

# **Fourth Year Pure Mathematics**

2025 Handbook  
School of Mathematics and Statistics



THE UNIVERSITY OF  
**SYDNEY**

<http://www.maths.usyd.edu.au/u/UG/HM/>



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Mathematicians are like Frenchmen: whatever you say to them they translate into their own language and forthwith it is something completely different.

Goethe, *Maximen und Reflexionen*

# Chapter 1

## The Structure of Pure Mathematics Four

### 1.1 Introduction

In linguistics it is increasingly believed that universal features of language are reflections of the structure of the human brain and its perception of the world around us. In a similar fashion, mathematics is a universal language that has been developed to understand and describe how nature and life work. Mathematics, both in structure and development, is inextricably bound to our attempts to understand the world around us and our perceptions of that world. We see this in the mathematical descriptions and formulations of models in the theoretical and applied sciences: from physics, computer science and information theory on the one hand, to engineering, chemistry, operations research and economics on the other.

Just as remarkable is the way in which esoteric and abstract mathematics finds applications in the applied sciences. Indeed, one of the most exciting developments in science over the past decade has been the re-emergence of a dynamic interaction between pure mathematicians and applied scientists, which is bringing together several decades of the relatively abstract and separate development of pure mathematics and the sciences. Examples include the applications of singularity theory and group theory to symmetry-breaking and bifurcation in engineering; number theory to cryptography; category theory and combinatorics to theoretical and computational computer science; and, most spectacular of all, the developments of general field theories in mathematical physics based on the most profound work in complex analysis and algebraic geometry. Of course, this interaction is not one way. For example, there is the discovery of “exotic” differential structures on  $\mathbb{R}^4$  utilising ideas from Yang-Mills theory.

There are many valid approaches to the study of Pure Mathematics in the final Honours Year. Thus, the course may be regarded as useful in its own right, or may lead on to an M.Sc. or Ph.D. or to a teaching position in University or High School. In another direction, what want a solid base from which to continue with studies in computer science or physics, for example. Finally, you may intend to seek employment with the CSIRO or in the operations research field, or in a financial institution. In the latter circumstances, one well-known advantage of studying mathematics is that mathematics gives training in a

particular way of thinking and an analytic approach to problem solving. Mathematicians are highly adaptable (and employable).

The Fourth Year Honours program in Pure Mathematics caters for the various needs described above by offering a highly flexible and adaptable program, which is both interesting and challenging. We offer a combination of courses, which introduce the major areas of mathematics, together with a smorgasbord of deeper courses that can be arranged to suit your personal requirements.

A description of the various components of the course is given below. For detailed descriptions of the essay project see Chapter 3.

Overall, the lecture courses offered at the level of PM4 and above are intended to introduce students to the major divisions of modern mathematics and provide a knowledge of some of the main ideas needed for the understanding of much of contemporary mathematics, while still reflecting the research interests within the pure mathematics research groups.

## 1.2 Pure Mathematics Honours/PG units for 2025

The Bachelor of Advanced Studies (new Honours) (Mathematics (Pure)) requires 48 credit points from the following tables including:

- (i) 6 credit points of 4000-level Honours coursework selective units from List 1, and
- (ii) 6 credit points of 4000-level Honours coursework selective units from List 2, and
- (iii) 12 credit points of 4000-level and 5000-level Honours coursework selective units from List 1, List 2, List 3, List 4 or List 5 (listed in the Faculty Handbook).
  - a maximum of 6 credit points of which may be from List 3, and
  - a maximum of 6 credit points of which may be from List 4, and
- (iv) 24 credit points of 4000-level Honours research project units.

See the [Faculty Handbook](#)

### LIST 1

Algebraic Topology (Semester 2) (some times offered on List 4)  
 Commutative Algebra (Semester 2)  
 Representation Theory (Semester 1)

### LIST 2

Functional Analysis (Semester 1)

### LIST 3

4000 or 5000-level units from a different School

### LIST 4

5000-level units from our School.

Note that MATH53XX can be taken instead of MATH43XX only with the approval of the honours coordinator.

If you are unsure about the combination of courses you should take, consult with your supervisor or the course coordinator. In any case, you are very welcome to attend all the lecture courses. Our expectation is that the pure honours students will complete at least 12 credit points of 4000-level Honours coursework selective units from List 1 and List 2.

## 1.3 Pure Mathematics 40xx Units of Study for 2025

### SEMESTER I

Metric Spaces (MATH4061)

Rings, Fields and Galois Theory (MATH4062)

Dynamical Systems and Applications (MATH4063)

### SEMESTER II

Differential Geometry (MATH4068)

Measure Theory and Fourier Analysis (MATH4069)

## 1.4 AMSI-ACE Courses

Students are welcomed to check the courses offered in January at the [AMSI Summer School](#) (hosted at the University of Sydney in 2025) and also courses available through [Advanced Collaborative Environment \(ACE\)](#) during Semester 1 or 2. Enrolment is through the unit AMSI4001 and requires explicit permission from the honours coordinator, Prof [Laurentiu Paunescu](#) (Carslaw 721, phone (02) 9351 2969, email [pm4coord@maths.usyd.edu.au](mailto:pm4coord@maths.usyd.edu.au)).

Students are encouraged to attend the AMSI Summer School even without credit. It is a great way to get to know other students around Australia and to expand their knowledge beyond our coursework program.





I fear that I bore you with these details, but I have to let you see my little difficulties, if you are to understand the situation.

Sherlock Holmes, *A Scandal in Bohemia*

## Chapter 2

# Entry, Administration and Assessment

## 2.1 Entry Requirements for Pure Mathematics Honours

The faculty offers two main Honours pathways:

- Combined Bachelor of Science/Bachelor of Advanced Studies (BAS) is an option if you commenced your studies after 2018 and it allows completing Honours as an embedded pathway in the final year of the program. Requires two majors.
- The Bachelor of Science (Honours) is a standalone (appended) Honours requiring an additional year of study. It is for students who
  - are not on track to complete two majors in the Bachelor of Science, or
  - are external students, or
  - commenced before 2018 and did not choose to transfer to the new curriculum version of their degree.
- See [Understanding Honours<sup>1</sup>](#) for information on the types of honours you can apply for (appended, joint, embedded).

Preliminary entrance into the honours program is through the [Faculty of Science application portal](#) or through the [Combined Bachelor of Advanced Studies](#). The [Faculty requirements](#) which must be met include:

- qualifying for a degree in a major which is cognate to the proposed honours stream (a major which provides a suitable background for the honours stream; in borderline cases the decision of whether a major is cognate is in the hands of the relevant Honours coordinator and the Faculty);
- qualifying for the pass degree with two majors one of which should be cognate to the proposed honours stream, a major which provides a suitable background for the honours stream;
- having a WAM of at least 65;

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<sup>1</sup><https://www.sydney.edu.au/students/understanding-honours.html>

- securing the agreement of a supervisor.

Please refer to the respective web sites for more details on the Faculty entry requirements to Honours.

In addition, the School of Mathematics and Statistics recommends that the students have a total of at least 18CP or 24CP (depending on their major requirements) of relevant 3XXX units in which :

- the average mark of Advanced level courses is at least 65;
- the average mark of Mainstream level courses is at least 75.

If you have a mix of advanced and mainstream courses, where some are above and some below the thresholds, if you are not sure which of your courses are relevant, or if your average is just on the wrong side of the threshold you can seek further advice from the relevant program's honours coordinator.

Entry to PM4 is also subject to the approval of the Head of School and judgement of the Honours coordinator.

For the Faculty of Science Honours **application procedures** see the [Honours in Science Information](#) page.

## 2.2 Structure of Honours

An honours year in Mathematics and Statistics involves four 6CP courses (worth 50% of the final mark) and a project (worth 50%).

### 2.2.1 The honours project (50%)

The honours project centres around an essay/thesis consisting of about 40-60 pages written on a particular topic from your chosen area. The thesis is due at the end of your final semester, specifically on Monday of week 13. For more information about the essay see Chapter 3.

### 2.2.2 The Talk

As part of the essay project, students are required to give a talk about their project. The talk is worth 5% of the project mark. The talk will usually take place about the mid-semester break of student's final semester. The aim of the talk is to explain to a broader audience the purpose and nature of the project. The talk is followed by 5 minutes dedicated to questions from the audience which includes staff members and fellow students.

### **2.2.3 Coursework (50%)**

The honours program specifies a couple of core courses as well as which combination of courses can be taken – please carefully read through the list of constraints! Full-time students will normally attend two 6CP lecture courses each Semester, for a total of four courses.

## 2.3 Important coursework information for all students

### 2.3.1 Selecting your courses

Regardless of whether you are a new or an old curriculum student make sure you **select your courses after consulting the Honours supervisor and the Honours coordinator!** See also Section 1.2 for the offerings.

## 2.4 Actions to be taken

All students intending to take Pure Mathematics 4 should see the *PM4 Course Coordinator*, Prof **Laurentiu Paunescu** (Carslaw 721, phone (02) 9351 2969, email [pm4coord@maths.usyd.edu.au](mailto:pm4coord@maths.usyd.edu.au)) at their earliest opportunity, and in any case well before the beginning of the new teaching year. The Course Coordinator will advise you about choosing a supervisor and a topic for the essay project (see also Section 3.2 below).

## 2.5 Administrative arrangements

The PM4 Course Coordinator is in charge of Pure Mathematics 4 and should be consulted about any organisational problems that may arise.

In particular, students should note that the Course Coordinator's permission should be obtained if you wish to substitute courses from outside, or take a reading course or a postgraduate course. In the first instance, however, you should discuss such matters with your supervisor. Provided you can agree, the Course Coordinator's permission would then normally be a formality.

Please take particular note of the procedure to be followed if you are sick or other circumstances arise that may lead to late submission of your essay (see Section 3.4). Also note that at the end of first semester a progress report must be given to the Course Coordinator (see Chapter 3).

When we know that you are enrolled for PM4 you will be given a computer account. *The usual way in which messages for PM4 students will be distributed will be via e-mail.* Please remember to check your e-mail regularly.

## 2.6 Assessment

Each PM4 lecture course is assessed as advertised in the official unit outline available from [www.sydney.edu.au/units](http://www.sydney.edu.au/units). Usually, a written (sometimes oral) exam is held during the exam period immediately following the course; however, some courses are assessed entirely by assignment.

The essay accounts for 50% of the year's assessment.

As well as assessing the Fourth Year performance, the Department is required to make a recommendation for a grade of Honours. In exceptional cases, the grade of Honours

awarded could differ from the level of performance in the Fourth Year. The possible results for fourth year are First Class Honours, Second Class Honours division 1, Second Class Honours Division 2, Third Class Honours and No Award (Fail), usually abbreviated I, II-1, II-2, III and F.

## 2.7 Honours grades

The Faculty of Science has given the following guidelines for assessment of student performance in fourth year.

- 95–100 Outstanding First Class quality of clear Medal standard, demonstrating independent thought throughout, a flair for the subject, comprehensive knowledge of the subject area and a level of achievement similar to that expected by first rate academic journals. This mark reflects an exceptional achievement with a high degree of initiative and self-reliance, considerable student input into the direction of the study, and critical evaluation of the established work in the area.
- 90–94 Very high standard of work similar to above but overall performance is borderline for award of a Medal. Lower level of performance in certain categories or areas of study above.
- Note:* An honours mark of 90+ and a third year WAM of 80+ are necessary but not sufficient conditions for the award of the Medal. Examiners are referred to the Academic Board Guidelines on the award of Medals found in the general policy pages at the front of the Examiners' Manual.
- 80–89 Clear First Class quality, showing a command of the field both broad and deep, with the presentation of some novel insights. Student will have shown a solid foundation of conceptual thought and a breadth of factual knowledge of the discipline, clear familiarity with and ability to use central methodology and experimental practices of the discipline, and clear evidence of some independence of thought in the subject area. Some student input into the direction of the study or development of techniques, and critical discussion of the outcomes.
- 75–79 Second Class Honours, First Division – student will have shown a command of the theory and practice of the discipline. They will have demonstrated their ability to conduct work at an independent level and complete tasks in a timely manner, and have an adequate understanding of the background factual basis of the subject. Student shows some initiative but is more reliant on other people for ideas and techniques and project is dependent on supervisor's suggestions. Student is dedicated to work and capable of undertaking a higher degree.
- 70–74 Second Class Honours, Second Division – student is proficient in the theory and practice of their discipline but has not developed complete independence of thought, practical mastery or clarity of presentation. Student shows adequate but limited understanding of the topic and has largely followed the direction of the supervisor.
- 50–69 Third Class Honours – performance indicates that the student has successfully completed the work, but at a standard barely meeting honours criteria. The student's understanding of the topic is extremely limited and they have shown little or no independence of thought or performance.

The award of a medal is *not* made just on the basis of a numerical mark or formula. The merits of each eligible candidate are debated by the relevant Board of Examiners.

## 2.8 School Facilities

Pure Mathematics 4 students traditionally enjoy a number of privileges. These include:

- Desk space in the Carslaw Building.
- A computer account with access to email and the internet, as well as  $\text{\TeX}$  and laser printing facilities for the preparation of essays and projects.
- A photocopying account paid by the School for essay/project source material.
- After-hours access to the Carslaw Building. (A deposit is payable.)
- A pigeon-hole in room 728 – please inspect it regularly as lecturers often use it to hand out relevant material.
- Participation in the School's social events.
- Class representative at School meetings.

## 2.9 Scholarships, Prizes and Awards

The following scholarships and prizes may be awarded to Pure Mathematics 4 students of sufficient merit. (Note that unless the conditions of the prize state otherwise, as in the David G.A.Jackson Prize and the A.F.U.W. Prize, these prizes are also open to all Honours students in the School of Mathematics and Statistics.)

### Joye Prize in Mathematics

To the most outstanding student completing fourth year honours in the School of Mathematics and Statistics.

Value: \$6000 plus medal and shield.

### George Allen Scholarship in Pure Mathematics

To a student proceeding to Honours in Pure Mathematics who has shown greatest proficiency in at least 24 credit points of Senior units of study in the School of Mathematics and Statistics.

Value: \$1000.

**Barker Prize**

Awarded at the fourth (Honours) year examiner's meetings for proficiency in Pure Mathematics, Applied Mathematics or Mathematical Statistics.

Value: \$550.

**Ashby Prize**

Offered annually for the best essay, submitted by a student in the Faculty of Science, that forms part of the requirements of Pure Mathematics 4, Applied Mathematics 4 or Mathematical Statistics 4.

Value: \$400.

**Norbert Quirk Prize No IV**

Awarded annually for the best essay on a given mathematical subject by a student enrolled in a fourth year course in mathematics (Pure Mathematics, Applied Mathematics or Mathematical Statistics) provided that the essay is of sufficient merit.

Value: \$250.

**David G.A. Jackson Prize**

Awarded for creativity and originality in any undergraduate Pure Mathematics unit of study.

Value: \$1100.

**Australian Federation of Graduate Women: Prize in Mathematics**

Awarded annually, on the recommendation of the Head of the School of Mathematics and Statistics, to the most distinguished woman candidate for the degree of B.A. or B.Sc. who graduates with first class Honours in Pure Mathematics, Applied Mathematics or Mathematical Statistics.

Value: \$300.

**Rolf Adams Prize**

This annual prize is awarded to the pure mathematics honours student who delivers the best talk.

Value: \$100.

**University Medal**

Awarded to Honours students who perform outstandingly. The award is subject to Faculty rules, which require a Faculty mark of 90 or more in Pure Mathematics 4 and a WAM of 80 or higher in 3rd year. More than one medal may be awarded in any year.





A man ought to read just as the inclination leads him; for  
what he reads as a task will do him little good.

Samuel Johnson

## Chapter 3

# The Essay

### 3.1 Introduction

The essay project has several objectives. First and foremost, it is intended to provide an essentially open-ended framework whereby you may pursue, develop and discover your interests in mathematics unencumbered by syllabus and the prospect of eventual written examination. Basic to this process is the use of the library (for more details see <https://www.library.sydney.edu.au/browse/science#tabs-468159dc1e-item-35c4d12b3d-tab> and communication with others, most especially your supervisor. The writing of the essay is a most valuable part of the project. The very act of writing is an invaluable aid to comprehension. A good essay should be carefully organised, clear, readable by others, laid out well, properly referenced and convey the essential ideas. Attainment of such writing skills is of great benefit whether or not you elect to stay in mathematics.

One point should, perhaps, be emphasised: the essay project is *not* generally intended to be a contribution to original research; however, the essay must clearly demonstrate that you understand and have mastered the material. Originality in presentation or view in the essay is required.

**Writing proficiency.** As mentioned above your essay is also assessed based on the quality of the writing. The university offers several resources that can help you achieve this goal. The [Learning Centre offers workshops](#) for students that need help with extended written work. Make sure you make use of these resources as early as possible as writing skills develop slowly over time and with much practice.

### 3.2 Choosing a Supervisor and topic

Choosing a supervisor and topic are the first two things that you should do, and are really not two choices, but one. It is recommended that you begin in the long vacation (preceding your fourth year) by seeking out members of staff and asking them about their interests and topics they would be keen on supervising. It is a good idea to ask them about their particular method of supervising and other questions important to you. Do not feel you must settle for the first person you talk to!

All staff members, lecturer and above, are potential supervisors.

There is not necessarily any correlation between supervising style and lecturing style. Also, the subject a lecturer taught you may not be their real area of interest. You should try to decide on a supervisor and topic *before* the start of first semester. Most staff members will be available during the last two weeks of the long vacation; if you have not arranged a topic and supervisor at the beginning of the long vacation, you will probably have to organise your supervisor and topic during these last two weeks.

Changes in supervisor and/or topic are possible during the year (the earlier the better!). If you do change supervisors then you must notify the PM4 Coordinator.

It is a good idea to have a provisional topic and supervisor in mind at the beginning of the long vacation. Your potential supervisor can then suggest some reading for you to do over the long vacation, and, if you have second thoughts about the topic or supervisor, it is then easy to change before the first semester starts.

To get the most benefit from the course, you should work closely with your supervisor. To this end, you may set up a regular hour each week to meet and discuss progress and problems with your essay project. Alternatively, you might come to some more informal arrangement.

You can expect your supervisor to:

- Help you select or modify your topic;
- Direct you to useful sources on your topic;
- Explain difficult points;
- Provide feedback on whether you are going in the right direction;
- Advise you on other course matters.

For a reasonable understanding of our program students should consult the [Mathematics and Statistics webpage](#), and seek the supervisor of their interest:

Below you find a list of available supervisors for 2025.

Dr Nathan Brownlowe – Carslaw 532

A/Prof Zsuzsanna Dancso – Carslaw 713

A/Prof David Easdown – Carslaw 619

Professor Andrew Mathas – Carslaw 718

Professor Alex Molev – Carslaw 707

Dr Daniel Tubbenhauer – Carslaw 827

A/Prof Oded Yacobi – Carslaw 724

Professor Ruibin Zhang – Carslaw 722

Professor John Cannon – Carslaw 618

Professor John Voight – Carslaw 613

A/Prof Dmitry Badziahin — Carlaw 634  
Dr Emma Carberry – Carlaw 723  
A/Prof Alex Fish – Carlaw 712  
A/Prof James Parkinson – Carlaw 614  
Professor Laurentiu Paunescu – Carlaw 721  
A/Prof Milena Radnovic – Carlaw 624  
Dr Jonathan Spreer – Carlaw 623  
A/Prof Anne Thomas – Carlaw 716  
Professor Stephan Tillmann – Carlaw 710  
Dr Haotian Wu – Carlaw 615  
A/Prof Zhou Zhang – Carlaw 620  
Professor Florica Cîrstea – Carlaw 719  
A/Prof Daniel Daners – Carlaw 715  
Prof Eduardo Altmann – Carlaw 523  
Prof Ben Goldys – Carlaw 709  
Prof Dingxuan Zhou – Carlaw 523  
For a complete list of potential supervisors [click here](#).

### 3.3 Essay content and format

The essay must start with an introduction describing the objective and contents of the essay. The essay may end with a summary or conclusion; however, this is optional. Should you wish to make any acknowledgements, they should appear on a separate page, following the introduction.

You should aim at the best scholarly standards in providing bibliographic references. In particular, clear references to cited works should be made, where appropriate, throughout the text. Furthermore, it is not acceptable to base large portions of your essay on the existing literature and whenever part of your essay closely follows one of your sources this must be *explicitly acknowledged* in the text. References should not appear in the bibliography unless they are referred to in the text. For the format of the references see the appendix.

The essay should be clear, coherent, self contained and something that others (your fellow students and other non-specialists in the topic) can read with profit. The essay should not exceed (the equivalent of) 60 pages one and a half spaced type of normal T<sub>E</sub>X font size (that is, as on this page). About 40 to 50 pages would normally be acceptable. Students are asked to try to keep their essays within these limits; overly long essay may be penalised. Supervisors should advise their students accordingly.

Take pains over style, especially clarity, precision and grammar. Aim at readability for the non-specialist. Avoid starting sentences with symbols. Aim for succinct statements of theorems and lemmas. Break up long proofs into lemmas. Cross reference previous results and notation, as this markedly improves readability.

Finally, the essay must be typed or printed and prepared in accordance with the instructions listed in the appendix. You should prepare your essay using a word-processing program such as L<sup>A</sup>T<sub>E</sub>X.

### 3.4 Submission of essay, assessment, corrections

A PDF copy of the essay should be emailed to the PM4 Course Coordinator for marking on Monday of Week 13 in Semester 2 (or Semester 1 in case you finish mid year). The same PDF of the essay should also be submitted via Turnitin to the relevant Canvas site by that deadline.

Any students submitting their essays past this time can anticipate a penalty of up to 5% per day or part thereof. Essays which are more than one day late may not be accepted. If, during the year, illness or other personal circumstances give a genuine reason for late submission of the essay, such matters should be reported to the Course Coordinator and your supervisor. Such circumstances should be reported as soon as possible, not at the last minute!

Each essay will be read independently by at least two members of the School. (The number of readers will depend on the staff available.) The candidate's supervisor may or may not be one of the readers. The markers may suggest corrections that should be made to the manuscript. If corrections are required, a final corrected copy of the essay should be given to the Course Coordinator for School records. If no corrections are required, one of the markers' copies will normally be kept by the School and the remaining two copies returned to the candidate.

### 3.5 Time management and progress reports

At the end of the first semester you should write a summary (approximately one page in length) of your essay project and progress and give this to the Course Coordinator. This should include a description of the project, the progress made in Semester 1, and what will be achieved in Semester 2. This must be approved by your supervisor before submission to the Course Coordinator.

Here are some rough guidelines and deadlines:

- Select supervisor and topic – before the beginning of first semester
- Reading, discussion and understanding – first semester
- Start work on first draft – by the end of first semester
- Final proofreading – mid-semester break

*Do not underestimate the time it takes you to do the actual writing.* Often it is not until you start writing that you will settle on a final view, or realise that you have misunderstood a particular part of the theory. Allow yourself sufficient time both for the typing and proof reading of the manuscript.

It is strongly advised that you provide your supervisor with drafts of your essay as soon as possible so that he/she may provide constructive feedback. In any case a complete draft must be submitted to your supervisor by 2 weeks before the final essay is due, namely Monday of Week 11.

The essay should be submitted by Monday of Week 13.

## Chapter 4

# The Talk

### 4.1 General remarks

Before the essay is submitted at the end of Second Semester, each student gives a talk on their essay project. The talks will usually take place about the mid-semester break or student's final semester.

The aim of the talk is to provide training in the explanation to others of the purpose and nature of a project, within definite time limits; twenty minutes for each talk, plus five minutes for questions.

All members of the Department, Fourth Year and postgraduate students are invited to the Fourth Year talks.

*The talk is worth 5% of your essay mark.*

### 4.2 Preparing the talk

The purpose of your talk is to convey to your *fellow students* (and the academic staff) what you are working on. They probably know very little about your essay topic; this comment may also apply to the academic staff. Do not make the talk too long or ambitious. Aim to convey the essence of your project to the audience rather than trying to impress the audience; after all, it is unlikely that you can cover the whole of your project in 20 minutes!.

The key to giving a successful mathematical talk is: "Keep it simple!" *One* idea, illustrated by one or two examples, is enough for a good talk. A special case often conveys more than a general, all-encompassing theorem. For example, to give the flavour of general fields, a detailed study of a simple, but unfamiliar field, such as  $GF(9)$ , might be appropriate.

Keep in mind that the audience is swept along with you and that they cannot go back to earlier stages of your talk like when they are reading an article. You are not giving a lecture, so although some definitions may be appropriate, lengthy technical proofs should be avoided. It is also not a good idea to over-develop the theory at the expense of examples: a well-chosen example is worth ten thousand theorems. Finally, try and relate your content to other areas of mathematics or applications; this can make the talk much more interesting for the general audience.

You should aim your talk at a general mathematical audience and *avoid* directing it at the odd specialist in your topic in the audience. Thus a good talk is judged by one criterion: you have given the audience, especially your fellow fourth year students, a good idea of your project and its significance.

Discuss the talk with your supervisor.

Having chosen the topic for your talk, prepare a written outline. Some people write their talk out in full, while others prefer to use only a written outline and allow improvisations. As it is probably your first talk of this kind, it is advisable to do a full dress rehearsal the previous evening; so find a blackboard or a projector and go through the complete talk. This will help you in judging the timing of your talk properly: it takes much longer to say things than you probably realise. If you can, find a sympathetic listener to give you feedback. Your listener does not have to be mathematically literate: a good talk is almost as much about theatre and presentation as it is about mathematics.

### 4.3 Slide Talks

Decide if the use of Beamer, PowerPoint or an overhead projector is appropriate. This allows preparation of complicated figures or tables ahead of time, or the inclusion of photocopies of published material in your exposition. Beware, however, that although the speaker can by this means pass a vast amount of information before the eyes of the audience very quickly, the audience will probably not take it all in. It is important either to write clearly and in large letters and to refer explicitly to each line (say by gradually revealing line-by-line) or, in the case of a diagram or complicated formula, to allow your audience time to absorb its detail.

If you are going to use  $\text{\LaTeX}$  to create slides then the use of the Beamer package is recommended.

## Chapter 5

# Your Future and Mathematics

As a fourth year student you are a member of the mathematics department and you should take advantage of the facilities it offers. The University of Sydney has one of the top mathematics research departments in the country, and it ranks very highly internationally in several areas. There are also a number of prominent international (short and long term) visitors to the department who give seminar talks within the department. It pays to keep an eye on scnews (the School's web based bulletin board), for upcoming seminar announcements.

The academic staff, the many postdocs and the visitors to the department are all usually very happy to talk mathematics talk with interested students: all you have to do is find the courage to ask!

Fourth year students are also very welcome to join the staff and postgraduates in the use of the tea room; this can be a good place to meet other people in the department.

### 5.1 Seminars

Students are welcome to any seminar run in the Department. For a schedule of upcoming seminars, see scnews and the seminar websites that are linked to from the main school webpage.

### 5.2 After fourth year, what then?

Recent graduates have found employment in a wide variety of occupations: computer related jobs, teaching (University or School), positions in insurance and finance. To find out more about where maths can take you:

<https://sydney.edu.au/careers/>  
<http://www.amsi.org.au>  
<http://www.austms.org.au/Jobs>

Here we shall just outline briefly the postgraduate degree options. For more information consult the departments web pages.

### 5.3 Higher degrees

A result of II-2 or better is the minimum requirement for entry into a higher degree at Sydney. However it should be noted that one should not normally contemplate continuing without a result of at least II-1. Anyone intending to undertake a higher degree should consult with the Mathematics Postgraduate Coordinator (Dr **Zsuzsanna Dancso**), as soon as possible. The usual practice is to enrol for an M.Sc. in the first instance and later to convert to a Ph.D. if it is desired to continue.

Information on scholarships for postgraduate study can be found at

<http://www.maths.usyd.edu.au/u/PG/>.

### 5.4 Scholarships and other support

Scholarships, prizes and travel grants are available both for study at Sydney and for study elsewhere. Full details can be found in the University Calendar and from the Scholarships Office (Administration Building). Intending applicants should obtain application forms from the Scholarships Office as soon as possible. *The closing dates for some scholarships can be as early as September.*

If you are considering further study at an Australian University, you should apply for an Australian Postgraduate Research Award (even for an M.Sc. by coursework). For study at a university in Britain or Canada, apply for a University of Sydney travelling Scholarship and also apply to the chosen university for employment as a Graduate Assistant.

### 5.5 Further study in another subject

As mentioned in the introduction to this booklet, it is quite possible to do Fourth Year Pure Mathematics and then continue with a higher degree in another subject. Within Australia, prerequisites vary from university to university and department to department, and for those intending to follow this path it is advisable to consult with the department concerned to determine an appropriate choice of fourth year topics. If you are intending to continue with postgraduate studies in another field *outside* Australia, do check prerequisites. Provided you have done third year courses in the subject at Sydney, you will *probably* not encounter significant problems over prerequisites.



It has long been an axiom of mine that the little things are  
infinitely the most important.

Sherlock Holmes, *A Case of Identity*

## Appendix A

# Instructions on Preparing the Manuscript

Essays must be typed using  $\text{\LaTeX}$  (or  $\text{\TeX}$ ), or a commercial word processing program such as word. Amongst professional mathematicians  $\text{\LaTeX}$  has become the standard; it produces better quality output than any word processing programs program—at least when it comes to mathematics. The downside to  $\text{\LaTeX}$  is that it takes some time to learn.

The fourth year coordinator will give an introduction to using  $\text{\TeX}$  and  $\text{\LaTeX}$  before the beginning of second semester. For those wishing to use  $\text{\LaTeX}$  Prof Mathas has written a  $\text{\LaTeX}$  class file that takes care of the basic layout of the essay; for information, as well as some basic tips on how to use  $\text{\LaTeX}$ , see <http://www.maths.usyd.edu.au/u/mathas/courses/pm4/>.

See <http://www.maths.usyd.edu.au/u/SMS/texintheschool.html> for links to  $\text{\TeX}$  and  $\text{\LaTeX}$  documentation available on the School's website. The  $\text{\LaTeX}$  package `amsmath` and `BiBTeX` are perhaps the most important. (Note that Prof Mathas' class file preloads the `amsmath` package, which is essential for adequately typesetting mathematics in a  $\text{\LaTeX}$  document. `BiBTeX` is used for automatically including a bibliography in a  $\text{\LaTeX}$  document.)

If you decide not to use this  $\text{\LaTeX}$  class file, then your document must nevertheless satisfy the following requirements.

1. A margin of at least 2.5cm must be left at the top, bottom, left- and right-hand side of each page. The margin is determined by the last letter or character in the longest line on the page.
2. All pages must be numbered (in a consistent way), except for the title page.
3. Avoid excessive use of footnotes. They are rarely necessary in mathematics.
4. Diagrams should be created using appropriate software; check with your supervisor first if you intend to use hand drawn diagrams.
5. Theorems, Propositions, and such like, should be labelled consistently throughout the document.
6. The font size must be 12pt.