Department of Mathematics

Undergraduate Project Guide

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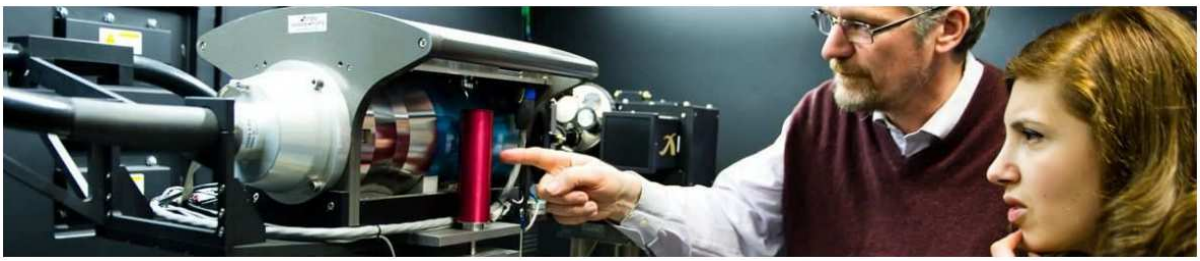

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Content

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1. Introduction

The Department of Mathematics offers projects to students in their third and fourth years. The projects can be a two-semester double project, or single semester projects. The double project has a 20 credit weighting for third year students (MATH30000) and a 30 credit weighting for fourth year MMath students (MATH40000). The single project has a 10 credit weighting for third year students (MATH30011 and/or MATH30022), and a 15 credit weighting for fourth year MMath students (MATH40011 and MATH40022). Students in the final year of the MMath programme are required to take 30 credits of project work: either as MATH40000; or as two 15 credit semester projects (MATH40011 and MATH40022). For students on the MMath Mathematics with Financial Mathematics degree programme the project has to be in Financial Mathematics. The requirements are different for some joint honours students: MMath&Phys students must take a 15 credit Mathematics project and a 20 credit Physics project; Students in the final year of the BSc Mathematics with a Modern Language degree programme can opt to do a one single-semester 10 credit project, which can be in either semester. Mathematics and Philosophy students must prepare a 20 credit Philosophy dissertation that is administered by the School of Social Sciences; and the Maths with Finance students have the option to take a project in Financial Mathematics.

2. Aims and intended learning outcomes (ILOs)

2.1. Aims

The aim of a project module is to give third and fourth year students an opportunity to research a chosen mathematical topic in depth; and to improve their communication skills. This is done through producing a written account and giving a short verbal presentation on the topic. The project also provides opportunities to develop transferable communication, time-management and task-management skills, through researching the topic and organising and producing the written and oral reports.

2.2. ILOs

The intended learning outcomes for projects are based on these aims. They are the following:

1. summarise and select appropriate mathematical content to defend arguments made;
2. present mathematical content in such a way as to communicate key ideas in written and verbal form;
3. accurately describe specific mathematical concepts;
4. write aims and objectives of the project and abstract content;
5. discuss mathematical arguments on specific topic and illustrate their place in wider subject area, in written forms.

These intended learning outcomes align to the six assessment criteria in the rubric below. The first five criteria (introduction, presentation, accuracy, content and understanding) principally apply to the written dissertation. Hence, there is a total of 90 marks for the dissertation. Half of these marks are allocated to communication of ideas (introduction, 10 marks; presentation, 15 marks and accuracy of argument, 20 marks) and half the marks awarded for comprehension (choice of content, 25 marks and understanding of material, 20 marks). The last 10 marks are for the oral presentation.

2.3. **Assessment rubric**

Undergraduate Rubric	**Insufficient Quality for pass in specific category**	**Sufficient contribution for pass**	**Average contribution**	**Good contribution**	**Very good contribution**
Abstract and Introduction (10 marks) Abstract. Statement of project's aims (what they will do) and objectives (how they will do it). Overview of the underlying problem and of what the dissertation accomplishes/reason for project. Contribution of student to field stated. Maps to ILO 4	**0, 1, 2, 3** No indication of what the project aims and objectives are. Abstract and introduction not present, lack essential information, or not relevant.	**4** Project aims and objectives lack clarity. Little indication of what the dissertation is aiming to accomplish. Abstract a present but a poor or inaccurate summary of dissertation.	**5** Aims and objectives of the project are clear. Introduction and abstract informative.	**6** Clear statement of project aims and objectives and set in wider context. Clear explanation of the underlying problem. Clear indication of contribution made by student. Abstract a good summary of work presented.	**7, 8, 9, 10** Insightful explanation of problem and very clear aims and objectives of project. Underlying problem very clearly explained. Abstract is a clear and succinct summary of dissertation.
Presentation (15 marks) Organisation and ordering of material; detailed bibliography. Clarity of writing; clarity of graphs, diagrams and tables and code (if applicable); consistent notation; formatting and accuracy of bibliography *(note that use of citations should be marked in content/understanding).* Maps to ILO 2	**0 to 5** Little or no attempt at organising the material. Unclear writing. Poor presentation that seriously hampers the understanding of the report.	**6, 7** Organisation weak but with plausible structure. Problems with presentation affecting readability. Diagrams and tables unclear. Bibliography lacks detail. Poor internal cross referencing.	**8** Sound writing and presentation of material in general. Tables and figures are present but without detail or legends. Cross referencing consistent.	**9, 10** Clear presentation and structure. Good elegant figures and graphs. Complete bibliography with good internal referencing.	**11 or more** Very clear presentation and command of language. Original and innovative ways of visualising and presenting results. Accurate and well formatted bibliography.
Accuracy (20 marks) Correctness of arguments; mathematical precision; correctness of computer code and analysis of outcomes (if applicable) Maps to ILO 3	**0 to 7** Incorrect or weak mathematical arguments. Non-reproducible code (if applicable).	**8, 9** Mathematical arguments are sometimes correct but lack precision and clarity. Ambiguity in the interpretation of results (if applicable).	**10, 11** Results appear correct and the mathematics is accurately reproduced. Level of detail in proofs and derivation variable.	**12, 13** Correct results and interpretation. Mathematical arguments show logical thinking and have sufficient detail.	**14 or more** Correct results and interpretation. Mathematical arguments are detailed and show

					good logical construction.
Content (25 marks) Selection of material; quality and quantity of material given the time-scale; evidence of individual expression; appropriate use and description of methodology; appropriate use of sources; appropriate description of background material/citations Maps to ILO 1	**0 to 9** Insufficient quantity and quality of material. Inadequate use of sources. No or little description of related literature.	**10, 11, 12** Fair selection of material. Adequate quality and quantity of work. Sketchy and incomplete explanation of used methods. Incomplete use of citations.	**13, 14** Sound selection of material and use of sources. Is able to reproduce standard results applicable to the particular project.	**15, 16, 17** Good and well-rounded selection of material. Challenging topic. Is able to reproduce results through independent work.	**18 or more** Has extended results beyond expectation for particular project. A large amount of independent work has been carried out.
Understanding (20 marks) Appreciation of meaning, context (did they justify inclusion of citations) and significance of work presented; independent thinking; soundness of conclusions reached; understanding of methods used. Maps to ILO 5	**0 to 8** Little sign of understanding of topic. Insufficient appreciation of context and importance of work. Little understanding of methods used.	**8, 9** Satisfactory understanding of main concepts and some of the methods. Some comprehension of wider context.	**10, 11** Good understanding of material. Some evidence of independent thinking and judgement is there, but could be improved.	**12, 13** Independent interpretation or appraisal of the results and material in the project.	**14 or more** Is able to interpret and critically appraise the results and materials of the project in a wider context.
Oral examination (10 marks) Verbal presentation skills; quality of presentation materials. Maps to ILO 2 Ability to respond to questions at oral examination Maps to ILO 5	**0, 1, 2, 3** Poor presentation with little or no preparation of content. No ability to answer questions around the topic.	**4** Presentation material and preparation sufficient. Presentation skills ok. Some understanding of topic shown through responses to questions.	**5** Presentation good with some loss of coherence. Question responses on the whole good with some gaps.	**6** Presentation material clear and tidy. Presentation skills good. Question responses clear on the whole.	**7, 8 ,9 10** Presentation material very clear and well explained. Excellent presentation skills All question responses clearly made with evidence of comprehension of wider topic.

3. The project supervisor

The role of the supervisor is to give guidance, initially and as the project develops, to make you aware of the standard and quantity of work required; to comment on the general shape of your report and to give a certain amount of detailed feedback, for instance on a sample or draft chapter. However, it is worth noting that it is not the role of a supervisor to proofread or correct the project. For double projects (full year) the student is expected to prepare a piece of work, referred to as an interim report, that must be submitted to Blackboard via the MATH40000 year module, by the single semester project deadline in January. This will typically be an early chapter of the project, a description of what the project will eventually contain and a work plan for the second semester. This interim submission will not be a formal part of the examination, but will ensure you are making adequate progress and are comfortable using LaTeX. It will also enable you to obtain feedback on your work and to discuss with your supervisor possible improvements to your writing style and presentation. Each project is different, and the frequency of meetings should be determined between you and your supervisor as the project progresses. It is usual to meet with your supervisor every two weeks initially to discuss progress, ideas and methods. However, you are encouraged to work independently and show initiative and creativity. The main responsibility for progress lies with you. If you are stuck or unclear about where you should be heading then you should contact your supervisor as soon as possible: do not postpone this because the deadline seems far away.

4. Project calendar

Project Information registration sessions for MMath students	
Project information session	Week 9/10 of semester 2*
Registration opens online	Week 9/10 of semester 2*
Registration deadline	Early June
Project registration information for BSc students	
Registration opens online	During course unit selection July / August
Registration deadline	Semester 1 projects - week 1 of semester 1* Semester 2 projects – week 12 of semester 1*
Submission deadlines	
Interim Report for double projects submission deadline (to Blackboard MATH40000)	First day of the January exam period*
Semester one project submission deadline	First day of the January exam period*
Semester one oral presentations	During the January exam period
Double project submission deadline	Week 11/12*
Semester two project submission deadline	First day of May/June exam period
Oral presentations	During the May/June exam period

*exact dates will be available from the project pages on the department website

5. The project report

5.1. Different types of project:

Broadly, projects can be divided into several types:

Reading several sources and presenting the mathematical ideas from these sources as a coherent whole. The mathematics is expected to be correct and substantial, and the presentation uniform and understandable to other students in your year.

Investigating a mathematical or statistical model using numerical/statistical methods. This may include developing new methods or applying existing methods to new problems.

Developing new mathematical ideas or adding details, where statements and/or proofs are not in the literature. Compared to the previous types, the amount of mathematics may be less, but should be no less accurate.

Essay style projects - for example a historical project. The amount of actual mathematics would probably be lower, but there should be a correspondingly greater amount of analysis and criticism.

Other types of project are also possible, and many projects will be a combination of more than one of these aspects. A mark of 100% would be obtainable for a perfectly written project which a student has done mostly independently and is sufficiently novel that the content could be published in a respectable journal.

5.2. What is expected

This varies according to the type of project.

Length: There is no set maximum or minimum length, and it depends on the 'density of the content'. Your supervisor will advise you on this for your specific project. As a rough guide, projects tend to be about 25 pages per 10 credits. If there are many diagrams, or much computer code then this should be increased by a corresponding amount, and essay style projects should also be a little longer.

Structure: Title page, Introduction, Table of Contents, Main body, Conclusion, Appendix, References (see below for more details

Correct English: Grammar, punctuation and spelling *are* important. Notice that in all books and research papers you read, the mathematics is punctuated properly, and displayed equations end in a full stop where appropriate. The book by Higham [1] (listed in the bibliography below) is an excellent manual for writing mathematics.

Typesetting: All projects must be typeset on a computer although diagrams may be added by hand. You will also be expected to submit a pdf version, which may exclude the diagrams if they are hand-drawn. See below for more details.

5.2.1. Plagiarism

Plagiarism is simply passing someone else's work off as your own, and is considered a serious offence. In mathematics, copying a definition or the statement of a theorem is not considered plagiarism. But for a long proof, it is much better to read it, absorb it and then write it in your own words, perhaps adding extra details. You could also give an overview of the general strategy or structure of the proof. If there is

something you want to copy more or less verbatim (perhaps a proof), then make sure you quote the source so you are not passing it off as your own. The electronic online submission Turnitin will be used to check for plagiarism. Please note that self-plagiarism, restating your own work from previous projects without reference, is also counted as plagiarism. More information and guidance on plagiarism can be found on the webpage below.

https://www.staffnet.manchester.ac.uk/tlso/policy-guidance/assessment/process-of-assessment/academic-malpractice/academic-malpractice-advice/

5.2.2. Originality

Writing a project is like telling a story, and there are various ways you can put a bit of originality into a mathematics project.

There might be details in a proof you don't understand at first reading, so when you write it add some details which would have helped you. Also where the original author has written "clearly, ..." you could add a justification of this point - why is it clear? Explaining the proof in a different way or drawing analogies to other proofs is another possibility.

A simple way to add something of your own is to add examples illustrating a definition or a theorem, or showing that a particular hypothesis is needed.

If you are reading from a text book that has exercises, then solve some of these exercises at the appropriate place in your project.

In numerical work, you can investigate a system or aspects of a system that have not been studied before. Also presenting your own computations of an existing result is your own original work.

Like telling a story, it's how the facts fit together in a narrative that makes it your own.

Finally there is the indisputable originality of proving a new result that cannot be found in the literature, or giving a significantly different proof of an existing result. Such a possibility is most likely to arise from suggestions by the supervisor.

5.3 The Software

5.3.1. Word processing

There are two types of software suitable for writing the project. Firstly the wysiwyg type such as MS Word or OpenOffice.org, both of which have equation editors though both have their limitations. The other type is LaTeX, which is the ideal for writing a large amount of mathematics - it has a steeper learning curve than the wysiwyg variety, but is usually worth the effort. If you are thinking of working in a research environment, then it is even more worthwhile investing the time to learn LaTeX. The Department also has a limited number of licenses for Scientific Word, a package providing a user-friendly front end to LaTeX. Whatever software is used to write the project it must be capable of producing machine readable (i.e. readable by Turnitin) pdf, needed for the online submission. Note, Turnitin cannot read pdf documents where written work is inserted as an image. For more information on the kind of files Turnitin accepts and can read please click on the link below.

https://help.turnitin.com/feedback-studio/turnitin-website/instructor/making-a-submission/file-requirements.htm

5.3.2. LaTeX

The department provides an online short course on LaTeX which is accessible from the Year modules MATHS3000 and MATHS4000, or from the link below. Demonstrations of the material are given during reading week in the first semester of term.

"https://personalpages.manchester.ac.uk/staff/paul.johnson-2/pages/latexShort.html"

5.4 The structure of the project report

Title page: The project must begin with a *title page* showing the title, author (you!), your student ID number, your supervisor's name, and the course code.

Contents: A *table of contents* while not essential is very helpful for the reader.

Summary (Abstract): An *introduction*, giving an overview of the project and its context, and perhaps mentioning prerequisites (such as saying, "the reader should be familiar with a first course in linear Algebra"). Often an introduction will contain a paragraph or so describing briefly what is done in each chapter. It is also worth stressing the original contributions that you have made in the abstract.

Main content: The *main body* should be divided into sections or chapters, rather than being a continuous stream of ideas.

Conclusion: Possibly a *conclusion*, summing up the most important aspects. This is often a good place to show an overall understanding.

Appendix: 'Appendices'' if relevant, giving for example computer code or mathematical details that would be distracting in the main body of the text

References: This should include in all the texts you have made use of during your project, including websites. Reference to websites should include the date of access, just as reference to a book should include the edition number if there's more than one. It is a good idea to collect this information as you progress, rather than trying to remember at the end which sources you used (usually an impossible task). There are several different acceptable styles for lists of references, and looking in books or research papers will help. It is important to cite specific references in your project. Simply providing a long list at the end is not helpful because it does not tell the reader what each reference was used for.

6. Oral presentation and examination

There will be an oral examination for every project that will take place after the submission deadline and will be scheduled by your supervisor at a mutually convenient time. The two semester project submission deadline is in place so that students can arrange their oral examination prior to the examination period. This exam should begin by the student giving a short (5-10 minute) presentation on the project, followed by questions from the examiners. The oral presentation has two main purposes; to develop the student's oral presentation skills and to test their understanding of the material in the written project. The presentation can be delivered with chalk and blackboard, with overhead transparencies, on a computer or with no visual aids at all. Please ensure you give the supervisor adequate notice of which method of delivery you prefer. In such a short presentation, you will not be able to cover all the details of the project, so do not try. It is better to give a short overview describing what you find are the most interesting points, and perhaps selected details.

7. Training for academic writing and oral presentations

For many of you this maybe the first time you write a large scale academic document and/or make an academic presentation. The university have various support mechanisms to help acquire the skills to do both of these successfully. Firstly, your supervisor should be able to help since they know the writing and presentation norms within your specific subject. Please do make sure to discuss this with them. Also, the My Learning Essentials team at the Library have many resources and workshops specifically for dissertation writing and presentations skills (link provided below). You are heavily encouraged to engage with these at the beginning of the academic year.

https://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/

8. Regulations

8.1. Who can take a project:

Level 3: Students may opt to do a project, which may be either a one semester (10-credit) or a two semester (20-credit) project. Normally, a student would not undertake a one semester project in each semester, however permission to do so can be granted by the Year 3 Tutor. Students cannot take two 10-credit projects in the same semester. A first semester project may be converted to a two-semester project up to the ninth week of the first semester, but this needs to be agreed with the supervisor. On some joint degree programmes where the mathematics modules of the third year would amount to less than 40 credits, you may not be permitted to take a double mathematics project. Therefore, you will need to check the programme structure of the course you are studying.

Level 4: All MMath students must take 30-credits worth of projects, which can be a two semester 30-credit project or a one semester project (15-credit) in each semester. Students who wish to take the latter option are required to arrange supervisors for both projects at the start of the academic year. As with level 3 students, you cannot take two 15 credit projects in the same semester.

MMath&Phys: Note that MMath&Phys. students on a Mathematics and Physics joint degree are governed by regulations in the Department of Physics. It is usual to do two projects, one in mathematics MATH40011 in the first semester or MATH40022 in the second semester (15 credits) and one in physics PHYS40181 in the first semester and PHYS40182 in the second semester (20 credits). There is a possibility of one combined project in an appropriate topic in mathematical physics with permission from both the Mathematics and Physics project coordinators.

8.2. Overlap

A student may do a project and also take a course that covers related material but the overlap must not be too large because, in terms of content, the project will be judged on the non-overlapping material. Check with the supervisor and plan ahead to avoid any such conflicts.

9. Registration

You ***must*** register by filling in the online registration form on Blackboard to confirm you have the agreement of the supervisor. The registration form for students entering the third year will be made available from Blackboard MATHS20000 study module in early July in line with course unit selection. The registration form for students entering the fourth year is available from Blackboard MATHS40000P via

the My Manchester student portal and will be available in either week 9 or 10*. All registration forms must be completed by their respective deadlines (see section 4). *If, having agreed to do a project, you later decide not to proceed, please inform the supervisor (since the supervisor might then be able to take on another student) and the Teaching and Learning Office.*

*specific dates will depend on the timing on the Easter break and term dates. These will be shown on the department website.

10. Submission

For Full Year Projects the student is required to submit an electronic copy of an Interim Report to Blackboard (the MATH40000 year module) by the semester one project deadline in January. This will typically be an early chapter of the project and a description of what the project will eventually contain. This interim submission will not form part of the examination but will ensure you are making adequate progress and are comfortable using LaTeX. It will also enable you to discuss with your supervisor, possible improvements to your writing style and presentation.

An electronic version in machine readable pdf format should be submitted online (via Blackboard). For information on what constitutes a readable format please see section 5.3.1. The deadlines for submission are the following:

2019/20 Project Submission Dates:

Semester 1 Projects and Full Year Interim Report – 13th January 2020
Full Year Projects – 5th May 2020
Semester 2 Projects – 13th May 2020

Late submissions will be subject to a penalty of a 10% reduction of the final mark for each weekday late.

The front page of your project should contain at least the following information: your name and student number; the name of your project supervisor; the relevant course code and the title of the project.

A Project Supervision Questionnaire will be sent to you after the oral examination has taken place. You should also keep a copy of the project for your own use at the oral examination.

11. References

[1] N.J. Higham, *Handbook of Writing for the Mathematical Sciences, 2nd ed.* Society for Industrial and Applied Mathematics (SIAM), Philadelphia, 1998. ISBN 0-89871-420-6.