

# Research Tools and Methods for the Mathematical Science

## Lecture 3: Writing for Mathematical Sciences

Matthew Roughan

`<matthew.roughan@adelaide.edu.au>`

[http://www.maths.adelaide.edu.au/matthew.roughan/  
Lecture\\_notes/ResearchToolsCourse/](http://www.maths.adelaide.edu.au/matthew.roughan/Lecture_notes/ResearchToolsCourse/)

School of Mathematical Sciences,  
University of Adelaide

March 19, 2015

# Intro

Proof by Necessity: “It had better be true or the whole structure of mathematics would crumble to the ground.”

A writer needs three qualities: creativity, originality, clarity and a good short term memory.

*Desmond J. Higham, More Commandments of Good Writing, 1992*

# Technical writing

All the previous themes +

I said, writing for science, maths and engineering is just like any other writing, but it isn't quite. Specifically

- Be precise
  - ▶ Repeatability
  - ▶ 6 Ws (Who, Why, How, When, Where, What)
  - ▶ Concrete nouns preferred to abstract
- Repetition is good
  - ▶ The spiral
  - ▶ Think global, write local
- Avoid common (technical writing) flaws
  - ▶ Avoid excessive prepositional qualifications
  - ▶ Active verbs preferred to passive

It will all make sense if we learn how people read a scientific paper.

# Be precise

## Think about repeatability

- Give me enough detail to repeat your experiment, ...
- Be quantitative, not qualitative (where possible)
- Avoid terms like “like” or “stuff” or “thing”
- Be careful with pronouns
- Describe data exactly: dates, amount, problems, ...
- Reference tools and methods
- Answer the easy questions

<http://www.icir.org/mallman/plea.txt>

- ▶ units
- ▶ define notation

## 6 Ws (Who, Why, How, When, Where, What)

- Its often a good way to get started on a blank page
  - ▶ just answer these questions
- Some people slavishly try to do all six, all the time
  - ▶ but some questions don't make sense
- We can answer the questions at different levels
  - ▶ in the intro – about this paper
  - ▶ in the literature review – about other papers
  - ▶ in the results – describing the results

## Concrete nouns preferred over abstract

Abstract nouns are by definition ambiguous, and the more often they crop up, the less informative the writing.

*Johnson [Joh82]*

Often abstract nouns can be replaced with a concrete *informative* noun, or eliminated altogether.

**Abstract:** *The **nature** of helium is **such that** it is a gas at room temperature.*

**Concrete:** *Helium is a gas at room temperature.*

Other common examples: thing, type, case, class, ...

Pronouns are another common source of ambiguity.

# Repetition is good

- Repetition is good

# Repetition is good

- Repetition is good
- Repetition is good (but you don't have to be dumb about it)



# Repetition is good

- Repetition is good
- Repetition is good (but you don't have to be dumb about it)
- Say the same thing more than once, but differently

Your readers are busy, and reading quickly [KLR89, p.59]. They don't read your text the way you think they do. They miss things.

# Scientific reading

- Start with the title
  - ▶ if that's boring throw the paper away
- Now read the abstract
  - ▶ if that's boring throw the paper away
- Now read the introduction
  - ▶ if, at any stage, you are bored, throw the paper away
- Now scan the rest of the paper
  - ▶ feel free to skip over anything that looks too hard
  - ▶ look mostly at pictures and tables
  - ▶ flick backwards and forwards randomly a few times
- If you can still be bothered, read the paper properly
  - ▶ you will still miss details!

This is not how I want you to read a paper, this is the reality of how your papers will mostly be read. And don't think reviewers are immune!

# Try this

Count the “f”s

*Five thousand famous artists from France, were of the opinion that if they framed paintings in frames of fine wood, then if anyone found their art full of fancy, at least they couldn't find fault in the frame.*

# Try this

Count the “f”s

*Five thousand famous artists from France, were of the opinion that if they framed paintings in frames of fine wood, then if anyone found their art full of fancy, at least they couldn't find fault in the frame.*

The answer is 18

# The Spiral

- Repetition could become boring
- Often our paper can't have strictly linear logic
  - ▶ e.g., we want to talk about a technical issue, but haven't defined it yet
- We need to bring reader in at the start, and being too detailed and technical can be a turn off [KLR89, p.59]
- We need a reader to “get” what we are talking about early
  - ▶ don't waste their time if they aren't interested in the topic
  - ▶ don't lose some readers who would be interested, but don't realise it until too late
- If a reader stopped at some point, would they get any take-away value from the paper?
  - ▶ think like a newspaper editor
  - ▶ think about lazy readers: what conclusion they will get?
  - ▶ think in the long run, not just about one paper

# The Spiral

Solution: write in a spiral

- repeat the same topics
  - ▶ start high-level, low detail, low “technical accuracy” [KLR89, p.76]
    - ★ low accuracy is what lots of people can't bring themselves to do
  - ▶ successively focus, bringing the reader along
    - ★ at each stage, more detail, more precision

- Can think in terms of sections

**title:** imprecise, general

**abstract:** still imprecise, but more detail

**intro:** still imprecise, but even more detail

**body:** finally, be very precise

but it doesn't have to be done in sections.

# Think global, write local

- Think big

- ▶ what is the message of your work
- ▶ what is your contribution
- ▶ why should anyone care

if you can't answer these, then you aren't doing the right work  
(for you at least)

- Be humble

- ▶ don't claim what you can't prove  
<http://www.icir.org/mallman/plea.txt>
- ▶ apart from inaccuracy, it irritates reviewers

- Its hard to get the right balance

- ▶ e.g., don't over-qualify statements to try to be technically accurate

## Avoid excessive prepositional qualifications

Johnson calls the difference catalogical vs analytical writing [Joh82].

**Catalogical:** *The need in the company for great increases in space, caused by a steady growth in research work, has necessitated the addition of a new wing to the laboratory.*

**Analytical:** *Because its research work has been growing steadily, the company is adding a new wing that will greatly increase its laboratory space.*

Catalogical lumps all details in together without order. Analytic gives the logic.

P.S. Johnston is actually making another classic mistake – which one?



## Active verbs preferred to passive

Passive verbs sound unnatural and weak, but technical people seem to like using them [Joh82].

**Passive:** *Correction of production errors was obtained through laboratory tests.*

**Active:** *The laboratory tests corrected production errors.*

Look for places where the subject of the verb receives the action of the verb, instead of just being done.

# Tools for writing

LaTeX – just learn it

These days I use pdflatex (with beamer for presentations) and bibtex, and I edit files with emacs, but there are other versions and packages to help you.

There are a vast number of helpful resources out there:

- [LaTeX – a Document Preparation System](#)
- [Getting to Grips with LaTeX](#)
- [Tony Roberts' notes on LaTeX](#)
- [Wiki book](#)
- [Tex StackExchange](#)
- [Comprehensive TeX Archive](#)
- [LaTeX cheat sheet](#)
- [Beamer](#)

## Other references

- David Goss <http://www.math.osu.edu/~goss.3/style.html> for hints on mathematical style.
- Dimitri Bertsekas [newslab.ece.ohio-state.edu/forstudents/resources/tenrules.pdf](http://newslab.ece.ohio-state.edu/forstudents/resources/tenrules.pdf) “Ten simple rules for mathematical writing” though they are anything but simple.
- Knuth *et al.* [KLR89]: for those who don't know, Knuth is responsible for TeX as well as much else.
- [Introduction to Journal-Style Scientific Writing](#)
- [Technical writing links](#)
- [Advice on Research and Writing](#)
- [Style resources for mathematics](#)
- [The Nuts and Bolts of Writing Papers](#)

# Summary

- Technical writing has a few extra challenges
  - ▶ precision
  - ▶ cynical view of readers
- LaTeX
  - ▶ too necessary to mathematical writing to bother justifying any more
  - ▶ too many resources out there for me to bother teaching it

# Assignment

Pick an abstract for a paper, and write a critique of it. Try to specifically look for the flaws I have described.

## Further reading I



J. SCOTT ARMSTRONG, *Creative obfuscation*, IEEE Transactions on Professional Communications **PC-25** (1982), no. 1,  
<http://public.lanl.gov/kmh/pc-25-30-armstrong.pdf>.



Nicholas J. Higham, *Handbook of writing for the mathematical sciences*, SIAM, 1995, Wonderful book with lots of good advice. Slightly out of date on the computing parts, but otherwise still very relevant.



Thomas P. Johnson, *How well do you inform?*, IEEE Transactions on Professional Communications **PC-25** (1982), no. 1,  
<http://public.lanl.gov/kmh/pc-25-5-johnson.pdf>.



Donald E. Knuth, Tracy L. Larrabee, and Paul M. Roberts, *Mathematical writing*, Mathematical Association of America, 1989,  
[jmlr.csail.mit.edu/reviewing-papers/knuth\\_mathematical\\_writing.pdf](http://jmlr.csail.mit.edu/reviewing-papers/knuth_mathematical_writing.pdf),  
contains a huge amount of very good advice, but loosely organised (just reports of a set of lectures).

## Further reading II



J.J. Siegfried, *A first lesson in econometrics*, *Journal of Political Economy* **78** (1970), [www.uibk.ac.at/econometrics/lit/siegfried\\_jpe\\_70.pdf](http://www.uibk.ac.at/econometrics/lit/siegfried_jpe_70.pdf).