The University of Melbourne
Department of Mathematics and Statistics

Master of Science
Research Training (Coursework) Guide
and
Honours & PGDip Guide
2010*

*This guide has been prepared to assist you in deciding whether to apply to enter MSc (research training: coursework), Honours or PGDip studies and in designing your course. You are advised that the rules governing the MSc and Honours programs are definitively stated in the official University Handbook. In the event of a disagreement between this Guide and the Handbook, it is the Handbook that is to prevail. The information in this Guide is given in good faith and correct (to the best of our knowledge) at the time of writing (October 2009). It has been carefully checked, but the Department of Mathematics and Statistics accepts no responsibility for the accuracy of the information.

Contents

1 Overview

The Master of Science program (two years full time) and the Honours and Postgraduate Diploma (PGDip) programs (one year full time study each) in Mathematics and Statistics are flexible programs allowing students to study subjects in four broad specializations: (A) Pure Mathematics, (B) Applied Mathematics and Mathematical Physics, (C) Operations Research and Discrete Mathematics, and (D) Statistics and Stochastic Processes. Subjects (to be referred to as postgraduate level, or **PG-level**, subjects in the present Guide) are taught at an advanced level and form an ideal preparation for research in Mathematics and Statistics, including doctoral (PhD) studies.

Each student will be assigned an academic supervisor from a specialisation, who will give individual advice and assist in developing an individual course plan for that student. Students are required to undertake a research project, and MSc students are also required to undertake a professional tool subject. The table below lists discipline subjects available to MSc and Honours/PGDip students in 2009 and 2010 (for semester allocation of PG-level subjects in 2010, see p. 12 of the guide). **Please note:** Starting from 2011, the coursework offerings will be somewhat different, to reflect changes due to the introduction of the New Melbourne Model. The structure of the program will be quite close to the present one, with a number of changes within the four specialisation areas.

MSc and Honours/PGDip Coursework and Thesis: Mathematics and Statistics (2009 & 2010)		
	Applied Mathematics & Math. Physics	**Pure Mathematics**
	Computational Differential Equations	Measure Theory
	Phase Transitions and Critical Phenomena	Commutative Algebra
Discipline subjects	Advanced Materials Modelling	Representation Theory
(12.5 points each)	Integrable Models (2009)	Algebraic Topology
	Mathematical Biology (2009)	Algebraic Geometry (2009)
	Topics in Dynamical Systems (2010)	Differential Geometry (2009)
MSc students	Random Walks and Random Structures (2010)	Functional Analysis (2009)
choose 8–11 subjects		Differential Topology (2010)
		Advanced Complex Analysis (2010)
Honour students	**Statistics and Stochastic Processes**	Geometric Group Theory (2010)
choose 6 subjects,	Business Forecasting	**Operations Research and**
PGDip choose 4–6 subjects	Mathematics of Risk (2010)	**Discrete Mathematics**
(see Section 2.4)	Probability for Inference	Optimisation for Industry
	Statistical Inference	Network Optimisation (2009)
NB: Not all subjects	Stochastic Processes	Scheduling and Optimisation (2010)
offered each year	Data Mining	Advanced Discrete Mathematics
	Consulting and Applied Statistics	Enumerative Combinatorics (2009)
		Experimental Mathematics (2010)
Professional tools	Systems Modelling and Simulation	
MSc students	eScience	Science in Context
choose one	Ethics in Science	Science and Communication
Research project	MSc: 50 points Honours/PGDip: 25 points	

2 Course Structure

2.1 Programs

In 2010 the following advanced level programs will be offered in the Department of Mathematics and Statistics:

- Master of Science Research Training (Coursework) in Mathematics and Statistics
  Coordinator: Dr Paul Norbury
- BSc (Hons) and PGDip in Mathematics and Statistics
  Coordinator: Dr Omar Foda

The following two programs are offered jointly by the participating departments:
Combined BSc (Hons) in Mathematics and Statistics/Computer Science (Computer Science coordinator: Dr Adrian Pearce); Combined BSc (Hons) in Mathematics and Statistics/Physics (Physics coordinator: Dr Nicole Bell).

2.2 MSc

The total weight of all components of the degree is **200** credit points.

Discipline Subjects MSc students must take 11 of the PG-level subjects from the list above (12.5 points each, total points 137.5). With the approval of the supervisor and the course coordinator, a student will be allowed to substitute up to *three* of the PG-level discipline Mathematics & Statistics subjects with lower level subjects or subjects from contiguous areas. Of these substitute subjects, up to two can be 200 or 300 level subjects needed to obtain requisite knowledge for PG-level discipline Mathematics & Statistics subjects and up to two can be PG-level subjects taught by other Departments of the University.

Professional Tools MSc students must take 'Systems Modelling and Simulation', unless they have completed 620-131 (2007) 'Scientific Programming and Simulation' or equivalent. If students have previously completed 620-131 (2007) 'Scientific Programming and Simulation', then they must take one of the other four professional tool subjects listed in the table on p. 3 (12.5 points each).

Research Project The Research Project (50 points) is an integral part of the degree, and a thesis is the main requirement for this component. Candidates must pass the Research Project to be awarded the Degree.

2.3 Honours

The total weight of all components of the degree is **100** credit points.

Discipline Subjects Honours students must take six of the PG-level subjects from the list above (12.5 points each, total points 75).

Research Project The Research Project (25 points) is an integral part of the degree, and a thesis is the main requirement for this component. Candidates must pass the Research Project to be awarded the Degree.

2.4 Postgraduate Diploma in Science (PGDip)

This program is similar to the BSc (Hons) program. The main difference is that the entry requirements are not as stringent and it is possible to replace up to two PG-level subjects by 300-level ones, subject to approval by the student's supervisor and the Honours Coordinator. The PGDip program may be more suitable than the Honours programs for students coming from overseas and for local students who have not majored in Mathematics or Statistics. Upon approval by the Head of the Department, a student may transfer from PGDip to Honours program not later than in the middle of his/her PDGip program and subject to the following Faculty of Science eligibility conditions:

- the student has completed a BSc, BbiomedSc or equivalent;
- the student has achieved an average of at least 65% over the assessed advanced coursework component of their course after one semester; and

- the student has made satisfactory progress in the research component of their course as determined by their supervisor and hence may reasonably be considered to be on track to achieve an overall mark of at least 65% at the conclusion of the program.

3 Comparison of MSc and Honours

The Master of Science in Mathematics and Statistics is a postgraduate degree whilst Honours is an undergraduate degree. The aims of these programs are to train students to enable them to proceed to further postgraduate study at the University of Melbourne or other institutions and equip students with a range of skills demanded by today's employers.

The Master of Science in Mathematics and Statistics is a two-year program that allows students to focus on a specialist area of the discipline and broaden their experience by taking subjects from other specialisations. The degree is an extension of the Department's existing Honours program, which consists of successful completion of six subjects and a minor thesis within one year of full time study. The existing Honours program is well regarded and has been operating successfully for decades.

The major difference in the two-year program is that students will receive a much better preparation for research, especially if a student aims at doing a PhD. The two-year program is broader, and students will complete subjects from more than one specialisation within Mathematics and Statistics. With the approval of the supervisor and the course coordinator, a student will be allowed to substitute up to *three* of the PG-level discipline Mathematics & Statistics subjects with lower level subjects or subjects from contiguous areas. Of these substitute subjects, up to two can be 200 or 300 level subjects needed to obtain requisite knowledge for PG-level discipline Mathematics & Statistics subjects and up to two can be PG-level subjects taught by other Departments of the University. A further difference is the requirement that students take the compulsory professional tool subject Systems Modelling and Simulation, which will ensure all graduates have the modelling and computational skills appropriate for employment as a mathematician or statistician.

Students enrolled in the MSc or Honours will be assigned an academic supervisor from their specialisation who will give individual advice and assist in developing an individual course plan for that student. For example, a typical MSc student in statistics would be advised to take the core subjects 'Business Forecasting', 'Mathematics of Risk', 'Probability for Inference', 'Statistical Inference', 'Stochastic Processes', 'Data Mining', 'Consulting and Applied Statistics' and the professional tool subject 'Systems Modelling and Simulation'. The remaining four subjects would depend on the student's interests. Thus, for example, a student with interests in optimisation and operations research would be encouraged to take 'Optimisation for Industry', 'Network Optimisation', 'Scheduling and Optimisation' and 'Random Walks and Random Structures'.

For many students, the advanced courses and project that they do after their first three years of undergraduate courses is the most exciting and valuable time in their studies. Following up their special interests enables students to develop their research and analytic skills and substantially extends the knowledge gained in earlier years. In some areas there is a possibility of applying theory to real-world problems. The MSc and Honours programs in Mathematics and Statistics provide an opportunity for students to carry out a research project under the supervision of a staff member who is an expert in the area. They will also learn how to effectively present their findings in print by using document preparation programs such as LaTeX, and how to prepare and deliver a professional oral presentation. Students will have the opportunity to share the findings of their research project with other students and staff in two presentations during the program. They will have the opportunity to acquaint themselves with the Internet and other tools essential in mathematical and statistical research such as MathSciNet (Mathematical Reviews online), to attend seminars that are designed to further extend their specialized knowledge and to inform them about research and job opportunities in Mathematics and Statistics.

MSc and Honours students are a part of the Australian mathematical and statistical community, and should consider membership in professional organizations. Full-time students in Australian Universities receive their first year of membership in the Australian Mathematical Society free and half-price membership to the Statistical Society of Australia.

4 Entry Requirements

4.1 MSc

A bachelor degree with a major in an appropriate discipline with at least an H3 (65%) in the major, or equivalent.

4.2 Honours

To be accepted into the Honours program you must satisfy the entry requirements of the Faculty of Science and the Department of Mathematics and Statistics.

- The Faculty of Science requirements:
  - Applicants must hold a Bachelor of Science (BSc) or equivalent qualification recognised by the Faculty of Science. Applicants currently enrolled in a BSc combined course at The University of Melbourne are not required to have completed their combined course to be eligible for Honours. However, these combined course applicants are required to have completed sufficient points to be eligible for the single Bachelor of Science degree.
  - In addition, applicants must also meet the following requirements, depending on their tertiary qualifications:
    * Graduates of the University of Melbourne BSc single degree must normally have a Faculty Honours Score (FHS) of at least 65%. The FHS is a weighted average based on a student's performance in their best 87.5 points of science study at the 300-level.
    * For combined course students the Faculty calculates a weighted average mark for the 300-level science subjects that have been completed. A weighted average of at least 65% is normally required for entry into Honours.
    * Applicants who have completed their degree at other institutions must demonstrate that they have achieved an average of 65% for the third year science subjects they have studied. The department reserves the right to scale the applicants results to make them comparable to the marks of the University of Melbourne students.
- The Department of Mathematics and Statistics requirement:
  - At least 65% in at least four 300-level Mathematics/Statistics subjects.

Students who do not meet this requirement, but who have achieved very good results in other areas, may be considered for entry to Honours on the recommendation of the Head of the Department of Mathematics and Statistics.

4.3 Recommended 300-level Subjects for Prospective MSc and Honours Students

It is important that prospective MSc and Honours (or PGDip) students select suitable 300-level Mathematics and Statistics subjects that provide appropriate background for their study. Students who wish to pursue MSc or Honours study in a certain specialization but miss one or more prerequisite courses should seek advice from their (potential) supervisor(s) and the appropriate lecturer(s) well before the start of their program.

The recommendations below are given in the form suitable for both

- students who started their undergraduate degrees prior to 2008 and
- New Generation degrees students (those who started their undergraduate studies in 2008+; please note that these students **will not** have access to Honours in Mathematics and Statistics).

The recommendations are stated for each of the four broad specialization areas in Mathematics and Statistics.

4.3.1 Recommendations in terms of the 300-level subjects offered in 2009

For the names & descriptions of the subjects with the codes mentioned below, please see the old version of the university Handbook at http://www.unimelb.edu.au/HB/areas/SMATH.html

A. Pure Mathematics. The subjects 620-311, 620-312, 620-321 and 620-322 are strongly recommended. Additional useful subjects are 620-351, 620-352 and 620-353.

B. Applied Mathematics and Mathematical Physics. For the Applied mathematics component of this stream, 620-331, 620-332 and 620-342 are strongly recommended. An additional useful subject is 620-381.

For the Mathematical Physics component, 620-231, 620-221 (or 620-252), 620-331 and 620-332 are strongly recommended. Additional useful subjects are 640-321 and 640-322 from the Physics Department.

C. Discrete Mathematics and Operations Research. For the Discrete Mathematics component of this stream, 620-221 (or 620-252), 620-352 and 620-353 are strongly recommended. Additional useful subjects are 620-351, and 620-381.

For the Operations Research component, 620-361 and 620-362 are strongly recommended. Additional useful subjects would be any two 300 level Mathematics and Statistics subjects.

D. Statistics and Stochastic Processes. For the Statistics and Applied Statistics component of this stream, 620-371, 620-372 and 620-374 are strongly recommended. Additional useful subjects are 620-301 and 620-302.

For the Probability and Stochastic Processes components of this stream, 620-301, 620-302 and 620-381 are strongly recommended. Additional useful subjects are 620-361, 620-371 and 620-374.

4.3.2 Recommendations in terms of the New Generation Subjects

First of all, it is strongly recommended that all students choose the following 200-level subjects: Real Analysis with Applications (or equivalent); Vector Calculus; Probability. Further, they should choose at least two of following the 200-level subjects: Group Theory with Linear Algebra; Dynamical Systems and Chaos; Discrete Mathematics and Operations Research; Statistics.

Students commencing the MSc program should have completed a major in one of the four specializations in the Department of Mathematics and Statistics. They are strongly recommended to study at least five 300-level Mathematics and Statistics subjects, with four being essential.

Specific 300-level recommendations related to the four specializations are listed below.

A. Pure Mathematics.

Essential: Group Theory with Linear Algebra; Complex Analysis; Algebra; Metric and Hilbert Spaces.

Strongly recommended: at least three of the following, with one being essential (excluding Partial Differential Equations): Graph Theory; Geometry; Discrete Mathematics; Partial Differential Equations.

B. Applied Mathematics and Mathematical Physics.

Essential: Dynamical Systems and Chaos; Complex Analysis; Numerical and Symbolic Mathematics; Partial Differential Equations.

Strongly recommended: at least two of the following: Graph Theory; Discrete Mathematics; Stochastic Modelling.

C. Discrete Mathematics and Operations Research.

Essential: Discrete Mathematics and Operations Research; Complex Analysis; Decision Making and Discrete Mathematics.

Also essential: at least two of the following: Techniques in Operations Research; Graph Theory; Stochastic Modelling.

D. Statistics and Stochastic Processes.

Essential: Statistics; Linear Statistical Models; Stochastic Modelling.

Also essential: at least one of the following: Probability and Statistical Inference; Modern Applied Statistics.

Strongly recommended: Complex Analysis.

5 How to Apply

5.1 MSc

Applications to the Master of Science program are made online: please go to

http://graduate.science.unimelb.edu.au/science/apply

Please refer to the above Faculty Web-site for application deadline(s); if there is none when you are viewing the site, please contact the Melbourne Graduate School of Science (click 'Contact us' at the bottom of the above-mentioned Web page). Under certain circumstances, students may be eligible for mid-year commencement (application deadline: Wednesday 30 June 2010).

5.2 Honours and Postgraduate Diploma

Applications to the Honours program are made online via

http://www.ssc.science.unimelb.edu.au/career/further/honours/application

This site, in particular, says that 'Applications close 20 November 2009. Any applications submitted after this date **may be considered subject to departmental approval.**' Under certain circumstances students may be eligible for mid-year commencement. In this case the applicant should contact the Honours Coordinator by Wednesday 30 June 2010. After these dates please talk to the Honours Coordinator.

Applications to the PGDip program are made online via

http://graduate.science.unimelb.edu.au/science/apply

The same deadline as for Honours applications applies.

Subject to the approval of the Departments of Physics and Mathematics and Statistics, an applicant who is able to devise an appropriate course plan in conjunction with both departments may be considered for mid-year entry for Combined BSc (Honours) in Mathematics and Statistics/Physics. The same policy applies to mid-year entry for Combined BSc (Honours) in Mathematics and Statistics/Computer Science.

Letters of acceptance are usually sent by the Faculty of Science in mid-December for commencement in Semester 1. See the Faculty of Science Honours website for the application process and timeline. The Faculty of Science does not allow students who have been offered a place in Honours to defer commencement of the course.

6 How to Find a Supervisor

Both MSc and Honours applicants are strongly encouraged to contact potential supervisors to discuss possible research projects before submitting their applications. Information about the Department, in particular the research activities of various research groups, can be found on the departmental web site:

http://www.ms.unimelb.edu.au

Research interests of individual staff members in the Department can be searched online at:

http://www.ms.unimelb.edu.au/Students/supervisorList.php

A supervisor and a second examiner will be appointed for each Honours student. To assist in this, a student is expected to contact a potential supervisor ahead of the beginning of the program. The Honours Coordinator should be advised after the supervision arrangement is finalized.

- The role of the supervisor is to suggest the content and aim of the project, discuss relevant sources including textbooks, papers, reports, industry materials etc., as well as the timeline for the project and the best strategy for combining the coursework and project. During the year, the supervisor should oversee the student's progress and provide advice and feedback.
- The second examiner acts as an advisor to the student when the principal supervisor is absent from the department.

The student is expected to provide a draft of the thesis in good time for the supervisor to read and comment on (doing that at least two weeks prior to the thesis submission date would be appropriate) and is responsible for submitting two final (bound hard) copies of the thesis by the deadline specified in this Guide. The supervisor and the second examiner will be responsible for marking the thesis.

7 CSP, HECS and Scholarships

7.1 CSP and HECS

The Master of Science programs will have 'Commonwealth Supported Places' (CSP) available for Australian students. BSc (Honours) and PGDip programs are supported by the Commonwealth. For more details, contact the Faculty of Science.

For more detail concerning CSPs, please visit the Commonwealth Government's Department of Education, Employment and Workplace Relations website 'Going to Uni':

http://www.goingtouni.gov.au/

For information for future International students (incl. tuition fees) please refer to:

http://www.futurestudents.unimelb.edu.au/int/apply/

For more information on tuition fees for MSc, please visit the following website:

http://graduate.science.unimelb.edu.au/science/fees

Honours students may wish to consider undertaking some part-time tutoring in the department in the first semester of their Honours year. For further information please see Dr Deb King (Director of the Mathematics and Statistics Learning Centre) as early as possible to register your interest.

7.2 Scholarships, Studentships, Awards and Prizes

Melbourne Graduate School of Science

The Melbourne Graduate School of Science offers a range of prizes and awards across graduate programs and disciplines to Australian and international students. There are also a number of scholarships available for students undertaking research programs. For more information, visit:

http://graduate.science.unimelb.edu.au/science/support

For Graduate Coursework Scholarships, check

http://www.services.unimelb.edu.au/scholarships/gradcoursework/

and for the Faculty of Science awards, prizes and scholarships, visit

http://www.science.unimelb.edu.au/scholarships

Maurice Belz Scholarships

The department offers up to three scholarships (valued at $7000 each) to students enrolled in our Honours Degree or Master of Science (research training) program, specialising in Statistics and undertaking a research project in one of these areas: Applied Statistics, Applied Probability and Stochastic Processes, Operations Research. Application deadline is Friday, 15 January 2010. For more detail please contact our Academic Support Officer (contact details are on p.10).

Departmental Studentships

In 2010 the department may offer up to 15 studentships ($1000 each) to Research Training Masters and Honours/PGDip students. The studentships will be awarded mid-year on a competitive basis to full-time students who enrol solely in the Department of Mathematics and Statistics and who have not been awarded any major scholarship (namely, $5000 or above). Necessary conditions for being considered for the award of the studentship are successful completion of the first semester and continuing enrolment. Successful completion of the first semester is defined as having completed at least three coursework subjects with an average of at least 65% (for MSc and Honours students) or 50% (for PGDip students).

Prizes

The department also awards the following prizes and scholarship for which Honours students are eligible:

Wyselaskie Scholarship: awarded to the best Honours student in Mathematics and Statistics.

Dwight's Prize: awarded to the best Honours student in Statistics.

Urquhart Prize: awarded to the student with the best overall performance in Mathematics in their Honours year (it is expected that MSc students will also be eligible for this prize in 2010).

Nanson/Wilson Prizes: awarded to best original memoir by a student within seven years of first enrolment.

8 Research Project

Provisional project titles and supervisors for MSc and Honours should be finalised by 31 January 2010 and recorded on the form 'Proposed Course Details 2010' (to be made available for downloading from the Honours page of the Department's Web site).

It is expected that projects will be prepared to a professional standard using a document preparation program such as LaTeX. Samples of recent projects can be found in a dedicated section of the Mathematics and Statistics Library, and a number of recent ones are available on the department website.

The final project submission dates are: 2:00pm on Friday 5 November 2010 for end-of-year completion and 2:00pm on Friday 4 June 2010 for mid-year completion (two bound hard copies of the thesis will need to be submitted to the General Office; the requirements apply to all MSc and Honours/PGDip students who are to complete their degrees in the respective semesters). For those students who do not meet the submission deadline, the Examiners will take this into account at the Examiners Meeting. Each student will be required to give a seminar on the subject of their Project on Friday 26 November 2010 (end-of-year completion) or Friday 25 June 2010 (mid-year completion).

The project will be assessed on criteria which will take into account the research areas (pure mathematics, applied mathematics, operations research, probability, applied statistics etc.) and different forms (such as predominantly survey, new research, biological or industrial application, modelling etc.) a thesis may take. These criteria will include:

- clarity of exposition;
- mathematical accuracy;
- mathematical insight displayed;
- coverage of the field and references;

and may be complemented by one or more of the following:

- description of the application and/or business context;
- mathematical modelling;
- presentation and analysis of numerical results.

The weights given to these components will take into account the nature of the project.

Student Seminars

During their candidature, students should give at least two talks. The first one could be a progress talk on their project or on another related topic and may be given before their research group. The second one will be presented as part of a mini 'conference' which is an all-departmental activity and which will be held at the end of the final semester of their degree (see above for the dates).

9 Pass Requirements

To be awarded an Honours qualification, an Honours student must achieve an overall weighted average of at least 65% in their Honours studies. MSc and PGDip students must pass all their subjects.

MSc and Honours/PGDip students should consider themselves a part of the research strength of the Department and view departmental seminars as a method of broadening their knowledge. It is therefore expected that students will attend all research seminars in the broader area of their chosen field.

10 Contact Details

- Dr Paul Norbury, MSc – Research Training (Coursework) Coordinator;
  phone: (03) 8344 7163, email: P.Norbury@ms.unimelb.edu.au.
- Dr Omar Foda, Honours Coordinator;
  phone: (03) 8344 3453, email: O.Foda@ms.unimelb.edu.au.
- Kirsten Hoak, Academic Support Officer;
  phone: (03) 9035 8013, email: khoak@unimelb.edu.au.

11 Key Dates

Application Dates for MSc students to commence their studies in 2010:

- Please see the Faculty Web site referred to in Section 5.1 above.

Application Dates for Honours/PDGip students to commence their studies in 2010:

- By Friday 27 November 2009 [???]
- Commencing in Semester 2: by Wednesday 30 June 2010

(Applications for Honours/PGDip may be accepted after these dates. Talk to the Honours Coordinator.)

Honours/PGDip Commencement: One week before the start of lectures (for those who start their Honours/PGDip studies in Semester 1, 2009)

Honours Thesis Submission Deadline:

- 2:00pm, Friday 5 November 2010 (end-of-year completion)
- 2:00pm, Friday 4 June 20010 (mid-year completion)

(For those students who do not meet the submission deadline, the Examiners will take this into account at the Examiners' Meeting.)

Research Project Seminars: Friday 26 November 2010 (end-of-year completion);
Friday 25 June 2010 (mid-year completion)

12 Useful Web Sites

Department of Mathematics and Statistics:

http://www.ms.unimelb.edu.au

Department Website for prospective MSc and Honours students:

http://www.ms.unimelb.edu.au/Students/MSc_Honours/Prospect_MSc_Honours.php

Melbourne Graduate School of Science:

http://graduate.science.unimelb.edu.au/

Faculty of Science MSc (Mathematics and Statistics) Website:

http://graduate.science.unimelb.edu.au/programs/msc/ms

Science Student Centre's Honours Website:

http://ssc.science.unimelb.edu.au/career/further/honours

Melbourne Scholarships Office:

http://www.services.unimelb.edu.au/scholarships/

University Career and Employment Website:

http://www.services.unimelb.edu.au/careers/

13 MSc and Honours/PGDip Discipline Subjects in 2010

Semester 1, 2010	Semester 2, 2010
Algebraic Topology Commutative Algebra Computational Differential Equations Consulting and Applied Statistics Data Mining Experimental Mathematics Measure Theory Optimisation for Industry Phase Transitions and Critical Phenomena Probability for Inference Representation Theory Topics in Dynamical Systems	Advanced Discrete Mathematics Advanced Materials Modelling Advanced Complex Analysis Differential Topology Geometric Group Theory Mathematics of Risk Random Walks and Random Structures Scheduling and Optimisation Statistical Inference Stochastic Processes

14 Appendix 1: Discipline Subjects

Please note: Starting from 2011, the coursework offerings will be somewhat different, to reflect changes due to the introduction of the New Melbourne Model. The structure of the program will be quite close to the present one, with a number of changes within the four specialisation areas. The subjects listed below are offered in 2009/10 (note that some of them are offered in one year only, please refer to the table on p. 12).

Advanced Complex Analysis
Coordinator: Paul Norbury
This course is a second course in complex analysis. Complex analysis is a powerful tool that can be applied in many problems from pure and applied mathematics and in numerical problems. Some applications will be discussed in the last few lectures of the course. Applications are listed below and will be chosen according to the tastes of the students. The syllabus of this subject include: holomorphic functions, Cauchy's theorem, maximum principle and Schwarz's lemma, residue theorem and argument principle, limits of analytic functions, power series, special functions, normal families, Riemann mapping theorem, applications. The applications of this subject include: heat flow, random walks, fluid flow, and electrostatics.
Recommended Pre-requisites: A subject in real and complex analysis (equivalent to 620-221 [2009] Real and Complex Analysis).

Advanced Discrete Mathematics
Coordinators: Richard Brak and Peter Forrester
The subject consists of four main topics. These are combinatorial logic by way of Sperners lemma and Ramsey theory; combinatorics on words and Sturmian sequences; bijective enumeration with applications to maps lattice paths and trees; integer partitions and tableaux. This subject has relevance to a broad range of specialisations.
Recommended Pre-requisites: Third year subjects in graph theory and/or discrete mathematics (equivalent to 620-352 [2009] Graph Theory or 620-353 [2009] Discrete Mathematics).

Advanced Materials Modelling
Coordinators: Yong Shi and Antoinette Tordesillas
This subject focuses on physical principles and techniques for modelling the behaviour of advanced materials, which find applications in modern technological advances ranging from nanoelectromechanical systems and Atomic Force Microscopy to processes in the pharmaceutical and geotechnical industries involving the manipulation of fine powders and grains. Particular attention will be paid to development of continuum techniques and discrete models for describing the deformation and mechanical behaviour of fluids and granular materials. As such this subject will draw directly on fundamental knowledge gained by students in the field of continuum mechanics. Topics to be covered include basic elements of granular deformation and flow and numerical methods in fluid mechanics. Advanced mathematical techniques will also be introduced enabling both exact and approximate solutions.
Recommended Pre-requisites: A third year subject in continuum mechanics (equivalent to 620-342 [2009] Industrial & Applied Mathematics).

Algebraic Geometry
Coordinator: Alex Ghitza
Algebraic geometry is the study of the zero sets of polynomials. As the name suggests, it combines algebra and geometry. It is a fundamental tool in many areas of mathematics, including differential geometry, number theory, integrable systems and in physics, such as string theory. Syllabus: Plane conics, cubics and the group law, genus of a curve, commutative algebra Noetherian rings, Zariski topology, the Nullstellensatz, coordinate ring of functions on a variety, projective varieties, singularities, divisors, Riemann Roch theorem.
Recommended Pre-requisites: A subject equivalent to 620-636 Commutative Algebra.

Algebraic Topology
Coordinator: Craig Hodgson
In this subject we study some of the fundamental questions in topology: classification of topological spaces and continuous maps between them. The aim is to reduce problems in topology to problems in algebra by introducing algebraic invariants associated to spaces and continuous maps. This is most successful for special classes of spaces including manifolds (locally Euclidean spaces) and CW complexes (built up by gluing together cells of various dimensions). We first study homology theory introducing singular homology

theory and the axiomatic approach of Eilenberg and Steenrod. We also show how homology calculations can be done efficiently for CW complexes. Next we study cohomology theory which is a kind of dual to homology theory. A new feature here is the existence of product operations which give important additional information about spaces and continuous maps. Finally we examine the very special properties of the homology and cohomology of manifolds including the key Poincare duality theorems.
Recommended Pre-requisites: Third year subjects in algebra and topology (equivalent to 620-321 [2009] Algebra and 620-322 [2009] Topology).

Business Forecasting
Coordinator: Aihua Xia
Forecasting is an indispensable part of decision making in business management and government planning. This subject discusses the concept of forecasting and deals with standard forecasting tools. Topics covered include autoregressive, autoregressive moving average and autoregressive integrated moving average time series models and general autoregressive conditional heteroscedasticity, elements of spectral analysis and linear predictors.
Recommended Pre-requisites: A theoretical statistics subject (equivalent to 620-202 [2009] Statistics) and a probability subject (equivalent to either 620-201 [2009] Probability or 620-205 [2009] Probability for Statistics.

Commutative Algebra
Coordinator: John Groves
Commutative algebra is the basis of modern algebraic geometry. It provides the rigorous foundation for the study of curves and surfaces and their generalisations. Students will study: basic properties of rings, basic properties of modules including Nakayama's Lemma; Hom and tensor; Localisation; Noetherian properties and the Hilbert Basis theorem; Associated primes and primary decomposition; Gröbner bases; Integral extensions; extension of primes in integral extensions; the Hilbert Nullstellensatz; Extended applications taken from Algebraic Geometry and Algebraic Number Theory.
Recommended Pre-requisites: A third year subject in algebra (equivalent to 620-321 [2009] Algebra).

Computational Differential Equations
Coordinator: Steven Carnie
This subject discusses techniques to determine numerical solutions to a variety of problems commonly encountered in science and engineering. Understanding the behaviour of the mathematical problem gives insight into the pitfalls for the unwary in using canned packages inappropriately or uncritically. Topics will include boundary value problems for ordinary differential equations and the solution of parabolic, hyperbolic and elliptic partial differential equations.
Recommended Pre-requisites: A third year subject in partial differential equations (equivalent to 620-331 [2009] Applied Partial Differential Equations); a basic level of proficiency in computer programming.

Consulting and Applied Statistics
Coordinator: Ian Gordon
This subject is about the application of statistics in real situations. It deals with thinking about data in a broad context; the client consultant relationship; consulting sessions; verbal and written communication skills; organizing the structure of a statistical problem; professional ethics; case studies; teamwork; presentation of results including graphical methods, tables, report writing; project work; supervised consulting; developing models; searching the literature for relevant background material and critical assessment.
Recommended Pre-requisites: Third year subjects in statistics (equivalent to 620-371 [2009] Linear Models and 620-372 [2009] Applied Statistical Inference).

Data Mining
Coordinator: Owen Jones
Data mining refers to the management and analysis of large data sets. Data mining became possible with the advent of large-scale data collection and the computing power necessary to process it. It involves all of the following steps: (1) Data Warehousing. (2) Data Cleaning. (3) Data Description and Visualisation. (4) Data Analysis and Interpretation. This course deals only with step (4) of the Data Mining process: data analysis and interpretation. It considers techniques for Rule Finding, Classification, Regression and Clustering. The themes that run through the course are:
1. Model fitting and selection and how to avoid overfitting.
2. Scalable algorithms that can be used with very large data sets.

3. How to acommodate high-dimensional data.
4. Actionability and interpretability of models.
Recommended Pre-requisites: A second year statistics subject (equivalent to 620-202 [2009] Statistics) and have had some exposure to computer packages.

Differential Geometry
Coordinator: Hyam Rubinstein
In this course students will become familiar with the basic notions of Riemannian metrics and curvature, geodesics and concrete examples such as hypersurfaces in Euclidean space, Lie groups and homogeneous spaces. Some fundamental tools of global differential geometry will be covered, for example, the Cartan-Hadamard theorem for manifolds of non positive curvature and O'Neill's formula for the curvature of homogeneous spaces.
Recommended Pre-requisites: A subject in real and complex analysis (equivalent to 620-221 [2008] Real and Complex Analysis).

Differential Topology
Coordinator: Paul Norbury
This course brings together analysis and topology. It will discuss intersections of submanifolds, transversality, Sard's theorem, deformations and the inverse function theorem. The course will then discuss the deep and fundamental concepts underlying intersection theory, in particular homology, cohomology and differential forms. Characteristic classes will also be discussed.
Recommended Pre-requisites: A subject in real and complex analysis (equivalent to 620-221 [2008] Real and Complex Analysis) and have been exposed to multivariate calculus.

Enumerative Combinatorics
Coordinator: Aleks Owczarek.
The subject is about the use of generating functions for enumeration of combinatorial structures including partitions of numbers and of sets permutations with restricted cycle structure connected graphs and other types of graph; solution of recurrence relations; methods of asymptotic enumeration; some applications in statistical mechanics. The methods covered have widespread applicability including areas of pure and applied mathematics and computer science.
Recommended Pre-requisites: A subject in real and complex analysis (equivalent to 620-221 [2008] Real and Complex analysis or 620-252 [2008] Analysis).

Experimental Mathematics
Coordinator: Jan De Gier
Modern computers have developed far beyond being great devices for numerical simulations or tedious but straightforward algebra; and in 1990 the first mathematical research paper was published whose sole author was a thinking machine known as Shalosh B Ekhad. This course will discuss some of the great advances made in using computers to purely algorithmically discover (and prove) nontrivial mathematical theorems in, for example, Number Theory and Algebraic Combinatorics. Topics include: Automated hypergeometric summation, Groebner basis, Chaos theory, Number guessing, Recurrence relations and BBP formulas.
Recommended Pre-requisites: There are no pre-requisities.

Functional Analysis
Coordinator: Jerry Koliha
Functional Analysis is the study of spaces of functions and various structures on these spaces, in particular norms. This subject has important applications to differential and integral equations in mathematics, engineering and physics. The syllabus will consist of the following: bounded linear operators between Banach and Hilbert spaces; operator topologies; classical spectrum of an operator; fine analysis of the spectrum; axiomatic spectral theory; isolated spectral sets; compact, Kato, Fredholm and Browder operators; self-adjoint, normal and unitary operators on a Hilbert space; C^* and von Neumann algebras.
Recommended Pre-requisites: A third year subject on measure and integral (equivalent to 620-312 [2009] Linear Analysis).

Geometric Group Theory
Coordinator: Lawrence Reeves
In Geometric Group Theory geometrical ideas are used to give new insights into group theory. Although its roots can be traced back to the work of Dehn at the beginning of the twentieth century, the subject has mostly been developed in the last twenty years. The subject draws on ideas from low dimensional topology and from hyperbolic geometry. In particular, coarse curvature conditions on groups, and their consequences, will be a core topic of the subject.
Recommended Pre-requisites: Third year subjects in algebra and topology (equivalent to 620-321 [2009] Algebra and 620-322 [2009] Topology).

Integrable Models
Coordinator: Omar Foda
This subject studies integrable dynamical systems using basic ideas from analysis, algebraic combinatorics, representation theory, quantum field theory and algebraic geometry. The KP hierarchy of nonlinear partial differential equations is primarily used as a representative example.
Recommended Pre-requisites: Second and/or third year subjects in vector analysis, complex analysis, ordinary and partial differential equations (e.g. equivalent to 620-252 [2008] Analysis and 620-331 [2009] Applied Partial Differential Equations).

Mathematical Biology
Coordinator: Kerry Landman
Modern techniques have revolutionised biology and medicine, but interpretative and predictive tools are needed. Mathematical modelling is such a tool. It provides explanations for counter intuitive results and predictions leading to new experimental directions. Mathematical techniques are beginning to play a key role in tackling challenges in the medical sciences. Mathematical biology has been applied to many applications and covers a large range of mathematical techniques, for example discrete time models, ordinary differential equations, partial differential equations, stochastic models and cellular automata. The broad flavour of the area will be discussed, with particular areas highlighted in more detail. Applications will be drawn from many areas including population growth, epidemic modelling, biological invasion, pattern formation, tumour modelling, developmental biology and tissue engineering.
Recommended Pre-requisites: A third year subject in partial differential equations (equivalent to 620-331 [2009] Applied Partial Differential Equations).

Mathematics of Risk
Coordinator: Konstantin Borovkov
Mathematical modelling of various types of risk has become an important component of the modern financial industry. The subject discusses the key aspects of the mathematics of market risk. Main concepts include loss distributions, risk and dependence measures, copulas, risk aggregation and allocation principles, elements of extreme value theory. A main theme is the need to satisfactorily address extreme outcomes and the dependence of key risk drivers.
Recommended Pre-requisites: A theoretical statistics subject (equivalent to 620-202 [2009] Statistics) and a subject in probability (equivalent to 620-201 [2009] Probability).

Measure Theory
Coordinator: Gregory Hjorth
Measure Theory formalises and generalises the notion of integration. It is fundamental to many areas of mathematics and probability and has applications in other fields such as physics and economics. Students will be introduced to Lebesgue measure and integration. Signed measures. Hahn-Jordan decomposition. Radon-Nikodym derivative. Conditional expectation. Borel sets and standard Borel spaces. Product measures. The Riesz representation theorem. The Krein-Milman theorem. The Stone-Weierstrass theorem. The measure disintegration theorem. Ergodic theory.
Recommended Pre-requisites: A third year subject in metric spaces, measure and integral (equivalent to 620-311 [2009] Metric Spaces and 620-312 [2009] Linear Analysis).

Network Optimisation
Coordinators: Sanming Zhou and David Wood
Network optimization problems arise from a diversity of areas such as Industry, Management, VLSI Layout, Transportation, Telecommunication, Computer Networking, Information Processing, etc. This subject is an introduction to Network Optimization with focus on important ideas, theoretical results and algorithms.

It covers classical problems that can be solved in polynomial time, and some more difficult (NP-hard) problems for which polynomial time algorithms are unlikely to exist.
Recommended Pre-requisites: An introductory level subject in operations research (equivalent to 620-261 [2008] Introduction to Operations) or a third year subject in graph theory (equivalent to 620-352 [2009] Graph Theory).

Optimisation for Industry
Coordinator: Heng Soon Gan
The use of mathematical optimisation is widespread in business, where it is a key management tool for planning and operations. It is also required in many industrial processes and is useful to government and community organizations. This subject will expose students to operations research techniques as used in industry. A heavy emphasis will be placed on the modelling process that turns an industrial problem into a mathematical formulation. The focus will then be on how to solve the resulting mathematical problem. Elementary linear programming and non-linear programming techniques will be reviewed, leading to an introductory treatment of integer programming techniques.
Recommended Pre-requisites: A third year subject in linear and non-linear programming (equivalent to 620-362 [2009] Applied Operations Research).

Phase Transitions & Critical Phenomena
Coordinator: Paul A. Pearce
The subject introduces the Gibbs ensembles of classical statistical mechanics, the relations to thermodynamics and the modern theory of phase transitions and critical phenomena including the concepts of critical exponents, universality and scaling. Applications include the ideal gas, mean field theories of fluids and ferromagnets and Ising lattice spin models.
Recommended Pre-requisites: A third year subject in applied mathematics methods (equivalent to 620-331 [2009] Applied Partial Differential Equations or 620-332 [2009] Integral Transforms or 620-353 [2009] Discrete Mathematics).

Probability for Inference
Coordinator: Aihua Xia
This is an advanced level course presenting probability theory from the measure theoretic viewpoint. Topics covered include probability spaces and random variables, the properties of probability measures, Lebesgue decomposition, probability measures on finite dimensional Euclidean spaces, integration and the properties of integrals, the monotone convergence theorem, uniform integrability, the dominated convergence theorem, moments and inequalities, the general notions of absolute continuity and singularity, Radon-Nikodym theorem and conditional expectation given a σ-algebra. The subject will also discuss generating functions (moment, characteristic), modes of convergence and limit theorems with applications to estimation and hypothesis testing. The presented material will be illustrated by applications to Statistics.
Recommended Pre-requisites: A subject in probability theory (equivalent to 620-201 [2009] Probability or 620-205 [2009] Probability for Statistics) and a third year stochastic modelling subject (equivalent to 620-301 [2009] Stochastic Modelling).

Random Walks and Random Structures
Coordinator: Barry Hughes
This subject is concerned with selected mathematical models of systems that evolve randomly with time and/or exhibit structural randomness and the application of these models in the physical biological and social sciences. Random walk models in discrete and continuous spaces and in discrete and continuous time are considered and related to both classical diffusion and to contemporary theories of anomalous diffusion. Random media are modelled using effective medium ideas scaling arguments and renormalization ideas and the rigorous framework of percolation theory.
Recommended Pre-requisites: It is recommended that students have completed a sound subject in real & complex analysis (equivalent to 620-221 [2008] Real and Complex Analysis or 620-252 [2008] Analysis) and a third year subject in partial differential equations (equivalent to 620-331 [2009] Applied Partial Differential Equations).

Representation Theory
Coordinator: Arun Ram
Symmetries arise in mathematics as groups. Representation Theory is the study of groups via their action on vector spaces and more general spaces. It has important applications in physics and to many other

problems such as differential equations. This subject provides students with the opportunity to study modules, SL2, cyclic and dihedral groups, diagram algebras: Temperley-Lieb, symmetric group and Hecke algebras, Brauer and BMW algebras, compact Lie groups, loop groups, affine Lie algebras and Dynkin diagrams, characters and character formulas, Induction, restriction and tensor products, connections to statistical mechanics, mathematical physics and geometry.
Recommended Pre-requisites: A third year subject in algebra (equivalent to 620-321 [2009] Algebra).

Scheduling and Optimisation
Coordinator: Peter Taylor
Scheduling is critical to manufacturing, mining, and logistics, and is of increasing importance in healthcare and service industries. Most automated systems, ranging from elevators to industrial robots, embed some kind of scheduling algorithms. Building on the Optimisation background provided in Optimisation for Industry, this subject teaches students how to solve more advanced problems. A particular focus will be scheduling problems, but other more general assignment problems will be discussed.
Recommended Pre-requisites: 620-616 Optimisation for Industry.

Statistical Inference
Coordinator: Richard Huggins
Classical statistics is concerned with parametric models, which are idealized versions of reality that allow the development of an elegant mathematical theory of inference. Modern Statistics develops methods that weaken the assumptions of these classical methods. In this course we review classical statistical methods and then consider their generalization using estimating equations. Topics include: Review of Classical Inference. Properties of Maximum Likelihood Estimators. Hypothesis Testing & Model Selection. Generalized Linear Models. The EM Algorithm. Optimal Estimating Equations, Quasi likelihood, Generalised Estimating Equations.
Recommended Pre-requisites: An undergraduate subject in statistics (equivalent to 620-202 [2009] Statistics) and either have taken or be concurrently enrolled in Probability for Inference from the present program.

Stochastic Processes
Coordinator: Konstantin Borovkov
The subject discusses the key aspects of the theory of stochastic processes that plays the central role in modern probability and has numerous applications in natural sciences in industry. Main concepts include finite dimensional distributions, path properties, convergence of stochastic processes, conditional expectations and martingales, submartingales and related inequalities, random walks, the strong law of large numbers and the functional central theorem, processes with independent increments and Markov processes. Applications to modelling random phenomena evolving in time are discussed throughout the course.
Recommended Pre-requisites: An undergraduate subject in probability (equivalent to 620-201 [2009] Probability or 620-205 [2009] Probability for Statistics) and a third year subject in stochastic modeling (equivalent to 620-301 [2009] Stochastic Modelling).

Topics in Dynamical Systems
Coordinator: Omar Foda
This is an introduction to mathematical topics in dynamical systems. Simple mechanical models will be used as concrete examples to introduce ideas and methods of great interest in pure and applied mathematics as well as in mathematical physics. The Hamiltonian approach to dynamical systems will play a central role in the presentation. All necessary mathematical tools, including differential forms, symplectic manifolds, Lie groups and the co-adjoint orbit method, will be introduced.
Recommended Pre-requisites: A subject in real and complex analysis (equivalent to 620-221 [2008] Real and Complex Analysis) and third year subjects in measure and integral and in partial differential equations (equivalent to 620-312 [2008] Linear Analysis and 620-331 [2008] Applied Partial Differential Equations).

15 Appendix 2: Procedures for Honours Students

The present appendix is an excerpt from the Department's Honours Procedures.

15.1 Introduction

The Honours program in Mathematics and Statistics is designed to:

- train students to enable them to proceed to postgraduate study at the University of Melbourne or other institutions; and to
- equip students with a range of skills demanded by today's employers that will make them highly employable.

For many students Honours is the most exciting and valuable year at university. Following up their special interests enables students to develop their research and analytic techniques and substantially extend the knowledge gained in earlier years. In some areas there is a possibility of applying theory to real world problems.

The Honours program in Mathematics and Statistics provides an opportunity for students to carry out an individual research project under the supervision of a staff member who is an expert in the area. They will learn how to effectively present their findings in print by using document preparation programs such as LaTeX, and how to prepare and deliver an oral presentation.

During the Honours program, students complete advanced Coursework consisting of at least six subjects, acquaint themselves with the Internet and other tools essential in mathematical and statistical research, such as MathSciNet (Mathematical Reviews online), and attend a series of seminars designed to further extend students' specialized knowledge and to inform them about research and job opportunities in Mathematics and Statistics. The students will have the opportunity to share the findings of their research project with other students and staff in a presentation at the end of the program.

Every year the Department of Mathematics and Statistics publishes an Honours Guide which gives up to date information about the Honours Program, including the details of the subjects making up the Coursework component together with their prerequisites, as well as giving principal dates for the Honours year.

Honours students are a part of the Australian mathematical and statistical community, and should consider membership in professional organizations. The Australian Mathematical Society offers one year's free membership to Honours students; the Statistical Society of Australia offers membership at half rate.

15.2 The Structure of the Program

Mathematics and statistics Honours students are required to undertake six PG-level coursework subjects for assessment.

The subjects taught by the department that can be counted towards the coursework component will be listed in the Honours Guide each year. A great deal of flexibility is allowed for the structure of the coursework. With the prior approval of both the supervisor and the Honours Coordinator, a student may substitute an equivalent subject taught by another department, either within the University of Melbourne or at another university, for a mathematics and statistics coursework subject.

With the assistance of the Student Administration Officer, the Honours Coordinator will keep a record of the subjects that each student is doing. It is the responsibility of the students to inform the Coordinator if they change subjects. Such a notification should be endorsed by the student's supervisor.

Honours coursework subjects should be subject to the same rules about information given to students, subject homepages etc. as the university mandates for undergraduate subjects. In particular, all components of assessment must be clearly described before the beginning of the subject, and a subject description posted on the Honours noticeboard.

In addition to their coursework, Honours students are required to complete a thesis, which is equivalent to two subjects of coursework. The marks for the thesis thus count for 25% of the student's assessment.

15.3 Assessment

It is desirable to have a significant component of the assessment for each subject as a written examination. The exam component should be worth at least 20%. Other forms of assessment can be by oral examination, by assignment, extended project or computer laboratory. If a lecturer does not want to offer an exam, he/she will have to state the case to the Honours Committee.

There will be two examiners' meetings for the Honours Program, one after the end of each semester when the results of the coursework (projects) have been compiled. The purpose of these meetings is to finalize Honours results, with a power to adjust marks in certain cases. The examiners' meeting also decides the allocation of the Wyselaskie scholarship for best overall Honours student in Mathematics and Statistics, chooses candidate Honours theses for the Nanson/Wilson prizes, and decides the allocation of the Dwight prize for the best Honours student in Statistics.

15.4 Supervision

At the beginning of their candidature a supervisor and a second examiner will be appointed for each Honours student. To assist in this process, a student is expected to contact a potential supervisor ahead of the beginning of the program. The Honours Coordinators should be advised after a supervisor is assigned.

- The role of the supervisor is to suggest the content and aim of the project, discuss relevant sources including textbooks, papers, reports, industry materials, etc., as well as the timeline for the project and the best strategy for combining the coursework and project. During the year, the supervisor should oversee the student's progress, and provide advice and feedback. It is the supervisor's responsibility to verbally communicate subject marks to students.
- The role of the second examiner is to act as an advisor to the student during the year, and to carry out the role of the supervisor when the supervisor is unavailable.

The student is expected to provide a draft of the Thesis in good time for the supervisor to read and comment, and is responsible for submitting two final copies of the thesis by the deadline specified in the Honours Guide. The supervisor and the second examiner will be responsible for marking the thesis. They should submit independent written assessments to the Honours Coordinators, together with a written report, which ought to contain a section that will be provided to the student as feedback.

The general criteria for examining of the projects are set out in the next section. They will be made known to the students at the beginning of the year.

15.5 Examination of Honours Projects

It is expected that Honours projects will be prepared to a professional standard using a document preparation program such as LaTeX. Most projects are in the range of 40–50 pages, excluding references, appendices, tables, etc., slightly more for applied and statistics topics and less for pure topics. Samples of recent projects can be found in a dedicated section of the departmental library.

The project will be assessed on several criteria which will be interpreted in the context of the mathematical/statistical category (pure mathematics, applied mathematics, operations research, probability, applied statistics, etc.), and will take into account the nature of the project (such as predominantly survey, new research, biological or industrial application, modelling, etc).

These criteria will include:

- clarity of exposition;
- mathematical accuracy;
- mathematical insight displayed;
- coverage of the field and references;

and may be complemented by one or more of the following:

- description of the application and/or business context;
- mathematical modelling;
- presentation and analysis of numerical results.

The weight given to these components will take into account the nature of the project.

The two examiners will assess the project independently. If there is a large discrepancy between the marks of the supervisor and the second examiner, the Honours Coordinator should ask them to consult about the case and either update their marks or provide a written explanation as to why they are different significantly.

Written reports by both examiners will be provided for the examiners' meeting and then released to the students.

Examiners are expected to attend the talks by the students whose projects they are examining.

15.6 Honours Project Seminars

In all walks of life, including academia, presentation skills need to be developed and practised. So, whether they are heading towards a research career, or to a job in teaching, government or industry, it is very important for our Honours graduates to have good oral presentation skills. Because of this, the department places a high degree of importance on Honours talks.

During their candidature, students should give at least two talks. The first could be a progress talk on their project or on another related topic, and may be given before their research group. The second will be presented as part of a mini 'Honours conference' which is an all-departmental activity, and which will be held at the end of the final semester (in early July for the students finishing mid year and in late November otherwise).

No student should be expected to give a talk without at least one or two practices in presence of their supervisor.