60 credits in Dissertation or Project modules.			
<b>Planned timetable:</b>	To be arranged.			
The aim of the project is to develop and foster the skills of experimental design, appropriate research management and analysis. The topic and area of research should be chosen in consultation with the supervisors in order to determine that the student has access to sources as well as a clear plan of preparation.				
<b>Pre-requisite(s):</b>	The student requires a letter of agreement			
<b>Anti-requisite(s)</b>	May not take more than 30 credits in other dissertation / project modules			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> As per Letter of Agreement.			
	<b>Scheduled learning:</b> 0 hours		<b>Guided independent study:</b> 0 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> As per Letter of Agreement.			
<b>Re-assessment pattern:</b>	As per Letter of Agreement.			
<b>Module coordinator:</b>	Prof N Ruskuc			
<b>Module teaching staff:</b>	Prof Nikola Ruskuc			
<b>Additional information from Schools:</b>	See also the guidelines within the general BSc/MA Honours project handbook for MT students, available at <a href="https://www.st-andrews.ac.uk/maths/current/ug/information/projects/">https://www.st-andrews.ac.uk/maths/current/ug/information/projects/</a>			

MT5599 Advanced Project in Mathematics / Statistics				
<b>SCOTCAT Credits:</b>	30	SCQF Level 11	<b>Semester</b>	Full Year
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students in the final year of a MMath/MPhys Honours degree programme in the School.			
<b>Planned timetable:</b>	Regular supervision as arranged with supervisor.			
This is a substantial project for final year students on integrated Masters degrees. The project will be chosen from a list published annually in the project booklet. It is also possible for students to nominate their own project, by agreement with a supervisor. Students will be required to investigate a topic in some depth, reporting regularly to their supervisor, submit a report by the end of April and give a presentation.				
<b>Pre-requisite(s):</b>	Available only to students in the final year of a mmath/mphys honours degree programme in the school.			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Typically and on average, 40 mins of project supervisions per week over whole year			
	<b>Scheduled learning:</b> 15 hours		<b>Guided independent study:</b> 288 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> Coursework = 100% (Project = 80%, Presentation = 20%)			
<b>Re-assessment pattern:</b>	Resubmission of project = 100%			
<b>Module coordinator:</b>	Prof N Ruskuc			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

<b>Module teaching staff:</b>	Team Taught		
<b>MT5731 Advanced Bayesian Inference</b>			
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	Not automatically available to General Degree students		
<b>Planned timetable:</b>	Lectures: co-taught with MT4531. Monday (even) 10-11, Tuesday 10-11, Thursday 10-11; Practicals: co-taught with MT4531, Monday 1-2pm		
This module examines the Bayesian framework for analysing statistical problems, including an introduction to the latest theoretical and practical developments in the field. The syllabus includes Bayes' theorem, standard inference for conjugate Bayesian analyses, prediction, model comparison, principles of Bayesian computational techniques and software, and Markov chain Monte Carlo theory and applications. Instruction of advanced aspects of the Bayesian framework theory and its application is carried out by guided independent study, involving completion of a substantial project.			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3507 or pass MT3508		
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT4531 or take MT5831		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures (10 weeks), 1-hour tutorial (9 weeks);		
	<b>Scheduled learning:</b> 35 hours	<b>Guided independent study:</b> 120 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 80%, Practical Examinations = 0%, Coursework = 20%		
	<b>As used by St Andrews:</b> 2-hour written examination = 60%, coursework = 40%.		
<b>Re-assessment pattern:</b>	2-hour written examination = 60%, Coursework = 40%		
<b>Module coordinator:</b>	Dr M Papatomas		
<b>Module teaching staff:</b>	Dr Michail Papatomas, Dr Giorgos Minas		

<b>MT5758 Multivariate Analysis</b>			
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b> 2
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	Not automatically available to General Degree students		
<b>Planned timetable:</b>	11.00 am Mon (even weeks), Tue and Thu		
This module provides theory and application for the analysis of multivariate data. Fundamental matrix material is presented including mean vectors, covariance matrices, correlation matrices and basic properties of multivariate normal distributions. Multivariate extensions to common univariate tests are subsequently covered. Distance metrics and general measures of similarity are explored, leading to the broader utility of multivariate methods in real-world problems, particularly for classification and dimension reduction. The most common and fundamental methods are covered, including Principal Components Analysis, multidimensional scaling, clustering and discriminant analyses. The practical component of the module focuses on analysis of real data using widespread software.			
<b>Pre-requisite(s):</b>	The student must have been accepted on to mmath statistics or mmath mathematics programmes.		
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT4609		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1 - 10), and 4 tutorials and 4 project group meetings over the semester.		
	<b>Scheduled learning:</b> 33 hours	<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 50%, Practical Examinations = 0%, Coursework = 50%		
	<b>As used by St Andrews:</b> 2-hour Written Examination = 50%, Coursework = 50%		
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%		
<b>Module coordinator:</b>	Dr V M Popov		
<b>Module teaching staff:</b>	Dr Valentin Popov, Dr Steven Drasco		

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5761 Applied Statistical Modelling using GLMs				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	Mon, Tues, Thur, Fri 3:00 - 4:00 (lectures), Tues, Thur 4:00 - 5:00 (practicals)			
	<p>This applied statistics module covers the main aspects of linear models (LMs) and generalized linear models (GLMs). In each case the course describes model specification, various options for model selection, model assessment and tools for diagnosing model faults. Common modelling issues such as collinearity and residual correlation are also addressed, and as a consequence of the latter the Generalized Least squares (GLS) method is described. The GLM component has emphasis on models for count data and presence/absence data while GLMs for multinomial (sometimes called choice-based models) are also covered for nominal and ordinal response outcomes. The largest part of the course material is taught inside an environmental impact assessment case study with reality-based research objectives. Political and medical examples are used to illustrate the multinomial models.</p>			
<b>Pre-requisite(s):</b>	Undergraduates must have passed at least one of MT4113, MT4527, MT4528, MT4530, MT4531, MT4537, MT4539, MT4606, MT4608, MT4609, MT4614.			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT4607 or take MT5753			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 4 lectures (x 5 weeks), 2 practicals (x 5 weeks)			
	<b>Scheduled learning:</b> 30 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 50%, Practical Examinations = 0%, Coursework = 50%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 50%, Coursework = 50%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof D L Borchers			
<b>Module teaching staff:</b>	Prof David Borchers, Dr Valentin Popov			

MT5763 Software for Data Analysis				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	Mon, Tues, Fri 3:30 - 4:30 (lectures). Mon, Tues, Fri 4:30 - 5:30 (Practicals)			
	<p>This module covers the practical computing aspects of statistical data analysis, focussing on packages most widely used in the commercial sector (R, SAS, SPSS and Excel). We cover the accessing, manipulation, checking and presentation of data (visual and numerical). We fit various statistical models to data, with subsequent assessment, interpretation and presentation. Good practice and 'reproducible research' is covered, as is computer intensive inference and big data considerations. This module is a short intensive course and is a core, preliminary, requirement for the MSc in Applied Statistics and Datamining and the MSc in Data Intensive Analysis. It covers material essential for study of the more advanced statistical methods encountered in subsequent modules.</p>			
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT1007 or pass MT3507 or pass MT3508 or take MT5762			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5756			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Three 2-hour lecture/practical classes (x 5 weeks)			
	<b>Scheduled learning:</b> 30 hours		<b>Guided independent study:</b> 120 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> Coursework = 100%			
<b>Re-assessment pattern:</b>	Coursework = 100%			
<b>Module coordinator:</b>	Dr C R Donovan			
<b>Module teaching staff:</b>	Dr Carl Donovan			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5764 Advanced Data Analysis				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	Mon 12:00-1:00 Weeks 2, 4, 5, 8, 10 Tues, Thur 12:00-2:00, Weeks 1-10 (lectures) Tues 2:00 - 3:00 Weeks 2-9 (practicals)			
This module covers modern modelling 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 and Generalised Additive Models; LASSO and the Elastic Net; models for non-independent errors and random effects. Pragmatic data imputation is covered with associated issues. Computer intensive inference is considered throughout. Practical applications build sought-after skills in R and the commercial packages SAS.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3508 and ( pass MT4606 or pass MT5761 )			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5757			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 hours of lectures lectures (Weeks 1 - 10) and 8 practicals over the semester.			
	<b>Scheduled learning:</b> 33 hours		<b>Guided independent study:</b> 116 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 60%, Practical Examinations = 0%, Coursework = 40%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 60%, Coursework = 40%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof L J Thomas			
<b>Module teaching staff:</b>	Prof Leonard Thomas			

MT5765 Medical Statistics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Not automatically available to General Degree students			
<b>Planned timetable:</b>	10:00 - Mon (odd weeks), Wed, Fri			
This module will cover a number of topics in medical statistics, that are important areas both in terms of methodological development and application. The main topic covered will be Survival Analysis, with others selected from Meta-analysis, Power calculations, Prospective vs Observational studies, Sequential analyses, Clinical trials.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3507 or pass MT3508			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 1 tutorial (x 10 weeks)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 115 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 65%, Practical Examinations = 0%, Coursework = 35%			
	<b>As used by St Andrews:</b> Coursework = 35%, 2-hour Written Examination = 65%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof A G Lynch			
<b>Module teaching staff:</b>	Prof Andrew Lynch			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5842 Advanced Analytical Techniques				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12noon Monday (odd weeks), Wednesday, Friday			
This module introduces students to important advanced applied analytic techniques such as Variational Calculus, Integral equations and transforms, solutions to differential equations by contour integrals, and the theory of Steepest Descent.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3503			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5802			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1-10), 1 tutorial (weeks 2-11)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 118 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 75%, Practical Examinations = 0%, Coursework = 25%			
	<b>As used by St Andrews:</b> 2-hour written examination = 75%, coursework = 25%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Prof A W Hood			
<b>Module teaching staff:</b>	Prof Alan Hood			

MT5846 Advanced Computational Techniques				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12 noon Monday (even weeks), Tuesday, Thursday.			
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 experience in implementing a variety of standard numerical methods where they will carry out three projects involving code development, testing and analysis/interpretation of results.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3802 and pass MT4112			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5806			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2 lectures (x 10 weeks), 1 practical (x 11 weeks)			
	<b>Scheduled learning:</b> 29 hours		<b>Guided independent study:</b> 120 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> Coursework = 100%			
<b>Re-assessment pattern:</b>	Oral examination = 100%			
<b>Module coordinator:</b>	Dr S J Brooks			
<b>Module teaching staff:</b>	Dr Stephen Brooks, Dr Richard Scott			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5849 Geophysical Fluid Dynamics				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	11am Monday (odd weeks), Wednesday, Friday			
<p>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.</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT4509			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5809			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures, 1 tutorial			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> 2-hour written examination = 100%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Dr R K Scott			
<b>Module teaching staff:</b>	Dr Richard Scott			

MT5850 Advanced Solar Theory				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	12 noon Monday (even weeks), Tuesday, Thursday			
<p>This module describes the magnetohydrodynamic processes at work in the solar atmosphere, using modern techniques of applied mathematics, and discusses the latest theories in relation to aspects of current research within the School.</p>				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT4510			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5810			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lecture (x 10 weeks), 1 tutorial (x 10 weeks)			
	<b>Scheduled learning:</b> 34 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> 2-hour written examination = 100%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Prof T Neukirch			
<b>Module teaching staff:</b>	Dr Thomas Neukirch			

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MT5853 Mathematical Biology 2				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	9am, Monday (odd weeks), Wednesday, Friday			
This module will explore real world applications of mathematics to biological and medical problems (e.g. cell movement, pattern formation in animal coat markings, spread of infectious diseases). The mathematical models that will be considered are mostly formulated in terms of nonlinear partial differential equations whose solutions can exhibit a range of interesting behaviour. The module will be useful to students who wish to specialise in Applied Mathematics in their degree programme.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3504			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5852			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 10 tutorials (x 10 weeks)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 50 minute class test = 10%, 2-hour written examination = 90%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Dr T Lorenzi			
<b>Module teaching staff:</b>	Dr Tommaso Lorenzi			

MT5854 Mathematical Oncology				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	9am, Monday (odd weeks), Wednesday, Friday			
Cancer is a complex disease, the second largest cause of death throughout the world (after cardiovascular diseases). Beginning with genetic mutations in a single cell, cancer progresses through several key growth phases - the avascular growth phase (nutrient delivered by diffusion of oxygen), tumour-induced angiogenesis (blood vessel growth), invasion and metastasis (spread to secondary parts of the body). Because of its complexity and multiscale nature (temporal and spatial), treatment of cancer is challenging. This module will introduce students to the mathematical modelling of the key phases of cancer growth and treatment via immunotherapy, chemotherapy and radiotherapy. The mathematical techniques used in the modelling will be nonlinear partial differential equations, and students will be exposed to current research taking place within the Mathematical Biology research group in the School of Mathematics and Statistics.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3504			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 1 tutorial (x 10 weeks)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 120 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 90%, Practical Examinations = 0%, Coursework = 10%			
	<b>As used by St Andrews:</b> 50 minute class test = 10%, 2-hour written examination = 100%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Dr N Sfakianakis			
<b>Module teaching staff:</b>	Dr Nikolaos Sfakianakis			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5863 Semigroups				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	9am Monday (odd weeks), Wednesday, Friday			
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				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3505 or pass MT4003			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5823			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 1 tutorial (x 10 weeks)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> 2-hour written examination = 100%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Prof J D Mitchell			
<b>Module teaching staff:</b>	Prof James Mitchell			

MT5864 Topics in Groups				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	10am, Monday (odd weeks), Wednesday, Friday			
Groups are important mathematical objects that arise in many contexts since they encode the symmetry appearing within any particular setting. This is an area of current research interest in the School and this expertise determines the choice of topics covered in this module. The overall aim of the module is to build on the foundations established in MT4003 and to take students deeper into this important and beautiful branch of mathematics. It will introduce students to advanced techniques used to handle and classify groups.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT4003			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5824			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 1 tutorial (x 9 weeks), 1 examples class (x 9 weeks)			
	<b>Scheduled learning:</b> 43 hours		<b>Guided independent study:</b> 108 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Dr C P Bleak			
<b>Module teaching staff:</b>	Dr Collin Bleak			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5865 Measure and Probability Theory				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	11am Monday (odd weeks), Wednesday, Friday			
This module introduces some of the powerful techniques and ideas of modern mathematical analysis and mathematical probability theory 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 mathematical foundations for probability theory, law of large numbers. Mathematical analysis and the use of probabilistic methods in analysis is one of the active research areas within the School, and the choice of topics will reflect current activity.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT3502			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5825			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (x 10 weeks), 1 tutorial (x 9 weeks)			
	<b>Scheduled learning:</b> 34 hours		<b>Guided independent study:</b> 119 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour Written Examination = 100%			
<b>Re-assessment pattern:</b>	2-hour Written Examination = 100%			
<b>Module coordinator:</b>	Prof L O R Olsen			
<b>Module teaching staff:</b>	Prof Lars Olsen			

MT5877 Ergodic Theory and Dynamical Systems				
<b>SCOTCAT Credits:</b>	15	SCQF Level 11	<b>Semester</b>	2
<b>Academic year:</b>	2019/0			
<b>Planned timetable:</b>	9am Monday (even), Tuesday, Thursday			
This module introduces the modern ergodic theory approach to understanding chaotic dynamical systems. Topics include recurrence, consequences of ergodicity, entropy, the structure of the space of invariant measures and unique ergodicity. This will give students an insight into a thriving field of mathematics, which is at the core of the research interests of many faculty in the Pure Division in the School of Mathematics and Statistics.				
<b>Pre-requisite(s):</b>	Before taking this module you must pass MT5825			
<b>Anti-requisite(s)</b>	You cannot take this module if you take MT5837			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> 2.5 lectures (weeks 1-10), 1 tutorial (weeks 2-11)			
	<b>Scheduled learning:</b> 35 hours		<b>Guided independent study:</b> 117 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 100%, Practical Examinations = 0%, Coursework = 0%			
	<b>As used by St Andrews:</b> 2-hour written examination = 100%			
<b>Re-assessment pattern:</b>	2-hour written examination = 100%			
<b>Module coordinator:</b>	Dr M J Todd			
<b>Module teaching staff:</b>	Dr Michael Todd			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5990 Independent Study Module				
<b>SCOTCAT Credits:</b>	20	SCQF Level 11	<b>Semester</b>	1
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students on an MMath, MPhys or MSc degree programme in the School			
<b>Planned timetable:</b>	To be arranged.			
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.				
<b>Pre-requisite(s):</b>	In taking this module undergraduate students must have permission of head of school.			
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Typically 1 hour project supervisions.			
	<b>Scheduled learning:</b> 12 hours		<b>Guided independent study:</b> 188 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> Coursework = 100%			
<b>Re-assessment pattern:</b>	Resubmission of coursework = 100%			
<b>Module coordinator:</b>	Dr A L Wilmot-Smith			
<b>Module teaching staff:</b>	Dr A Wilmot-Smith			

MT5991 Professional Skills for Mathematical Scientists				
<b>SCOTCAT Credits:</b>	30	SCQF Level 11	<b>Semester</b>	Full Year
<b>Academic year:</b>	2019/0			
<b>Availability restrictions:</b>	Available only to students studying MSc Mathematics			
<b>Planned timetable:</b>	To be arranged.			
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.				
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Varies. Typically 1 project supervision per week over whole year.			
	<b>Scheduled learning:</b> 24 hours		<b>Guided independent study:</b> 276 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%			
	<b>As used by St Andrews:</b> Coursework = 100%			
<b>Re-assessment pattern:</b>	Resubmission of coursework = 100%			
<b>Module coordinator:</b>	Prof J D Mitchell			
<b>Module teaching staff:</b>	Prof James Mitchell			

## Mathematics & Statistics - Honours Level - 2019/0 - September - 2019

MT5999 Advanced Project in Mathematics / Statistics			
<b>SCOTCAT Credits:</b>	40	SCQF Level 11	<b>Semester</b> 1
<b>Academic year:</b>	2019/0		
<b>Availability restrictions:</b>	This module is not running from 2019/20 onwards and has been replaced by the new module MT5599 (Advanced Project in Mathematics/Statistics).		
<b>Planned timetable:</b>	To be arranged.		
This is a more substantial project which, for MMath students, will replace the existing Honours project. The project will be chosen from an approved list of topics. The student will be required to investigate a topic in some depth, submit a report by the end of April and give a presentation.			
<b>Pre-requisite(s):</b>	The student must have been accepted to an mphys or mmath programme		
<b>Learning and teaching methods of delivery:</b>	<b>Weekly contact:</b> Typically and on average, 40 mins of project supervisions per week over whole year		
	<b>Scheduled learning:</b> 16 hours	<b>Guided independent study:</b> 384 hours	
<b>Assessment pattern:</b>	<b>As defined by QAA:</b> Written Examinations = 0%, Practical Examinations = 0%, Coursework = 100%		
	<b>As used by St Andrews:</b> Coursework = 100%: Project = 80%, Presentation = 20%		
<b>Re-assessment pattern:</b>	Resubmission of project = 100%		
<b>Module coordinator:</b>	Prof N Ruskuc		
<b>Module teaching staff:</b>	Prof Nikola Ruskuc		