MATHEMATICAL WRITING

A Guide for for Research Summaries, Expositions and Publications

Mathematical writing is above all else, writing. It is a creative process that requires the author to crystallize their understandings and to offer explanations for close scrutiny. Naturally, general advice to all writers applies in our discipline as well.

In *A Poetry Handbook,* Mary Oliver says, "to write well, it is entirely necessary to read widely and deeply." Much of our reading as mathematicians is purposeful, as we seek to understand a proof in order to extend it in our own work or check the conditions of a theorem that we wish to apply. Publications such as the Bulletin of the AMS are excellent sources of well-crafted mathematical papers written for a wide mathematical audience. Well written expositions attract an audience. By reading about craft and style, as in the suggestions given below, you will begin to notice their use in the works that you appreciate.

An enduring point of writing craft is to know and write for your audience. In mathematics, this will determine which definitions may be assumed and how much detail to include in technical proofs. While this will vary depending on the publication venue, one useful suggestion is to write so that a graduate student in your area could read your manuscript and would easily find any needed references from the bibliography. In addition, imagine how readers might use your work: some will progress through in the order it is presented, but some will dip in and out, trying to extract results that they find interesting or useful. Can you make your writing accessible for the second kind of reader?

Keep it simple. Avoid making matters harder than they are. Avoid using cumbersome notation. Avoid using fancy words, always use the simpler synonyms. Simplify and shorten explanations whenever possible.

In mathematical writing, the introduction also functions effectively as the discussion and conclusion of the paper. Here, we provide the context of the problem and its relation to the work of others. We explain what we will prove in the manuscript and (hopefully) discuss the consequences. It is also here that the mathematical writer might dare to be bold and raise a question for future exploration or make a conjecture. A well-crafted introduction describes the main results of the manuscript in the landscape of currently understood mathematics, explains the key insights of the work, and provides guidance to applying or extending the results.

For many working mathematicians, writing is a regular part of the job, and so you should consider setting aside a time and place to write regularly, and then keep the appointment with yourself. In the *Handbook*, Mary Oliver compares the relationship between our creative self and "the learned skills of the conscious mind" to that between Romeo and Juliet — the relationship is based on the individuals keeping their appointment. Finding a voice as a mathematical writer is a product of consistency in practice and confidence in the value of the mathematics communicated. Keeping a research journal, sketching ideas for proposals, or maintaining written correspondence with colleagues are valuable learning activities.

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KEY POINTS

- Know your audience and write for your audience.
- Familiarize the reader with the problem and issues.
- Write with straightforward language.
- Read your drafts out loud multiple times.

RESOURCES

The resources compiled below are concerned primarily with the style and craft of mathematical writing: the blending of formulas and sentences, the structure of mathematical texts, and practices that support the clear communication of complex ideas. Once you have a complete draft, reading aloud from a printed copy can help you to detect errors and awkward constructions. If your campus has a dedicated writing center, the staff there can also help to polish your mathematical writing.

Guidelines for Good Mathematical Writing by Francis Su (3 pgs) and Some Remarks on Writing Mathematical Proofs by John Lee (6 pgs): these cover basic writing points for undergraduates which apply to all mathematical writing. Note how the authors speak directly to the reader.

How to Write Your First Paper by Steven Krantz (Notices of the AMS 54 (2007), 1507-1511): this covers publishing, starting from selecting a research question, deciding to publish and the full journal submission process.

A Primer of Mathematical Writing, Second Edition by Steven Krantz (2017, 277 pgs): a free download book from an author recognized for clear and engaging expositions. An in depth discussion of the types and particulars of mathematics writing — many considerations are covered.

How to Write Mathematics by Steenrod, Halmos, Schiffer, Dieudonné (1973, 64 pgs): independent essays on writing mathematics

Writing Mathematics Well by Leonard Gillman (1987, 49 pgs)

Mathematical Writing by Donald Knuth, Tracy Larrabee, Paul Roberts (117 pgs)
Handbook of Writing for the Mathematical Sciences by Nicholas Higham (353 pgs) — with downloadable chapters.

A Poetry Handbook by Mary Oliver (1994).