Graduate Diploma in Mathematical Science (MA75)

Year offered: 2010
Admissions: Yes
CRICOS code: 046041M
Course duration (full-time): 2 semesters (1 year)
Course duration (part-time): 4 semesters (2 years)
Domestic fees (indicative): 2010: Full fee tuition $7,250 (indicative) per semester
International Fees (indicative): 2010: $10,750 (indicative) per semester
Domestic Entry: February, July or Summer Program
International Entry: February and July
Total credit points: 96
Standard credit points per full-time semester: 48
Standard credit points per part-time semester: 24
Course coordinator: Dr Troy Farrell
Discipline coordinator: Dr Troy Farrell
Campus: Gardens Point

Prior to Enrolment
Potential applicants for this course are advised to contact the Course Coordinator prior to submitting their application to discuss their plans. International students in particular, should be aware that full-time enrolment of at least 36 credit points per semester may not be possible. This is due to the need to meet unit prerequisites. Units are not offered externally although units do have varying amounts of on-line material available. Lectures, tutorials and computer-based practicals may be timetabled during the day or early evening.

Overview
This course enables graduates from any discipline to develop their knowledge and skills in one or more areas of the mathematical sciences. Strands available include mathematical modelling/applied mathematics, computational mathematics, statistics/statistical modelling, quantitative analysis/financial mathematics and operations research. This course recognises that students may not have studied mathematics for some time.

Career Outcomes
Knowledge and skills in mathematics and/or statistical techniques are increasingly in demand in many different areas, for example, quantitative analysis in the finance area; statistical and mathematical modelling in natural resources and health management; operations research in transport management, and mathematics teaching.

Entry Requirements
To be eligible to enrol, an applicant will normally have completed an undergraduate degree in any discipline. Students who do not have sufficient background may be advised to enrol in MA65 Graduate Certificate in Mathematical Sciences first, subject to approval of the Head of the relevant discipline area.

Course Design
The program of study for an individual student will be decided in consultation with the course coordinator and will take into account the student's background and area of interest within the mathematical sciences.

In the Graduate Diploma, at least 24 credit points must be taken from advanced postgraduate mathematics units. Up to 24 credit points can be taken from units other than mathematics units and there is a limit of 36 credit points from project units.

Further Information
For further information about this course, please contact:

Troy Farrell
Phone: +61 7 3138 2782
Email: enquiry.scitech@qut.edu.au

Course structure

- Total credit points: 48
- At least 36 credit points must be taken from postgraduate mathematics units.
- Up to 12 credit points can be taken from units other than mathematics units.
- The units recommended will depend upon your mathematics background from secondary school or tertiary studies, length of time since you have studied mathematics, and your areas of interest.

Units available:

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MAN312  Linear Algebra
MAN313  Mathematics of Finance
MAN314  Statistical Modelling 2
MAN315  Operations Research 2
MAN413  Differential Equations
MAN414  Applied Statistics 2
MAN420  Computational Mathematics 2
MAN422  Mathematical Modelling
MAN461  Discrete Mathematics
MAN480  Introduction to Scientific Computation
MAN521  Applied Mathematics 3
MAN522  Computational Mathematics 3
MAN524  Statistical Inference
MAN525  Operations Research 3A
MAN533  Statistical Techniques
MAN536  Time Series Analysis
MAN613  Partial Differential Equations
MAN623  Financial Mathematics
MAN624  Applied Statistics
MAN625  Operations Research 3B
MAN672  Advanced Mathematical Modelling
MAN700  Project
MAN717  Minor Project
MAN761  Analysis
MAN764  Applied Mathematical Modelling
MAN765  Bayesian Data Analysis
MAN766  Applied Time Series Analysis
MAN768  Advanced Techniques in Operations Research
MAN769  Mathematics of Finance
MAN771  Computational Mathematics 4
MAN774  Perturbation Methods
MAN775  Statistical Modelling of Financial Processes
MAN777  Mathematics of Fluid Flow
MAN778  Applications of Discrete Mathematics
MAN787-1 Project
MAN787-2 Project
MAN787-3 Project

Course structure Note

If you wish to take any of the project units you will need to discuss your plans and the proposed content with the Course Coordinator.

Strand Information

The following strand information is to assist you with unit selection. You do not have to enrol in all units listed for a strand. The prerequisite units are given to guide you. Depending on your background, you may have already covered some of the units listed (or equivalent units) in your undergraduate studies. If you have not studied any mathematics for some time, you may need to undertake one or two units prior to commencing those listed in the strand information.

Mathematical Modelling/Applied Mathematics

Advanced Postgraduate Mathematics Units:
MAN521  Applied Mathematics 3
MAN613  Partial Differential Equations
MAN672  Advanced Mathematical Modelling
MAN761  Analysis
MAN764  Applied Mathematical Modelling
MAN774  Perturbation Methods
MAN777  Mathematics of Fluid Flow
Prerequisite Units:
MAN121  Calculus and Differential Equations
MAN122  Algebra and Analytic Geometry
MAN220  Computational Mathematics 1
MAN311  Advanced Calculus
MAN312  Linear Algebra
MAN422  Mathematical Modelling

Computational Mathematics

Advanced Postgraduate Mathematics Units:
MAN521  Applied Mathematics 3
MAN522  Computational Mathematics 3
MAN771  Computational Mathematics 4
Prerequisite Units:
MAN121  Calculus and Differential Equations
MAN122  Algebra and Analytic Geometry
MAN220  Computational Mathematics 1
MAN311  Advanced Calculus
MAN312  Linear Algebra
MAN420  Computational Mathematics 2  
MAN480  Introduction to Scientific Computation  

**Operations Research**  
Advanced Postgraduate Mathematics Units:  
MAN525  Operations Research 3A  
MAN625  Operations Research 3B  
MAN768  Advanced Techniques in Operations Research  
Prerequisite Units:  
MAN121  Calculus and Differential Equations  
MAN122  Algebra and Analytic Geometry  
MAN210  Statistical Modelling 1  
MAN315  Operations Research 2  

**Statistics/Statistical Modelling**  
Advanced Postgraduate Mathematics Units:  
MAN524  Statistical Inference  
MAN533  Statistical Techniques  
MAN536  Time Series Analysis  
MAN624  Applied Statistics  
MAN765  Bayesian Data Analysis  
MAN766  Applied Time Series Analysis  
MAN775  Statistical Modelling of Financial Processes  
Prerequisite Units:  
MAN101  Statistical Data Analysis 1  
MAN121  Calculus and Differential Equations  
MAN122  Algebra and Analytic Geometry  
MAN210  Statistical Modelling 1  
MAN314  Statistical Modelling 2  
MAN414  Applied Statistics 2  

**Mathematics for Secondary Teaching**  
Students interested in teaching would usually select across a range of areas of mathematics and statistics, but must take at least 24 credit points from advanced postgraduate mathematics units.  
Students could select up to 24 credit points from units offered by the Faculty of Education related to the teaching of mathematics.  

**Potential Careers:**  
Actuary, Mathematician, Quantitative Analyst, Statistician.  

**UNIT SYNOPSES**  

**MAN101  Statistical Data Analysis 1**  
Experiments, observational studies, sampling, and polls; data and variables; framework for describing and manipulating probability; independence; Binomial and Normal distributions; population parameters and sample statistics; concepts of estimation and inference; standard error; confidence intervals for means and proportions; tests of hypotheses on means and proportions (one sample and two independent samples); inference using tables of counts; modelling relationships using regression analysis; model diagnosis; use of statistical software.  
**Antirequisites:** MAB101, MAB141, BSB123, EFB101  
**Assumed knowledge:** Grade of at least Sound Achievement in Senior Mathematics B (or equivalent) or MAN105 or MAB105 is assumed knowledge  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1 and 2010 SEM-2
MAN105 PREPARATORY MATHEMATICS
This unit is a substitute for Senior Mathematics B for those students who need the equivalent background for the successful study of units which assume it. It includes: basic number facts, natural numbers, integers, rational numbers, real numbers and their operations; basic algebra; functions and equations, graphs, linear functions, equations and applications; systems of linear equations; quadratic, exponential, logarithmic and trigonometric functions, properties and applications; introduction to calculus; rates of change, derivatives, rules of differentiation, second derivatives, maxima and minima and applications; integration and applications. This unit is incompatible with an exit assessment of High Achievement or better in Senior Mathematics B.

**Antirequisites:** MAB105  **Assumed knowledge:** Year 10 Level 6 Mathematics is assumed knowledge  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1 and 2010 SEM-2

MAN120 ALGEBRA AND CALCULUS
This unit introduces and reviews the elementary concepts of function, calculus, matrices and vectors with special reference to applications in science, technology and business where appropriate. Topics covered include the algebra of complex numbers, elementary functions (polynomial, trigonometric, exponential and logarithmic) and their properties, differentiation and integration methods and principles, geometric and algebraic applications of vectors and the solution of linear systems using matrices.

**Antirequisites:** MAB100, MAB120, MAB180  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

MAN121 CALCULUS AND DIFFERENTIAL EQUATIONS
This unit extends the areas of function and calculus introduced in MAN120 by introducing series representations for functions and more advanced methods of differentiation and integration for functions of one variable. A strong connection to real world problems is made by introducing the use of differential equations in modelling, and exploring appropriate methods of solution. Practical calculations of volumes and surface areas of solids of revolution extend your interpretations of the definite integral. Taylor and Fourier series are introduced as a means of approximating functions by sums of polynomials and periodic functions. Some more advanced methods for indefinite integrals, such as partial fraction decomposition, are also introduced.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

MAN122 ALGEBRA AND ANALYTIC GEOMETRY
This unit extends your knowledge in the areas of functions, calculus, matrices and vectors introduced in MAN120 by introducing functions of more than one variable, partial derivatives and multiple integrals, vector valued functions, and matrix methods for the solution of systems of linear equations.

**Antirequisites:** MAB112, MAB122, MAB127, MAB132  **Assumed knowledge:** Grade of at least Sound Achievement in Senior Mathematics C (or equivalent) or MAN120 or MAB120 or MAB100 or MAB125 is assumed knowledge  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

MAN200 MATHEMATICAL FOUNDATIONS
This unit is intended to cater for students who may not have studied mathematics for some years and who are enrolled in postgraduate coursework in mathematical science. The unit is tailored to suit individual needs. Content may be organised into modules and may also include material delivered in a workshop for industry participants.

**Other requisites:** Unit coordinator approval is required to enrol  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

MAN201 MATHEMATICS
This unit caters for students who need more than one mathematics unit to provide the necessary background for studying more advanced units in postgraduate coursework in mathematical science. Students may use material from one first level undergraduate material with extension material or combine content from more than one first level unit.

**Other requisites:** Unit coordinator approval is required to enrol  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

MAN210 STATISTICAL MODELLING 1
This unit includes: probability; independence; system reliability; using conditional probability in modelling; Bayes; introductory Markov chains; random variables and distributions; special distributional models; Bernoulli process; Poisson process; exponential; introductory queuing processes; expected values and moments; goodness-of-fit tests; measures of dependence; introductory bivariate and correlation properties; conditioning arguments.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1 and 2010 SEM-2

MAN220 COMPUTATIONAL MATHEMATICS 1
This unit includes: sources of error; computer arithmetic; solution of nonlinear equations in one variable; solution of systems of linear equations; interpolation; finite differences; numerical differentiation and integration; solution of first order linear differential equations; MATLAB programming. Students without an exit level of Sound Achievement in four semesters of Senior Mathematics C need to be concurrently enrolled in MAN120 if MAB100 not completed earlier.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-2 and 2010 SEM-2

**MAN281 MATHEMATICS FOR COMPUTER GRAPHICS**

This unit introduces students to the mathematics involved in computer graphics, computer games and virtual reality. It is heavily reliant on analytic, Euclidean and projective geometries, elementary trigonometry and elementary calculus in both two and three dimensions. The unit will develop the mathematical concepts and where practicable show how these concepts are then applied in the field of computer graphics.

**Assumed knowledge:** Grade of at least Sound Achievement in Senior Mathematics B (or equivalent) or MAB105 / MAN105 is assumed knowledge  
**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-2

**MAN311 ADVANCED CALCULUS**

This unit includes the following: polar coordinates; parametric equations; conic sections; quadric surfaces; vector-valued functions; Fourier series; functions of several variables; graphs; partial derivatives; total derivatives; extrema; Lagrange multipliers; Taylor series for multivariable functions; double and triple integrals; Green's theorems; line and surface integrals; divergence theorem; Stoke's theorem; applications.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN312 LINEAR ALGEBRA**

This unit covers the following broad topics from linear algebra: matrix analysis; eigenvalues and eigenvectors; vector spaces; inner product spaces.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN313 MATHEMATICS OF FINANCE**

This unit includes: interest rates; solution of problems in compound interest; applications of annuities; valuation of securities; quantitative techniques in business and finance.

**Prerequisites:** MAN121  
**Antirequisites:** MAB313  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-2

**MAN314 STATISTICAL MODELLING 2**

This unit includes: models for stochastic processes and statistical methods, which have applications in engineering, information technology, finance, and physical and life sciences. Markov chains; random walks; branching processes; queueing processes; long-term behaviour of processes; use of generating functions; bivariate and conditional distributions; transformations of random variables; beta and gamma distributions; mixture distributions; order statistics, minimum and maximum.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN315 OPERATIONS RESEARCH 2**

This unit introduces the essential features of operations research methods. It develops a number of basic mathematical techniques to solve generic problems and the theoretical foundations of these techniques. Students should develop the ability to apply various operations research methods, algorithms and techniques in the solution of practical problems. Students will also look at the applications of operations research techniques to real-world problems.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN316 DIFFERENTIAL EQUATIONS**

This unit includes: linear and nonlinear differential equations; series methods; Laplace transform; transforms of derivatives and integrals; systems of differential equations; basic theory on linear systems; solution of linear systems with constant coefficients; matrix methods; phase plane analysis.

**Prerequisites:** MAB311 or MAB312 or MAN311 or MAN312  
**Antirequisites:** MAB413  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN414 APPLIED STATISTICS 2**

This unit includes: Simple linear regression (revision), multiple linear regression, making inferences from regressions, choosing a model, checking model assumptions, general linear models - analysis of covariance, ANOVA revisited, designing experiments, issues in designing experiments, analysing experimental results, further experimental designs, assumptions, and how to cope if they aren't met, simulations.

**Prerequisites:** MAB101 and MAB111  
**Assumed knowledge:** Recommended MAB112  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-2

**MAN420 COMPUTATIONAL MATHEMATICS 2**

This unit includes: direct methods for systems of linear equations; solution methods for special matrix systems.
(banded matrix systems, block-banded matrix systems, data structures and algorithms for storing and manipulating sparse matrices, reordering schemes); vector and matrix norms (basic theory and definitions, error bounds for direct methods, condition numbers); iterative methods for systems of linear equations (Jacobi, Gauss-Siedel, Successive Over-Relaxation, conjugate gradient); iterative methods for the eigenvalue problem.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN422 MATHEMATICAL MODELLING**
This unit includes models developed with the "real world" description. These models are taken from the areas of cancer research, population growth and engineering. Emphasis is on mathematical modelling and not on the development of new mathematical content.

**Prerequisites:** MAN121  **Antirequisites:** MAB422  **Assumed knowledge:** MAN220 is recommended for prior/concurrent study for exposure to MATLAB  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN461 DISCRETE MATHEMATICS**
This unit has three basic components. They are combinatorics, abstract algebra and number theory. Combinatorics, which is about 60% of the unit, will largely consist of enumeration techniques in variopis settings. Abstract algebra (~20%) will advance the student’s knowledge of groups, rings and fields to include additive groups, multiplicative groups; polynomial rings, finite fields, isomorphisms, and homomorphisms. Number theory (~20%) will include methods of proof including induction and contradiction, modular arithmetic and congruence, gcd/lcm and theorems involving these, fundamental theorem of arithmetic, Fermat’s theorems, Euler’s theorem.

**Prerequisites:** MAN122 or MAB112 or MAB122  **Antirequisites:** MAB461, MAB621  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN480 INTRODUCTION TO SCIENTIFIC COMPUTATION**
This unit teaches students how to implement a mathematical algorithm in a modern scientific computing environment (eg Matlab). A case-study approach is used with an emphasis on writing efficient code. Also an overview of other software packages used in mathematics will be given.

**Antirequisites:** ITB849, MAB480  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN521 APPLIED MATHEMATICS 3**
Topics selected from: partial differential equations such as the wave, heat and Laplace equations; special functions (gamma, delta, Bessel and error functions, Legendre polynomials); vector analysis and applications (vector algebra, vector calculus, fields, grad, div, curl, line and surface integrals, divergence theorem, Stoke's theorem, applications); functions of a complex variable (analytic functions, contour integrals, Laurent series, residues).

**Prerequisites:** MAN311 or MAB311  **Antirequisites:** MAB521  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN522 COMPUTATIONAL MATHEMATICS 3**
This unit includes: deriving the basic equations that describe fluid motion; the finite volume method for solving PDEs (application to the generalised diffusion equation, cell-centred and vertex-centred schemes, handling of boundary and initial conditions); solution of systems of nonlinear equations (Newton’s method, Inexact Newton methods, Globally convergent methods).

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN524 STATISTICAL INFEERENCE**
This unit includes: maximum likelihood estimation, confidence intervals and hypothesis tests, introduction to Bayesian inference, prior and posterior distributions, Bayesian inference for binomial data, Poisson count data and normal data, simulation techniques for sampling from distributions. Use of software Matlab and R. Assumed knowledge: exposure to introductory ideas of statistical inference, including parameter estimation, confidence intervals and hypothesis testing, such as provided by a first course in statistics or data analysis.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN525 OPERATIONS RESEARCH 3A**
This unit develops problem-solving skills and sharpens analytical skills. This unit introduces the technical issues involved in applying operations research principles, methods and algorithms in the solution of real-world problems.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN533 STATISTICAL TECHNIQUES**
This unit builds on your knowledge and skills of statistical techniques and aims to provide you with an understanding and a working knowledge of some more specialised statistical techniques and their applications. Topics covered include quality management concepts and tools for statistical process control, modelling and analysis of reliability (for inanimate objects) and survival (for living entities), and multivariate techniques such as principal
components analysis, discriminant analysis and cluster analysis.

**Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN536 TIME SERIES ANALYSIS**
The following core content will be covered: fundamentals of time series analysis; time series models; nonstationary processes; seasonal ARIMA models; vector autoregression; long-range dependence and fractional ARIMA models; co-integration of nonstationary processes. The computer package S-Plus will be used to implement and simulate the models and techniques developed throughout the unit.

**Prerequisites:** MAB314 and MAB414  **Antirequisites:** MAB536, MAN526  **Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN613 PARTIAL DIFFERENTIAL EQUATIONS**
This unit includes the following: derivation of certain partial differential equations; solution of partial differential equations by separation of variables, Laplace and Fourier transforms; Sturm-Liouville systems; special functions; Green's functions.

**Antirequisites:** MAB613  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN623 FINANCIAL MATHEMATICS**
This unit includes the following: quantitative techniques in business, economics and finance; theory and structure of interest rates; general accumulation and discounting functions; force of interest; discounting including Modern Portfolio theory and extension; varying interest; general annuities; varying annuities; continuous varying annuities; mathematical analysis of financial transactions in money and capital markets; life annuities and life assurances; the life table; basic life table functions; life annuities and assurances; policy values; paid up policy values; changes to policies; use of life table; superannuation.

**Prerequisites:** (MAN313 or MAB313) and (MAN311 or MAB311)  **Assumed knowledge:** EFB210 is highly recommended prior study  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN624 APPLIED STATISTICS**
This unit includes the following: fractional factorial designs, blocking, aliasing; development of basic statistical software (eg SAS) programming skills; modelling continuous responses using regression techniques, diagnostics, transformations, model choice and plots; modelling binary data and proportions using linear logistic models; modelling count data using loglinear models; modelling survival data and hazard modelling using loglinear models; data analysis and inference techniques based on simulation techniques, such as the bootstrap; non-linear regression techniques such as regression trees.

**Prerequisites:** MAB414  **Antirequisites:** MAB624  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN625 OPERATIONS RESEARCH 3B**
This unit includes: phases of an operations research study; decision analysis; queuing theory; simulation; implementation in operations research; heuristic techniques.

**Prerequisites:** MAN315  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-2

**MAN672 ADVANCED MATHEMATICAL MODELLING**
Models are developed beginning with the description of 'real world' problems. Emphasis is on the mathematical modelling and not on the development of new mathematical techniques. The unit includes: mathematical modelling; model formulation; dimensional analysis and re-scaling; curves of pursuit; bungy jumping; modelling with systems of ordinary differential equations; phase plane methods for analysing systems of ODEs; bacterial growth in a chemostat; predator-prey models with harvesting; limit cycles; oscillations and excitable media; modelling with partial differential equations; motion of a continuum; continuity; traffic flow; aggregation of slime mould amoebae; momentum; ideal gas dynamics; quasi-linear PDEs.

**Prerequisites:** (MAN422 or MAB422) and (MAN312 or MAB312)  **Antirequisites:** MAB672  **Credit points:** 12  **Contact hours:** 4 per week  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1

**MAN700 PROJECT**
This project is based on a problem from the student's workplace or interests. Permission to enrol in this unit must be obtained from the Course Coordinator.

**Other requisites:** Unit coordinator approval is required to enrol  **Credit points:** 24  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

**MAN717 MINOR PROJECT**
This project may be related to that undertaken in MAN700 or in MAN787 or in a separate area. It must be self-contained and is assessed separately. Permission to enrol in this unit must be obtained from the Course Coordinator.

**Other requisites:** Unit coordinator approval is required to enrol  **Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

**MAN761 ANALYSIS**
This unit includes: convergence in R; uniform convergence; Lebesgue integral; convergence theorems; Lp-spaces;
metric spaces; completeness and compactness; contraction mappings; normed and Banach spaces; dual spaces; linear operators; Hilbert spaces; Hilbert-adjoint operator; linear operator equations; spectrum of a linear operator.

Prerequisites: MAB311 and MAB312  Credit points: 12
Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-2

MAN764 APPLIED MATHEMATICAL MODELLING
This unit enables students to develop and practice mathematical modelling skills by considering topical problems from current research activities and beyond the discipline of mathematics. Some of the problems considered include the dispersion of a pollutant in a river, waves of pursuit and evasion, Turing mechanisms and the generation of spatial patterns in biological or biochemical systems. A notable emphasis of this unit is the collaborative development of mathematical models for novel problems.

Prerequisites: MAB613 and MAB672  Credit points: 12
Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-2

MAN765 BAYESIAN DATA ANALYSIS
This subject builds on the foundations of Bayesian analysis laid in MAB524 to extend modelling and computational approaches to real world problems. Skills in using statistical computing platforms for Bayesian analysis, model development and comparison, and extending computational approaches will be developed. You are encouraged to apply skills to data modelling tasks motivated by their work or research areas.

Prerequisites: MAB524 or MAN524  Credit points: 12
Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-1

MAN766 APPLIED TIME SERIES ANALYSIS
This unit introduces you to the modern tools of Time Series Analysis. It covers both linear and nonlinear time series models; state-space models; generalised state-space models; the Kalman recursions for filtering, prediction and smoothing; applications to business and financial time series. The unit will develop the mathematical and statistical concepts and show how these concepts are then applied in practical situations.

Prerequisites: (MAN524 or MAB524) and (MAN536 or MAB536)  Credit points: 12  Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-1

MAN768 ADVANCED TECHNIQUES IN OPERATIONS RESEARCH
This unit includes the following: inventory systems modelling, material requirement planning, just-in-time production; production planning and scheduling, including static and dynamic methods, aggregate planning, LP/LDR/SDR techniques; resources allocation; heuristics; operations scheduling, including sequencing and balancing techniques, job shop scheduling, assembly line balancing; NP-completeness.

Prerequisites: (MAN525 or MAB525) and (MAN625 or MAB625)  Credit points: 12  Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-1

MAN769 MATHEMATICS OF FINANCE
This unit introduces you to some modern tools of mathematical finance. It follows a basic and intuitive approach to understand the concepts of bond futures, forward contracts and swaps. Binomial models will be used to demonstrate some key features of options pricing. Brownian motion and Markov processes will then be introduced to explain the Black-Scholes market model and the option valuation formula.

Prerequisites: MAN623 or MAB623 or MAN522 or MAB522  Credit points: 12  Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-1

MAN771 COMPUTATIONAL MATHEMATICS 4
Topics selected from: conservation equations for fluid motion; boundary and initial conditions; finite difference methods for diffusion equations (difference formulae, consistency, order, stability, convergence); finite volume methods (application to diffusion equations; cell-centred and vertex centred schemes); solution of advection-diffusion equations (monotonicity, stability, TVD schemes, upwinding, flux limiting); numerical optimisation (line search, trust region methods; Steepest descent, Newton, Quasi-Newton, Conjugate Gradients; constrained optimisation; KKT conditions; active set methods, penalty functions; specially structured problems; nonlinear least squares; quadratic programmes; the augmented Lagrangian; sequential quadratic programming algorithms).

Prerequisites: MAB522 and MAB613  Credit points: 12  Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-2

MAN774 PERTURBATION METHODS
This unit includes: regular and singular perturbation expansions; asymptotic expansions, strained coordinates; boundary layer analysis and matched asymptotic expansions; selected examples from industrial applications and mathematics applied in medicine and biology.

Prerequisites: (MAN413 or MAB413) and (MAN521 or MAB521)  Credit points: 12  Contact hours: 3 per week  Campus: Gardens Point  Teaching period: 2010 SEM-1

MAN775 STATISTICAL MODELLING OF FINANCIAL PROCESSES
This unit includes the following: Wiener process; martingales; Markov processes; stochastic integrals and stochastic calculus; equivalent martingale measure; stochastic differential equations (SDE); the martingale-SDE
approach to option pricing; replicating portfolio; statistical estimation of stochastic volatility via ARCH/GARCH-type models; quasi-likelihood estimation of long-range dependence and non-Gaussianity in financial processes.

**Prerequisites:** MAB524 and MAN536  
**Credit points:** 12  
**Contact hours:** 3 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1 and 2010 SEM-2

**MAN777 MATHEMATICS OF FLUID FLOW**
The mathematics of fluid flow involves solving ordinary and partial differential equations arising as simplifications of the Navier-Stokes equations. Approximation techniques for flows in thin layers are also considered as well as approximations of flows of low and high viscosity. Questions addressed include: why a spinning cricket ball swerves in the air; how much does a blockage in an artery or vein increase the pressure; and why is there no solution for flow past a cylinder for zero Reynolds number.

**Prerequisites:** MAN613 or MAB613  
**Credit points:** 12  
**Contact hours:** 3 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN778 APPLICATIONS OF DISCRETE MATHEMATICS**
This unit has two main areas of study. One is the application of graph theory to a number of practical problems including trees and shortest path algorithms. The other area is advanced number theory and includes the topics of divisibility, congruence, multiplicative functions, primitive roots, quadratic residues and applications to cryptology including the RSA algorithm.

**Prerequisites:** MAN461 or MAB621  
**Credit points:** 12  
**Contact hours:** 3 per week  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1

**MAN787 PROJECT**
This project is research-based and involves writing a thesis and giving an oral presentation. Permission to enrol in this unit must be obtained from the Course Coordinator.

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2010 SEM-1, 2010 SEM-2 and 2010 SUM

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