

Career View

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Mathematics and Statistics

Mathematics is fundamental to the study of virtually all science subjects and a prerequisite for the study of many others. More and more careers need some knowledge of mathematics. Whether you are interested in becoming a linguist, geographer or psychologist, a share-broker, architect or market researcher, a computer programmer, physicist or biologist - mathematics opens doors! In addition, the demand for statisticians and for people who have a working knowledge of statistics has burgeoned in recent years.

Statistics is an area of applied mathematics and is concerned with the collection, analysis and interpretation of data. Statisticians examine data and use it to draw conclusions about the nature of the data collection process or the 'population' which provided it. Statistics form an integral part of many scientific research programmes, particularly in environmental, biological and social sciences.

A distinction can be made between the various branches of statistics and the rest of mathematics. Mathematics is inherently highly precise, whereas statistics deals with variability and probability. In this leaflet we include statistics under the umbrella of mathematics.

Operations Research, the study of which requires a good understanding of statistics, is the science of decision making in business, industry and government. This involves designing models for a 'system' and then analysing and optimising these models. This process can be applied to resource allocation, inventory control, scheduling, optimal design, and the operation of large-scale systems.

Widening Opportunities

Mathematics opens doors because it provides a critical knowledge base, enabling you to study subjects such as physics, chemistry, economics and engineering, and because it compliments and supports so many others. In the job market, many employers consider it a plus if one or more maths papers are included in a degree, as this indicates a good level of numerical ability. The higher you rise in a career, the more likely you are to need management skills, which will include the ability to make decisions based on the analysis of numerical data. The study of mathematics will help to develop your powers of analysis, logical thinking and problem solving, and also help you think concisely and precisely; attributes needed for almost all careers. Your career prospects are therefore enhanced if you include mathematics in your degree.

Where do Mathematicians and Statisticians Work?

Mathematicians and mathematical statisticians are employed in a wide variety of organisations, often as part of a multi-disciplinary team in which their particular expertise complements that of others. But by far the

Topical coverage of career related issues brought to you by Victoria University Career Development and Employment.

Areas covered include how degrees and courses relate to employment opportunities, to life/work planning, graduate destination information and current issues or material relevant to the employment scene.

Your comments and suggestions always welcomed.



greatest use of mathematics is in various specialist applied areas such as statistics, operations research, biometrics (statistics for the study of biology), econometrics (statistics for the study of economics) and in disciplines which are highly mathematical in nature such as meteorology (the study of weather and climate), geophysics (the physics of the earth), seismology (the scientific study of earthquakes), vulcanology (the scientific study of volcanoes and related phenomena), astronomy (the scientific study of the material universe and the earth's place within it), metrology (the science of weights and measures) and computer science.

The main employers include:

- **Government Departments and State-Owned Enterprises.** Statistics New Zealand gathers, collates, analyses and validates data about New Zealand e.g. household spending, population, and employment. They recruit graduates from mathematics, statistics and other maths-based disciplines.

The Treasury manages the public purse, assisting the government to gain the maximum value from public spending. The Reserve Bank manages 'monetary policy' ensuring that we have a stable and efficient financial system. Both employ well-qualified graduates with a minimum of honours in econometrics, economics and financial mathematics.

The Government Communications Security Bureau gathers foreign intelligence and also assists government departments and agencies protect their electronic information resources and communications systems and are therefore critical to the security of New Zealand. Graduates with good honours, masters and doctorates in mathematics, operations research and statistics are particularly sought after.

State owned enterprises (SOEs) like Transpower, the owner and operator of New Zealand's high-voltage electricity transmission grid, and Meridian Energy, Genesis Power, and Mighty

River Power Ltd, electricity generators and retailers, employ maths, statistics and operations research graduates and also graduates from other highly numerate disciplines like physics and engineering as statisticians, financial/business analysts and pricing analysts.

The Meteorological Service of New Zealand gathers, analyses and provides weather information for the public of New Zealand, and for a wide range of domestic and foreign commercial customers, (see the profile of Liz McLaughlin). They employ mathematics, statistics, physics and geophysics graduates.

Other government departments in which graduates in numerate disciplines are employed are Ministry of Health and the Health Funding Authorities, Ministry of Economic Development, Ministry of Education, Ministry of Internal Affairs, Ministry of Social Development and Ministry of Defence.

- **Crown Research Institutes:**

All CRIs employ graduates with Honours, Masters and PhDs in mathematics, operations research and statistics for mathematical modelling e.g. AgResearch models biological systems such as TB in possums and parasites in sheep; Industrial Research Ltd models the performance of natural materials, new products and manufacturing processes. Ecological statisticians are employed at Landcare Research Ltd; seismologists and physicists at the Institute of Geological & Nuclear Sciences. Biometricians are employed at HortResearch, AgResearch and at National Institute of Water and Atmospheric Research Ltd (NIWA). The Institute of Environmental Science and Research (ESR) employs biostatisticians, applied mathematicians, chemists and biochemists.

- **Financial Institutions including banks, insurance companies, business and management consulting firms.** The financial sector employs statisticians, financial mathematicians, financial analysts, actuaries,

investment advisers, share-brokers, operations researchers, economists, economic statisticians and auditors (accountants). They target graduates with degrees in mathematics, statistics, operations research, money and finance, economics and econometrics.

- **Industry and Commerce.** Graduates combining statistics, operations research, computer science, economics, management and other commerce subjects are in demand. Manufacturing and processing companies and utility suppliers in the telecommunications, electricity, gas and petrochemical industries employ theoretical and applied mathematicians, operations researchers, statisticians and economists. The IT industry often recruits graduates from maths-related disciplines in addition to graduates from computer science and engineering. A general understanding of mathematics (particularly statistics) is very valuable in business services including marketing, market research, accounting, management and communications.

- Good mathematical skills are also advantageous in the **construction industry**. Mathematical calculations play a significant part in the work done by architects, technicians, engineers, quantity surveyors and planners. Applied mathematics is used in all branches of engineering which include: civil, mechanical, electrical and electronic, chemical and process, natural resources, mining and forestry, engineering.

- **Education.** Schools, universities and other educational institutions employ teachers and educators at all levels. Applicants for teacher training with degrees in mathematics, physics and related disciplines are particularly welcomed as there continues to be a shortage of new entrants to the profession in these subject areas.

Skills and Personal Qualities

The skills and qualities listed below are often inherent talents but will be developed and

enhanced through the study of mathematics. This is one reason why people who have studied mathematics are in demand.

Numerical confidence - A prime requirement for all mathematical work is to be comfortable with numbers, their relative size and what they express. This includes not just a mechanical approach but an ability to see when numbers make sense and are within the bounds of possibility.

Quantitative skills - Many maths-related jobs require a good sense of quantity and its measurement. The ability to identify and measure quantities and develop or use relationships between the variables that the quantities represent is important.

Problem solving - Mathematicians enjoy the challenge of wrestling with and solving problems, and of applying lateral thinking to finding solutions. Asking “what if?” they often use intuition and creativity to identify possible solutions to a problem. They will then apply their skills in logical thinking and analysis to systematically evaluate the relative merits of each solution.

Computer literacy - Computers are used extensively in all statistical and most other mathematical work, so early familiarity with appropriate and current software is advantageous. Computer science courses should be included in a degree if advanced operations research courses are intended.

Teamwork - Mathematicians are often employed as part of a team, in which different specialists are required to contribute their skills. It is important to be able to work well in a group.

Communication and interpersonal skills - Mathematicians who can communicate complex information or ideas to their non-specialist managers, colleagues and clients are very valuable. It is also helpful if they can write reports in clear, jargon-free English.

How Much Maths Do I Need?

- **Examples of jobs that need advanced mathematics or statistics** - mathematics teacher, physicist, engineer, chemist, physicist, geophysicist, seismologist, meteorologist, actuary, statistician, operations research consultant, biometrician, econometrician, computer programmer, investment/funds manager, epidemiologist, communications and information technology specialist and metrologist.
- **Examples of jobs that need some university level general mathematics** - junior maths teacher, manager, architect, biochemist, accountant.
- **Examples of jobs that need university level statistics** - maths teacher, psychologist, marine biologist, geographer, economist, accountant, stockbroker, banker, market analyst, market researcher, business analyst, survey statistician, social science researcher, ecologist, biochemist, forensic scientist, medical doctor, medical and health researchers, commercial lawyer, manager and biologist, policy analyst.

Graduate Profiles



Liz McLaughlin

Lead Forecaster, Meteorological Service of New Zealand

Liz completed her Bachelor of Science (Honours) degree at Victoria University in 1985 and joined the MetService early the following year. She then did a nine-month training course, including two graduate papers in dynamic and physical meteorology offered by the School of Earth Sciences at Victoria, as part of a Diploma in Applied Science in

meteorology. This she completed part-time over the next two years. No statistics courses were included in her degree and while that is not a major disadvantage in her work, they would have opened opportunities in research. Liz adds that with computers such an integral part of meteorology, advanced studies in that area are helpful.

Prior to her current position Liz was working as an Aviation Weather Forecaster. She describes this role as "writing forecasts - which are a great deal more detailed than public forecasts on the radio - for each of the aerodromes around the country. Pilots need to know exactly how high the cloud is going to be, or how low the visibility will be in rain, because it affects whether they can actually land at an airport. The work also involves any sort of weather that can affect aircraft such as winds and turbulence."

Today as Lead Forecaster with the Meteorological Service Liz's job entails analyzing the day-to-day weather of New Zealand and the South Pacific, drawing the prognosis maps for the next two to three days and providing guidance to other forecasters on expected weather. Lead Forecasters build up the basic framework of the weather patterns and broadscale weather features for the next few days; other forecasters, focussing on aviation, marine, public or commercial forecasting, build on this framework and adapt the forecasts to the needs of their individual clients.

"Weather forecasting is of tremendous importance in people's lives and the economy, as they decide whether it's safe to cut the hay, put out the washing or sail into the South Pacific", Liz says. "Supercomputers all over the world are used to continually analyse global weather patterns through mathematical modelling. Our job is to look at these global weather predictions and using New Zealand-based research, specialized local models, and our experience, apply them regionally, nationally, locally and finally to a specific site such as Wellington Airport, a ski-field or the Americas Cup race

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areas. Each computer model has its own strengths and weaknesses and all of the output needs to be assessed daily to ensure that the best available information is used.”

In the Meteorological Service there is an opportunity to get experience in the different forecasting sections. Besides lead forecasting, which she has done now for about three years, Liz has worked in aviation, marine and public forecasting. She has also spent a year as part of the Meteorological Service’s Learning and Development Centre, helping to train new graduates as weather forecasters.

Apart from the 16-day shift cycle (11pm-6am, 6am-2pm, and 3pm-11pm) which means working unsociable hours at times, Liz thoroughly enjoys her work and shift work does allow for lots of time off during the week to shop, study and relax. Eventually, however, Liz would like to move into management within the Meteorological Service, where shifts are not worked and where she would have new challenges to meet.



Paul Coleman

*Coastal Distributions
Co-ordinator, Caltex
New Zealand*

Paul completed his Bachelors degree in Science in 2001, with majors in statistics and operations research.

He had always enjoyed maths at school and decided to continue his studies in this field at university, initially taking maths and stats. He says that taking diverse papers in the first year is important, as there may be subjects better suited to you, which you may never otherwise discover. That’s how Paul discovered operations research which he then chose to major in.

Paul feels that the time spent at university and the subjects he studied, developed his self-

confidence and strong skills in analysis, information processing, prioritising, planning and scheduling –all of which are essential in his current role.

Paul has worked for Caltex as a Coastal Distributions Co-ordinator for two months now and really enjoys what he does. He is responsible for ensuring that all ports on the coast have sufficient product. In the first few weeks on the job, challenges included becoming familiar with oil industry jargon and terminology and understanding the roles of his colleagues and how they relate to his. “With the training wheels on the bike almost off now”, Paul welcomes the level of responsibility that he has been given so early on.

Paul was quite surprised to discover that in his role he needs to spend a considerable amount of time on the telephone and that it is a valuable aid to him in his job. He also spends quite a lot of time “sitting in front of the computer” and produces four or five statistical reports a month amongst other things. He feels that some applied computer papers as part of his degree would have been useful.

Paul’s advice to anyone preparing to study in the same field is to make sure first year papers are diverse and be prepared for the fact that “what you learn at school doesn’t flow on exactly into what you’ll do at university.”

Hilary Baber



*Project Tester/Adviser,
Ministry of Education*

“I started my BSc at Victoria in 1998. I wasn’t sure what I wanted to major in, so I took a variety of subjects including mathematics, statistics, psychology

and biology. By the end of my first year I had really enjoyed statistics, so I decided to major in

statistics and operations research.

“The Statistics Department was always supportive and I found the lecturers and tutors very approachable. There are quite a few papers at 200 and 300 level and I enjoyed being able to cover a wide variety of subjects. One thing I really enjoyed about both statistics and operations research papers was the computer content. I used a number of different software packages which gave me good skills and experience. Group work was encouraged during computer work and tutorials, which provided a good way of getting to know other students and develop teamwork skills.

“In my final year I worked for the Statistics Department as an assignment marker. This was one of the highlights of my time at Victoria, and I enjoyed the challenges it offered. For the past six months I have been working at the Ministry of Education on a Project as a Tester/Adviser. This has involved working to bring in a new database and computer system and it is great to be able to put the skills and knowledge gained from my degree to practical use.

Mehaka Rountree



*Strategic Advisor,
Statistics, Research and
Reporting, Wellington
City Council*

“I have always enjoyed playing with numbers and solving problems. After studying for two years at polytech the next step was to carry

on studying at university level. The prospect of studying science let alone mathematics at university was always very daunting. I initially didn't have enough confidence in myself to believe that I could achieve at that level. The first year at Victoria allowed me to find my feet and gain some confidence in my abilities and myself.

“Coming from a Polynesian background it was fantastic to have the support of the whanau network and mentoring programme, Te Ropu Awhina Putaiao. It really made a difference, especially when you just wanted contact with people who were dealing with the same pressures and problems that you were, or needed guidance from people that had been in the same position as you, or needed a mentor who would offer you practical, individual help with your studies.

“I graduated in 2001 with a Bachelor of Science in statistics and operations research and a Bachelor of Arts in religious studies. Looking back I am very glad that I completed an arts degree with a science degree. It's very easy to get lost in the world of science and it's important to gain the skills to successfully express yourself to people who aren't necessarily scientifically minded.

“I started work with Wellington City Council in November of 2001 as a Strategic Advisor, Statistics, Research and Reporting. My responsibilities include the monitoring of performance and achievement within the organisation and the monitoring of the Council's activities and projects throughout the community. I am responsible for managing the statistical information that comes into and goes out from the Council, including publications that report on statistics about Wellington. The position offers great scope to apply and improve on the skills that I have gained and it's great to be finally putting all the skills that I gained at university into practice.”

Hilary Ferral



Mathematical Statistician, Statistics New Zealand.

"I completed my first degree in music "a long time ago" in London. After moving to NZ, working as an orchestral player and teacher, and raising

my family, I decided on a change of direction and planned to do a Bachelor of Science degree in mathematics at Victoria.

"I was worried about the 25-year gap from mathematics and making the transition back to the classroom. I took the "Return to Study" course run at Victoria where I gained many useful hints, and learned my way around the university. I met other people in similar situations to mine and I found the course invaluable in giving me the confidence I needed to take the plunge into university student life.

"I began study in 1996, and completed my BSc in 1998 and a BSc (Hons) in statistics in 2000. I had to balance the demands of a young family with my study schedule. The range of student support services all helped to make it possible. There were also opportunities at the university to earn money as a tutor and I worked as a research assistant over the summer breaks. .

"I am currently in the Survey Methods section of Statistics New Zealand. My work is mostly associated with sample design and variance estimation in household surveys. I enjoy thinking mathematically and welcome the challenges my job offers. I like working in an environment where I am expected to keep up with current statistical knowledge and practices and where further study is supported and encouraged."

Mathematics and Statistics Courses at Victoria

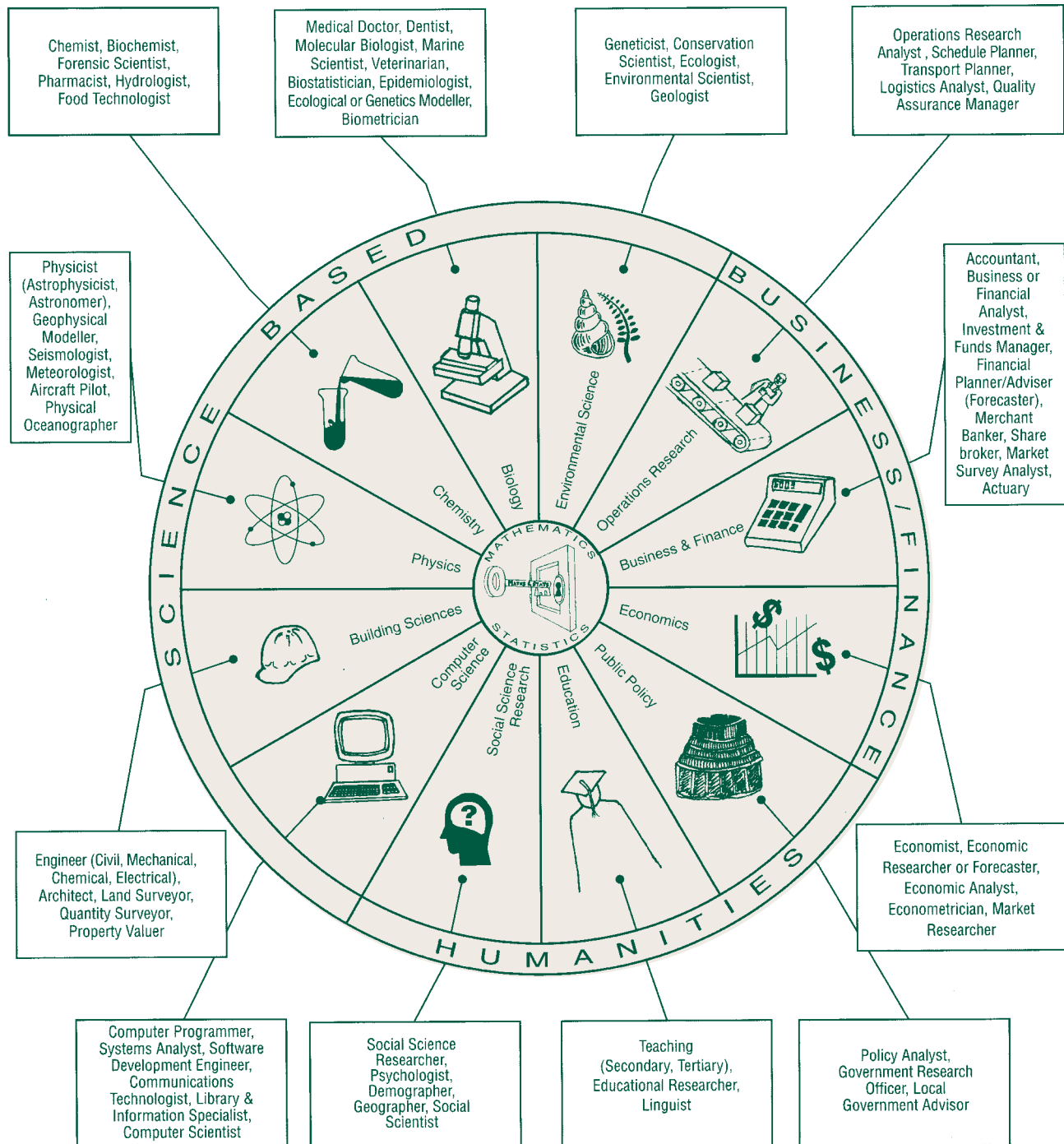
Victoria offers papers in pure and applied mathematics, statistics and operations research at undergraduate and postgraduate levels. Subjects may be studied independently or combined with a wide range of other subjects. Calculus and applied mathematics go well with science courses; discrete mathematics and algebra are suited to computer science students; statistics is also an essential tool in the social sciences; and operations research combines naturally with commerce and economics. These courses all lead on to Bachelor of Science (BSc) undergraduate degrees with majors in mathematics, statistics or operations research. The Mathematics Department also offers courses at first year level for students who wish to strengthen their mathematics without going on to more advanced studies.

Students who major in mathematics, statistics or operations research often decide to do postgraduate study. An Honours degree (BSc Hons) involves taking an additional year of advanced papers that extend the undergraduate material.

A Masters Degree (MSc or MA) typically involves doing several advanced papers and producing an MA or MSc thesis based upon a research project. A PhD or Doctorate typically involves the production of a PhD thesis based on original research which results in new knowledge. Completion of a PhD will require three years full-time study.

The university also offers a Graduate Diploma in Science for graduates and those with appropriate or other work experience. Relevant specialisms include biodiversity, geophysics, logic and computing, mathematics, meteorology, modelling with differential equations, physics, statistics and operations research.

Maths Stats Wheel



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