INTRODUCTION

Kia ora, welcome to the School of Mathematics, Statistics and Operations Research. The School offers courses in the world's longest continuously studied discipline. There are three main subject areas within the School:

Mathematics Statistics Operations Research

Each of these disciplines has its own style, methodology and problems but they are also strongly interlinked. Our courses are labelled MATH, OPRE or STAT to indicate the discipline to which they are most strongly allied, but in many cases there is significant overlap with other disciplines.

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MATHEMATICS, STATISTICS AND OPERATIONS RESEARCH
Te Kura Mātai Tatauranga, Rangahau Pūnaha

Location: School Office: Cotton Building, Floor 3, Room 358
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SCHOOL CONTACTS

STAFF		ROOM	CONTACT
Head of School			
A/Prof Megan Clark		356	463 6738
Deputy Head of School			
Prof Rob Goldblatt (Acting)		438	463 5660
Programme Directors			
Mathematics	Dr Christopher Atkin	361	463 6739
Statistics & Operations Research	Dr I-Ming Liu	424	463 5648
Disability Liaison Advisor			
A/Prof Megan Clark		360	463 6738
Advisor to Maori & Pacific Nation Students			
Prof Geoff Whittle		320	463 5650
Advisor to International Students			
Dr Nokuthaba Sibanda		532	463 6779
Advisor to Women Students			
Ginny Whatarau		357	463 5666
Administration			
Ginny Whatarau	School Manager	357	463 5666
Prema Ram	Administrator	358	463 5341
Rowan McCaffery	Administrator	358	463 5651

TEACHING STAFF	ROLE / RESEARCH INTERESTS	ROOM	CONTACT
Mathematics			
Dr Steven Archer	Senior Tutor	363	ext. 8316
Dr Christopher Atkin	Global Analysis and Geometry	361	463 6739
Dr Colin Bailey	Mathematical Logic, General Algebra	362	463 5658
Dr Carolyn Chun	Matroids, Graphs, Combinatorics	426	463 6744
Dr Peter Donelan†	Singularities, Invariant Theory, Robotics	441	463 5659
Prof Rod Downey	Computability, Complexity, Combinatorics, Algebra	324	463 5067
Prof Rob Goldblatt	Mathematical Logic, General Algebra	438	463 5660
Dr Noam Greenberg	Computability Theory, Set Theory	436	463 6778
Dr Asher Kach	Computability Theory	426	463 6744
Dr Byoung Du (BD) Kim	Number Theory, Arithmetic Geometry	434	463 5665
Dr Dillon Mayhew	Matroids, Complexity, Combinatorics, Graph Theory	435	463 5155
A/Prof Mark McGuinness	Industrial Applied Maths, Modelling	323	463 5059
Dr Hung Le Pham	Functional Analysis	440	463 6732
Dr Ken Pledger	Geometry, History of Mathematics	439	463 6780
Prof Matt Visser*	Black Holes, General Relativity, Cosmology	321	463 5115
Prof Geoff Whittle**	Combinatorics, Matroids, Graph Theory	320	463 5650
Statistics and Operations Research			
Dr Richard Arnold	Biostatistics, Bayesian Statistics, Statistics in Physics	540	463 5668
A/Prof Stefanka Chukova	Warranty Analysis and Reliability	537	463 6786
A/Prof Megan Clark	Mathematics and Statistics Education	356	463 6738
Dr John Haywood	Time Series, Forecasting, Seasonal Adjustment, Statistical Modelling	534	463 5673
Dr Yuichi Hirose	Semiparametric maximum likelihood estimation in case-control sampling	529	463 6421
Dr Mark Johnston	Combinatorial Optimization, Environmental Systems Modelling	531	463 5669
Prof Estate Khmaladze†	Asymptotic Statistics, Random Processes, Martingale Methods	536	463 5652
Dr I-Ming (Ivy) Liu	Categorical Data Analysis	424	463 5648
Dr Shirley Pledger***	Biometrics	539	463 6788
Dr Nokuthaba Sibanda	Biomedical Statistics, Bayesian Statistics	532	463 6779
Emeritus Prof Tony Vignaux	Bayesian Methods in Data Analysis, Dimensional Analysis	533	463 5276
Dr Dong Wang	Multivariate Analysis	541	463 5275

* *available in Trimester 1 2010*
** *not available in 2010*
*** *available before May and after August 2010*
† *Graduate Coordinator – for all graduate study enquiries*

ENTRY REQUIREMENTS FOR 100-LEVEL MATHEMATICS AND STATISTICS COURSES

At present there are three levels of entry to Mathematics and Statistics courses at Victoria University.

- *Well prepared calculus students* may enrol directly to MATH 142 Calculus 1B. You will need at least 18 credits of NCEA Level-3 Calculus (including the differentiation, integration, and trigonometry achievement standards), preferably with some at Merit or Excellence level; or an equivalent qualification. Otherwise MATH 141 Calculus 1A is required for entry into MATH 142.

- *Reasonably well prepared students* who have gained 16 NCEA Level-3 mathematics credits are given direct entry to MATH 141 Calculus 1A, MATH 151 Algebra, MATH 161 Discrete Mathematics and Logic, and STAT 131 Probability and Decision Modelling, with the proviso that for entry into STAT 131, at least 12 of your credits should be from the Calculus domain.

- *Less well prepared students* are given entry to MATH 132 Introduction to Mathematical Thinking and STAT 193 Statistics for Natural and Social Sciences. A pass in MATH 132 gives entry into MATH 141, MATH 151, MATH 161 and STAT 131.

  Although less well prepared students are given entry to STAT 193 and MATH 132, if your background is extremely weak then a great deal of work may be required. Support is given to assist students prepared to put in this work.

- In addition to the three entry levels already mentioned, *advanced and gifted students* may be granted direct entry to 200-level courses. This applies to very few students. Entry is at the discretion of the appropriate programme director.

For further advice on entry to Mathematics or Statistics courses, contact the School Office, or a relevant academic staff member. (Contact details on the previous pages.)

MATHEMATICS COURSES

Summer Courses Jan-Feb 2010

MATH 132 CRN 17286 **INTRODUCTION TO MATHEMATICAL THINKING** 15 POINTS [3/3]
Coordinator: Dr Steven Archer
Restrictions: MATH 100-199; QUAN 103, 111
Lectures: Tue, Thu, Fri 1:10-4pm, from 5th Jan to 12th Feb in HULT 119

An introduction to some fundamental ideas and methods in mathematics, including solving equations and inequalities in 1 and 2 variables, matrix arithmetic and algebra, trigonometry, sets, relations and logic, the basic ideas of calculus.

100-Level Courses

(See page 4 for details on NCEA entry requirements for these courses.)

MATH 132 CRN 17150 **INTRODUCTION TO MATHEMATICAL THINKING** 15 POINTS [1/3]

Coordinator: Dr Colin Bailey
Restrictions: MATH 100-199; QUAN 103, 111
Assessment: To be announced
Lectures: Mon, Thu, Fri 12-1

An introduction to some fundamental ideas and methods in mathematics, including solving equations and inequalities in 1 and 2 variables, matrix arithmetic and algebra, trigonometry, sets, relations and logic, the basic ideas of calculus.

MATH 141 CRN 17151 **CALCULUS 1A** 15 POINTS [1/3]

Coordinator: Dr Christopher Atkin
Prerequisites: 16 credits NCEA level 3 Mathematics, or MATH 132
Restrictions: MATH 113, 142; QUAN 111
Assessment: Weekly assignments (10%); test (30%); examination (60%)
Lectures: Mon, Tue, Thu 4-5

The properties of functions of one variable and their use for modelling continuous phenomena, including ideas and applications of differential and integral calculus.

MATH 142 CRN 17160 **CALCULUS 1B** 15 POINTS [2/3]

Coordinator: Dr Peter Donelan
Prerequisites: MATH 141 or a comparable background in Calculus (see page 4)
Restrictions: MATH 113
Assessment: Weekly assignments (10%), mid-term test (30%), final exam (60%)
Lectures: Mon, Wed, Fri 3-4
Tutorials: 1 hour per week (to be arranged)
Recommended Reading: Anton, H., Bivens, I., and Davis, S., *Calculus - Early Transcendentals*, Ninth Edition, Wiley, 2009. Older editions of the same book (for instance by Anton alone) are generally satisfactory.

Further topics in differential and integral calculus, including l'Hôpital's Rule, Taylor polynomials, implicit, parametric and polar representation of curves, the Riemann integral, techniques of integration, differential equations, and functions of two variables and their properties.

MATH 151 CRN 17161 **ALGEBRA** 15 POINTS [1/3]

Coordinator: Dr Noam Greenberg
Prerequisites: 16 credits NCEA level 3 (or equivalent) Mathematics or MATH 132
Restrictions: MATH 114
Assignments:
Assessment: Two in-term tests (0 or 20% each), Final Exam (60, 80 or 100%)
Lectures: Mon, Wed, Thur 1-2

An introduction to linear algebra, including matrices and vectors, complex numbers, eigenvectors, and algebraic structures (including some basic number theory).

MATH 161 CRN 17162 **DISCRETE MATHEMATICS AND LOGIC** 15 POINTS [2/3]

Coordinator:	Dr Dillon Mayhew
Prerequisites:	16 credits NCEA level 3 (or equivalent) Mathematics or MATH 132
Restrictions:	MATH 114
Assessment:	Weekly assignments (10%), mid-term test (30%), final exam (60%). The exam may count for 100% if this is to the student's advantage.
Lectures:	Mon, Thu, Fri 4-5

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. Other topics covered include sets and relations. The second half of the course introduces the fundamental concepts of graph theory, which is the study of networks.

200-Level Courses

MATH 211 CRN 18322 **STRUCTURES AND SPACES IN ALGEBRA AND TOPOLOGY** 15 POINTS [2/3]

Coordinator:	Dr Hung Le Pham
Prerequisites:	MATH 142 (or MATH 113), MATH 151 or 161 (or MATH 114).
Lectures:	Mon, Wed, Fri 4-5
Tutorials:	1 hour per week, to be arranged
Assessment:	To be advised
Textbook:	To be advised

An introduction to the mathematical structures that describe symmetry and continuity, in particular groups and topological spaces.

MATH 243 CRN 18323 **MULTIVARIABLE CALCULUS** 15 POINTS [2/3]

Coordinator:	[Enquiries to Dr C. J. Atkin]
Prerequisites:	MATH 142 (or MATH 113), MATH 151 (or MATH 114)
Restrictions:	MATH 206
Lectures:	Mon, Tue, Fri 3-4
Tutorials:	1 hour per week, to be arranged
Assessment:	Weekly Assignments (10%), mid-term test (30%), final exam (60%).
Textbook:	Anton, "Calculus", in any of its editions (as for MATH 142).

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 **DIFFERENTIAL EQUATIONS** 15 POINTS [1/3]

Coordinator:	[Enquiries to Dr P. S. Donelan]
Prerequisites:	MATH 142 (or MATH 113), MATH 151 (or MATH 114)
Restrictions:	MATH 206, MATH 223
Lectures:	Mon, Tue, Fri 12-1
Tutorials:	1 hour per week, to be arranged
Assessment:	Weekly assignments (10%), mid-term test (30%), final exam (60%).
Textbook:	Zill D. G and Cullen M. R., Differential Equations with Boundary Value Problems, 7th edition, 2009

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 251 CRN 18325 **LINEAR ALGEBRA** 15 POINTS [2/3]

Coordinator:	Dr Colin Bailey
Prerequisites:	MATH 151 (or MATH 114)
Restrictions:	MATH 207
Lectures:	Mon, Wed, Fri 1-2
Tutorials:	To be arranged
Assessment:	To be advised
Textbook:	To be advised

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

MATH 261 CRN 18326 **DISCRETE MATHEMATICS 2** 15 POINTS [1/3]

Coordinator:	Dr Dillon Mayhew
Prerequisites:	MATH 161 (or MATH 114)
Restrictions:	MATH 214
Lectures:	Mon 11-12, Wed 4-5, Thur 9-10
Tutorials:	To be arranged
Assessment:	To be advised
Textbook:	To be advised

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

300-Level Courses

MATH 301 CRN 3505 **CALCULUS 3** 24 POINTS [2/3]

Coordinator:	Dr Peter Donelan
Prerequisites:	MATH 206 or 223 (or MATH 209 or 222 or 244)
Recommended:	MATH 207
Lectures:	Mon, Wed, Thur 10-11
Tutorials:	2 tutorials per week, to be arranged
Assessment:	Weekly Assignments (10%), Final examination (50%), test (20%), project (10%), presentation (10%)
Recommended Reading:	Boyce W.E. and Di Prima R.C., *Elementary Differential Equations and Boundary Value Problems*, 9th edition, 2009.

Calculus of functions from $\boldsymbol{R}^m$ to $\boldsymbol{R}^n$; ordinary and partial differential equations; systems of differential equations and applications.

MATH 308 CRN 7527 **GEOMETRY** 12 POINTS [2/3]

Coordinator:	Dr Ken Pledger
Prerequisites:	MATH 142 or MATH 113
Corequisites:	MATH 251 or MATH 207
Lectures:	Tue, Fri 11-12
Tutorials:	1 hour per week, to be arranged
Assignments:	Weekly
Assessment:	*Either* 100% final examination (2 hr); *or* 75% examination, 14% term test and 11% assignments; whichever is greater.
Textbook:	Either the course notes *Extracts from Euclid* available from the Student Notes Distribution Centre for approximately $7, or any edition of Euclid's *Elements*

The mathematics of shapes, rather than formulae. A broad survey of major ideas in geometry from ancient times up to this century.

MATH 309 CRN 7528 **MATHEMATICAL LOGIC** 24 POINTS [1/3]

Coordinator:	Professor Rob Goldblatt
Prerequisites:	MATH 214 or 207 or COMP 202
Restrictions:	MATH 409
Lectures:	Tue, Wed, Fri 2-3 in CO228
Tutorials:	Mon 2-3 in CO228 (NOTE: the class will meet on the first day of the trimester, Monday 1st March)
Assignments:	Weekly
Assessment:	*Either* 100% final examination *or* 70% final examination, 20% test and 10% assignments
Textbook:	Burris, *Logic for Mathematics and Computer Science*, Approximate cost: $90.

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 sentential logic; first-order logic of quantifiers and predicates; the beginnings of model theory, including completeness and compactness theorems; and an introduction to the theory of computability, including Turing machines and Godel's Incompleteness Theorem for formal arithmetic. Co-taught with MATH 409.

MATH 311 CRN 9591 **ALGEBRA** 24 POINTS [1/3]

Coordinator:	Dr Noam Greenberg
Prerequisites:	MATH 207 or 214
Restrictions:	MATH 302, 303
Lectures:	Mon, Wed, Thur, Fri 3-4
Tutorials:	One of the four lecture times will be used for a tutorial.
Assignments:	Eleven assignments, due weekly.
Assessment:	*Either* 100% final examination *or* 70% final examination, 20% test and 10% assignments; whichever is greater
Recommended Reading:	Fraleigh, J.B., *A First Course in Abstract Algebra*, Addison-Wesley, 2002, $100 approximately.

An introduction to the study of algebraic structures, especially groups, rings and fields, with emphasis on general concepts, such as subgroups, homomorphisms, integral domains as well as on applications to other areas of mathematics, such as number theory and geometry.

MATH 312 CRN 9592 **ANALYSIS** 24 POINTS [1/3]

Coordinator:	Dr Christopher Atkin
Prerequisites:	MATH 206, 207
Restrictions:	MATH 304, 305
Lectures:	Mon, Thur, Fri 10-11
Tutorials:	2 hours per week, to be arranged
Assignments:	Weekly
Assessment:	*Either* 100% final examination (3 hr) *or* 70% final examination and 30% test, whichever is the greater
Recommended Reading:	1. Spiegel, M.R., *Schaum's Outline of Theory and Problems of Complex Variables*, McGraw-Hill. 2. Rudin, W., *Principles of Mathematical Analysis*, McGraw-Hill.

Real numbers, metric spaces and compactness, sequences and series, continuity, functions of a complex variable, Cauchy's theorem, residues.

MATH 322 CRN 546 **APPLIED MATHEMATICS** 24 POINTS[1+2/3]

Coordinator:	Dr Mark McGuinness
Prerequisites:	MATH 206, 207 (or 209 or 210 or 223)
Lectures:	Mon, Tue, Thur 5-6
Tutorials:	To be arranged
Assessment:	A combination of assignment work, projects and tests depending on the topic, the final mark being the average of those in the 3 topics.

Three topics in applied mathematics, not including any taken by the same candidate in GPHS/MATH 323. Topics may include: cartesian tensors, seismology, classical mechanics, fluid mechanics, meteorology, fractals, numerical analysis, quantum mechanics, special relativity.

MATH 323 CRN 8584 **MATHEMATICS FOR EARTH SCIENCES** 24 POINTS[1+2/3]

Coordinator:	Dr Mark McGuinness
Prerequisites:	MATH 206, 207 (or 209 or 210 or 223)
Restrictions:	GPHS 323
Lectures:	Mon, Tue, Thur 5-6
Tutorials:	To be arranged
Assessment:	A combination of assignment work, projects and tests depending on the topic, the final mark being the average of those in the three topics.

Three topics in applied mathematics, chosen from the following, and not including any taken by the same candidate in MATH 322: fluid mechanics, cartesian tensors and applications, seismology, meteorology project, meteorology coursework, fractals, classical mechanics. Also taught as GPHS 323.

MATH 324 CRN 15668 **CODING AND CRYPTOGRAPHY** 24 POINTS [2/3]

Coordinator:	Professor Rod Downey
Prerequisites:	MATH 207 or 214 or MATH 261
Lectures:	Mon Thur, Fri 12-1
Tutorials:	To be arranged.
Textbook:	Hill, R., A First Course in Coding Theory, 2002, cost $120 approx.

Vector spaces over finite fields; coding theory; finite geometries and designs. Hadamard Codes, non-prime fields and BCH Codes. Shannon's Theorem, Cryptography, one-way functions, discrete logarithm, public key integration and RSA Codes.

Coding theory is the art of sending information through a "noisy" channel without losing information. Cryptography studies the problem of sending messages in secret through a public channel, as for example when we give bank account information over the internet. Both are branches of a rapidly growing branch of mathematics called Information Theory. The course is an introduction to the area.

STATISTICS AND OPERATIONS RESEARCH COURSES

100-Level Courses

(See page 4 for details on NCEA entry requirements for these courses.)

STAT 131	CRN 1790	**PROBABILITY AND DECISION MODELLING**	15 POINTS	[2/3]
Coordinator:		Dr John Haywood		
Lecturer:		Dr Mark Johnston		
Restrictions:		may not enrol in or credit STAT 131 after passing STAT 231		
Lectures:		Mon, Thur, Fri 12-1		
Tutorials:		One hour per week, to be arranged.		
Assignments:		Approximately weekly.		
Assessment:		10% assignments, 15% test plus 75% final exam		
Course Materials:		A suitable scientific calculator, cost approximately $30. Course Notes, from Student Notes, cost approximately $15.		

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

STAT 193	CRN (see below)	**STATISTICS FOR NATURAL AND SOCIAL SCIENCES**	15 POINTS	[1/3] [2/3]
Coordinator:		Dr Richard Arnold		
Lecturers:		A/Prof Megan Clark, Dr I-Ming (Ivy) Liu, Dr Yuichi Hirose, Dr Dong Wang, Dr Nokuthaba Sibanda, Dr Shirley Pledger.		
Restrictions:		QUAN 102, STAT 231		
Lectures:		**1/3**: **Stream A (CRN 1791)**: Mon, Wed, Fri 3-4 **Stream B (CRN 11333)**: Mon, Wed, Fri 12-1 **2/3**: **Stream A (CRN 4442)**: Mon, Tue, Thur 10-11 **Stream B (CRN 6164):** Mon Tue, Thur 4-5		
Tutorials:		One hour per week, to be arranged, including: • One Tagata Pasifika tutorial for Maori and Pacific students. • 为中国学生我们特开中文辅导课。(One Mandarin tutorial) Ten hours per week of help sessions (to be advised) will be available for individual assistance.		
Assignments:		An alternation of ordinary and practical data assignments		
Assessment:		*Either* 10% test, 15% project assignments, 75% final exam, *or* 100% final exam, whichever is greater		
Course Materials:		An appropriate scientific calculator will be needed. A Casio fx-82 TL or fx-82 MS is acceptable, cost approximately $25.		
Textbook:		Clark, M.J. and Randal, J.A., *A First Course in Applied Statistics: with applications in biology, business and social sciences*, Pearson, 2004, cost approximately $60.		

An applied statistics course for students who will be advancing in other disciplines as well as those majoring in Applied Statistics. It is useful for students majoring in Biological Science subjects, Geography, Linguistics, Psychology, social sciences such as Education and is also suitable for BCA students. This course assumes no previous knowledge of Statistics, but Mathematics to Year 12 is preferred.

Topics covered include estimation and comparison of means and proportions, simple regression and correlation, and analysis of variance.

200-Level Courses

OPRE 252 CRN 18327 **PROBABILITY AND SIMULATION** 15 POINTS [1/3]
STAT 232 CRN 18329

Coordinator:	Dr John Haywood
Lecturers:	Dr Yuichi Hirose, Dr Stefanka Chukova
Prerequisites:	MATH 142, MATH 151, and one of (STAT 131 or STAT 193 or QUAN 102)
Restrictions:	STAT 231
Lectures:	Mon, Thur, Fri 3-4
Tutorials:	One of the three lecture times will be used for a tutorial.
Laboratories:	Computer lab times to be arranged.
Assignments:	Approximately weekly
Assessment:	Assignments 15%, in-class tests 20%, final exam 65%
Course Materials:	An Introduction to R (from Student Notes), cost approximately $10, a suitable scientific calculator, cost approximately $25.

This course can be taken as STAT 232 or as OPRE 252.

This course provides a foundation in probability, necessary for further courses in Statistics or Operations Research. Simulation is introduced and all concepts are illustrated using the statistical software R. Topics will be chosen from: programming and simulation with R, probability and event theory, ordered and unordered sampling, conditional probability, Bayes' Theorem, random variables, distribution functions, expectation, variance, moment generating functions, joint distributions, covariance, correlation, simulation modelling, queueing models, games and Markov chains. No previous computer programming experience is required. OPRE 252 and STAT 232 are co-taught.

OPRE 253 CRN 18328 **OPERATIONS RESEARCH** 15 POINTS [1/3]

Coordinator:	Dr Mark Johnston
Lecturers:	Dr Stefanka Chukova, Dr John Haywood
Prerequisites:	One of (MATH 141, 142, 151, 161 or STAT 131) or a comparable background in Mathematics and Statistics
Restrictions:	OPRE 251
Lectures:	Tue, Wed, Thu 11-12
Tutorials:	One of the three lecture times will be used for a tutorial.
Laboratories:	Computer lab times to be arranged.
Assignments:	Approximately weekly
Assessment:	Either assignments 20%, in-class tests 20%, final exam 60% or 100% final exam, whichever is greater.
Course Materials:	A suitable scientific calculator, cost approximately $25.
Textbook:	Hillier, F.S. and Lieberman, G.J., Introduction to Operations Research (8th ed.), McGraw-Hill, 2005. This text also serves as the text for OPRE 353, OPRE 354 and OPRE 355 (starting in 2011).

Operations research is decision-making, based on the formulation, analysis and optimisation of decision models. Topics will be chosen from: decision making under uncertainty, utility theory, game theory, inventory models, forecasting, project management, network models, linear, integer, dynamic and stochastic programming and modelling of optimisation problems. A computer package will be used. No previous computer programming experience is required.

STAT 233 CRN 18330 **STATISTICS 2** 15 POINTS [2/3]

Coordinator:	Dr Yuichi Hirose
Lecturer:	Prof Estate Khmaladze
Prerequisites:	STAT 232
Restrictions:	STAT 231
Lectures:	Mon, Wed, Fri 9-10
Tutorials:	One of the three lecture times may be used for a tutorial.
Laboratories:	Computer lab times to be arranged.
Assignments:	Approximately weekly
Assessment:	Assignments 15%, in-class tests 15%, final exam 70%
Course Materials:	An Introduction to R (from Student Notes), cost approximately $15, a suitable scientific calculator, cost approximately $25.

An introduction to statistical inference, illustrated using the statistical software R. Topics will be chosen from: the use of R and concepts from probability; limiting distributions, laws of large numbers, the central limit theorem; methods of estimation, properties of estimators; interval estimation and hypothesis testing; confidence intervals and hypothesis tests for means, proportions and variances; linear regression; goodness of fit tests, contingency tables and analysis of variance.

STAT 292 CRN 18331 **APPLIED STATISTICS 2A** 15 POINTS [1/3]

Coordinator:	Dr Shirley Pledger
Lecturer:	Dr I-Ming (Ivy) Liu
Prerequisites:	STAT 193 or a comparable background in statistics
Restrictions:	STAT 291
Lectures:	Mon, Wed, Fri 9-10
Tutorials:	One hour per week, to be arranged
Laboratories:	Students choose their times for computing, 1-3 hours per week
Assessment:	15% from assignments, 20% from in-class tests, and 65% from the final examination.
Course Materials:	STAT 292 Lecture Notes 2010, from Student Notes, cost approximately $30. You will need a suitable scientific calculator, cost approximately $30.

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 non-parametric tests, design of experiments, oneway and multiway ANOVA and t-tests for difference of means, simple linear regression, analysis of covariance, binomial and Poisson distributions, two-way contingency tables, models for binary response variables, and log-linear models for two-way contingency tables. Examples from the biological, environmental, health, behavioural and social sciences are used for illustration, using a statistical computing package. No previous experience with computers is assumed.

STAT 293	CRN 18332	**APPLIED STATISTICS 2B**	15 POINTS	[2/3]

Coordinator:	Dr Nokuthaba Sibanda
Lecturer:	Dr Dong Wang
Prerequisites:	STAT 292 (or a comparable background in statistics)
Restrictions:	STAT 291
Lectures:	Mon, Tue, Fri 10-11
Tutorials:	One hour per week, selected from scheduled lecture times.
Laboratories:	Students choose their times for computing, 1-3 hours per week
Assessment:	20% from assignments, 10% from an in-class test, and 70% from the final examination.
Course Materials:	STAT 293 Lecture Notes 2010, from Student Notes. You will need a suitable scientific calculator. Each of these costs approximately $30.

More advanced presentation of statistical methods appropriate for applications in the biological, environmental, health and social sciences. Illustrative examples use the statistical software R. Topics will be selected from ANOVA, randomised blocks, nested designs, multiple linear regression, data exploration, introduction to likelihoods, use of AIC for model comparisons in exploratory studies, generalized linear models, logit link models for binary response variables, three-way contingency tables, log-linear models, and an introduction to survival analysis.

300-Level Courses

OPRE 351	CRN 947	**OPERATIONS RESEARCH**	24 POINTS	[1/3]

Coordinator:	Dr Mark Johnston
Lecturers:	Dr Stefanka Chukova, Dr Dong Wang
Prerequisites:	COMP 102, OPRE 251 and at least 15 pts from (MATH 200-269, STAT 231, QUAN 203).
Lectures:	Mon, Tue, Wed, Fri 9-10
Tutorials:	One of the four lecture times will be used for a tutorial.
Laboratories:	Computer lab times to be arranged
Assignments:	Approximately weekly
Assessment:	Either 40% coursework plus 60% final exam or 100% final exam, whichever is greater.
Textbook:	Hillier, F.S. and Lieberman, G.J., Introduction to Operations Research (8th ed.), McGraw-Hill, 2005.

A course in the theory, algorithms and applications of optimisation. Topics will be chosen from: modelling of optimisation problems using linear programming, integer programming, duality and sensitivity analysis, transportation models, network optimisation, data envelopment analysis, dynamic programming, stochastic programming, vehicle routing, scheduling models (including timetables and sports tournaments) and combinatorial optimisation. A computer package will be used.

OPRE 352	CRN 949	**SIMULATION AND STOCHASTIC MODELS**	24 POINTS	[2/3]
Coordinator:		Dr Stefanka Chukova		
Lecturer:		Prof Tony Vignaux		
Prerequisites:		COMP 102; OPRE 251 or OPRE 252 or STAT 231 or STAT 232 or STAT 291 or STAT 292 or QUAN 201 or QUAN 203.		
Restrictions:		COMP 312; COMP 349 (1998-2003).		
Lectures:		Mon, Tue, Wed, Fri 2-3		
Tutorials:		One of the four lecture times will be used for a tutorial.		
Laboratories:		Computer lab times to be arranged.		
Assignments:		Approximately weekly		
Assessment:		Either (35% coursework, 15% project, 50% final exam) or (70% final exam, 30% project), whichever is greater.		
Course Materials:		A suitable scientific calculator will be needed, cost approximately $25.		
Textbook:		Hillier, F.S. and Lieberman, G.J., Introduction to Operations Research (8th ed.), McGraw-Hill, 2005.		

A course on simulation, queues and queue networks. Simulation is a computing and statistical technique for conducting experiments on models that describe the behaviour, uncertainty and structure of real world systems including queues. Simple queue networks will be studied. You must be able to program in a high-level programming language before starting this course.

STAT 331	CRN 1796	**STATISTICS**	24 POINTS	[2/3]
Coordinator:		Dr I-ming (Ivy) Liu		
Lecturer:		A/Prof Megan Clark		
Prerequisites:		MATH 206, 207, STAT 231		
Lectures:		Tue, Wed, Thur 3-4		
Tutorials:		One hour per week, to be arranged		
Assignments:		Weekly assignments plus two projects		
Assessment:		30% projects, 70% final exam		
Recommended Reading:		Mood, Graybill and Boes, *Introduction to the Theory of Statistics*, 3rd Ed.; Weisberg, *Applied Linear Regression*, 2nd Ed.; Graybill, *Theory and Application of the Linear Model*, Duxbury Press, 1976.		

Topics will be chosen from: distribution theory; estimation including minimum variance unbiased estimators and sufficiency; hypothesis testing; theory of the multivariate normal distribution; linear statistical models: theory and applications, including multiple regression techniques and the design and analysis of simple experiments. The statistical packages R or S-Plus will be used.

STAT 333 CRN 1797 **PROBABILITY AND RANDOM PROCESSES** 24 POINTS [1/3]

Coordinator: Prof Estate Khmaladze
Prerequisites: MATH 206, STAT 231
Lectures: Mon, Tue, Thur 4-5
Tutorials: One hour per week, to be arranged
Assignments: Weekly
Assessment: 20% coursework, 80% final exam.
Recommended Reading: Shiryayev, A., *Probability*, Springer, New York; Taylor, H.M. and Karlin, S., *An Introduction to Stochastic Modeling* (3rd ed.), Academic Press;
Ross, S., *Introduction to Probability Models* (6th ed.), Academic Press.

Introduction to probability spaces; almost sure convergence; conditioning and conditional probability; random sums of random summands with examples; elements of the theory of martingales - Doob's inequality and applications; Poisson processes on the real line; Poisson processes in space and connection with the binomial processes of statistics; elements of renewal theory.

STAT 338 CRN 4665 **MULTIVARIATE STATISTICS** 24 POINTS [2/3]

Coordinator: Dr Dong Wang
Lecturer: Dr John Haywood
Prerequisites: STAT 291 (or 292)
Lectures: Mon, Tue, Wed, Thur 1-2
Tutorials: One of the four lecture times will be used for a tutorial
Assessment: 10% assignments, two assessments (tests and/or projects, to be advised) worth a total of 30%, final exam 60%

An introduction to various practical analysis techniques for multivariate statistical data. Statistical software will be used throughout the course to illustrate the application of the various techniques to multivariate data, although prior knowledge of such software is not necessary. Topics will be chosen from: multivariate regression, principal component analysis, factor analysis, correspondence analysis, multivariate analysis of variance, cluster analysis, and multidimensional scaling.

STAT 392 CRN 3048 **SAMPLE SURVEYS** 24 POINTS [1/3]

Coordinator: Dr Richard Arnold
Prerequisites: STAT 193 or equivalent; 30 approved 200- or 300-level points;
Restrictions: STAT 439
Lectures: Mon, Tue, Wed, Thur 5-6
Tutorials: One hour per week to be arranged
Assessment: All internal: project assignments and two term tests
Recommended Reading: Lohr, Sharon L., *Sampling: Design and Analysis*

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 and APST 439.

GENERAL COURSE PLANNING

Degrees and Majors

The School offers the following Majors or specialisations for the Bachelor of Science (BSc) degree:

- Mathematics
- Operations Research
- Management Science
- Statistics
- Applied Statistics

In addition there are majors available in the Bachelor of Arts (BA) and a number of Conjoint Degree Programmes.
Details of these can be obtained from the relevant School or Faculty, or in the *VUW Calendar* (available online at http://www.victoria.ac.nz/home/study/calendar.aspx).

Many of the School's courses form an integral part of other degrees and majors; for full details of those programmes see the relevant School or Faculty.

The School also offers a wide range of **postgraduate programmes**; consult the Graduate Study Prospectuses which are obtainable from the web site http://msor.victoria.ac.nz or from the School Office. Of particular interest to undergraduates could be the Graduate Diploma in Science (GDipSc), which is a 1-year full-time programme which allows you to complete the equivalent of a BSc major in a different discipline to your first degree.

Course codes, trimesters and CRNs

Course codes include a 4-letter subject code and a 3-digit number – the first digit denotes the level of the course. The University has three trimesters each year. Most courses are offered in just one of the three trimesters, but some are offered more than once and some are spread over two trimesters. Each offering of a course has a unique Course Reference Number (CRN) which will be needed for enrolment forms and accessing information online. The general dates for the trimesters, including the exam periods, are:

- 1st trimester (1/3): March – June
- 2nd trimester (2/3): July – October/November
- 3rd (or summer) trimester (3/3): November – February
  (Note: Some summer courses are taught as block courses in just part of the summer trimester.)
- 1st and 2nd trimesters (1+2/3): March – October/November

Help and Advice

You are welcome to approach staff members for advice. If it is a matter concerning a particular course, you should in the first instance contact the course coordinator. For more general advice on planning, first contact the School Office, room 358, telephone 463-5341 or email office@msor.vuw.ac.nz and the staff there will direct you to the relevant advisor.

If a problem arises for which you would rather not approach the course coordinator or lecturer, feel free to consult the Head of School.

Designated staff in the school are able to advise women students, Māori and Pacific Nation students, international students, and students with disabilities about any specific concerns – they are listed in the staff directory at the front of this prospectus.

What is meant by Restrictions

A number of courses in the prospectus show one or more *Restrictions* against other courses. This means that the listed course may not be credited to a degree if any of the restricted courses have already been passed and credited or are being taken at the same time. For example, MATH 141 is restricted against MATH 113, MATH 142 and QUAN 111. So you cannot enrol in MATH 141 this year at the same time as, say, QUAN 111 or if you have already passed QUAN 111 or MATH 113. Likewise you could not take MATH 141 the following year if you pass MATH 142 this year. However MATH 141 is not in the Restrictions list for MATH 142 so you can, of course, proceed from 141 to 142.

Degree Planning (First Year Students)

You should plan your course of study as a coherent programme over the three or more years required. Usually, first-year students can only enrol in 100-level courses. In choosing your courses it is important to take account of:

- The overall requirements of the degree(s) you have chosen.
- The specific requirements of your major subject(s).
- Entry criteria for 100-level courses (see page 4 for NCEA entry requirements, or their equivalent).
- Prerequisites for courses you plan to take in the future, especially prerequisites in other subject areas.
- Workload constraints: 60 points per trimester represents standard full-time study. Most full-time first-year students take seven or eight courses (105/120 points per year).
- Timetable constraints: draw up your own timetable to ensure you do not have any clashes.

There is usually some choice about which courses you take, especially in your first year. This enables you to build a programme that can keep options open.

It is possible to take a degree with a ‘double major’ by satisfying the requirements of two subject areas, or to take a ‘double degree’ by taking two degrees from different faculties. Some sharing is permitted, so a double degree requires fewer points than the two degrees separately.

The official degree statutes are set out in the *VUW Calendar* and should be referred to if you are in doubt.

The School is currently in the process of changing its major requirements and its course structure. This began in 2009 with the introduction of new 100-level courses. In 2010 there are entirely new courses at 200-level, and in 2011 the 300-level courses will be changed. This means that there is a clear distinction between students enrolled before 2009 and those enrolling for the first time in 2009 or later.

PLANNING A DEGREE IN MATHEMATICS

The BSc in Mathematics is a three-year qualification. You may specialise in pure or applied branches of the subject within the majors. Employers in a wide variety of work environments place a high value on a Mathematics major.

What follows are the requirements for the majors in two sections; the first for students enrolled prior to 2009 and the second for those first enrolled in 2009 or 2010.

Section 1: for Students Enrolled Prior to 2009

To major in ***Mathematics*** you need:

1. MATH 113 (or MATH 206)
2. MATH 114 (or MATH 207 or 214)
3. A further 18 points from COMP 102, STAT 131, STAT 193, QUAN 102
4. At least 48 points in MATH at the 300-level
5. 44 more points of 200 or 300-level MATH courses

Note: To complete the degree you need an additional 24 points at 300-level, enough 200- and 300-level courses to make a total of 180 points at 200 and 300-level, and sufficient courses at all levels to total at least 360 points.

If you still need to complete some 200-level courses, for instance as prerequisites for 300-level, note that the new 200-level courses are worth only 15 points. If necessary, check with the Programme Director or with the course coordinators that your proposed combination of courses is satisfactory.

Third Year

300-level mathematics courses provide opportunities to specialise into areas of particular interest, and in general you should seek academic advice before making a final selection. You need to take at least 72 300-level points for your BA or BSc degree, with at least 48 of these from MATH. You can make up the balance with more MATH courses, or with courses from another discipline.

Other courses that may complement those described in this prospectus include PHIL 334 (Logic and Computation) or PHIL 335 (Logic)*, and a number of the QUAN, MOFI, GPHS, and MGMT courses. Keep in mind the requirements of your chosen major subjects, and whether you might want to go on to Honours or a Graduate Diploma.

*PHIL 334 and 335 are taught in alternate years

Section 2: for Students First Enrolled in 2009 or 2010

To major in ***Mathematics*** you need:

1. MATH 142, MATH 151, and MATH161.
2. 60 points from MATH 300-399, provided that 15 points may be replaced by an approved 300-level course from another subject.
3. 60 further points from MATH 200-399, provided that 15 points may be replaced by an approved 200 or 300-level course from another subject.

To major in mathematics you must pass MATH 142, 151 and 161. You also need at least 60 points of 300-level mathematics and 120 points altogether from 200-level and 300-level mathematics. This means that, for example, you could do 45 points of 200-level mathematics and 75 points of 300-level mathematics. You may also replace up to 30 points of 200 or 300-level mathematics by an approved course from another subject in the way described above. Allowable substitutions are discussed further on. (Note: All new undergraduate MATH courses are 15 points.)

Planning a first-year programme

The core first-year courses MATH 142, 151 and 161 require a good mathematics background (see page 4 for more detailed NCEA entry requirements).

To enrol in MATH 151 Algebra, or MATH 161 Discrete Mathematics and Logic, you should have at least 16 NCEA Level 3 Mathematics credits. Otherwise you should first enrol in and pass MATH 132 Introduction to Mathematical Thinking.

MATH 141 Calculus 1A is designed partly as a transitional course to MATH 142 Calculus 1B, but it is also a stand alone calculus course. To enrol in MATH 141 you should have at least 16 NCEA Level 3 Mathematics credits. Otherwise you should enrol in and pass MATH 132 Introduction to Mathematical Thinking. For direct entry to MATH 142 you require at least 18 credits NCEA level 3 Mathematics.

MATH 132 Introduction to Mathematical Thinking is intended as a transitional course to our other first-year courses. Although it requires no specific entry qualifications, it does assume some basic mathematical knowledge. As a general indication, it expects students to have a mathematical competence around NCEA Level 2 (Year 12). Assistance is available for those who find the course difficult, but prospective students whose mathematics is very weak or rusty are recommended to discuss their options with an academic advisor beforehand.

Second Year

There are now five 15 point courses at 200-level. Broadly speaking, MATH students with an interest in any kind of calculus or applied mathematics should take *at least* MATH 244, MATH 243, and MATH 251; those with a more theoretical bent towards algebra or analysis should take *at least* 211, 243, and 251; whilst those more interested in discrete mathematics or computer science should take *at least* 211, 251, and 261. To achieve the MATH major with only 45 points at 200-level, you need 75 points at 300-level, and your choice may not be very wide. The more courses you pass at 200-level, the more options you have later on.

Third Year

The courses that will be offered at 300-level in 2011 have not been finally decided. Each will be of 15 points; some of the 2010 courses will be split in two, and some material will be redistributed.

Allowable Substitutions

STAT 232 / OPRE 252, STAT 233, and OPRE 253, along with the old OPRE 251, STAT 231, should all be allowable substitutions for a major in Mathematics as described earlier. As courses throughout the school will be changing we cannot say precisely what the allowable substitutions at 300-level will be. However there will be courses similar to the current OPRE 351, STAT 331 and STAT 333. We would expect these courses to be allowable substitutions.

Computing Facilities and Regulations

Calculators are frequently valuable for Mathematics courses. You are advised to have at least a basic scientific calculator. Though they are not required, you may prefer one with graphic or symbolic capabilities – these are permitted in most examinations, so long as they do not have user-stored material in their memories. Many courses make use of mathematical software packages, particularly Maple and Matlab, which are available in the School's computing laboratories. Course coordinators can advise you about the availability of student editions of Maple and Matlab.

All users of computing laboratories should familiarise themselves with the Information Systems Statute found on the VUW policy website: http://monster.vuw.ac.nz and see the rules posted in the Laboratories.

PLANNING A DEGREE IN STATISTICS OR OPERATIONS RESEARCH

The School offers majors in Statistics, Applied Statistics, Operations Research, and Management Science. The Statistics major focuses primarily on the theoretical aspects of the discipline, and requires MATH courses to 200-level. The major in Applied Statistics emphasises the use of particular statistical techniques, appropriate for data encountered in a variety of applications. A major in Applied Statistics is a useful complement to a major in Statistics or in disciplines such as Psychology, Ecology & Biodiversity, Marine Biology or other biological or social sciences. The Operations Research and Management Science majors focus on the techniques required to build and analyse models of systems and real life phenomena, to aid scientific and commercial decision-making.

What follows are the requirements for the majors in two sections; the first for students enrolled prior to 2009 and the second for students first enrolled in 2009 or 2010.

Section 1: for Students Enrolled Prior to 2009

To major in ***Statistics*** you need:

1. MATH 113, MATH 114 and STAT 131 (or a comparable background in 100-level Mathematics and Statistics)
2. MATH 206, MATH 207 and STAT 231
3. STAT 331 and at least 24 further points from courses labeled STAT 300-399.

Note: To complete the degree you need an additional 24 points at 300-level, with at least 360 points in total, of which at least 180 points must be from 200 and 300-level courses.

To major in ***Applied Statistics*** you need:

1. STAT 193 or QUAN 102 and a further 15 100-level points in MATH, STAT or QUAN
2. STAT 291, 338 and 392
3. At least 15 points from 200-level STAT, OPRE, MATH, or one of (BIOL 222, 242, ENVI/GEOG 214, 222, GEOG 215, GEOL 242, LING 211, 325, MAOR 211, 222, MGMT 206, PSYC 325, PUBL 306, QUAN 201, 202, 203, SOSC 203, 212, SPOL 205, 207, STAT 339).

Note: To complete the degree you need an additional 24 points at 300-level, with at least 360 points in total, of which at least 180 points must be from 200 and 300-level courses. Requirement 3 above may be replaced by an approved combination of relevant courses at 200-level or above.

To major in ***Operations Research*** you need:

1. STAT 131, COMP 102 and one of MATH 113, MATH 114 (or a comparable approved background in 100-level Mathematics and Statistics)
2. OPRE 251; 22 points from MATH 200-269 or STAT 200-289
3. OPRE 351 and 352

Note: To complete the degree you need an additional 24 points at 300-level, with at least 360 points in total, of which at least 180 points must be from 200 and 300-level courses.

To major in ***Management Science*** you need:

1. MGMT 101; STAT 131, COMP 102 and one of MATH 113, MATH 114 (or a comparable approved background in 100-level Mathematics and Statistics)
2. OPRE 251; MGMT 206† or an alternative 200-level MGMT course
3. OPRE 351, OPRE 352; one of MGMT 314 - 316

Note: To complete the degree you need at least 360 points in total, of which at least 180 points must be from 200 and 300-level courses.

†MGMT 206 is the prerequisite for MGMT 315 and 316
See the Commerce & Administration prospectus for more information on MGMT courses.

If you still need to complete some 200-level courses, for instance as prerequisites for 300-level, note that the new 200-level courses are worth only 15 points. If necessary, check with the Programme Director or with the course coordinators that your proposed combination of courses is satisfactory.

Third Year

In general you should seek academic advice before making a final selection from the courses available. You need to take at least 72 300-level points for your BA or BSc degree. Most majors require fewer points than this in the major subject at 300-level, so you will either take more than the minimum in your major subject, or else take some course(s) in an additional subject at 300-level.

Section 2: for Students Enrolled for the First Time in 2009 or 2010

The requirements for a major in ***Statistics*** are:

1. MATH 142, 151 and STAT 131 (or a comparable background in 100-level Mathematics and Statistics)
2. STAT 232, 233, MATH 243, 251
3. 60 points from approved STAT 300-level courses. New 15-point courses at 300-level will be offered in 2011.

The requirements for a major in ***Applied Statistics*** are:

1. STAT 193 or QUAN 102 and a further 15 100-level points in MATH, STAT or QUAN
2. STAT 292, 293, and a further 30 points from STAT 200-299, OPRE 200-299, MATH 200-299, BIOL/ENVI 222, ENVI/GEOG 214, GEOG 215, LING 211, 330, MGMT 206, PSYC 232, 325, PUBL 306, QUAN 201, 202, 203, SPOL 205, 207, or an approved combination of other relevant courses..
3. 60 points from approved STAT 300-level courses. New 15-point courses at 300-level will be offered in 2011.

The requirements for a major in ***Operations Research*** are:

1. COMP 102; STAT 131 or 193, one of MATH 142, MATH 151 (or a comparable approved background in 100-level Mathematics and Statistics)
2. OPRE 252, 253; 30 further points from MATH 200-299, MGMT 206 (or its equivalent course), OPRE 250-259, STAT 230-239
3. 45 300-level points from OPRE 351, 352, 353; 15 further approved 300-level points from COMP, MATH, QUAN, STAT or MGMT 314-316 (or their equivalent MGMT courses)

Note: For the three majors above; to complete the degree you need an additional 15 points at 300-level, with at least 360 points in total, of which at least 210 points must be from 200 and 300-level courses.

The requirements for a major in ***Management Science*** are:

1. MGMT 101; COMP 102; STAT 131 or 193, one of MATH 142, MATH 151 (or a comparable approved background in 100-level Mathematics and Statistics)
2. OPRE 252, 253; MGMT 206; 15 further 200-level points from MATH 200-299, OPRE 250-259, STAT 230-239
3. 30 300-level points from OPRE; 15 300-level points from MGMT 314-316 (or equivalent MGMT courses); 15 further 300-level points from COMP, MATH, MGMT 314-316 or STAT.

Note: To complete the degree you need at least 360 points in total, of which at least 210 points must be from 200 and 300-level courses.

MGMT 206 is the prerequisite for MGMT 315 and 316

See the Faculty of Commerce and Administration for more information on MGMT courses.

Planning a First Year Programme

There are two courses available at 100-level: **STAT 131** and **STAT 193**.

STAT 131 (Probability and Decision Modelling) is intended mainly for students following through to higher level Statistics, Operations Research, Management Science, Mathematics, Physics, Geophysics, Engineering or Computer Science, or those intending to study Econometrics or other quantitative disciplines.

STAT 131 is for students with at least 16 Level 3 NCEA Mathematics credits, including plenty of Calculus. Otherwise students are advised to take STAT 193. Students need to take MATH 142 and MATH 151 to proceed to some of the second year STAT and OPRE courses. See page 4 for more details on Mathematics entry requirements.

STAT 131 can be successfully combined with the more applied 100-level course, STAT 193.

STAT 193 (Statistics for Natural and Social Sciences) is an applied statistics course which provides a suitable statistical background for students majoring in Applied Statistics or the natural and social sciences, especially Psychology, Ecology & Biodiversity and Marine Biology or those who plan a career in social policy formulation. *Preferred entry level: at least Year 12 Mathematics.*

The Student Learning Support Service offers workshops during the year for students with a weak mathematical background and the Science Faculty provides Whanau Support tutorials for Māori & Pacific students and equity help sessions for Science, Engineering and Architecture & Design students relating to STAT 131 and 193 (contact the Deputy Dean (Equity), Science Faculty Student Administration Office).

Second Year

Students advancing in *Statistics* should take STAT 232, 233, MATH 243 and 251. Those advancing in *Operations Research* need OPRE 252, 253 and 30 points from 200-level MATH, STAT, COMP or QUAN.

Students wishing to advance in *Applied Statistics* should take STAT 292, 293, which lead on to 300-level courses.
BSc *Management Science* students should take OPRE 252, 253 and MGMT 206 (or its equivalent course). More computing would be valuable.

Third Year

The courses that will be offered at 300-level in 2011 have not been finalised. Each will be of 15 points, and they will cover a rearrangement of present 300-level courses.

Computing Facilities

Calculators are required in all STAT and OPRE courses. The undergraduate courses at 200 and 300-level in Statistics and Operations Research make use of statistical and other computer packages such as R, SAS, Python and SimPy. The Operations Research courses use special-purpose OR packages.

MAJOR IN ENVIRONMENTAL SCIENCE

Environmental Science is a new science major offered from across four schools in the Faculty and allows students to acquire the mathematical and scientific background necessary to become environmental scientists.

A BSc graduate in ENSC will have the following attributes:

- A broad understanding of the general principles of environmental science across a range of sciences;
- Expertise about how their other major links with and is informed by Environmental Science;
- An ability to analyse critically and understand environmental issues; a capability of working in teams and preparing information for a wide range of audiences;
- An ability to undertake basic research in an area of Environmental Science;
- Contribute to the analysis of an issue in Environmental Science.

The ENSC major will be overseen from the School of Geography, Environment and Earth Sciences and requires the following:

- Must be linked to a partner Science Major from Biological (BIOL, BMAR, EBIO), Physical (CHEM, APHS, PHYS), Mathematical (MATH, STAT, APST) or Earth Sciences (GEOL, GPHS, PHYG, GEOG).
- A 300-level independent research project.
- A 300-level modular course on a variety of environmental science topics that will allow students to link in the partner major to an environment science context.

Specific major requirements are:

- STAT 193, 15 pts from MATH courses and 30 further pts from 100-level BIOL, CHEM, PHYS, GEOG, ESCI, MATH, STAT
- *60 pts at 200-level from the above list of courses not required by the partner major
- ENSC 301, 302 or 303 and further approved 300-level courses to achieve at least 60 pts

Note: with approval, up to 30 pts may be shared at 200-level only with the partner major.
For MATH major with ENSC major:

MATH Year 1	Year 2	Year 3
MATH 142 – 15	MATH 243 – 15	MATH 3xx – 15
MATH 151 – 15	MATH 244 – 15	MATH 3xx – 15
MATH 161– 15	MATH 251 – 15	MATH 3xx – 15
STAT 193 – 15	MATH 261 – 15	MATH 3xx – 15
COMP 102 – 15	MATH 211 – 15	ENSC 301 – 15
CHEM 114 – 15	CHEM 202 – 15	OPRE 3xx – 15
CHEM 115 – 15	CHEM 203 – 15	CHEM 302 – 15
PHYS 114 – 15	OPRE 253 – 15	ENSC 302 – 15
120 points	**120 points**	**120 points**

For STAT major with ENSC major:

STAT Year 1	Year 2	Year 3
MATH 142 – 15	STAT 232 – 15	STAT 3xx – 15
MATH 151 – 15	STAT 233 – 15	STAT 3xx – 15
STAT 131 – 15	MATH 243 – 15	STAT 3xx – 15
STAT 193 – 15	MATH 251 – 15	MATH 3xx – 15
BIOL 113 – 15	BIOL 271 – 20	BIOL 370 – 20
BIOL 114 – 15	BIOL 227 – 20	BIOL 371 – 20
BIOL 111 – 15	BIOL 222 – 20	ENSC 301 – 15
GEOG 111 – 15		ENSC 302 – 15
120 points	**120 points**	**130 points**

For APST major with ENSC major:

APST Year 1	Year 2	Year 3
STAT 193 – 15	STAT 292 – 15	STAT 392 – 15
MATH 141 – 15	STAT 293 – 15	STAT 393 – 15
GEOG 111 – 15	OPRE 252 – 15	STAT 338 – 15
GEOG 112 – 15	BIOL 222 – 20	OPRE 3xx – 15
GEOG 114 – 15	ENVI 214 – 20	ENSC 301 – 15
BIOL 132 – 15	ESCI 201 – 20	ENSC 302 – 15
ESCI 132 – 15	GEOG 215 – 20	GEOG 315 – 20
		GEOG 314 – 20
120 points	**125 points**	**130 points**

REGULATIONS FOR THE BSC DEGREE

The BSc degree was reviewed during 2007-08 and in 2009 a new construction of the qualification was developed. It provides the depth of a strong science education in 1 or 2 specialised Science subjects (majors) combined with the breadth to take a major from outside Science, or a variety of interest courses.

Regulations for the BSc (for all new students from 2009)

- A minimum of 360 approved points
  - 210 points above 100-level of which 150 points must be Science
  - 75 Science points at 300-level
- 90 points may be from outside Science
  With an additional 30 points if specified in the major
- At least 1 Science major
- A second major may be from any other first degree
  - A maximum of 150 points permitted from outside Science.

Regulations for the conjoint BSc/BTeach (for all new students from 2010)

The conjoint BSc/BTeach allows a student to teach in both primary and secondary schools and complete a BSc with a major in a Science/Maths/Social Studies/Technology teaching subject.

- A minimum of 540 approved points
  - 325 points above 100-level
  - 145 points at 300-level
- At least 240 Science points
  - 135 Science points above 100-level
- At least 280 BTeach points
- Must include one Science major in a teaching subject
- Must include at least two courses at 200-level for a second teaching subject.

Regulations for the conjoint BSc/BCA (for all new students from 2010)

- A minimum of 540 approved points
  - 360 points above 100 level
  - 150 points at 300-level
- At least 210 BCA points
- At least 240 BSc points
  - 150 Science points above 100-level
  - 75 of these at 300-level
- At least one major from each degree
- Must maintain a B- grade point average to stay in the programme.

All BSc students are required to demonstrate communication skills in order to be awarded the degree. A BSc with a major from the School should include at least 15 points from the following list of approved subjects: OPRE 253, MATH 301, MATH 324, OPRE 351, OPRE 352, STAT 392 or 15 points from any course in the Faculties of Humanities and Social Sciences (excluding courses from the New Zealand School of Music), Law, and Education.

Graduate attributes for the BSc degree (from 2009)

Communication
- Competence in both oral and written communication.
- The ability to access and evaluate scientific and technical knowledge, and to communicate it both orally and in writing.
- The ability to communicate scientific and technical knowledge to a non-specialist.

Critical Thinking and Creativity
- The ability to evaluate knowledge and ideas from a range of disciplines.
- Competence in applying analytical, quantitative and technical skills to problems.
- A comprehension of current issues and debates in their area of expertise.
- An understanding of the scientific approach to obtaining knowledge about the world, including a respect for experimental evidence, an appreciation of sound experimental design, and an openness to new ideas and theories that explain scientific observations.
- An appreciation of the nature of scientific research and its role in generation new knowledge.

Leadership
- The ability to work independently and in collaboration with others.
- Ability to mentor future generations of learners.

Personal

- A broad knowledge of science across a range of fields with a deeper knowledge in at least one scientific discipline.
- The ability to engage in independent learning.
- An awareness of the challenges facing humanity and the planet and the role of science in understanding and addressing them.
- An understanding of ethical issues in their discipline.
- An understanding of and respect for social and cultural diversity, equity, and human rights.
- Intellectual integrity.
- The ability to use advanced information and communication technologies.
- An ability to handle and interpret large datasets.

GENERAL INFORMATION

Library Services for Science

A specialist team of science librarians is available to help support the learning and research needs of students at all levels. Individual consultations are available with your subject librarian. For details visit: http://www.victoria.ac.nz/library/subjectguides/science/index.aspx
Services offered by the library include regular library tours, a variety of study spaces for group work or quiet study, computer facilities and access to the latest online resources. To find out more go to the library website at http://www.victoria.ac.nz/library/ or visit the reference desk in the central library. You can also contact the library by phone, email or Instant Messaging through the 'Ask a Librarian' service.

Official School Communications

Official notices of the School are posted on noticeboards in the Cotton building. Each course will have a specific web presence, which may be used for announcements – check your course outline or the School website for details. You may also be communicated with via your School email account, or via a course-specific forum.

Student Services Group

The Student Services Group provides a range of services to all students, to help you make the most of your time at University. Visit the website www.victoria.ac.nz/st_services to find out more.

Prizes and Scholarships

Information on prizes and Scholarships can be found at:
http://www.victoria.ac.nz/home/admisenrol/payments/scholarships

Vic OE (Victoria Overseas Exchange)

As a Victoria student you have the chance to attend one of over 100 world-class institutions overseas and study towards your Victoria degree while paying normal Victoria tuition fees.
In order to be eligible for exchange, you must:

- have completed a year of full-time study by the time you leave for your exchange
- have achieved a B average overall in your studies at Victoria and be an academically sound student
- be able to demonstrate that you would be a good ambassador for Victoria

Application Deadlines

- 16 January 2010 (for study in Trimester 2, 2010)
- 16 July 2010 (for study in Trimester 1, 2011)

For more information:
Website www.victoria.ac.nz/exchange
Email exchangestudents@vuw.ac.nz

FACULTY OF SCIENCE

Te Wāhanga Pūtaiao

Faculty of Science Student Administration Office
Location: Level 1, Cotton Building
Phone: 04-463 5101
Email: science-faculty@vuw.ac.nz
Web: http://www.victoria.ac.nz/science
Office hours: 8.30 am – 5 pm (Tuesday from 9.30 am)

Student Advisers can help with admission requirements, degree planning, changing courses, transfer of credit from other tertiary institutions, and anything else that may crop up during your time at Vic. They also deal with other aspects of student administration such as enrolment, exams organisation and the maintenance of student records.

The advisers support students throughout their study. To ensure you get good continuity of personal service, advisers manage a particular group of students, identified by the first letter of your surname:

A-H	Belinda Tuari	belinda.tuari@vuw.ac.nz	463 5982
I-Q	Rachel Zhang	rachel.zhang@vuw.ac.nz	463 5983
R-Z	Celia Simpson	celia.simpson@vuw.ac.nz	463 5981

Johan Barnard Manager, Student and Academic Services tel 04-463 5980
Shona de Sain Associate Dean (Students) tel 04-463 5092

Te Rōpū Āwhina

Te Rōpū Āwhina whānau in the Faculties of Science, Engineering and Architecture and Design at Victoria University of Wellington was established in 1999. Āwhina is about people and collective success. The kaupapa of Āwhina is to produce Māori and Pacific science, engineering, architecture and design professionals to contribute to Māori and Pacific development. Anyone who assists the building of Āwhina is part of the whānau.

Website: www.victoria.ac.nz/science/awhina
Contact details: CO148, (04) 463 5987, teropuawhina@gmail.com