


SCIENCE, TECHNOLOGY AND ENGINEERING

# MATHEMATICS AND STATISTICS UNDERGRADUATE SUBJECT GUIDE 2011



A guide for students studying subjects in  
mathematics and statistics

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## MATHEMATICS

### MAT1CA CALCULUS A

15 Credit Points. Semester: 1 Bendigo  
The development of calculus was a crucial step in the evolution of much of modern pure and applied mathematics. The key concepts of differential and integral calculus are explored in this unit, which lays the foundation for subsequent major studies in mathematics or studies within the engineering program.

### MAT1CB CALCULUS B

15 Credit Points. Semester: 2 Bendigo  
The aim of Calculus B is to continue the theme of Calculus A in developing the foundations for studies in a wide range of areas of mathematics and engineering. Students are introduced to second-order differential equations, vector quantities and their application in geometry and mechanics, matrix algebra and the eigenvalue problem, and differentiation of functions of several variables.  
Prerequisite: MAT1CA.

### MAT1CFE CALCULUS AND FUNCTIONS FOR ECONOMICS

15 Credit Points. Semester: 1 Melbourne  
Mathematics 1CFE provides the mathematical foundation for all economics units requiring a knowledge of calculus. It reviews and extends material covered in VCE and provides an introduction to some of the ideas of mathematical reasoning with an overarching theme of clear communication skills in the mathematical sciences. The unit runs in two streams. One stream is dedicated to the concepts and techniques of differentiation and integration and, whilst there is much revision, there are many refinements and extensions of the ideas presented in VCE as well as greater expectations of presentation of written material. The other stream commences with a review of algebra techniques and a formal treatment of sets and number systems and then, in the second half of the semester, introduces constrained optimisation, including the use of Lagrange multipliers. The teaching emphasis is on active student engagement in solving mathematical problems.  
Incompatible: MAT11CFN, MAT1CFN, MAT11EN, MAT11EN, ECO11QA, ECO12QA, MAT1CNS, MAT1CPE.

### MAT1CLA CALCULUS AND LINEAR ALGEBRA

15 Credit Points. Semester: 2 Melbourne  
In this unit students will build on MAT1CNS/CFE/CPE to complete a coverage of the mathematics required for second year study in mathematics, engineering and mathematically based disciplines. Approximately half the unit is about calculus, covering Taylor polynomials and first and second order differential equations. The other half contains a study of vectors, matrices and systems of linear simultaneous equations. The teaching emphasis is on active student engagement in solving mathematical problems.  
Prerequisite: MAT1CFN or MAT1CFE or MAT1CNS or MAT1CPE or MAT1EN.  
Incompatible: MAT1FEN, MAT12CLA, MAT12FEN, CSE1LAP.

### MAT1CNS CALCULUS AND NUMBER SYSTEMS

15 Credit Points. Semester: 1 Melbourne  
Mathematics 1CNS is the foundation unit for all studies requiring a knowledge of mathematics. It reviews and extends material covered in VCE and provides an introduction to the ideas of mathematical reasoning with an overarching theme of clear communication skills in the mathematical sciences. The unit runs in two streams. One stream is dedicated to the concepts and techniques of differentiation and integration and, whilst there is much revision, there are many refinements and extensions of the ideas presented in VCE as well as greater expectations of presentation of written material. The other stream commences with a review of algebra techniques and a formal treatment of sets and number systems and then proceeds to use these ideas, in the second half of the semester, in an introduction to mathematical logic and proof. The teaching emphasis is on active student engagement in solving mathematical problems.  
Incompatible: MAT1CFE, MAT1EN, ECO1QA, MAT1CFN, MAT1CPE.

### MAT1CPE CALCULUS AND PROBABILITY FOR ENGINEERS

15 Credit Points. Semester: 1 Melbourne  
Mathematics 1CPE is the foundation unit for all engineering students. It reviews and extends material covered in VCE and provides an introduction to some of the ideas of mathematical reasoning with an overarching theme of clear communication skills in the mathematical sciences. This unit runs in two

streams. One stream is dedicated to the concepts and techniques of differentiation and integration and, whilst there is much revision, there are many refinements and extensions of the ideas presented in VCE as well as greater expectations of presentation of written material. The other stream commences with a review of algebra techniques and a formal treatment of sets and number systems and then, in the second half of the semester, uses these tools and calculus in a formal introduction to probability. The teaching emphasis is on active student engagement in solving mathematical problems.  
Incompatible: MAT1CNS, ECO1QA, MAT1CFE, MAT1EN, MAT1CFN.

### MAT1DIS DISCRETE MATHEMATICS

15 Credit Points. Semester: 2 Bendigo  
Students survey the mathematical structures which occur throughout computing-related disciplines and which are needed to fully appreciate the processes involved in modern information technology. Topics include number bases, computer representation of numbers, propositional and predicate logic, sets, binary relations, recursion, Boolean algebra and its application to digital circuits, and cryptography.

### MAT1DM DISCRETE MATHEMATICS

15 Credit Points. Semester: 1 Melbourne  
The unit is an introduction to discrete mathematics, which is a fundamental part of modern mathematics. The unit contains a range of important mathematical topics not taught in secondary school nor in other undergraduate units. Students interested in going on with mathematics are strongly encouraged to enrol in this unit. Among the topics covered are: numbers in bases other than 10, recurrence relations, complexity of algorithms, graph theory, Boolean logic, and finite state machines. All these topics are central to the application of mathematics in electronics and computer science. Examples within each topic are chosen with a view to helping students develop their problem-solving skills.  
Incompatible: CSE21DMO, MAT12DM, MAT11DM.

### MAT1MAB MATHEMATICAL APPLICATIONS IN BIOLOGY

15 Credit Points. Semester: 2 Melbourne  
In this unit students are introduced to how mathematical models are used in biological, biophysical and health sciences and insight into how they may be derived from biophysical assumptions. A small but representative range of biophysical applications is investigated. The unit is organised in modules, each focusing on a specific application. Typical applications include population dynamics, vaccination and epidemics, water catchment models, greenhouse models, growth and form in organisms and flocking behaviour in animal populations. The unit is delivered mainly on-line. Learning resources including all lecture materials will be available on-line. Students meet one hour per week for a problem solving class to work through problem sets designed to strengthen basic mathematical skills. Considerable use is made of spreadsheets as a tool for understanding mathematical models and performing calculations. Assessment involves a mixture of paper based work and electronically submitted work.

### MAT1MIT MATHEMATICS FOR IT

15 Credit Points. Semester: 1 Bendigo  
Mathematics for IT provides students with a firm grounding in basic algebra, as well as introducing mathematical concepts that play an important role in modern information technology. Topics include numbers and algebra, power functions, exponentials and logarithms, Big-O notation, modular arithmetic, elementary cryptography, error-detecting and error-correcting codes, graph theory (particularly trees), and Huffman codes.

### MAT1PHM PHARMACY MATHEMATICS

15 Credit Points. Semester: 1 Malaysia. 2 Bendigo, Malaysia  
In Pharmacy Mathematics, students are introduced to some of the fundamental mathematical and statistical techniques that are required for pharmacy studies and research. The first part of the unit provides a revision of differential and integral calculus, and an introduction to mathematical modelling and differential equations. Emphasis is then given to statistics, with the major topics being probability distributions, basic statistical inference and confidence intervals, hypothesis testing, and simple linear regression. Throughout the unit, topics will be illustrated with examples drawn from contemporary pharmacy practice.  
Special Conditions: Available for students enrolled in the Bachelor of Pharmacy course.

### MAT2AAL APPLIED ALGEBRA

15 Credit Points. Semester: 2 Melbourne  
The study of algebraic structures, such as groups,

fields and vector spaces, underpins a large amount of modern computer science. Group theory, the principal mathematical tool for analysing symmetry, is genuinely 20th century mathematics and has widespread applications in all areas of science. Field theory and linear algebra have important applications to coding theory, which is used to preserve the security of computer networks. This unit is taught in two parallel streams. One begins with some number theory then develops the basics of group theory and ends with the axiomatic treatment of vector spaces. The other stream includes an introduction to error-correcting codes and rings, fields and polynomials. The material is presented with an emphasis on an understanding of the structures, and their applications.  
Prerequisite: MAT1CLA or MAT1CB.  
Incompatible: MAT2PDM.

### MAT2ANA ANALYSIS OF REAL NUMBERS AND FUNCTIONS

15 Credit Points. Semester: 1 Melbourne  
The limits of sequences and limits of functions are studied in this unit. Initially we study them in one dimensional space and then in higher dimensions. We also study series and various tests are derived to determine the convergence or otherwise of these series. We then extend the basic idea of limit to include sequences of functions and sequences of sets in metric spaces. A powerful theorem called The Contraction Mapping Theorem will be derived. This theorem plays a fundamental role in analysis and its applications. We will use it to establish the existence and uniqueness of solutions to certain differential equations.  
Prerequisite: MAT1CLA.  
Incompatible: MAT2PAA.

### MAT2CC CALCULUS C

15 Credit Points. Semester: 1 Bendigo  
In Calculus C, a variety of concepts and techniques that have important practical applications in applied mathematics and engineering are introduced. Topics to be studied include the calculus of vector fields, multiple integrals and Fourier series.  
Prerequisite: MAT1CB.

### MAT2LAL LINEAR ALGEBRA

15 Credit Points. Semester: 2 Melbourne  
Linear algebra is one of the cornerstones of modern mathematics. Simple geometrical ideas, such as lines, planes, rules for vector addition and dot products arise in many places, including calculus, signal processing, mechanics, differential equations and numerical analysis. This unit is an introduction to the mathematics which allows these geometrical ideas to be applied in non-geometrical contexts, such as decomposing a signal into periodic components.  
Prerequisite: MAT1CLA or MAT1FEN.  
Incompatible: MAT21LA, MAT21ELA, MAT2LA, MAT2ELA.

### MAT2LIN LINEAR ALGEBRA

15 Credit Points. Semester: 2 Bendigo  
The approach taken in this unit is the use of linear algebra as a tool and language for understanding and solving problems from a wide variety of disciplines such as statistics and computing. Matrices and systems of linear equations are introduced, and we show how the familiar notions of point, line, plane and distance can be generalised. Basic ideas such as basis, linear independence and eigenvalues are studied. Applications may include Leontief economic models, curve-fitting, regression, factor analysis, Markov chains, environmental management, game theory, error-correcting codes, tomography and computer graphics.  
Prerequisite: MAT1CB.

### MAT2MEC MECHANICS

15 Credit Points. Semester: 2 Melbourne  
In this unit students deal with the kinematics and dynamics of a particle and systems of particles, and some of the types of differential equations which arise in the mathematical descriptions of the motions studied. The main mechanical topics emphasize the study of particle dynamics and conservation laws, rigid rotating bodies and the two body problem with central forces, based on Newton's second law of motion. The new solutions of differential equations considered are solutions of second order differential equations with non-constant coefficients, with expansions about ordinary points and regular singular points. The main tools used are derived from concepts in MAT2VCA.  
Prerequisite: MAT2VCA or MAT2AVC.  
Incompatible: MAT2AM, MAT22AM.

### MAT2MFC MATHS TOPICS FOR COMPUTER SCIENCE

15 Credit Points. Semester: 2 Melbourne  
This unit develops ideas encountered in first-year discrete mathematics (MAT1DM), and introduces several new topics. The various mathematical topics

will be of interest and use to computer science students and to students of mathematics. It is a core unit for students enrolled in the Bachelor of Computer Systems Engineering and Bachelor of Computer Science degrees. The unit treats theoretical foundations and numerical aspects of topics including relational algebra, finite state machines, regular and context free languages, Turing machines and computability. Also covered are the Z-transform (generating functions), random number generators, cryptography, parameterised curves and Bezier curves. These topics have applications to areas such as databases, performance analysis and computer graphics. No programming experience is required. Prerequisite: MAT1DM and (MAT1CNS or MAT1CPE or MAT1CFN). Incompatible: MAT2MCS.

### MAT2GT GRAPH THEORY

15 Credit Points. Semester: 1 Bendigo  
Graphs are made up of points together with lines joining some of those points. In addition to their intrinsic interest, graphs are used to model the structures of objects as diverse as molecules, sentences, communications networks, and silicon chips. We will explore these models as well as the underlying mathematical structures. Algorithms are fundamental to the subject, for example, communications networks rely heavily on algorithms which minimise costs or maximise efficiency, while sorting and searching are ubiquitous in databases. Particular applications will depend on the interests of the class. This unit is particularly suitable for computing, mathematics and engineering students. Prerequisite: MAT1DIS or MAT1CA.

### MAT2VCA VECTOR CALCULUS

15 Credit Points. Semester: 1 Melbourne  
Many quantities in the physical world can be represented by smoothly varying functions of position. This unit develops, with a computational flavour, the differential and integral calculus of scalar and vector fields in cartesian and curvilinear coordinates. Three important partial differential equations are introduced: the wave equation, the heat equation and Laplace's equation; they are reduced to several ordinary differential equations by the technique of separation of variables. In another part of the unit, Laplace transforms are introduced as a technique for solving constant coefficient ordinary differential equations with discontinuous forcing terms. Prerequisite: MAT12CLA OR MAT12FEN OR MAT1CLA OR MAT1FEN. Incompatible: MAT2AVC.

### MAT3AC ADVANCED CALCULUS AND COSMOLOGY

15 Credit Points. Semester: 1 Melbourne  
This unit has a dual purpose. The first is to unify linear algebra and vector calculus from second year into the sort of calculus used in differential geometry and analysis. The second aim is to use this advanced calculus to model the evolution of the large scale structure of the Universe using Einstein's theory of gravity. Topics include: advanced calculus on curves and surfaces, implicit and inverse function theorems, the calculus of variations and geodesics, surfaces and curvature, introduction to space-time and its geometry, modelling the expansion of the Universe with general relativity. No background in physics is assumed. Prerequisite: (MAT21LA and MAT21AVC) or (MAT2LAL and MAT2VCA).

### MAT3CA COMPLEX ANALYSIS

15 Credit Points. Semester: 2 Bendigo  
The development of the theory of functions of a complex variable provides a fascinating example of how initial vague and uncertain ideas can be turned into a powerful and rigorous theory with far-ranging applications. The key aspects of this development are studied, from the first attempts to satisfactorily define and manipulate complex numbers, to the immense contribution of mathematicians such as Cauchy in the 19th century and finally to the modern era, where the advent of high speed computers has brought mathematics to a wide audience. Prerequisite: MAT2CC.

### MAT3CZ COMPLEX ANALYSIS

15 Credit Points. Semester: 1 Melbourne  
The theory of functions of a complex variable aims at extending calculus to the complex domain. Both differentiation and integration acquire new depth and significance. After introducing complex functions of a complex variable, the course covers the differentiation, analyticity, and integration of such functions, including pole singularities and residues. Important integration theorems are followed by application to Fourier transforms and the use of the latter in solving ordinary differential equations. The discussion of complex functions includes branch points and branch cuts, and conformal mappings.

Prerequisite: MAT21AVC and MAT22APD; or MAT21PAA; or MAT2ANA; or MAT2VCA.  
Incompatible: MAT31CZE, MAT3CZE.

### MAT3DQ DYNAMICS AND QUANTUM MECHANICS

15 Credit Points. Semester: 2 Melbourne  
The first component of this unit, dynamics, is concerned with the Hamiltonian description of classical mechanics (in contrast with MAT2MEC, which looks at the Newtonian description). The approach due to Hamilton allows the dynamics to be derived from a scalar function (the Hamiltonian) and reveals more of the structure and underlying principles which govern the dynamics. Topics include conservation laws and canonical transformations. The second component is quantum mechanics and we use the Hamiltonian treatment of the classical central force problem of gravity (the Kepler problem) and electrostatics (the Coulomb problem) to bridge the gap between classical and quantum mechanics. Topics include energy eigenvalue problems in one, two and three dimensions and the hydrogen atom is treated as the quantisation of the classical Coulomb problem. Prerequisite: MAT2MEC or (MAT2AM and MAT2APD).

### MAT3DS DISCRETE ALGEBRAIC STRUCTURES

15 Credit Points. Semester: 2 Melbourne  
Special Conditions: Assessment and class requirements depend upon number of students enrolled. If more than 16 students enrolled, assessment will be one 3-hour examination (80%), four assignments (20%) and class requirements: three 1-hour lectures per week.  
This unit is a continuation and expansion of MAT2PDM/MAT2ALL. Further applications of finite groups to counting problems will be given. Finite fields and their applications will be discussed. The applications of ring theory to the classification of cyclic codes will be presented. Approximately half the unit will be devoted to ordered sets, lattices and Boolean algebras. Applications of lattices to concept analysis and applications of ordered sets to computer science will be discussed. Prerequisite: MAT2PDM or MAT2AAL.

### MAT3LPG LINEAR PROGRAMMING AND GAME THEORY

15 Credit Points. Semester: 2 Melbourne  
Linear Programming and Game Theory are relatively new branches of mathematics. Linear Programming involves maximising and minimising a linear function subject to inequality and equality constraints. Such problems have many economic and industrial applications. Game Theory deals with decision making in a competitive environment. This unit studies the simplex technique for solving linear programming problems and gives an introduction to game theory and its applications. Prerequisite: MAT21LA or MAT21ELA or MAT2LAL. Incompatible: MAT3ALP.

### MAT3MFM MATHEMATICAL FLUID MECHANICS

15 Credit Points. Semester: 2 Melbourne  
An introduction to incompressible fluid flow, with emphasis on the structure of basic approximations in the theory of fluids and solutions of problems using the approximations. The unit is fully online. Special Conditions: This subject is delivered in fully on-line mode. Each fortnight lecture notes will be posted on-line. There will be worked problems each fortnight with answers available in a separate format. A bulletin board discussion will be provoked twice weekly. All emails will be guaranteed a response within 48 hours of receipt. The examination will be supplied on-line with defined start and end times. Prerequisite: (MAT21AVC or MAT2AVC) and (MAT3CZ or MAT3CZE).

### MAT3NM NUMERICAL MATHEMATICS

15 Credit Points. Semester: 1 Bendigo  
Students are introduced to a wide variety of concepts and methods in computational mathematics. Topics covered are solutions of non-linear equations, interpolation, smoothing and optimisation, numerical integration, numerical linear algebra, and solutions of ordinary differential equations. Use is made of modern computer packages to illustrate key aspects of these numerical problems and to facilitate their solution. Prerequisite: MAT2CC.

### MAT3SC SCIENTIFIC COMPUTING

15 Credit Points. Semester: 1 Melbourne  
Numerical mathematics studies both the accuracy and stability of computations and thus plays a vital role whenever computers are used to solve quantitative problems. The main theme of this unit is an introduction to numerical computing, including floating point arithmetic, sources of error, ill conditioning and stability of algorithms. This theme is illustrated by developing and analysing algorithms for solving non-linear equations and differential equations and for evaluating integrals. The practice classes will

be conducted using MATLAB as a computational environment. No previous experience with MATLAB is required.

Prerequisite: MAT1CLA or MAT1FEN.  
Incompatible: MAT3NA, CSE31NC.

### MAT3TA TOPOLOGY AND ANALYSIS

15 Credit Points. Semester: 1 Melbourne  
The concept of the real numbers underpins a major part of mathematics, both pure and applied. This unit begins with a careful construction of the real numbers and a discussion of their properties. This is followed by a discussion of the theory of metric spaces. The most basic properties of open sets in metric spaces can be used to motivate a more generally applicable definition of open sets, which leads to the idea of a topological space. A study of fundamental concepts in the theory of topological spaces such as compactness and connectedness yields results of very general application. In particular, they can be applied to problems in the analysis of the real numbers. The unit concludes with a discussion of quotients and products of topological spaces. Prerequisite: MAT22PAB or MAT2ANA.

### MAT3TIM TOPICS IN MATHEMATICS

15 Credit Points. Semester: 1 Bendigo. 2 Bendigo  
This unit provides an opportunity for advanced students to study a suitable topic in mathematics which is not covered in other subjects offered by the Department of Mathematics. The topic will depend on the interests of students and available staff. Special Conditions: Students wishing to enrol in this unit must seek approval from the Deputy Head of the Department of Mathematics and Statistics. Prerequisite: successful completion of 30 credit points of mathematics units at second year level and permission of the Head of the Department of Mathematics and Statistics.

## STATISTICS

### STA1LS STATISTICS FOR LIFE SCIENCES

15 Credit Points. Semester: 1 Melbourne. 2 AW, Melbourne  
In this unit students will be introduced to the basic statistical methods that are very useful for students in biological sciences, medical sciences, agricultural sciences, nutrition, and health sciences. For example, this unit will cover essential skills for students to analyse data from experiments and write reports. It is specifically designed for students who do not have a strong background in mathematics, and further, it does not assume any previous training in statistics or probability. The unit covers descriptive statistics, estimation, hypothesis testing, test for proportions and means, analysis of variance, regression analysis, and analysis of cross-classified data. The use of a statistical computing package is an integral part of this unit. Successful completion qualifies students for the second-year level units in statistics STA2AS, STA2MS, STA2BS and STA2RSP. Special Conditions: This unit can be taken at first-year level in either first or second semester or at second-year level (STA2LS) where one extra one-hour project class is required. Only available in Albury-Wodonga in semester two. Incompatible: STA11LS, STA12LS, STA21LS, STA22LS, STA2LS, STA1SS, STA2SS, ECO10BES, ECO11BES, ECO12BES, ECO1BES, ECO11SB, ECO12ISB, ECO11SB.

### STA1PSY STATISTICS FOR PSYCHOLOGY

15 Credit Points. Semester: 2 AW, Melbourne  
This unit is designed to introduce students undertaking the major stream of psychology to a range of statistical methods used in contemporary psychological research. Topics include: descriptive statistics, data entry and manipulation; exploratory data analysis, basic probability models and sampling, estimation and confidence intervals, hypothesis testing and its relation to confidence intervals; the power of a test and its relation to sample size; effect sizes and an introduction to meta-analysis; analysis of single and two group designs; correlation and simple linear regression; analysis of categorical data; non-parametric statistical methods. The statistical computing package SPSS is an integral part of this unit with weekly tutorials held in a computing laboratory. Co-requisite: For students in the Faculty of Science, Technology and Engineering, this subject is normally a co-requisite for PSY1PYB. Incompatible: STA12OCT, STA1OCT.

### STA1SS STATISTICAL SCIENCE

15 Credit Points. Semester: 1 Melbourne  
Students who complete this unit qualify for all second year statistics units. Objectives include providing

a working knowledge of exploratory data analysis, hypothesis tests and parameter estimates, as well as a working knowledge of a statistical computer software. Simulation and real world data studies are used to gain familiarity with random sampling and probability models. Statistical methods to be learned include inference for a binomial parameter, difference of two proportions, population means, measure of association, fitting a straight line by the method of least squares, test of homogeneity and exact test for independent classification in a two by two contingency table.

Prerequisite: Year-12 mathematics or STA1LS or STA11LS.  
Incompatible: ECO11BES, ECO12BES, ECO1BES, ECO11SB, ECO12ISB, ECO11SB, ECO11BSW, ECO12BSW, STA21SS, STA2SS, STA1LS, STA2LS.

#### STA1STM STATISTICAL METHODS

15 Credit Points. Semester: 2 Bendigo  
In this unit students will be introduced to statistical methods which are frequently used in science, business, health science and the social sciences. Topics include descriptive treatment of sample data, elementary probability and distributions, estimation and hypothesis testing of means and proportions. Other topics may include sample survey techniques, introduction to regression and chi-square distribution. The statistical package SPSS will also be introduced.  
Incompatible: ECO11SB.

#### STA2AS MODERN APPLIED STATISTICS

15 Credit Points. Semester: 1 Melbourne  
Building on the understanding of applied statistical methods developed in first year statistics units, this unit provides an understanding of these methods at an intermediate level. This unit does not require a knowledge of calculus and is ideally suited to students with a strong interest in applications of statistics in fields such as biological, medical and psychological science. This unit also provides an introduction to the open source statistical computing package R. This unit forms part of the accredited major in statistics and so it is important for students wishing to take this major.  
Prerequisite: STA1SS or STA2LS or STA1LS or STA1PSY or STA1OCT or ECO11BES or ECO12BES or ECO11SB.  
Incompatible: STA2MS, STA2MAS, STA2RSP, STA2BS.

#### STA2BIO BIostatISTICS

20 Credit Points. Semester: 1 AW  
In this unit students practice with the techniques commonly used in biostatistics chosen from: chi-squared tests, regression methods, one and two-way analysis of variance and bio-assay. Students are introduced to the important experiment design principles of randomisation and blocking. Extensive experience with a major statistical package is gained, with some of the data sets being provided by biological science staff.  
Prerequisite: STA11LS, STA12OCT or STA12PSY.

#### STA2BS BIostatISTICS

20 Credit Points. Semester: 1 Melbourne  
This unit consists of two streams: the Modern Applied Statistics stream (see STA2AS) and a stream covering a range of topics of interest to biological science and environmental science students. Building on the understanding of applied statistical methods developed in first year statistics, this unit provides an understanding of these methods at an intermediate level, with a special emphasis on biological applications. This unit does not require a knowledge of calculus. An introduction to the open source statistical computing package R is included.  
Prerequisite: STA1OCT or STA1PSY or STA1LS or STA2LS or STA1SS or STA2SS or ECO11SB.  
Incompatible: STA2RSP, STA2AS, STA2MS.

#### STA2LS STATISTICS FOR LIFE SCIENCES

20 Credit Points. Semester: 1 Melbourne, 2 Melbourne  
This is the same as STA1LS with an additional one-hour project class per week in which students are guided in writing reports on studies they design, conduct and analyse.  
Incompatible: STA11LS, STA12LS, STA1LS, STA21LS, STA22LS, STA1SS, STA2SS, ECO11BES, ECO12BES, ECO11SB, ECO12ISB, STA21PR, STA22PR, STA2PR.

#### STA2MD MODELS FOR DATA ANALYSIS

15 Credit Points. Semester: 2 Melbourne  
The analysis of scientific, engineering and economic data makes extensive use of probability models. This unit describes the most basic of these models and their properties. Specific topics covered in this unit include a wide range of discrete and continuous univariate distributions; joint distributions; conditional expectation; mean and variance of linear combinations of random variables; Chebyshev's inequality; moment generating functions; the law of large numbers; the

Central Limit Theorem. To help students with little or no previous knowledge in calculus one lecture per week consists of both lecture and tutorial work in "calculus for statistics".

Prerequisite: STA1SS or STA11SC or STA1LS or STA2LS or STA1PSY or STA1OCT or STA2SS or ECO11SB.  
Incompatible: STA2MDA.

#### STA2MS MEDICAL STATISTICS

20 Credit Points. Semester: 1 Melbourne  
This unit consists of two streams: the Modern Applied Statistics stream (see STA2AS) and a stream covering a range of topics in medical statistics. Building on the understanding of applied statistical methods developed in first year statistics units, this unit provides an understanding of these methods at an intermediate level, with a special emphasis on medical statistics applications. This unit does not require a knowledge of calculus. An introduction to the open source statistical computing package R is included.  
Prerequisite: one of STA1OCT, STA1PSY, STA1LS, STA2LS, STA1SS, STA2SS, ECO11BES, ECO12BES, ECO11SB.  
Incompatible: STA21MAS, STA2MAS, STA2RSP, STA2AS, STA2BS.

#### STA2PR STATISTICS PROJECTS

5 Credit Points. Semester: 1 Melbourne, 2 Melbourne  
Students are guided through the design, collection of data, statistical analysis and report writing for two projects.  
Prerequisite: ECO11SB or ECO12ISB or ECO11BES or ECO12BES or STA1SS or STA1LS.  
Incompatible: STA21LS, STA21SC, STA21SS, STA21PR, STA22PR, STA22LS, STA2SS, STA2LS.

#### STA2RSP R STATISTICAL PROGRAMMING

5 Credit Points. Semester: 1 Melbourne  
This unit provides an introduction to the statistical computing package R. This package is open source and available free of charge. R is a very powerful computing package that includes many excellent graphical displays.  
Prerequisite: STA1LS or STA1SS or STA1PSY or STA1OCT or STA2SS or STA2LS.  
Incompatible: STA2AS, STA2MS, STA2BS.

#### STA2SS STATISTICAL SCIENCE

20 Credit Points. Semester: 1 Melbourne  
This is the same as STA1SS, with an additional one-hour project class per week in which students are guided in writing reports on practical problems.  
Incompatible: STA11SS, STA1SS, STA1LS, STA21LS, STA22LS, STA2LS, STA21PR, STA22PR, STA2PR, ECO11SB, ECO12ISB, ECO11SB, ECO11BES, ECO12BES, ECO1BES.

#### STA3AP APPLIED PROBABILITY FOR COMPUTER SYSTEMS ENGINEERS

15 Credit Points. Semester: 2 Melbourne  
The aim of this unit is to introduce important probability models frequently encountered in areas related to the engineering sciences. In particular, students will be provided with fundamental tools in the areas of system reliability and queueing theory. Topics include series-parallel system reliability, analysis of system functionality via Markov chain modelling, and analysis of queues and networks of queues with emphasis on the Poisson process in time. This unit may also be useful to students with an interest in applications of statistical modelling.  
Special Conditions: This unit is designed for students taking one of the Computer Systems Engineering degrees, but is also available to any student who has completed either STA2MDA or STA2MD.  
Prerequisite: MAT1EN and MAT1FEN (from 2009 MAT1CPE and MAT1CLA) or STA2MDA or STA2MD.  
Incompatible: STA31PM, STA3PE.

#### STA3AS APPLIED STATISTICS

15 Credit Points. Semester: 2 Melbourne  
This unit provides advanced-level introductions to the topics of sample surveys, multivariate analysis and time series analysis. These topics are very important in applied statistics. The unit also includes an introduction to statistical consulting.  
Prerequisite: STA2MDA or STA2MD.

#### STA3BS BIostatISTICS

15 Credit Points. Semester: 1 Melbourne  
Students will learn to design and analyse experiments in the life sciences and agriculture. The topics covered in this unit include a brief review of non-parametric methods; randomisation, blocking and randomised block designs; one-way and two-way layouts; multiple comparison procedures: fixed and random effects; mixed models; multiple linear regression; analysis of covariance; factorial designs; and an introduction to fractional factorial designs.  
Prerequisite: One of STA2MAS, STA2BS, STA2MS, STA2MDA, STA2MD, STA2AS.

Incompatible: AGR41EXP, AGR4AED, STA3EXD EXPERIMENTAL DESIGN  
15 Credit Points. Semester: 1 Bendigo  
The design of experiments is a branch of statistics which has many applications, especially in the experimental sciences, psychology and education. Topics include basic concepts in experimental design, randomisation, blocking and replication and the analysis of variance for factorial and repeated measures designs. Extensive use of statistical packages is a feature of this unit.  
Prerequisite: STA1STM.

#### STA3LM ANALYSES BASED ON LINEAR MODELS

15 Credit Points. Semester: 2 Melbourne  
Linear models are the most commonly used class of models in applied statistics. They are used to relate a response variable to one or more explanatory variables to both determine the form of this relationship and make predictions. The methods are widely used in many areas of application including agricultural science, biological science, economics, engineering, health science, medical science and psychological science. Topics covered in this unit include the simple linear regression model, derivation and properties of the ordinary least squares estimators, inference, diagnosis and prediction in the simple linear regression model, the multiple linear regression model, inference in the multiple linear regression model, the use of dummy variables and general regression models when the classical regression assumptions are violated. This unit has a combined flavour of both theoretical derivations and practical application through the use of a software package.  
Prerequisite: one of STA2MAS, STA2BS, STA2MS, STA2MDA, STA2AS, STA2MD, STA2LM.  
Incompatible: ECO31EME, ECO3EME.

#### STA3MA MULTIVARIATE ANALYSIS

15 Credit Points. Semester: 2 Bendigo  
Most statistical problems involve many variables and therefore multivariate data analysis has an enormous range of applications. After reviewing key aspects of statistical methods for one variable and multiple regression, students are introduced to common multivariate statistical methods: screening and describing multivariate data, principal component analysis, factor analysis, cluster analysis and logistic regression. En route, you will encounter the multivariate Normal distribution, learn about matrix algebra and how to use SPSS for multivariate data analysis.  
Prerequisite: MAT2LIN and either STA2FOR or STA3EXD.

#### STA3SI STATISTICAL INFERENCE

15 Credit Points. Semester: 1 Melbourne  
This unit comprises components in estimation and testing hypotheses. Topics in the first component include method of moments and maximum likelihood, reduction by sufficiency and invariance, unbiasedness, consistency, efficiency and robustness. The second component examines size and power of tests, Neyman-Pearson lemma, optimality of tests, the likelihood ratio test and relationship to confidence interval estimation.  
Prerequisite: STA2MDA or STA2MD.

#### STA3TIS TOPICS IN STATISTICS

15 Credit Points. Semester: 1 Bendigo, 2 Bendigo  
This unit provides an opportunity for students to study a suitable topic in applied statistics which is not covered in other subjects offered by the Department of Mathematics and Statistics. The topic will depend on the interests of students and available staff.  
Special Conditions: Students wishing to enrol in this unit must seek approval from the Deputy Head of the Department of Mathematics and Statistics.  
Prerequisite: successful completion of 30 credit points of statistics subjects at second year level and permission of the Head of the Department of Mathematics and Statistics.

#### Want to know more? Get in touch!

For more information about the mathematics and statistics subjects featured here or information on Honours and Postgraduate subjects:

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