Written & Oral Presentation:
Tips for better writing

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Elements of universal style

A classic book "The Elements of Style" by Strunk and White goes through a lot of examples illustrating their key recommendations:

- always use **clear, precise language**, even when expressing complex ideas
- engage your reader's attention through **examples, illustrations, and anecdotes**
- **avoid** opaque **jargon**
- **vary** your vocabulary, sentence length, and frames of reference
- favor **active verbs and concrete nouns**
- **write with conviction**, passion, and verve

Personal style

For some things there is no universal agreement or necessarily a right or wrong answer:

- **Personal pronouns**: Using I and we, or **addressing the reader** directly, say with "you" instead of "one". (I recommend you do it)
- **Use of jargon**: Should you avoid jargon all together? (I suggest using it as needed if avoiding it distracts).
- **Personal voice**: Is the writer a person or does the paper exist in a separate objective impersonal frame of reference? (I suggest you should make yourself known and unique)
- **Nonstandard structure**: Is it OK to deviate from IMRAD? (I suggest yes but only once you become proficient and fluent in the standard form. For now use the standard form as a template to help you structure your writing.)
- **Creative expression, humor, puns, engaging titles**: Is it OK to be funny, at the risk of sounding "unprofessional"? (I suggest it is but only sparingly).

Smart Sentencing

Sword points out that stylish academic writers:

1. employ plenty of **concrete nouns and vivid verbs**, especially when discussing abstract concepts.
2. **keep nouns and verbs close together**, so that readers can easily identify "who's kicking whom."
3. **avoid** weighing down their sentences with extraneous words and phrases, or **"clutter."**

Active vs. passive

- Sword writes "Many academics, however, give little **thought to their verbs**, favoring forms of be (*is, am, are, was, were, been*) and predictable scholarly verbs such as *analyze, show, examine, and consider*"

- Example of a passive sentence:
  "Although standard statistical methods are available for incorporating measurement error and other sources of variation, they are not commonly applied, and they have rarely been considered in the context of phylogenetic statistics in which trait values are correlated among related species."
  Can you rewrite this to be more active and lively?

- By contrast, consider this active and vibrant sentence:
  "Insects suck, chew, parasitize, bore, store, and even cultivate their foods to a highly sophisticated degree of specialization."

Changing passive to active

Hingham gives some examples from math:

- Passive: The answer was provided to sixteen decimal places by Gaussian elimination.
  Active: Gaussian elimination gave the answer to sixteen decimal places.
- Passive: The failure of Newton's method to converge is attributed to the fact that the Jacobian is singular at the solution.
  Active: Newton's method fails to converge because the Jacobian is singular at the solution.
- Passive: A numerical example is now given to illustrate the above result.
  Active: The following numerical example illustrates this result.
- **Passive and indirect**: Verification of the optimality of y was achieved by checking that the Hessian matrix was positive definite.
  Active: We verified the optimality of y by checking that the Hessian matrix was positive definite.

Active vs. passive

- **When is passive voice useful?**
- Answer: If the subject is of secondary importance to the action itself. Examples:
- "Passive constructions can be employed by stylish writers" places passive constructions front and center, whereas an actively worded phrase such as "Stylish writers employ passive constructions" would have put more weight on the author's role.
- "An ingenious proof of this conjecture was constructed by C. L. Ever", emphasizes the ingenuity of the proof instead of the author.

Subject, verb, object

- Advice from Sword: "Measure the **distance between nouns and their accompanying verbs**.
- When agent and action become separated by more than about a dozen words, readers quickly lose the plot."
- Example: "The *knowledge* that criminalization of marijuana use can lead to a wide variety of other social ills, including an increased risk of addiction to more dangerous and expensive drugs such as heroine and cocaine, *has not prevented* lawmakers..."

Clutter

- "Other contributors to clutter include *it, this, that, and there*."
  Example:
  "*It* is now generally understood that constraints play an important role in commonsense moral thinking and generally accepted that they cannot be accommodated by ordinary, traditional consequentialism...Some have seen *this* as the most conclusive evidence that consequentialism is hopelessly wrong, while others have seen it as the most conclusive evidence that moral common sense is hopelessly paradoxical."

- Question: "Some *who* have seen this *what*? Isn't it the author's job, not ours, to make the sentence's meaning clear?"

- Why should we have to work so hard to figure out what this sentence is trying to say?

- Even worse: "There are a number of studies that show that *this* is a bad idea because *it*..."

This, it, that

Sword summarizes the standard guidelines:

- Use **this** only when accompanied by a **modifying noun**: "This argument shows" rather than merely "This shows"
- Use **it** only when its referent—that is, the noun it refers to—**is crystal clear**.
- For example, in the sentence "The woman threw the lamp through the window and broke *it*," *what* did the woman break, the lamp or the window?
- **Avoid** using **that** more than once in a single sentence, except in a parallel construction or for stylistic effect. Don't write stuff like: "Sentences that rely on subordinate clauses that in turn contain other clauses that introduce new ideas that distract from the main argument that the author is trying to make..."

Which vs. that

Hingham writes:

- **that** defines and restricts, whereas **which** informs and does not restrict:
  "Consider the Pei matrix, which is positive definite." We are being told additional information about the Pei matrix: that it is positive definite.
  "Consider a Pei matrix that is positive definite." Now we are being asked to focus on a particular Pei matrix from among several: the one that is positive definite.

- If you're not sure whether to use which or that, see whether your sentence looks right with commas around the relevant clause. Generally, **replace which by that** whenever it sounds right to do so (avoid the "wicked which")

Avoid

- The adjectives or adverbs **very, rather, quite, nice** and **interesting** should be used with caution in technical writing, as they are imprecise.

- Avoid using nouns as adjectives:
  "method of *iteration parameter* estimation" ->
  "method for estimating iteration parameters"

- Avoid the dangling participle:
  "Substituting (3) into (7), the integral becomes..." ->
  "Substituting (3) into (7), we find that the integral is..."

- Hyphernate compound adjectives before a noun:
  This is an ill—posed problem but This problem is ill posed.

(Semi)colons

- A **semicolon** can be used instead of a period (but *not* instead of a comma!) to link two sentences that are very connected by content: "This bound has the disadvantage that it uses a norm of X; moreover, the multiplicative constant can be large when X is not a normal matrix."

- Use an **Oxford comma** before and/or linking the element of a list of more than two items to **avoid ambiguity**: "I invited the professors, Aleks and Miranda." vs "I invited the professors, Aleks, and Miranda."

- If items in a list contain commas, use a semi-colon to avoid ambiguity: "The test collection includes matrices with known inverses or known eigenvalues; ill-conditioned or rank deficient matri ces; and symmetric, positive definite, orthogonal, defective, involutary, and totally positive matrices."

Clarity and emphasis

- **Avoid exclamation points** in scientific writing unless the emphasis is required to understand the importance or meaning of the sentence, as in:

  "When A is tridiagonal the computation of $A^{-1}u$ costs little more than the computation of Au!"

- **Ideally, each paragraph contains a main idea or thought that separates it from its neighbours**.

- A long paragraph that is hard to break may be indicative of convoluted thinking. A mix of different paragraph lengths is best. The best writers occasionally slip in one—sentence paragraphs.

- Generally, it is best to **use the least abstract, most specific word possible**. In order of increasing specificity:

  result-theorem-inequality; optimum-minimum-global minimum

Quality vs quantity, and abbreviations

- **Compare with** (and **not compare to**) analyses similarities and differences between two things:
  "We now compare Method A with Method B"
- **Less/much** refers to quantity, amount or size, **fewer/many** to number.
  less should be used with singular nouns and fewer with plural nouns:
  less research $=>$ fewer papers.
- Prefer "for example" and "that is" over **e.g.** and **i.e.** – either way, surround them by **two commas**.
- **cf.** has only one period, because it is an abbreviation of a single word: the Latin confer, meaning compare;
  It's used *incorrectly* instead of "see" in "cf. [6] for a discussion".
- The abbreviation **et al.** is short for et alia.

Tense

- The **present tense** works most of the time and is easiest to use to avoid making arbitrary decisions and most importantly to **keep the tense consistent** throughout.
- Present can be used to refer to subsequent parts of the paper: "This **is** proved in Theorem X" and not "This **will be** proved in Theorem X"
- Present can also be used for backward references, but past tense is more common:
  "We showed in Section X that..."
- You can refer to earlier works either in present or past tense.
- In the summary of work in the Conclusions use past tense.

Mathematical Writing

I will follow Hingham's book with tips specific to mathematical writing.

- A **theorem** is a major result that is of independent interest: Label, name and/or number theorems.
- A **lemma** is an auxiliary result and usually not of independent interest but may be found to be important later.
- A **proof** should emphasize the outline and key ideas: readers want to learn the technique and not the details.
  "A great deal can be accomplished with arguments that fall short of being formal proofs."

Proofs

- Guide the reader through the proof with phrases like:
  - The aim/ idea is to ...
  - Our first goal is to show that ...
  - Now for the harder part ...
  - The trick of the proof is to find ...
  - ... is the key relation.
- Keep the reader pacing with phrases like:
  - First, we establish that
  - Our task is now to
  - Our problem reduces to
  - It remains to show that
  - We are now in a position to
  - Finally, we have to show that

Definitions

"A graph is *connected* if there is a path from every node to every other node." (the italics makes it clear this is a definition)

- Ask yourself why you are making a definition: **is it really necessary?**
- It is **bad practice** to give a **long sequence of definitions** at the start of a work.
  Ideally, a definition should be given in the place where the term being defined is **first used**.
- To reinforce notation that has not been used for a few pages you can **repeat definitions** inline:
  "The optimal step length $\alpha^\star$ ..."
- You should aim for a definition that is **short**, expressed in terms of a **fundamental property or idea**, and **consistent** with related definitions.
- In definitions, "if" is the same as "if and only if"

Misc.

- Words are often better than equations even if not as "precise":
  "Define $C \in \mathbb{R}^{n \times n}$ by the property that vec (C) is the eigenvector corresponding to the smallest eigenvalue in magnitude of A, where the vec operator stacks the columns of a matrix into one long vector."
- Use "**for all**" and "**there exists**" instead of the shorthand $\forall$ and $\exists$ especially in text.
- "Time step" (a process) is different from "**time step size**" (a number).
- Avoid **ambiguity in slashed fractions**:
  Write $x^2/12\, f'(x)$ as $x^2/\left(12 f'(x)\right)$ or $x^2 f'(x)/12$.

Displayed Equations

- An equation is **displayed** when:
    - it needs to be numbered
    - it would be hard to read if placed in-line, or
    - it merits special attention, perhaps because it contains the first occurrence of an important variable.
- Break long equations over **multiple lines** at binary operations, put the operation on the next line, and align the parallel operations among lines:

$$
A = B + C
$$
$$
+ \int X(x)\, dx
$$
$$
= B + C + D.
$$

- Remember to be careful not to add **extra paragraph breaks** (empty lines) **around displayed equations** in LaTex:
  use comment lines for spacing around displayed equations.

Typesetting equations

- Most important thing to pay attention to:
  "**Mathematical expressions, including displayed equations, are part of the sentence and so should be punctuated.**"

- E.g.: A commonly used norm is the p-norm [**no colon**]

$$\|A\|_p = ..., \quad A \in \mathbb{R}^{m \times n}, \quad [\textbf{comma}]$$

where $p \geq 1$ and the vector norm

$$\|a\|_p = \left(\sum_{i=1}^{n} |a_i|^p \right)^{1/p}. \quad [\textbf{period}]$$

- Avoid starting a sentence with a mathematical expression, particularly if a previous sentence ended with one:
  "A is an ill-conditioned matrix" $=>$ "The matrix A is ill-conditioned"

Math punctuation

- Separate mathematical symbols by punctuation marks or words:
  "Since $p^{-1} + q^{-1} = 1$, $\|\cdot\|_p$ and $\|\cdot\|_q$ are dual norms." should be
  "Since $p^{-1} + q^{-1} = 1$, the norms $\|\cdot\|_p$ and $\|\cdot\|_q$ are dual."

- The definite article "the" is inappropriate when the object to which it refers is (potentially) not unique or does not exist:
  "Let **a** Schur decomposition of A be $QTQ^\star$"

- If **nesting braces/brackets**, choose a standard order and **be consistent**, e.g., Chicago Manual $\{[()]\}$.
  It is fine to use only () but make sure they are \left(and \right).

- Lists should be punctuated properly with \cdots or \dots with **symmetric operators or commas**:

$$x_1 + x_2 + \cdots + x_n, \quad x_1 > x_2 > \cdots > x_n, \quad x_1, x_2, \ldots, x_n$$