Do's and don'ts of mathematical writing.

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Abstract

This document compiles practical tips for writing and formatting mathematical reports. It focuses on what to do (and what to avoid) to keep your writing clear, organized, and straightforward. You can use these tips for your final exam reports, master's thesis, or any future research work.

Contents

1. Introduction

Writing a mathematical report can feel overwhelming at times, but it's an essential skill that will serve you well throughout your academic and professional journey. Whether you are working on a final project for this course, preparing your master's thesis, or writing a research paper, presenting your ideas clearly and effectively is just as important as the mathematics itself. This guide is here to simplify the process. It presents practical tips on how to structure, format and refine your work to create a polished and professional report.

2. Best practices

2.1. Structure and organization

A well-structured report is essential for effectively communicating your work. Whether your focus is mathematical, numerical, or a combination of both, organizing your report into distinct and logically connected sections ensures clarity and impact. The abstract, introduction, conclusion, and bibliography form the core of any report and should be present regardless of the focus.

2.1.1 Abstract, introduction, conclusion, and bibliography

Abstract The abstract serves as a concise summary, outlining the main objectives, methods, and key findings of your work. It should briefly indicate whether the report is theoretical, numerical, or both, and emphasize its broader significance. Regarding the format, a good abstract should not be longer than 10 or 12 lines and appear in a slightly smaller font than the main body.

Introduction The introduction sets the stage for the rest of the report by clearly introducing the problem being addressed and its context. It provides necessary background, establishes the motivation for the study, and highlights how the work builds upon or diverges from existing literature. The goals and contributions should be explicitly stated, whether they involve proving a theorem, presenting experimental results, or combining theoretical insights with numerical validation.

Conclusion The conclusion ties the report together by summarizing the main outcomes and their significance. It should reflect on the broader implications of the findings, acknowledge any limitations, and propose, if possible, directions for future work.

Bibliography After the conclusion, a carefully compiled bibliography is essential to provide credit to prior work and to guide readers who wish to explore the subject further. The bibliography should include all references cited in the report, following a consistent and widely accepted citation style (see e.g. APA, MLA, or IEEE). Ensure that every referenced work—whether a paper, book, dataset, or software—is accurate, complete, and up to date. By doing so, you not only acknowledge the contributions of others but also reinforce the credibility of your report and its connection to the broader body of research.

2.1.2 Main body

The structure of the main body of the report should be adapted to the focus of the work.

Proof-focused reports For reports primarily focused on mathematical theorems and proofs, it is essential to begin with a section on preliminaries. This section defines key terms, introduces notation, and presents any foundational results required for the subsequent discussion. The main theorem(s) should then be stated clearly, followed by a logically structured proof. If the proof involves multiple steps or relies on intermediate results, these should be organized into subsections. Optional sections may include examples or applications to illustrate the theorem in practice or to demonstrate its utility in specific cases.

Experimental reports For reports centered on numerical experiments, the main body should focus on methodology, results, and discussion. The methodology section should describe the experimental setup in detail, including the algorithms used, the datasets involved, and the evaluation metrics employed. Sufficient detail must be provided to ensure the work can be reproduced by others. The results section should present findings in a clear and accessible manner, often accompanied by tables, graphs, or visualizations to enhance understanding. Following this, a discussion section should interpret the results in the context of the problem, addressing their implications and any limitations or challenges encountered. A url link to access the code should be also shared. This may be a google colab, or a github page depending on the nature of your document.

Hybrid reports When combining theoretical and numerical components, the report should integrate these aspects in a cohesive manner. Theoretical contributions should be presented first, including any theorems, proofs, and supporting analysis. The numerical component should then follow, with a detailed description of the experimental design and its connection to the theoretical framework. Rather than treating the results and discussion as separate entities, these elements should be integrated, directly comparing theoretical predictions with experimental observations. For reports with exceptionally long proof, supporting lemmas and their proofs may be deferred to the appendix.

2.2. Formatting standards

Maintaining consistent formatting is essential for presenting your work clearly and ensuring it meets academic standards. The entire document should be prepared using LaTeX, which is the preferred tool for producing mathematical documents. LaTeX ensures consistent formatting across sections, provides excellent support for mathematical notation, and allows for precise control over layout and structure. Using LaTeX also makes it easier to incorporate references, figures, and tables seamlessly into the document.

2.2.1 Equations

Equations are a central component of technical reports. Outside of proof sections, displayed equations should be used selectively : they must be reserved for expressions important enough to warrant the attention of the reader. These equations should be centered for clarity and emphasis. Simple or less critical equations should be written inline, to maintain a smooth narrative flow.

A careful attention should be paid to the layout of equations. LaTeX environments like `align` or `multline` are essential for managing multi-line equations, ensuring readability, and avoiding awkward breaks. Only number equations that will be referenced later in the document, and ensure numbering follows a consistent sequence. Restarting equation numbering at each section is discouraged unless the document is exceptionally long (100+ pages).

2.2.2 Figures and tables

Figures and tables must include descriptive captions, placed below them. All visual elements should be referenced in the main text and formatted for clarity, with vector graphics (e.g., PDF or SVG) preferred for figures. For plots generated using python, save the figures in the pdf format, to ensure it appears properly.

2.3. Additional writing tips

We finish this section with additional writing tips to ensure clarity and precision throughout your report.

2.3.1 Key terms and acronyms

Define all key terms and acronyms the first time they appear in the text. Keep definitions concise, precise, and consistent with established usage in the field. For acronyms, provide the full term followed by the abbreviation in parentheses (e.g., Singular Value Decomposition (SVD)) before using the abbreviation independently. This practice eliminates ambiguity and ensures that readers, regardless of their familiarity with the topic, can follow the material effortlessly.

2.3.2 Presenting proofs and derivations

Write proofs and derivations with sufficient detail to allow readers to verify the reasoning independently. Clearly state all assumptions, intermediate results, and justifications for each step. For longer proofs or derivations, organize the content into subsections or move supplementary details to an appendix to maintain readability. Adding brief annotations or explanatory comments can provide intuition for complex steps without disrupting the logical flow. These practices ensure a balance between mathematical rigor and accessibility, enhancing the overall clarity of your work.

2.3.3 Presenting numerical experiments

Each numerical experiment should have a clearly defined purpose. It may confirm a mathematical result by demonstrating alignment between theory and practice, or it may serve to validate a conjecture numerically, providing evidence to support or refine theoretical insights. When presenting numerical experiments, begin with a detailed description of the experimental setup. Specify the algorithms used, parameters chosen, datasets involved, and the evaluation criteria applied. This level of transparency ensures that your experiments can be reproduced and their conclusions properly assessed. Particular attention should be paid to the aesthetics of your plots and visualizations. Well-designed and visually appealing figures not only draw the reader's attention but also enhance their understanding of the results. Include clear labels, consistent formatting, and appropriate

captions to maximize clarity. Finally, interpret and comment on the results thoughtfully, linking them to the theoretical framework or highlighting their implications. A careful analysis strengthens the connection between your numerical work and its broader mathematical context, ensuring that the results are meaningful and accessible to the reader.

3. Common pitfalls

This section gathers common mistakes I have seen in students reports that can seriously affect the quality of their document (and consequently their grade!). Recognizing and avoiding these issues can greatly improve the clarity and professionalism of your document.

3.1. Poor writing practices

Poor writing is one of the most common issues that detracts from a report's quality. Two key problems are the use of vague or ambiguous statements and excessive jargon that serves no purpose other than to complicate the text unnecessarily.

3.1.1 Vague and ambiguous statements

Vague statements undermine the clarity of your report, making it difficult for readers to grasp your findings or assess their significance. These statements often lack specifics, leaving key details unstated. For example:

> ***Bad Example:*** *The results appear to indicate that the algorithm is better in some cases.*

This statement is problematic because it provides no concrete information. What does "better" mean? Is it faster, more accurate, or more efficient? What are "some cases"? Without clear definitions or evidence, the claim is meaningless and does not contribute to the reader's understanding.

> ***Good Example:*** *The results show that Algorithm A achieves a 15% lower error rate compared to Algorithm B on the synthetic dataset, particularly for high-noise scenarios.*

This revised statement specifies the metric of comparison (error rate), quantifies the improvement (15%), and identifies the context (high-noise scenarios). Such clarity not only makes the statement easier to understand but also allows the reader to evaluate the results critically. To avoid vagueness, always quantify results where possible, specify the conditions under which they hold, and define comparative terms like "better" or "faster." A clear statement helps establish credibility and demonstrates a strong grasp of your work.

3.1.2 Excessive jargon

Overuse of technical jargon can alienate readers and obscure the main message of your report. While some jargon is necessary for precision, overloading sentences with unnecessarily complex terms creates barriers to understanding, even for an informed audience. Consider the following:

> ***Bad Example:*** *The hyperdimensional stochastic perturbation of the process in the transitional Markovian phase yielded non-intuitive results.*

This sentence overcomplicates the explanation by using specialized terms like "hyperdimensional stochastic perturbation" and "transitional Markovian phase" without context or necessity. Such language adds confusion rather than clarity.

> ***Good Example:*** *The Markov process showed unexpected behavior during the transition phase, likely due to random noise in the system.*

The improved version uses simple, clear language while maintaining technical accuracy. Terms like "unexpected behavior" and "random noise" are accessible and allow readers to focus on the underlying idea rather than deciphering unnecessary complexity. To strike a balance, use jargon only when it adds precision and cannot be replaced with simpler terms. Always define technical terms when they are first introduced, and provide context to help readers understand their relevance. This approach ensures your report remains accessible and communicates effectively, even to readers outside your immediate field.

3.2. Formatting errors

Formatting errors are a frequent issue in technical reports and can significantly diminish their quality and professionalism. Attention to detail in formatting is crucial to ensure your report is clear, polished, and easy to read. This section highlights common formatting pitfalls and provides guidelines to help you avoid them.

3.2.1 Inconsistent formatting and improper citations

One of the most noticeable issues in a report is inconsistent formatting. Variations in font sizes, styles, or spacing across sections can make the document appear unprofessional and disorganized. Ensure consistency by adhering to a predefined style guide for headings, subheadings, and body text.

Improper citations are another common problem. Missing references, inconsistent citation styles, or failure to follow a recognized format can reduce your report's credibility. Choose a widely accepted citation style, such as IEEE, APA, or MLA, and apply it consistently throughout the document. Tools like LaTeX's biblatex or natbib make managing citations straightforward and reduce the risk of errors. A professional and well-formatted bibliography is critical to establishing your work's connection to the broader research context.

3.2.2 Figures and tables

Figures and tables are essential tools for presenting data and results, but they are often mishandled in reports. Every figure or table must have a descriptive caption that explains its content and purpose. Captions for figures and tables should appear below them. Without captions, readers cannot fully grasp the meaning of your visuals, reducing their impact.

Equally important is the inclusion of relevant discussion in the main text. Never include a figure or table without explicitly referencing it and explaining its significance. Connect the visual element to your narrative, describing the key observations or trends it illustrates.

Additionally, figures and tables should be placed thoughtfully within the report. As a general rule, position them at the top of a page to preserve the document's flow. They

should not take up more than half a page unless they are located in the appendix. Large visuals can disrupt the structure of your report, so only include them in the main text if they are critical to the discussion. Supplementary visuals or overly detailed tables should be deferred to the appendix to maintain focus in the main body.

3.2.3 Screenshots

Screenshots of text or figures are a frequent and problematic inclusion in student reports. They often appear pixelated or poorly aligned, giving the report an unpolished and amateurish look. Screenshots should only be used if absolutely necessary, such as when displaying an interface or software output that cannot be recreated otherwise.

Whenever possible, use tools like LaTeX to typeset text and produce vector-based graphics for figures. Software such as `Matplotlib`, `TikZ`, or `ggplot2` can generate high-quality visuals that integrate seamlessly into your document. If you must include a screenshot, ensure it is of the highest resolution and properly annotated to make its content clear. Low-quality or unnecessary screenshots detract from the overall professionalism of your work.

4. Conclusion

In this document, we outlined some practical guidelines for writing and formatting mathematical reports. From structuring your work and presenting results to avoiding common pitfalls, these recommendations aim to help you produce clear and professional documents. Good writing is not just about technical accuracy; it is about effectively communicating your ideas and engaging your readers. Whether you are preparing a report for a course, a master's thesis, or a research paper, the skills emphasized in this guide will serve you well throughout your academic and professional career. Finally, remember that clarity and professionalism in writing reflect a deep understanding of your subject. Take the time to revise, proofread, and polish your work. Writing is an iterative process, and each step is an opportunity to refine your ideas and strengthen your arguments. With practice and attention to detail, you will develop the ability to write mathematical reports that not only convey your results but also inspire confidence and respect from your readers.