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Soft skills for mathematicians, L1+L2

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Course contents

PhD course: **Soft Skills for Mathematicians**

Parts/sections:

1. Writing a scientific paper
2. Submission, revision and giving feedback
3. Writing/presenting a popular material
4. Oral presentations
5. Writing applications
6. Career building in academia

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A good mathematician

What makes a good mathematician/statistician?

Obvious answer: someone who can solve hard important problems

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A good mathematician

What makes a good mathematician/statistician?

Obvious answer: someone who can solve hard important problems

But more is required:

- Ability to identify important problems
- Ability to write interesting and pedagogical papers explaining solution
- Ability to given an interesting pedagogical oral presentation of solutions
- Ability to successfully apply to positions and grants

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General comments

Unlike mathematics there is no exact *right* or *wrong* in writing and presenting

The more you write/present – the better you get!

Writing and presenting is very important – this is what you are paid for!

Research results never published or presented don't exist!!

This course is about the "package" – not the mathematical content

The "package" is equally important for reaching out!

The course is **not** about software (LaTex or similar)

Some references: Halmos, Chatfield, Purdue University, Gillman, Higham, ...

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Before starting to write

Procedure (Chatfield): Preparation – writing – revision

Things to consider when preparing:

- Who is the typical reader?
- Which journal? (Affects style and structure)
- What are the main messages? (Not too few or worse, too many) Write them down!
- What is good notation to be used?

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The "decreasing rule"

Keep in mind the decreasing or "half-time" rule:

Out of all people that read the title

- 50% read the abstract
- 25% read the introduction
- Half of readership is lost with each section
- $<$ 1% read the appendices

I think these numbers are **very optimistic** ...

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Consequences

The title is very important: to deliver the main message AND to attract the reader

The abstract is very important: should contain the main messages, a bit about methodology and attract interest

The introduction is very important: I think it shold contain a very short background, a statement of the problem(s) treated, a presentation of the results and description of the rest of the paper

Have the "decreasing rule" in mind: someone who reads 1-2 pages should benefit from the paper!

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More things before getting started

Who should be author? Those who have contributed substantially. **Decide in advance!**

In what order? Depends on subject. **Decide in advance!**

What "type" of journal will you submit to? Will affect how you structure paper. **Aim fairly high! But not unrealistic ...**

Who/what should be acknowledged? Supervisor (if not an author), others who have contributed, financial support (not the home university), referees – if their comments were important

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Getting started

The first thing to do: write a **skeleton** ($\approx$ list of contents)

The skeleton should contain the different (sub-)sections

The skeleton should also contain a description of what parts come in the different (sub-)sections (relating to the "main messages")

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A common structure of a mathematical paper

- Title, authors and abstract
- Introduction (possibly also containing main results)
- The model/problem
- one or more sections of theory
- illustration/application/numerics
- Discussion/conclusion
- Appendix (sometimes placed after references or separately)
- References

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Writing the main text

If several authors: divide the (sub-)sections according to competence

My experience: don't write simultaneously – better if one starts and the next takes over (this makes the styles deviate less)

It's ok to leave out some technical bits at first to keep *logical line* in writing procedure

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Minor comments

- Don't use complicated language
- Equations are part of sentences
- Use, but don't over-use, bold face and italics
- Don't start sentence with mathematical symbol
- Avoid abbreviations
- Number only equations that are referred to
- Try to make the text "flow": leave less relevant technicalities to appendices (or technical sections)
- Admit or give reference where logical steps are left out
- Don't use phrases like: "it easily follows that ..." better with: " standard but tedious calculations reveal that ..."

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More minor comments

- Avoid too **much** mathematical notation

- Mathematical notation should be logic and easy to remember

- Use words rather than math-symbols in running text: "Pick an element x in X" rather than "Pick $x \in X$"

- Lemma – Theorem – Corollary

- Proposition: a weaker form of theorem

- Use "I" or "we" in text? I prefer "we" even if only one author: We = I and the reader

- Use figures, tables etcetera – it makes the text look more varying (beside explaining/illustrating something)

- All figures/tables and similar must be referred to in text

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More minor comments

- Use capital letters when referring to figures, theorems, and simimlar: ... as shown in Figure 3 ...

- Use spell- and grammar-check, and possibly AI software like ChatGPT

- Use active (not passive) form in sentences

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Specific remarks: Title and abstract

- Should be written "afterwards"
- **Title**: spend time deciding this! It is very important
- **Title**: should be informative, "catchy" and short (hard ...)
- **Abstract**: should both give the main result and attract the reader
- The abstract is not part of the paper: something defined in the abstract must also be defined in the main text

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Specific remarks: Introduction

Introduction

- Readers who only read introduction should benefit from this

- Should explain the question studied + a minor background

- I think the main results should also be stated here: what have you shown/proven?

- Unless given elsewhere, the introduction should end by describing the structure of the rest of the report

- It should also try to catch the interest of the reader: why is this an interesting problem?

- Good to start with a short motivating background. But not a long historical overview

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Specific remarks: Citations and references

- There are different ways of referring and writing reference list. Be consistent

- Better with too many than too few references

- All items in reference list must be cited in text

- Direct the unfamiliar reader to some background text covering "your" area

- Avoid citing unpublished work

- Give page reference when citing books

- **Don't quote/copy (e.g. from web) without citing. This is criminal!!!!!!** Beware of Copyrights

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Specific remarks: Discussion/Conclusion section

- Should summarize main results (repeat the important!)

- Mention the strength of the results and why they are interesting

- Mention also what can be done better, alternative routes, interesting extensions and open questions

- Posing interesting unsolved problems is perhaps even more important than solving problems!

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Specific remarks: Appendix (and technical sections)

- Here you can be more technical/advanced

- Should contain material that is not central and would stop the "flow" in the main text

- Each appendix should start with what it is about

- Each appendix should end with the result that is referred to in main text

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After the first draft written

- Leave the manuscript for a few days (otherwise you are "blind")
- Then go through it:
  - First look at the general structure: is everything there?, adequate level of detail?, easy to follow the logical line?, can something be removed? Are readers attracted?
  - Then go through the manuscript in detail
  - Pretend you are a typical reader of the journal in question
  - Change whole paragraphs rather than sentences
  - focus more on removing than adding things!
- If several authors: read and comment each others' contributions
- Repeat everything above (at least) once more **Date versions!**

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After the second and third drafts are written

- If sole author: have someone else read and comment the manuscript (supervisor, student colleague, ...).
- Preferably someone being the intended "typical reader"
- Adjust according to suggestions: other reader will react similarly
- Possibly also: Send to **proof-reader**
- Reconsider journal choice: aim fairly high, check reference list for candidate journals

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Submitting

- Once this has been done: **Submit!**: no paper is perfect! (Many potentially good scientists fail due to never being completely satisfied with a manuscript)

- One author has contacts with journal: **corresponding author**

Cover letter: Write a short letter without any mathematical symbols explaining: why your manuscript is interesting, what your main results are, and why the manuscript is suited for that particular journal

Suggesting referees: Many journals encourage or require you to suggest referees. Suggest people you build your work on. Fine if they have positive impression of you, but not close collaborators

- If the journal allows (nearly all journals do!): put also manuscript on ArXiv/similar