Undergraduate courses 2023 Mathematics, Statistics, and Data Science

School of Mathematics and Statistics
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VICTORIA UNIVERSITY OF WELLINGTON
TE HERENGA WAKA

BACHELOR OF SCIENCE

Bachelor of Science Degree Requirements

- A total of 360 points
- At least 210 points must be from 200 and 300-level courses, including:
    - At least 150 points must be from courses listed for the BSc
    - At least 75 points must be from 300-level courses listed for the BSc
- 90 points can be from outside science (some majors also permit an additional 30 outside points).
- At least one Major, and a second Major may be from science or from any other first degree with a maximum of 150 points permitted from outside science.

Science Major Requirements

- 60 points at 300-level
- 60–80 points at 200-level
- 45–60 points at 100-level

Science Minor Requirements

- 60 points above 100-level specified in the major, of which 15 points must be at 300-level.

BACHELOR OF ARTS

Bachelor of Arts Degree Requirements

360 approved points including:

- maximum of 180 points at 100-level
- minimum of 180 points at 200/300 level, including at least 75 points at 300 level
- at least 180 points must be in subjects from Part A of the BA Schedule*

*Note that Data Science, Mathematics and Statistics courses are in Part B of the BA Schedule.

GRADUATE CERTIFICATE IN SCIENCE

- 60 points courses for the BSc at 200 and 300 level
- 40 points must be at 300 level
- With approval, you may substitute 20 points worth of courses from other programmes at the University

GRADUATE DIPLOMA IN SCIENCE

- Complete 200 and 300 level courses worth at least 120 points from the BSc schedule
- At least 75 points must be at 300 level
- With approval, you may substitute 30 points worth of courses from other programmes at the University

PLEASE NOTE

Cancellation of courses

The courses offered by the University and listed in this prospectus may be cancelled by the University as a result of insufficient resources or student demand, or if other unforeseen circumstances arise.

Timetable changes

Check the timetable online for confirmation of course times.
www.wgtn.ac.nz/students/study/timetables

HOW TO USE THIS GUIDE

Course code	Course reference number	Title	Points	Trimester
↓	↓	↓	↓	↓
MATH 151	**CRN 17161**	**ALGEBRA**	**15 PTS**	**1/3**

YOUR PROGRAMME

Use this template to plan your programme. Start by adding in the core papers for your degree.

Year 1:							120 points
Year 2:							120 points
Year 3:							120 points

ENTRY REQUIREMENTS 100-LEVEL MATHEMATICS AND STATISTICS

MATH 141	12 NCEA Level 3 achievement standard credits Mathematics or 16 Level 3 Mathematics/Statistics
MATH 142	The following NCEA Level 3 Mathematics achievement standards: 3.6 (differentiation, AS91578) 3.7 (integration, AS91579) **and one of** 3.1 (conics, AS91573) 3.3 (trigonometry, AS91575) 3.5 (complex numbers, AS91577) Differentiation must be achieved with excellence. One other of the above standards achieved with merit or excellence.
MATH 151	12 NCEA Level 3 achievement standard credits Mathematics or 16 Level 3 Mathematics/Statistics
MATH 161	12 NCEA Level 3 achievement standard credits Mathematics or 16 Level 3 Mathematics/Statistics
MATH 177	16 NCEA level 3 achievement standard credits in mathematics, including: 3.6 (differentiation, AS91578) and 3.7 (Integration, AS91579), OR equivalent background in Maths or one of (MATH 141, ENGR 122, 123, QUAN 111)

PREREQUISITES AND RESTRICTIONS

Starting at 200-level, courses are listed with prerequisites and restrictions.

Prerequisites are the courses that are required for entry into the course. For example, If STATXXX has (STATYYY, ZZZ) listed as prerequisites, then you must have passed STATYYY **AND** STATZZZ before you can enrol in STATXXX.

Restrictions are the courses that you **should not have already passed** before enrolling in the course. For example, if MATHXXX has MATHYYY listed as restriction, it probably means that MATHYYY contains more advanced material than MATHXXX. If you have already passed MATHYYY, or if you are currently enrolled in MATHYYY, then you will usually not be allowed to enrol in MATHXXX.

MATHEMATICS

The BSc in Mathematics is a three-year qualification. Here, we describe the regulations concerning the MATH major within the degrees.

MAJOR REQUIREMENTS

MATH major requirements from 2022 onwards:

- MATH 142, MATH 151, MATH 161
- 15 points from (COMP 100-199, DATA 202, ENGR 222, MATH 245, STAT 293)
- 120 points from MATH 200-399, of which at least 60 points must be from MATH 300-399

MATH major requirements before 2022*:

- MATH 142, MATH 151, MATH 161
- 60 points from MATH 300-399
- 60 further points from MATH 200-399

* Students enrolled in a MATH major before 2022 will graduate under the regulations in place when they enrolled.

100-LEVEL COURSES

MATH 132	**CRN 17286**	**INTRODUCTION TO MATHEMATICAL**	**15 PTS**	**3/3**
	CRN 17150	**THINKING**	**15 PTS**	**1/3**

Restrictions: ENGR 121-123, MATH 100–199, QUAN 111

This course provides an introduction to or review of fundamental skills and ideas for students who require some mathematics in their degree. Topics will include elementary arithmetic, algebra, coordinate geometry, functions and an introduction to matrices for solving simultaneous equations. There will be an emphasis on the history of mathematical ideas and how they have evolved: the goal is not only to apply mathematical tools correctly, but to understand them.

MATH 141	**CRN 17151**	**CALCULUS 1A**	**15 PTS**	**1/3**

Prerequisites: 16 AS credits NCEA Level 3 Mathematics (or equivalent) or MATH 132

Restrictions: ENGR 122, MATH 142, QUAN 111

This course provides a thorough development of the differential calculus and an introduction to the integral calculus. Starting from the notion of functions and limits, we define the derivative and give the idea of an integral using limits. Rules for computing derivatives and integrals are deduced, and applications to physical modelling included.

MATH 142	**CRN 17160**	**CALCULUS 1B**	**15 PTS**	**2/3**

Prerequisites: MATH 141 or QUAN 111, or NCEA Level 3 Achievement Standards 3.6 (Differentiation, AS91578) achieved with excellence, 3.7 (Integration, AS91579), one of (3.1 (Conics AS91573), 3.3 (Trigonometry, AS91575), 3.5 (Complex numbers, AS91577)) with at least one of (3.1, 3.3, 3.5, 3.7) achieved with merit or excellence, or an equivalent background in mathematics

This course develops integral calculus starting with the problem of defining “area”. The highlight is the Fundamental Theorem of Calculus which links integration and differentiation. Techniques of integration are developed, including the substitution rule, integration by parts and integration of rational functions by partial fractions. Applications include calculating areas and volumes and solving differential equations arising from physical processes. Sequences and series are introduced to represent functions as series and to approximate them using their Taylor polynomials.

MATH 151	CRN 17161	ALGEBRA	15 PTS	1/3

Prerequisites: 16 AS credits NCEA Level 3 Mathematics (or equivalent) or MATH 132

An introduction to linear algebra, including matrices and vectors, systems of linear equations, complex numbers, eigenvectors, and algebraic structures.

MATH 161	CRN 17162	DISCRETE MATHEMATICS AND LOGIC	15 PTS	2/3

Prerequisites: Approved level of achievement in NCEA Level 3 Calculus or one of (ENGR 121-123, B+ or better in MATH 132, MATH 141-177, QUAN 111) or equivalent background in mathematics.

Logic underlies all of mathematics. In this course we will introduce the basic notions of logic and discuss what makes some arguments good (or valid), while other arguments are invalid. This leads to a definition of a mathematical proof, particularly via mathematical induction. Other topics include sets, relations, functions, elementary counting principles, and properties of divisibility of the integers. The second half of the course introduces the fundamental concepts of graph theory, which is the study of networks.

MATH 177	CRN 19803	PROBABILITY AND DECISION MODELLING	15 PTS	2/3

Prerequisites: 16 AS credits NCEA level 3 Mathematics or Statistics, including AS 3.6 (Differentiation, AS91578) and 3.7 (Integration, AS91579), or one of (ENGR 122, 123, MATH 141, QUAN 111) or equivalent background in mathematics

An introduction to probability models in statistics, decision making and operations research, including key concepts of probability, random variables and their distributions, decision theory and utility theory. Goodness-of-fit tests are used to check the validity of fitted models.

ENGR 121	CRN 26052 CRN 31158	ENGINEERING MATHEMATICS FOUNDATIONS	15 PTS	1/3 2/3

Prerequisites: 16 AS credits NCEA level 3 Mathematics (or equivalent) or MATH 132
Restrictions: Any pair (MATH 141/QUAN 111, MATH 151/161/177)

An introduction to the range of mathematical techniques employed by engineers, including functions and calculus, linear algebra and vector geometry, probability and statistics. There is an emphasis on applications and modelling.

ENGR 122	CRN 26053	ENGINEERING MATHEMATICS WITH CALCULUS	15 PTS	2/3

Prerequisites: ENGR 121 or MATH 141
Restrictions: The pair MATH 142 and MATH 151

Further mathematical techniques employed by electronic and computer systems engineers, with emphasis on methods of calculus, differential equations and linear algebra. There is an emphasis on engineering applications and use of software.

ENGR 123	CRN 27044 CRN 31159	ENGINEERING MATHEMATICS WITH LOGIC AND STATISTICS	15 PTS	2/3 3/3

Prerequisites: ENGR 121
Restrictions: The pair MATH 161 and (MATH 177 or QUAN 102 or STAT 193)

Mathematical techniques employed by network and software engineers, including methods of combinatorics, logic, probability and decision theory. The course emphasises engineering applications of these techniques.

200-LEVEL COURSES

MATH 212	CRN 31091	INTRODUCTION TO REAL ANALYSIS	15 PTS	1/3

Prerequisites: (MATH 142, 161) or B+ or better in both (ENGR 122, 123)
Restriction: MATH 211

An introduction to the basic techniques of real analysis in the familiar context of single-variable calculus.

MATH 243	CRN 18323	MULTIVARIABLE CALCULUS	15 PTS	2/3

Prerequisites: (MATH 142, 151) or B+ or better in ENGR 122

The calculus of vector-valued functions of one variable (curves in the plane and in space), of scalar-valued functions of several variables, and of vector-valued functions of several variables (vector fields); double and triple integrals, line and surface integrals.

MATH 244	CRN 18324	MODELLING WITH DIFFERENTIAL EQUATIONS	15 PTS	1/3

Prerequisites: (ENGR 121, 122) or (MATH 142, 151)

Types of ordinary differential equations and methods of solution (analytical methods, numerical algorithms, Fourier series, Laplace transforms); boundary-value and initial-value problems; systems of equations; qualitative analysis of solutions; applications.

MATH 245	CRN 30099	COMPUTATIONAL MATHEMATICS	15 PTS	2/3

Prerequisites: ENGR 122 or ENGR 123 or (MATH151 and (141 or 142))

Mathematical, numerical and computational techniques for practical problems involving optimization, simulation and approximation. The course emphasises the properties and implementation of numerical algorithms for solving linear, non-linear and differential equations, least squares, singular-value decomposition, splines and Monte Carlo methods. Some previous experience in programming is highly desirable.

MATH 251	CRN 18325	LINEAR ALGEBRA	15 PTS	2/3

Prerequisites: (MATH 151, 161) or B+ or better in (ENGR 122 or MATH 151)

Fields, vector spaces, linear transformations, eigenvectors, spectral decomposition, quadratic forms.

MATH 261	CRN 18326	DISCRETE MATHEMATICS 2	15 PTS	1/3

Prerequisites: MATH161 or B+ or better in ENGR 123

Enumerative combinatorics (binomial coefficients, Stirling numbers, the inclusion-exclusion principle, generating functions, Burnside's Lemma) and algorithmic graph theory (shortest paths, matchings, flows).

MATH 277	CRN 19804	MATHEMATICAL STATISTICS	15 PTS	1/3

Prerequisites: (MATH 142, 177) or B+ or better in both (ENGR 122, 123)

Topics will be chosen from: basic probability theory; introduction to random variables and expectation; joint distributions, correlation and linear combinations of random variables; introductory estimation and hypothesis testing; nonparametric methods; one-way analysis of variance; linear regression; goodness of fit tests and contingency tables. The statistical software R will be used.

ENGR 222	CRN 33042	COMPUTATIONAL ALGEBRA AND CALCULUS	15 PTS	1/3

Prerequisites: (ENGR 121, 122) or (MATH 142, 151)

The course will cover fundamental concepts in linear algebra and multivariable calculus and their applications to physical and engineering problems. Mathematical software will be used extensively. Topics covered will include dimensionality, linear transformations, matrix decomposition, Taylor series, calculus of vector-valued functions and calculus of two-variable functions.

300-LEVEL COURSES

MATH 301 CRN 3505 DIFFERENTIAL EQUATIONS 15 PTS 2/3

Prerequisites: MATH 243, 244
Recommended: MATH 251

Exact solution and qualitative analysis of systems of ordinary differential equations; partial differential equations; applications.

MATH 309 CRN 7528 MATHEMATICAL LOGIC 15 PTS 2/3

Prerequisites: MATH 161, 15 pts from (MATH 211, 212, 251, 261); 15 further 200-level MATH pts or COMP 261

An introduction to the semantics and proof theory of symbolic languages, explaining the role of logic in describing mathematical structures and formalising reasoning about them. Topics covered include propositional logic; first-order logic of quantifiers and predicates; and the beginnings of model theory, including completeness and compactness theorems.

MATH 311 CRN 9591 ALGEBRA 15 PTS 1/3

Prerequisites: MATH 151, MATH 251 or 261

The basic algebraic structures, especially groups, rings and fields, with emphasis on general concepts, such as subgroups, homomorphisms, and factorization; some applications.

MATH 317 CRN 31092 METRIC SPACES 15 PTS 1/3

Prerequisites: MATH 211 or 212
Restriction: MATH 312

An introduction to spaces with a generalised length function called a metric. Metric spaces are fundamental objects in modern analysis with notions of convergence of sequences and continuity of functions in a very general framework.

MATH 318 CRN 31093 HILBERT SPACES 15 PTS 2/3

Prerequisites: MATH 211 or 212, MATH 251

An introduction to Hilbert spaces and linear operators on Hilbert spaces. It extends the techniques of linear algebra and real analysis to study problems of an intrinsically infinite-dimensional nature.

MATH 321 CRN 19910 APPLIED MATHEMATICS I 15 PTS 1/3

Prerequisites: 30 200-level MATH pts (not including MATH 261), or ENGR 222

The course emphasises the development of mathematical modelling and numerical skills that are essential for solving problems that commonly arise in applied mathematics. Of particular interest is modelling problems via ordinary differential equations and partial differential equations and subsequently developing discretisations of these equations that give rise to accurate and stable numerical methods. Modelling techniques covered include dimensional analysis, homogenisation and perturbation analysis. Numerical methods covered include finite difference methods, Runge–Kutta methods and the method of lines.

MATH 322 CRN 546 APPLIED MATHEMATICS II 15 PTS 2/3

Prerequisites: 30 200-level MATH pts (not including MATH 261), or ENGR 222

Two topics in applied mathematics, not including any completed by the same candidate in MATH323 in the current trimester, or in any of MATH321, MATH322 or MATH323 in a previous trimester. Available topics may include: oceanic fluids, classical mechanics, quantum mechanics, special relativity, advanced numerical linear algebra, fractals, Cartesian tensors, inverse theory.

MATH 323	CRN 8584	MATHEMATICS FOR EARTH SCIENCES	15 PTS	2/3

Prerequisites: 30 200-level MATH pts (not including MATH 261), or ENGR 222

Two topics in applied mathematics, not including any completed by the same candidate in: MATH323 in the current trimester; or any of MATH321, MATH322 or MATH323 in a previous trimester. Available topics may include: Cartesian tensors and applications, inverse theory, oceanic fluids, fractals, advanced numerical linear algebra, classical mechanics, quantum mechanics, special relativity.

MATH 324	CRN 15668	CODING AND CRYPTOGRAPHY	15 PTS	2/3

Prerequisites: MATH 251 or (ENGR 121 or MATH 151; 15 further 200-level MATH points)

The main ideas of modern coding theory (finite vector spaces, linear codes, coding bounds, perfect codes, cyclic codes) and cryptography (classical ciphers, the one-time pad, Shannon's Theorem, linear shift registers, public key cryptography, one-way functions, the RSA cryptosystem, key distribution and digital signatures).

MATH 335	CRN 19902	COMPUTABILITY AND COMPLEXITY	15 PTS	1/3

Prerequisites: MATH 161, 15 pts from (MATH 211, 212, 251, 261); 15 further 200-level MATH pts from (MATH 200-299 or COMP 261)

The basic theory of the algorithmic content of mathematics. Models of computation. Undecidability and computational calibration via reducibilities and hierarchies. Applications (word problems, Conway games, etc.), Basic complexity. NP, SPACE and P. Combinatorial reductions and probabilistic and parametrized complexity.

MATH 353	CRN 19903	OPTIMISATION	15 PTS	1/3

Prerequisites: MATH 142, 151; 15 pts from (MATH 243, 244, 251, 261); 15 further 200-level MATH pts

A course in the theory, algorithms and applications of linear and non-linear optimisation.

MATH 361	CRN 29085	GRAPH THEORY	15 PTS	1/3

Prerequisites: MATH 161 and 15 pts from MATH 200-299

Topics in graph theory including: Menger’s Theorem and connectivity, colourings and flows, Ramsey Theory, topological graph theory including Kuratowski’s Theorem, tree width and its applications.

MATH 377	CRN 19805	PROBABILITY AND RANDOM PROCESSES	15 PTS	1/3

Prerequisites: MATH 243; MATH 277 or STAT 232

The course provides a firmer foundation in probability theory and an introduction to random processes. Introductory topics: continuity of probability measures; Stieltjes integrals; almost sure convergence. Main topics: conditional distributions and effects of conditioning; martingales in discrete time; Poisson point processes; birth and death processes; renewal processes.

STATISTICS

The Statistics major can have a theoretical (mathematical statistics) emphasis, an applied emphasis, or incorporate computational modelling, depending on the courses you take.

MAJOR REQUIREMENTS

- MATH 177 or STAT 193; 15 further points from MATH 100–199, STAT 100–199
- (MATH 243, 277) or (STAT 292, 293); 30 further 200–level points from the Science schedule or other approved courses
- STAT 332 or 393; 15 further points from STAT 300–399; 30 further 300-level points from (DATA 303, 304, MATH, STAT)

- **MATH 177** is needed for a major in **Statistics** with a **mathematical statistics** or **computational modelling** emphasis, and for a major in **Actuarial Science.**
- **STAT 193** is highly recommended for a major in **Statistics** with an **applied statistics** emphasis, and for a major in **Data Science**.

MINOR REQUIREMENTS

- One of (MATH 277, STAT 292) and one of (MATH 377, STAT 332, 393, 394)
- 15 further points from (DATA 303, 304, MATH 277, 353, 377, STAT 292, 293, 300-399)
- 15 further points at 200- or 300-level from the Science schedule.

100-LEVEL COURSES

MATH 177	**CRN 19803**	**PROBABILITY AND DECISION MODELLING**	**15 PTS**	**2/3**

Prerequisites: 16 AS credits NCEA level 3 Mathematics or Statistics, including AS 3.6 (Differentiation, AS91578) and 3.7 (Integration, AS91579), or one of (ENGR 122, 123, MATH 141, QUAN 111) or equivalent background in mathematics

An introduction to probability models in statistics, decision making and operations research, including key concepts of probability, random variables and their distributions, decision theory and utility theory. Goodness-of-fit tests are used to check the validity of fitted models.

STAT 193 (SEE STREAMS)	**STATISTICS IN PRACTICE**	**15 PTS**	**1/3 2/3 3/3**

Restrictions: MATH 277, QUAN 102

Streams:

1/3: Stream A (CRN 1791)
Stream B (CRN 11333)
2/3: Stream A (CRN 4442)
Stream B (CRN 6164)
3/3: Steam A (CRN 17069)

An applied statistics course for students who will be advancing in other disciplines as well as those majoring in Statistics. It is particularly suitable for students majoring in Biological Science subjects, Geography, Health, Linguistics, Psychology, social sciences such as Education, and is also suitable for BCom students. This course assumes no previous knowledge of statistics, but mathematics to Year 12 is preferred. Topics covered include estimation, confidence intervals and hypothesis testing, comparison of means and proportions, simple regression and correlation, and analysis of variance.

200-LEVEL COURSES

MATH 277	**CRN 19804**	**MATHEMATICAL STATISTICS**	**15 PTS**	**1/3**
Prerequisites:		(MATH 142, 177) or B+ or better in both (ENGR 122, 123)		

Topics will be chosen from: basic probability theory; introduction to random variables and expectation; joint distributions, correlation and linear combinations of random variables; introductory estimation and hypothesis testing; nonparametric methods; one-way analysis of variance; linear regression; goodness of fit tests and contingency tables. The statistical software R will be used.

STAT 292	**CRN 18331**	**APPLIED STATISTICS 2A**	**15 PTS**	**1/3**
Prerequisites:		STAT 193 or ENGR 123 or QUAN 102 or a comparable background in Statistics		

This course is central to the Applied Statistics stream. Topics are statistical methods and their application in the biological, environmental, health and social sciences, including design of experiments, one-way and multi-way ANOVA and t-tests for difference of means, regression, analysis of covariance, binomial and Poisson distributions, contingency tables, models for binary response variables, and loglinear models for contingency tables. Examples from the biological, environmental, health, behavioural and social sciences are used for illustration, using statistical computing software.

STAT 293	**CRN 18332**	**APPLIED STATISTICS 2B**	**15 PTS**	**2/3**
Prerequisites:		STAT 292		

Following on from STAT 292, this course presents further topics in ANOVA and regression with examples in the biological, environmental, health and social sciences. Topics covered include algebra of expectations and variances, one-way ANOVA theory, permutation tests, randomised block designs, nested designs, multiple linear regression, data exploration, use of AIC for model comparisons in exploratory studies, Poisson regression models. Illustrative examples use the statistical software R. No previous experience with R is assumed.

300-LEVEL COURSES

COMP 312 **DATA 304**	**CRN 10444** **CRN 32013**	**SIMULATION AND STOCHASTIC MODELS**	**15 PTS**	**1/3**
Prerequisites:		COMP 102 or 112 or 132 or DATA 202, one course from (MATH 177, 277, STAT 292, ENGR 123); 15 further 200-level COMP, DATA, MATH, NWEN, STAT or SWEN points		
Restrictions:		OPRE 354		

Simulation and modelling of stochastic systems, covering examples from operations research and computer science, including queues, networks and computer systems. Design, analysis and validation of simulation experiments. Previous experience with computer programming is required before starting this course.

MATH 377	CRN 19805	PROBABILITY AND RANDOM PROCESSES	15 PTS	1/3

Prerequisites: MATH 243, 277

The course provides a firmer foundation in probability theory and an introduction to random processes. Introductory topics: continuity of probability measures; Stieltjes integrals; almost sure convergence. Main topics: conditional distributions and effects of conditioning; martingales in discrete time; Poisson point processes; birth and death processes; renewal processes.

STAT 332	CRN 19809	STATISTICAL INFERENCE	15 PTS	2/3

Prerequisites: MATH 243, 277

This course covers distribution theory; estimation including minimum variance unbiased estimators and sufficiency; hypothesis testing and an introduction to order statistics. The topics of estimation and hypothesis testing met in MATH 277 will be looked at in greater depth. Optimal estimation procedures and tests will be developed.

STAT 335	CRN 27136	STATISTICAL MODELS FOR ACTUARIAL SCIENCE	15 PTS	2/3

Prerequisites: MATH 277

This course introduces a range of models used in actuarial science, including Markov chains, Markov processes and transition, survival models and estimation with graduation methods and binomial models for mortality.

STAT 391	CRN 19810	MATHEMATICAL METHODS FOR APPLIED STATISTICS	15 PTS	1/3

Prerequisites: STAT 292

Restrictions: MATH 243, and both (ENGR 122/MATH 142, 251)

This course covers key mathematical methods used in the construction and maximisation of likelihoods, analyses of experimental data and general linear models, and exploration of probability distributions. Topics will include differentiation and optimisation of functions, matrices and their properties, probability distributions and integration. The statistical software R will be used.

STAT 392	CRN 3048	SAMPLE SURVEYS	15 PTS	1/3

Prerequisites: STAT 193 (or equivalent), 30 approved points from 201-399

Restrictions: STAT 439

An introduction to practical aspects of survey sampling, including writing a survey proposal, costing, non-sampling errors, rudiments of sampling theory, questionnaire design, fieldwork, basic analytic techniques, and report writing. This course is co-taught with STAT 439.

STAT 393	CRN 19811	LINEAR MODELS	15 PTS	2/3

Prerequisites: (MATH 243, 277) or (STAT 293, 391)

This course will cover general linear models: theory and applications, including maximum likelihood estimation, model selection, AIC, tests of hypotheses, confidence intervals, and residual diagnostics. It includes longitudinal analysis for continuous responses using fixed or random effects methods. The course covers the theory of generalised linear models and gives examples for binary and count data. The statistical software R will be used.

STAT 394	CRN 19808	MULTIVARIATE STATISTICS	15 PTS	2/3

Prerequisites: MATH 277 or (STAT 292, 391)

General concepts and various practical analysis techniques are introduced for multivariate data. Topics will be chosen from: principal component analysis, cluster analysis, factor analysis, discriminant analysis, canonical correlations, the multivariate general linear model and multidimensional scaling. Statistical software will be used to apply the techniques to multivariate data.

ACTUARIAL SCIENCE

The role of an actuary is to quantify risk and uncertainty to help businesses manage those risks. Actuaries are employed by banks, insurance companies, investment firms and other companies. They give advice on insurance, pension schemes, company mergers, the management of financial projects and investments.

The Actuarial Science major introduces students to the technical and professional aspects of actuarial science and may enable students to gain accreditation towards qualifying as an actuary with one of the internationally recognised actuarial institutes.

Students enrolling in this major, available in both the Bachelor of Science (BSc) and Bachelor of Commerce (BCom), may consider taking it alongside a second major in Economics, Finance, Mathematics or Statistics. Graduates will be qualified to work in the fields of actuarial work, risk management, financial and statistical analysis.

MAJOR REQUIREMENTS

a. ACCY 130, ECON 130, 141, MATH 142, 177 (MATH 151 or at least a B+ in QUAN 111)
b. ACTS 201, ECON 201, FINA 201 or 202, MATH 277
c. ACTS 301, (FINA 303 or 306), STAT 335; one further course from (ACTS 336, FINA 303, 306, MATH 377).

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	Trimester 1	Trimester 2
Year 1	ACCY 130: Accounting for Decision Making ECON 130: Microeconomic Principles MATH 141: Calculus 1A MATH 151: Algebra	ECON 141: Macroeconomic Principles MATH 142: Calculus 1B MATH 177: Probability and Decision Modelling
	+ 15 further points	
Year 2	ACTS 201 Financial Mathematics ECON 201: Intermediate Microeconomics FINA 201: Introduction to Corporate Finance MATH 277: Mathematical Statistics	MATH 243: Multivariable Calculus
	+ 30 further points	
Year 3	MATH 377: Probability and Random Processes STAT 335: Statistical Models for Actuarial Science	ACTS 301: Actuarial Science ACTS 336: General Insurance Techniques FINA 303: Derivatives
	+ 45 further points	

MINOR REQUIREMENTS

ACTS 201, 301, MATH 277 and one further course from part (b) or (c) of the major requirements.

200-LEVEL COURSES

ACTS 201	CRN 29082	FINANCIAL MATHEMATICS	15 PTS	1/3 1/3
Prerequisites:		QUAN 102 (or STAT 193 or MATH 177), QUAN 111 (or MATH 141/142, 151)		

Mathematical principles of compound interest, geometric series and annuities; valuation of loans; returns on financial transactional duration and immunisation theory; term structure of interest rates; stochastic interest rates.

300-LEVEL COURSES

ACTS 301	CRN 27135	ACTUARIAL SCIENCE	15 PTS	2/3
Prerequisites:		ACTS 201, ECON 141, MATH 277		

This is a capstone course for the Actuarial Science major that brings together skills and knowledge from prior courses to develop an understanding of their practical application in the actuarial profession. It provides grounding in the mathematical techniques that can be used to model risks and contingencies.

ACTS 336	CRN 31125	GENERAL INSURANCE TECHNIQUES	15 PTS	2/3
Prerequisites:		MATH 277		

This course provides the mathematical foundation necessary to set premiums and reserves for general insurance contracts. It provides an overview of the various techniques used in general insurance, including loss distributions, ruin theory, credibility, run-off triangles and general insurance modelling.

STAT 335	CRN 27136	STATISTICAL MODELS FOR ACTUARIAL SCIENCE	15 PTS	2/3
Prerequisites:		MATH 277		

This course introduces a range of models used in actuarial science, including Markov chains, Markov processes and transition, survival models and estimation with graduation methods and binomial models for mortality.

DATA SCIENCE

Data literacy is an essential component of future citizenry – the ability to make sense of data, critique its use and communicate with and about it, are becoming hugely valuable skills. Data Science combines ideas from statistics, computing and mathematics to provide new insights that are crucial to the survival of businesses, governments and institutions that want to transform their data into information, insights and novel data products. Pair your Data Science major alongside another subject to extract and provide meaningful insights to any field, including actuarial science, biology, chemistry, economics, geography, linguistics and media studies.

MAJOR REQUIREMENTS

a. DATA 101; one of (COMP 102, 112, 132, the pair (INFO 151, 226)); one of (MATH 177, QUAN 102, STAT 193)
b. DATA 201, 202; one of (MATH 277, QUAN 203, STAT 292), one further course from (COMP 261, GEOG 215, INFO 264, MATH 245, 251, 261, 277, PHIL 269, QUAN 201, 203, STAT 292, 293)
c. DATA 301, 303, COMP 309*; one of (DATA 304-399, COMP 307, ECON 303, GEOG 315, INFO 377, MARK 317, MATH 353, MGMT 315, 316, STAT 391, 392, 394, SWEN 304)

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Sample programme for BSc major:

	Trimester 1	Trimester 2
Year 1	DATA 101: *Introduction to Data Science* STAT 193: *Statistics in Practice* MATH 141: *Calculus 1A* MATH 151: *Algebra*	COMP 132: *Programming for the Natural and Social Sciences* INFO 151: *Databases* MATH 142: *Calculus 1B* MATH 177: *Probability and decision Modelling*
Year 2	DATA 202: *Data Management & Programming* STAT 292: *Applied Statistics 2A* CYBR 171: *Cybersecurity Fundamentals* PHIL 269: *Ethics and Data*	DATA 201: *Techniques of Data Science* GEOG 215: *Introduction to GIS* MATH 245: *Computational Mathematics* STAT 293: *Applied Statistics 2B*
Year 3	DATA 303: *Statistics for Data Science* DATA 304: *Simulation and Stochastic Models* MATH 353: *Optimisation* SCIS 211: *Contemporary Issues in Science, Environment and Technology*	DATA 301: *Data Science in Practice* COMP 309: *Machine Learning Tools and Techniques* DATA 351: *Data Science Internship* STAT 394: *Multivariate Statistics*

MINOR REQUIREMENTS

DATA 201, 202, one course from (DATA 301, 303, COMP 309), and one further course from parts (b) or (c) of the major requirements.

100-LEVEL COURSES

DATA 101	**CRN 31056**	**INTRODUCTION TO DATA SCIENCE**	**15 PTS**	**1/3**
	CRN 31191		**15 PTS**	**3/3**

This course addresses the basics of working with data, including sources and types of data, wrangling and cleaning data, analysing and visualising data, assessing data quality, and communicating results derived from data. Students will work with data sources from science, the humanities, and commerce and will apply their knowledge to propose solutions to real-world problems using data. Issues of accuracy, privacy and the ethics of data and the legislative framework of data collection, transmission, storage and use are introduced, including specific aspects of Māori data sovereignty relevant to data science.

200-LEVEL COURSES

DATA 201	**CRN 31057**	**TECHNIQUES OF DATA SCIENCE**	**15 PTS**	**2/3**

Prerequisites: DATA 101, one of (COMP 102, 112, 132, INFO 151), one of (ENGR 123, MATH 177, QUAN 102, STAT 193)

Computational techniques relevant to data science, including data integration and encryption. Mathematical concepts and techniques underlying data generation, representation and transformation.

DATA 202	**CRN 31058**	**DATA MANAGEMENT AND PROGRAMMING**	**15 PTS**	**1/3**

Prerequisites: One of (COMP 102, 112, 132) or C INFO 226

Restriction: SCIE 201 in 2017-2018

An introduction to practical aspects of data management for those who work with data sources. Students will apply programming and data management techniques using a high-level language and SQL. Web scraping, data transformation, data cleaning, summary and visualisation.

300-LEVEL COURSES

DATA 301	**CRN 32011**	**DATA SCIENCE IN PRACTICE**	**15 PTS**	**2/3**

Prerequisites: DATA 201, one of (DATA 202, SCIE 201 in 2017-18), DATA 303

A capstone course in data science. The course will introduce interactive displays, infographics and dashboards, focussing on communication, reporting and visualisation. It will bring together techniques in statistical and mathematical modelling with programming as well as social and ethical perspectives on data science.

DATA 303	**CRN 32012**	**STATISTICS FOR DATA SCIENCE**	**15 PTS**	**1/3**

Prerequisites: STAT 293 or (DATA 202 (or SCIE 201 in 2017-2018) and one of (MATH 277, QUAN 203, STAT 292))

The course develops aspects of statistical modelling and inference underpinning data science, including binary, count and ordinal data. The role of data and modelling in decision making is examined in a variety of contexts.

DATA304	**CRN 32013**	**SIMULATION AND STOCHASTIC**	**15 PTS**	**1/3**
COMP312	**CRN 10444**	**MODELS**		

Prerequisites: One course from (COMP 102, 112, 132, DATA 202); one course from (ENGR 123, MATH 177, 277, STAT 292); 15 further 200-level COMP, DATA, MATH, NWEN, STAT or SWEN pts

Restrictions: OPRE 354

Simulation and modelling of stochastic systems, covering examples from operations research and computer science, including queues, networks and computer systems. Design, analysis and validation of simulation experiments. Previous experience with computer programming is required before starting this course.

DATA 351	**CRN 32015**	**DATA SCIENCE INTERNSHIP**	**15 PTS**	**2/3**

Prerequisites: DATA 201, one of (MATH 277, STAT 292), one of (DATA 202, QUAN 203, SCIE 201 in 2017/18), 15 further 200-level points all with B+ average. This course is limited entry.

Students will complete an approved and supervised project in a public, private or non-profit organisation with established data science work stream. It will enable students to gain professional work experience in the application of data science and to develop teamwork and communication skills in a relevant organisation.

WHO TO CONTACT

Te Herenga Waka—Victoria University of Wellington offers a range of services that cover all student-related matters from applications/enrolment to graduation.

Student Success Team, Te Wāhanga Ahunui Pūkaha—Faculty of Engineering:

Address:	Level 1, Cotton Building
Phone:	0800 04 04 04
Email:	info@vuw.ac.nz
Website:	www.wgtn.ac.nz/science/student-success
Hours:	9 am–4 pm Monday, Wednesday, Thursday, Friday 9.30 am–4 pm Tuesday

Johan Barnard	Manager, Student Success	04 463 5980
Chris Hollitt	Associate Dean (Undergraduate Students)	04 463 6965

STAFF CONTACTS

(All room numbers refer to the Cotton Building)

STAFF		ROOM	PHONE
Head of School	A/Prof Ivy Liu	356	463 5648
Deputy Head of School	A/Prof Lisa Clark	442	463 6734
Programme Directors			
Mathematics	A/Prof Dillon Mayhew	435	463 5155
Statistics	Dr Yuan Yao		
Data Science	Prof Richard Arnold	538	463 5668
Disability Liaison Advisor	Georgia Dix	358	463 5651
Advisors to Māori and Pacific Nation Students	Jasmine Hall	254	463 9545
Advisor to International Students	Morgan Holschier	358	463 5651
Advisor to Women Students	Ginny Whatarau	357	463 5666
Administration			
Ginny Whatarau	School Manager	357	463 5666
Morgan Holschier	Postgraduate Coordinator	358	463 5651
Rachele Herrera	Senior Administrator	358	463 9542

TEACHING STAFF	ROLE / RESEARCH INTERESTS	ROOM	PHONE
MATHEMATICS			
Dr Steven Archer	Lecturer (teaching)	363	886 4493
Dr Nick Brettell	Matroid theory, graph theory, algorithms	427	
A/Prof Lisa Clark	Algebra and functional analysis	442	463 6734
Prof Rod Downey	Computability, complexity, combinatorics, algebra	324	463 5067
Prof Noam Greenberg	Computability theory, set theory	438	463 6778

Dr Tanya Gvozdeva	Lecturer (teaching)	362	
Jasmine Hall	Assistant lecturer	254	463 9545
Dr Brendan Harding	Fluid dynamics, iterated function systems	433	463 5662
Prof Astrid an Huef	Functional analysis, operator algebras, dynamical systems	439	463 6780
Dr Byoung Du Kim	Number theory	434	463 5665
A/Prof Dillon Mayhew	Matroids, complexity, combinatorics, graph theory	435	463 5155
Prof Stephen Marsland	Shape analysis, diffeomorphism groups, machine learning, complexity	443	4639695
A/Prof Sasha Melnikov	Mathematical logic, computability theory, computable algebraic and metric structures	323	
Prof Mark McGuinness	Industrial applied maths, modelling	362	
Dr Dimitrios Mitsotakis	Numerical analysis, differential equations, nonlinear waves	441	463 6739
Dr Hung Le Pham	Functional analysis	440	463 6732
Dr Dan Turetsky	Computability theory, algorithmic randomness	438	463 5660
Prof Matt Visser	Black holes, general relativity, cosmology	321	436 5115

DATA SCIENCE			
Prof Richard Arnold	Biostatistics, Bayesian statistics, statistics in geophysics	538	463 5668
Prof Alejandro Frery	Statistical computing; signal, image, network analysis, data analysis, synthetic aperture radar (SAR) imagery	537	
Prof Stephen Marsland	Shape analysis, diffeomorphism groups, machine learning, complexity	443	463 9695
Dr Binh Nguyen	Image analysis, visualization	363	463 5275
Dr David Huijser	Bayesian statistics, data modelling	542	

STATISTICS			
Dr Ryan Admiraal	Social network analysis, disease modelling	536	436 5275
David Cox	Lecturer (teaching), longitudinal data, central limit theorems	547	463 6788 Extn 8759
Dr John Haywood	Time series, forecasting, seasonal adjustment, statistical modelling	541	463 5673
Dr Yuichi Hirose	Estimation theory, model selection, sampling methods	546	463 6421
A/Prof Ivy (I-Ming) Liu	Categorical data analysis	356	463 5648
Dr Louise McMillan	Model-based clustering, statistical ecology	429	463 9545
Dr Nokuthaba Sibanda	Biomedical statistics, statistical process control, applications of Bayesian statistics	543	463 6779
Prof Peter Smith	Telecommunications, statistics in engineering	539	463 6738
Dr Budhi Surya	Levy process, optimal stopping, applied probability, financial stochastics	544	463 5669
Dr Yuan Yao	Statistical learning, high-dimensional data analysis, survival analysis, empirical processes	533	463 7059