MA313/MA335 Communication skills
(Version 10.11.2022a)

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How this works

- If you take both **MA313** and **MA335**, then your task is to write a short (1000–1500 words) essay and to give a 10 minute presentation.
- If you only take one of these modules, just write an essay.
- Essay deadline: 5pm, Friday 18 November, 2022 (i.e., end of Week 11).
- Presentations: Week 12.

Scope and Choosing Your Topic

- We provide a list of possible topics (see below), but you are welcome to suggest your own.
- Irrespective of the topic you choose, you should consider your class-mates as the intended audience for your essay and presentation. We wish to assess your skill at researching a topic, and communicating what you have learned. The depth and breath of your knowledge is of secondary importance.
- You may express preferences but we cannot guarantee that we'll be able to accommodate these.
- Send an email to Niall (Niall.Madden@UniversityOfGalway.ie) stating
  - your first choice of a topic,
  - (optional:) your second choice, and
  - (optional:) a topic that you don't want under any circumstances,
  - your ID number.

  by Monday, 26 September, 2022.
  Include the module code(s) in the email subject line.

Suggested topics: mathematics

Consider writing an essay on one of the following topics. Where the topic has not been covered in any module you've taken, your essay should introduce this to your class. If the topic is elementary (e.g., covered in a module you've already taken), consider presenting a tutorial on it, including background, explanation, and exercises.

1. ~~Should abstract algebra be taught at second level?~~ (Brendan C)
2. ~~Symmetry in Islamic art~~ (Delaney M)
3. ~~Geometry and M.C. Escher~~ (Dara J)
4. ~~The group of the Rubik Cube~~ (Lauren W)
5. Platonic solids.
6. Archimedean solids.
7. Snelson tensegrities.
8. Polyominoes.
9. ~~Musical temperament~~ (Kirsty M)
10. Cauchy's Rigidity Theorem.
11. ~~How to make a flexible polyhedron and will it help you to light a fire?~~ (Sean K)
12. ~~Newton vs. Leibniz~~ (Shauna F)
13. ~~The Poincaré Conjecture~~ (Elizabeth B)
14. Positive definite matrices and Cholesky factorization
15. The QR decomposition
16. ~~Norms of vectors and matrices~~ (Luke D)
17. ~~What do eigenvalues *really* tell us about a matrix?~~ (Vicka M)
18. ~~The pseudo-inverse of a matrix~~ (Oscar C)
19. ~~Three ways to compute the determinant of a matrix~~ (Paul McG)
20. ~~Graphs of matrices, and matrices of graphs~~ (Taylor O'C)
21. The Hilbert matrix
22. Pauli matrices
23. ~~Hadamard matrices~~ (Cianna M)
24. ~~Permutation matrices and their properties~~ (Ciara C)
25. ~~Toeplitz matrices~~ (Caelan G)
26. ~~Composing music with matrices~~ (Elisha O'R)
27. ~~Linear Algebra in an Elastic Solids or a GR course — what's the use?~~ (Adrian W)

Possible topics: The mathematics of mathematicians

Essays may be based on the life and work of an eminent mathematician. They may include a short biographical section, but the main emphasis should be on the impact and legacy of their work. This should be reflected in the title, for example "Olga Taussky and the Development of Matrix Theory". When contacting Niall, you should indicate what aspect of this person's work you plan to study. Tip: MacTutor may be a better starting point than Wikipedia.

28. ~~Niels Henrik Abel and Abel's theorem, theory of Abelian integrals and Abelian functions~~ (Grainne O).
29. Arthur Cayley and ...
30. ~~André-Louis Cholesky and the solution of the normal equations~~ (Stephanie R)
31. ~~Carl Friedrich Gauß and the invention of least squares~~ (Laura F)
32. Gene Golub and ...
33. ~~Hypatia and her work on algebraic equations and conic sections~~ (Wiktoria J)
34. ~~Katherine Johnson and the mathematics of the space race~~ (Aoife M)
35. ~~Ada Lovelace and the first computer program~~ (Catherine M)
36. ~~Maryam Mirzakhani and billiards~~ (Chloe T)
37. ~~Isaac Newton and Newton's Laws (or maybe Method in 2D)~~ (Niamh H)
38. Issai Schur and ...
39. James Joseph Sylvester and
40. Terence Tao and patterns in the prime numbers
41. ~~Alan Turing and Cryptoanalysis~~ (Jeffrey F)
42. ~~Dorothy Vaughan and calculations for flight paths and computer programming~~ (Leanne G)
43. Maryna Viazovska and ...
44. ~~William Rowan Hamilton and the quaternion group.~~ (Mark F)
45. Some other notable mathematician (that you suggest) and their mathematics.

Essay Structure I

- The essay should contain:
  - A title, followed by your name, ID number, email address, and the module(s) in which of MA313 and MA335.
  - An abstract: a short single paragraph that neatly summarises the essay.
  - An introduction, which gives a more detailed overview of the content and organisation of the essay.
  - One or more main sections, that contain the main body of the essay.
  - A conclusion: what have you learned?
  - Bibliography. (More below).
- Don't attempt to be exhaustive. Instead, choose key points that you find interesting and learn and write about these.
- Your essay should build a narrative (in essence, it should tell a story). Its structure might help you prepare for your presentation (Week 12).
- Approx length: 1000–1500 words.

Literature and Bibliography

- You should **cite** all sources that you use.
- Wikipedia and similar pages can be useful starting points but they are **not** peer reviewed scientific resources. More importantly, Wikipedia is a tertiary source. However, it has links to useful primary sources.
- The bibliography can include web-links (such as Wikipedia or even videos), but should include at least 2 references to books or articles. These should be cited clearly in the main text of the essay. For example,

  > *When you cite a reference by number, it is good style to incorporate the author's name, as discussed by Higham [1, Section 6.11].*

- When citing a book, try to be specific about the chapter or section you are referring to.
- Ideally, you should rely on several sources.
- Choose one of the many common citation styles and stick with it.
- Pieces of text that are taken verbatim from sources should be clearly indicated.
- When in doubt, use your own words.

What happens next

- By 5pm, Monday 26 September, submit your choice to topic on the MA313 Blackboard module (See "Communication Skills: Essay topics").
- By 5pm, Monday 17 October, submit your progress report (more details to follow).
- By **5pm, Friday, 18 November** upload your essay, in PDF. Your submission will be checked for originality using TurnItIn.
- **Only for students registered in both MA313 and MA335.** In the week 21-25 November you will give a short presentation and submit your slides from the presentation on Blackboard by 5pm, Friday, 25 November (more details on presentations to follow).

Tentative Marking Schemes

(This marking scheme may be revised before final submission).
Selecting topic and progress report:

- Submit an agreed topic (2 pts)
- Submit an a progress report, with essay outline, and information on bibliography (2 pts)

Essay:

- Use and correct citation of peer reviewed reputable sources. (4 pts)
- Evidence of thorough research on topic. (5 pts)
- Clarity, style and structure of essay. (5 pts)
- Accuracy of mathematical content. (4 pts)

Presentation:

- Structure (5 pts) and content (5 pts) of slides;
- Pacing of presentation, clarity of verbal explanations, ability to answer questions (8 pts)

Note: you will have to submit your slides to be graded separately.

References I


Nicholas J. Higham.
Handbook of writing for the mathematical sciences.
Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 2020.
Third edition of [MR1223778].