Project Guide

MA4K9: R-Project

Version for 2026/2027 – DRAFT

General information

R-Projects are research projects carried out under the direct supervision of a member of the permanent academic staff of the Warwick Mathematics Institute. This guide explains the components of the module and lists the assessment criteria by which your work will be judged. For further practical information, important deadlines, and module news, consult the module website and the Moodle page.

Key Deadlines:

- **Topic & supervisor registration: 1 November 2026.**
- **Interim Presentation to supervisor: 23 January 2027.**
- **Dissertation submission: 6 April 2027.**
- **Final Presentation: Term 3 (normally in week 3 or 4).**

Content

1 Module structure

1.1 Topic and supervisor

The R-Project can be in any area of mathematics offered by permanent staff and Warwick Zeeman Lecturers (WZLs). Before you register for an R-Project, you must first take the following steps:

- Find a member of staff willing to supervise you;
- Agree on a theme suited to your mathematical background and interests, and to your supervisor's expertise;
- Negotiate a provisional title and brief for your project, and discuss its aims and objectives. It is normal for this to need renegotiating as the project evolves and final titles may differ from the provisional title originally registered.

A list of the R-Project themes offered by staff members can be found here[1]. It might also be useful to look at the research interests of permanent staff[2].

If you have your own ideas about a theme for an R-Project, feel free to ask any permanent member of staff or WZLs whether they would be willing to be your supervisor, but remember, staff are under no obligation to supervise an R-Project, and are, in any case, discouraged from supervising more than two a year.

Once you have agreed with your supervisor on the details of the project, register your choice on the Moodle page of the module. **The registration needs to completed by 1 November 2026**.

Important

It is the responsibility of the student to find a member of staff willing to supervise. Only register on Moodle after having obtained permission from your supervisor and reached agreement on the provisional project title.

1.2 Structure of the year

- In your first meeting(s) with your supervisor, establish expectations concerning the nature of the project, literature search, computational work (if any), etc. Furthermore, agree a schedule and expectations for regular meetings.
- Keep in contact with your supervisor and attend your supervisions.
- At the beginning of Term 2, you hold a meeting with your supervisor to discuss your progress to date and your plans going forward. This meeting is referred to as the Interim Presentation, but it is not a formal presentation. (See below for details). Following this meeting you must submit an Interim Report.
- In Term 2, discuss the written dissertation with your supervisor. Typically you will discuss draft sections as you write your dissertation. The dissertation must be produced using the LaTeX template provided below and must be submitted by the deadline.
- By the beginning of Term 3, agree a schedule and format for your final presentation.. The date, time, and mode of presentation are decided by mutual agreement.
- Keep yourself and your supervisor abreast of announcements on Moodle.
- Discuss with your project supervisor any use of generative AI (see section below).

[1] https://warwick.ac.uk/fac/sci/maths/currentstudents/modules/ma4k9/topics/
[2] https://warwick.ac.uk/fac/sci/maths/research/staff_res_ints/

1.3 Using generative AI

It is essential that you discuss with your project supervisor in advance any use of generative AI in conducting your project research and in producing the written dissertation. If you do use generative AI in your project, then you must declare it, state which generative AI was used and how, and explain why it was used. This will then be taken into account when the project is assessed.

2 Source material

You will be guided by your supervisor.

2.1 The Internet

Apart from search engines there are subject specific resources that you may not have yet used. Some are free, but the University of Warwick has also subscribed to mathematics databases. Via the Library these can be conveniently accessed,

MathSciNet is an on-line searchable version of Mathematical Reviews, the American Mathematical Society journal of reviews of (mainly research) articles in learned mathematical journals. http://www.ams.org/mathscinet

Google Scholar is a free tool and lists all the places where a given article or book has been quoted in subsequent articles or books. It is a good way of tracking recent developments in a given circle of ideas. Find one or two seminal works in the area and then see who has been citing them lately. http://scholar.google.co.uk

Science Citation Index / Web of Science is another database that is particularly useful if you want to search beyond mathematics. https://www.webofscience.com/

Arxiv is an preprint server. Many researchers deposit preliminary versions of their papers whilst they are in the reviewing process. This is useful for awareness of the latest development, however care has to be taken as the results might not be properly vetted by the research community yet. https://arxiv.org/

2.2 Libraries and bookshops

There are a number of libraries at your disposal:

The Central Campus Library. The mathematics books usually have call numbers starting with the letters QA. For books on the applications, you may need to consult the "subject" section of the University's online catalogue at http://webcat.warwick.ac.uk/

The Mathematics Institute Library. It has a modest collection of advanced undergraduate and research-level books, but more importantly, it houses most of the University's collection of mathematics periodicals (journals). As fourth year MMath students, you have access to the institute library and mathematics common room.

Other academic libraries. Books and journals not in the Warwick libraries can be obtained through Inter-Library Loan. This service is costly for borrowing books, but it is ideal for obtaining a photocopy of a journal article or a few pages from a book. You'll need your tutor's signature on the form.

Public libraries. They often house good reference collections, will get books on request (but not always quickly), and often provide Internet access.

Bookshops. You may wish to buy a book or two for your Project work. When you own a book, you have unlimited access to it, are free to annotate it, and have the long-lasting pleasure of possession. The University has a book selling partnership with Blackwells, and of course there are reliable Internet suppliers.

3 Interim Presentation to Supervisor

The Interim Presentation is a meeting with your supervisor at the start of Term 2, where you discuss your progress to date and and your plans going forward. It is not a formal presentation. The meeting is based on a short written Interim Report that you are required to complete. The template for the report can be found on the Moodle page.

The report should be two sides of A4: one side summarising progress to date, and the other stating the goals and target timetable for the remainder of the project. The summary of progress to date will typically consist of a list of identified sources (books, articles, etc.) and specific accomplishments (material that has been read and digested, calculations that have been performed, theorems that have been proved, computer programmes that have been written, etc.).

After you have met with your supervisor to discuss your progress, you must submit the Interim Report via the Moodle page. **The deadline for submitting the Interim Report is 23 January 2027.**

4 The Dissertation

Important

The Dissertation must be your individual and personal work. The choice of material and the way it is presented must be entirely your own.

The dissertation **must be produced using the Latex template provided on R-Project Moodle page**. The main body of the dissertation should normally be about 30 pages (excluding the title page, table of contents and bibliography) and strictly no longer than 40 pages. Be guided on the length by discussions with your supervisor. If necessary, additional information may be included in the form of appendices (for example you may include a printout of a computer programme) but you have to structure your dissertation in such a way that the markers should be able to judge your report without this additional information. Appendices do not count towards the page limit.

4.1 How long should I spend on the project?

Bear in mind that the core module MA4K9 Project is worth 30 CATS and represents 25% of your overall course credit for the final MMath year. You should therefore expect to spend in the region of 300 hours on its various components.

Some food for thought:

- Beware the temptation of spending too little time on the Project in Term 1;
- The range of skills and abilities used in the Project are different from those needed in a conventional timed maths exam. Take advantage of this chance to show your versatility;
- The Project components will each be marked in a range from 0% to 100% like a maths exam;

- It is advisable to set aside sizeable chunks of time to work on your Project because longer periods of concentration are more efficient.

4.2 Writing the dissertation

You may follow these recommended steps to produce your dissertation:

- Settle on a structure for your dissertation (see the next section).
- Prepare a framework for your document, listing the ideas and results you want to get across and the mathematical scaffolding that will support them. Plan chapter and section headings to reflect your chosen structure.
- Now write a first draft of the whole dissertation (introductory and concluding chapters are best written last). Then put it away for a few days and try to forget about it.
- After this fallow period, re-read and revise your first draft. Be prepared to prune both your material and your prose.
- Show your second draft to one or two literate mathematical friends who know you well enough to offer helpful criticism. Heed their comments and prune again.
- Produce a final draft, do a spell check, make sure the references to earlier results bear the right numbers and that the labels on the citations tally with the corresponding items in your bibliography. Once more put the document on ice.
- Re-read your dissertation with pride and pleasure, edit lightly, and then *submit* in good time for the deadline.

4.2.1 Structuring your dissertation

There are many ways of telling a story (think of the books you have read and the films you have seen). You can gradually build to a final climax with cliff-hangers along the way. You can reveal all at the start and use flash-backs to show how you got there. You can present your material in the form of a personal odyssey from ignorance to enlightenment (writing in the first- person 'I') or give a historical perspective, describing how the work of key players contributed to the development of the ideas.

Whichever format you choose, the basic underlying structure should have a beginning, a middle, and an end. The structure and layout may be usefully discussed with your supervisor who will be able to advise bearing in mind the nature and area of the project.

- The *beginning* might contain *two* kinds of introduction. In the *first* you state your brief and describe the scope of your theme, its background and context, why you find it interesting and/or important, and why you chose it.
- In a *second* introduction, you gather up all the preparatory results and ideas that will be needed in the main body (in a short work like this, do not expect to prove every mathematical result from first principles, but do state them clearly and give references in the literature for their proofs).
- The *middle* is where you unfold your story and make your case. It contains the meat, your main results and arguments, the heart of the matter. Here you aim to demonstrate mathematics in action by proving theorems and showing how their conclusions are applied to real-life problems. Here you can be creative by devising examples that illustrate the ideas and results you have described.

- When you get to the *end*, for some projects it is often helpful to the reader to tell them again what you have done (preferably in fresh ways), why it was appropriate, and hint at what you might have done if you had more space and time.

  Another excellent way to finish is to end with a section of "open questions" or "future directions" where you discuss what you might have done if you had more space and/or time.

- Most importantly, the *end* should end with a list of references, in fact, *all* the references you have consulted, not just the ones you have cited in the course of your report (you might wish to include an evaluation of your references). There are various styles of referencing: pick up a few books, compare their styles, and choose the one that you find most pleasing.

4.2.2 Style and presentation

What constitutes good style and attractive presentation is not uniquely defined. There are broadly-agreed conventions about spelling, grammar, and the layout of mathematics on the page, but these are sometimes disputed in the detail.

Good style makes a document comfortable to read and easy to understand. The writing and presentation should reinforce meaning and aid its assimilation. Good style should not jar, get in the way, or intrude on the reader's consciousness.

We do not want to impose strong views about style on you. There are excellent books on this very personal subject and you must develop your own canons of good taste. To help you do this, we recommend the following 3 books; they in turn make their own recommendations for further reading.

- *How to write mathematics* by N.E. Steenrod, P.R.Halmos, M.M. Schiffer and J.A. Dieudonné
- *Handbook of Writing for the Mathematical Sciences* by N.J. Higham
- *A Primer of Mathematical Writing* by S.G. Krantz

These books will convince you that there is much to be learned when it comes to writing well, particularly when writing mathematics.

4.2.3 Plagiarism

It is important that you avoid plagiarism. This does not mean that all of the ideas in the project are purely your own, in fact, we expect very few (or even none) of the ideas to be purely your own, but expect them to come mainly from books or other reputable sources. The originality of the project should come from how you collate information from these sources and put them together in a new way, creating a new and interesting exposition on the topic.

To avoid plagiarism there are a number of things that you should do:

- always give careful references (citations) when an idea is not your own
- combine ideas from various sources together to create an original structure to your project
- re-write the ideas in your own words.

When re-writing the ideas in your own words, this does not mean it is fine or good practise to just change a few words, symbols, or notation. Also note that when you re-write ideas in your own words, you should still give proper reference to your original source(s).

Important

Make it absolutely clear throughout which is your own work and which is derived from other sources. Cite your sources frequently.

4.2.4 Guidance on use of AI

We give the following guidance (in line with the university policy):

- DO NOT input any PERSONAL or CONFIDENTIAL DATA into any AI tool.
- If you use an AI you must set out why, where and how you have done so.
- Please do so in the declaration section in the template for the dissertation. If you have a lot to declare then an additional section in an appendix might be appropriate.
- The information that you provide will be accounted for in the assessment.
- Keep a good record of all interactions with any AI that you later use or rely upon. This may be via screen-grabs, or other recording techniques.

It is important that you discuss with your project supervisor any use of generative AI in conducting your project research and in producing the written dissertation.

5 Final Presentation

This will take place either be in a room or online on a designated day in Term 3 (typically set between April and Summer exams) to be mutually agreed between student and markers. You will be required to give a prepared talk, lasting between 20 and 25 minutes, on the theme of your dissertation. After the talk, you will be asked to answer questions on your dissertation from your supervisor and second staff examiner for a further 20 minutes or so. Thus the examination should normally last no more than 45 minutes.

5.1 Some pointers

Discuss the final presentation with your supervisor and decide on whether you will give a *blackboard* presentation or a projected *pdf* presentation.

- Make sure you understand everything written in your dissertation.
- Keep your talk to within the allotted time without rushing at the end.
- Prepare thoroughly and rehearse the talk.
- Be prepared to answer questions, engage in discussion and derive your results on the board if asked.
- Convey the essential message, results and ideas
- Speak clearly and at a comfortable speed. Pause at suitable points.
- If appropriate write clearly on the chalkboard, whiteboard or tablet.
- You may wish to include animations and videos.

- If you use the projection of a pdf then produce clear and legible slides. Do not fidget with the slides or the pointer.
- If in a room then do not stand in front and obscure what you want your audience to see on the slides.

5.2 Sources of good advice on giving a talk

(i) Chapters 10 and 11 (entitled "Writing a Talk" and "Giving a Talk", respectively) in the Second Edition of Nicholas Higham's

"Handbook of Writing for the Mathematical Sciences"

published by SIAM in 1998 (ISBN 0-89871-420-6). There is a copy in Central Campus Library with classification number `QA 41.H4`.

(ii) Steven Krantz has his own Ten Commandments for giving a talk on pages 128–134 of his entertaining and opinionated book

"A Primer of Mathematical Writing"

It was reprinted by the American Mathematical Society in 1998 (ISBN 0-8218-0635-1) and a copy can be found in Central Campus Library with classification number `QA 41.K7`.

(iii) Here are two accessible short articles:

"How to talk Mathematics" by Paul Halmos, and

"How to Give a Good Talk" by Joe Gallian.

The Halmos article appears in the *Notices of the American Mathematics Society*, Volume 21 (1974), pages 155-158, while a PDF of Gallian's essay can be easily found with Google.

(iv) As usual, there is plenty of good advice on the Web.

6 Assessment

The R-Projects are assessed on:

- Interim Presentation to supervisor, based on the Interim Report (5%)
- Dissertation (80%)
- Final Presentation (15%)

6.1 Assessment of the Interim Presentation

The discussion with your supervisor in Term 2 concerning your progress is given only a light assessment, but it is imperative that you take it seriously. The Interim Report must demonstrate to both your supervisor and the R-Project module leader that sufficient progress has been made. In particular, you need to demonstrate that you have familiarised with the topic at an appropriate level and that you have clear objectives of sufficient depth and breadth.

6.2 Assessment of the Dissertation

These are the standard criteria for assessing a dissertation; marks awarded on the basis of the dissertation may be modified in the light of evidence from the oral.

- *The amount of work and effort undertaken:* This might be evidenced by the breadth and depth of your reading and research in the literature, the organisation and presentation of the material, new skills you acquired (e.g. learning to program or to use a mathematical package such as Matlab, etc.), work on examples and calculations.
- *The clarity and accuracy of the explanation and justification:* Is your exposition of the material well directed at your target audience, easy to read, and logical? Does it have a good story to tell? Are your proofs comprehensive and mathematically correct?
- *The level of the material and the depth of understanding:* Is the intellectual content deep? Have you assimilated and understood it well, and also convinced the reader of this? Does your exposition carry the stamp of your ownership of the material?
- *The quality of the scholarship:* Is your written English concise, fluent, correctly spelt and grammatical? Is the quality of the word-processing good (well laid out and free of typos)? Is the mathematics typeset well (with suitable font styles and sizes and well-displayed expressions)? Are your sources reliable, and are they regularly cited (so that the reader can clearly distinguish your own contributions) and listed in a conventional bibliography at the end? Is the material well structured and sensibly numbered for cross-referencing?
- *The degree of originality:* Originality may be shown in a number of ways, for instance: in the way the material is organised; by making new connections between existing ideas or areas of knowledge; through a new proof or a generalisation of a known result, including perhaps relaxed hypotheses or a stronger conclusion; through the creation of examples that illustrate the theory or establish its limits of validity; by creative use of the library and the resources on the Web.

Important

Make it absolutely clear throughout which is your own work and which is derived from other sources. Cite your sources thoroughly. Carefully read Section 4.2.3 on *plagiarism* and Section 4.2.4 on the *use of AI tools* in this document and discuss with your supervisor.

6.3 Assessment of the Final Presentation

This will take place either online via MS Teams or in a room with a blackboard or screen. The mode of presentation will be agreed between student and markers. Your mark for the final presentation will be based on the following:

- *Your prepared talk:* Your talk should be a succinct survey of your work. Your account can be informal and personal but it should (i) show clearly that you have a good knowledge and understanding of the subject and its context and (ii) take into account the likely knowledge of the people attending your talk.
- *Post talk questions:* After your talk the examiners may ask you questions about the material in your project and you will be expected to engage in a general discussion about such things as your motivation for choosing the topic, any difficulties you met, and your ideas for taking the work further.

- *Your background knowledge and understanding:* You will be expected to know something about the background of your theme and its place in the broader scheme of things. The oral will be used to test the thoroughness of your understanding and to identify your own personal contributions as distinct from what is already in the public domain or has been generated by others or otherwise.