Research Methodology: Lecture 6

Palash Sarkar

Applied Statistics Unit
Indian Statistical Institute, Kolkata
India
palash@isical.ac.in



Scientific Writing – II



Issues

- Micro-level discussion.
- Stylistic issues.
- Examples of bad and good writings.

- Donald E. Knuth, Tracy Larrabee, and Paul M. Roberts. *Mathematical Writing.*
- Franco Vivaldi. *Mathematical Writing: An Undergraduate Course.*
- Many other resources and tips on good writing.

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Writing Aids/Resources

- Dictionary.
  - Oxford, Webster; online dictionaries.
- Thesaurus.
  - Roget's; online thesaurus.
- Grammar.
  - Wren and Martin; your favourite book; online grammar.
- Latex user manual.
- Spell checker.
  - British/American style.



Basic Stylistic Issues

- Use paragraphs.
  - Each paragraph should consist of a few sentences and convey a single idea.
  - A paragraph should be related to the one before and the one following it.
- Be careful to avoid starting successive sentences with the same word or the same set of words.
  - Starting sentences with ‘The’ is very tempting.
  - Starting sentences with ‘Thus,’, ‘Consequently,’, ‘Therefore,’ or ‘So,’ can become a habit in mathematical writing.
- Avoid repetition of words in the same sentence or in nearby sentences.
  - While writing about your contributions, avoid starting successive sentences with ‘Our’; also, avoid repeated use of the word ‘our’.



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Basic Stylistic Issues (Contd.)

- Notice and avoid stylistic cliches.
  - An example of a cliche would be starting the abstract with “In this paper . . .”.
- Be careful in the use of punctuation.
  - No space before a punctuation symbol and a space after it.
- Be careful not to overdo any of the above.
  - Read and re-read (and get others to read) to ensure smooth reading of the material.



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Notes
from
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Notes 1

Symbols in different formulas must be separated by words.
Bad: Consider S_q, $q < p$.
Good: Consider S_q, where $q < p$.

Do not start a sentence with a symbol.
Bad: $x^n - a$ has n distinct zeroes.
Good: The polynomial $x^n - a$ has n distinct zeroes.

Do not use the symbols $\ldots, \implies, \forall, \exists,;$
replace them by the corresponding words.



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Notes 2

The statement just preceding a theorem, algorithm, etcetera, should be a complete sentence or should end with a colon.
Bad: We now have the following
Theorem. $H(x)$ is continuous.

It should be rewritten, for example, like this:
Good: We can now prove the following result.
Theorem. The function $H(x)$ defined in (5) is continuous.

Even better would be to replace the first sentence by a more suggestive motivation, tying the theorem up with the previous discussion.



Notes 3

The statement of a theorem should usually be self-contained, not depending on the assumptions in the preceding text. (See the restatement of the theorem in point 4.)

- Being very particular about this may result in half-page theorem statements.

The word “we” is often useful to avoid passive voice; the “good” first sentence of Example 4 is much better than “The following result can now be proved.” But this use of “we” should be used in contexts where it means “you and me together”, not a formal equivalent of “I”. Think of a dialog between author and reader.

In most technical writing, “I” should be avoided, unless the author’s persona is relevant.



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Notes 4

Do not omit “that” when it helps the reader to parse the sentence.
Bad: Assume A is a group.
Good: Assume that A is a group.

The words “assume” and “suppose” should usually be followed by “that” unless another “that” appears nearby.

But never say “We have that $x = y$,” say “We have $x = y$.”

Avoid unnecessary padding “because of the fact that” unless you feel that the reader needs a moment to recuperate from a concentrated sequence of ideas.



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Notes 5

Vary the sentence structure and the choice of words, to avoid monotony.

Avoid words like “this” or “also” in consecutive sentences; such words, as well as unusual or polysyllabic utterances, tend to stick in a reader’s mind longer than other words, and good style will keep “sticky” words spaced well apart.

Do not merely provide a sequence of formulas. Tie the concepts together with a running commentary.



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Notes 6

Try to state things twice, in complementary ways, especially when giving a definition. This reinforces the reader's understanding. All variables must be defined, at least informally, when they are first introduced.

Motivate the reader for what follows. Perhaps the most important principle of good writing is to keep the reader uppermost in mind: What does the reader know so far? What does the reader expect next and why?

When describing the work of other people it is sometimes safe to provide motivation by simply stating that it is "interesting" or "remarkable"; but, it is best to let the results speak for themselves or to give reasons why the things seem interesting or remarkable.



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Notes 7

When describing your own work, be humble and do not use superlatives of praise, either explicitly or implicitly, even if you are enthusiastic.

Many readers will skim over formulas on their first reading of your exposition. Therefore, your sentences should flow smoothly when all but the simplest formulas are replaced by “blah” or some other grunting noise.

Display important formulas on a line by themselves. If you need to refer to some of these formulas from remote parts of the text, give reference numbers to all of the most important ones, even if they are not referenced.

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Notes 8

Do not use the same notation for two different things. Conversely, use consistent notation for the same thing when it appears in several places.

For example, do not say "A_j for $1 \leq j \leq n$" in one place and "A_k for $1 \leq k \leq n$" in another place unless there is a good reason.

It is often useful to choose names for indices so that i varies from 1 to m and j from 1 to n, say, and to stick to consistent usage.

Typographic conventions (like lowercase letters for elements of sets and uppercase for sets) are also useful.



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Do not get carried away by subscripts, especially when dealing with a set that does not need to be indexed; set element notation can be used to avoid subscripted subscripts.

For example, it is often troublesome to start out with a definition like "Let $X = \{x_1, \ldots, x_n\}$" if you are going to need subsets of X, since the subset will have to defined as $\{x_{i_1}, \ldots, x_{i_m}\}$, say. Also you will need to be speaking of elements x_i and x_j all the time.

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Notes 10

Sentences should be readable from left to right without ambiguity. Bad examples:
“Smith remarked in a paper about the scarcity of data.”
“In the theory of rings, groups and other algebraic structures are treated.”

Small numbers should be spelt out when used as adjectives, but not when used as names (i.e., when talking about numbers as numbers).
Bad: The method requires 2 passes.
Good: Method 2 is illustrated in Fig. 1; it requires 17 passes. The count was increased by 2. The leftmost 2 in the sequence was changed to a 1.

Capitalize names like Theorem 1, Lemma 2, Algorithm 3, Method 4.



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Do not say “which” when “that” sounds better.

Use “which” only when it is preceded by a comma or by a preposition, or when it is used interrogatively.

Experiment to find out which is better, “which” or “that”, and you will understand this rule.

Bad: Do not use commas which are not necessary.
Better: Do not use commas that are not necessary.

Another common error is to say “less” when the proper word is “fewer”.



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The opening paragraph should be your best paragraph, and its first sentence should be your best sentence.

If a paper starts badly, the reader will wince and be resigned to a difficult job of fighting with your prose. Conversely, if the beginning flows smoothly, the reader will be hooked and will not notice occasional lapses in the later parts.

Probably the worst way to start is with a sentence of the form “An x is y.” For example,

Bad: A commonly used data structure is the priority queue.
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Notes 13

Resist the temptation to use long strings of nouns as adjectives: consider the packet switched data communication network protocol problem.

Linebreaks in the middle of formulas are undesirable.

Comments such as, “We demonstrate the second conclusion by contradiction,” and “There must be a witness to the unsortedness of P,” are useful because they tell the reader what is going on or bring in new and helpful vocabulary.

Extraneous parentheses can be distracting. For example, in the phrase “let k be $(c_i - c_j) + 1$,” the parentheses should be omitted.



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One of two following approaches may be used with respect to tenses of verbs:

Either use present tense throughout the entire paper, or write sequentially. Sequential writing means that you say things like, “We saw this before. We will see this later.”

The sequential approach is more appropriate for lengthy papers. You can use it even more effectively by using words of duration: “We observed this long ago. We saw the other thing recently. We will prove something else soon.”



Notes 15

Do not overdo the use of colons. While the colon in ‘Define it as follows:’ is fine, the one in ‘We have: ⟨formula⟩’ should be omitted since the formula just completes the sentence.

Should the first word after a colon be capitalized? Yes, if the phrase following the colon is a full sentence; no, if it is a sentence fragment.

While too many commas will interfere with the smooth flow of a sentence, too few can make a sentence difficult to read.



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Notes 16

Allowing formulas to get so long that they do not format well or are unnecessarily confusing "violates the principle of 'name and conquer' that makes mathematics readable."

For example, '$v = c + u(c_i - c_j + 1)$' should be '$v = c + ku$, where $k = c_i - c_j + 1$', if you are going to do a lot of formula manipulation in which $(c_i - c_j + 1)$ remains as a unit.

Remember to minimize subscripts. For example, 'p_i is an element of P' could more easily be 'p is an element of P'.

Remember to place words between adjacent formulas. A particularly bad example: "Add p k times to c."



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In general, a conversational tone giving signposts and clearly written transition paragraphs provides for pleasant reading.

An easy-to-read proof may contain phrases such as “The lemma is half proved,” and “We divide the proof into two parts, first proving $\langle$blah$\rangle$ and then proving $\langle$grunt$\rangle$.”

You can give relations in two ways, either saying ‘$p_i < p_j$’ or ‘$p_j > p_i$’. The latter is for “people who are into dominance.” The former is much easier for a reader to visualize after you have just said ‘$p = (p_1, p_2, ..., p_n)$ and $i < j$’.

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