

Style Guide for Mathematical Papers

by Nat Queen

Introduction

While checking students' essays and also examination papers in the School of Mathematics, I have noticed that certain deficiencies or inconsistencies of English style occur frequently. This has led to the present style guide. It makes no claim to completeness – it is merely a collection of guidelines for good style which I feel can improve many mathematical documents. I have tried to give not only some useful recommendations, but also the reasons for them, which I hope will make the rules easier to understand and remember.

Mathematics

All equations and other mathematical expressions, both in running text and when displayed on separate lines, should be accompanied with appropriate punctuation, according to their function in the sentence. As an example, note the final comma in the following:

We have the Laplace transforms

$$\mathcal{L}[1] = \frac{1}{s} \ (s > 0), \quad \mathcal{L}[\delta(t)] = 1,$$

where $\delta(t)$ is the Dirac delta function.

Alternatively, if the two equations in this example were printed on separate lines, the punctuation (commas) would be exactly the same.

When an equation involves a set of alternative expressions, grouped by means of a bracket, appropriate punctuation should be used to separate the various items. Example:

Consider the function

$$f(x) = \begin{cases} -1 & \text{if } x < 0, \\ 0 & \text{if } x = 0, \\ +1 & \text{if } x > 0. \end{cases}$$

Note in particular the full stop in this example (needed to end the sentence).

When one clause in a sentence ends with a symbol or a number and is followed by another clause in the same sentence, the second clause should begin with a word. Example:

This function has the property that if $a < b$, we have $F(a) < F(b)$.

This is much clearer than the same sentence without the words 'we have'.

Lists

Displayed lists of items should be punctuated, just as if they occurred within the text. Example:

Differentiate the following functions:

- (a) $f(x) = x^4$;
- (b) $g(x) = e^{3x}$;
- (c) $h(x) = \ln x$.

This example also illustrates that a colon should always be added after the word ‘following’ (or its accompanying noun) when a list of items is introduced in this way.

In such lists, it is permissible to use commas instead of semicolons. Alternatively, if the items in the list consist of long sentences, it may be more appropriate to end them with full stops.
Example:

Prove the following:

- (a) All the eigenvalues of a Hermitian matrix are real.
- (b) Eigenvectors belonging to distinct eigenvalues of a Hermitian matrix are mutually orthogonal.

The same rules of punctuation should be used in lists of items introduced by bullet points • instead of other labels.

Spelling

British spelling. Follow standard British (not American) usage. Examples:

- centre (not ‘center’)
- neighbourhood (not ‘neighborhood’)
- disc (not ‘disk’)
- rigour (not ‘rigor’) – but note the correct spelling rigorous.

Doubled consonants. In British usage, a final ‘l’ in a word is always doubled when certain suffixes are added:

travel, travelled, travelling, traveller

(This is in contrast with American usage, where the final ‘l’ is not doubled when the preceding syllable is unstressed.) Other final consonants are doubled only if the last syllable of the root word is stressed:

- refer, referred, referring, referral; but note the spellings alter, altered; centre, centred;
- focus, focused, focusing (but some dictionaries also indicate that the alternative spellings ‘focussed’ and ‘focussing’ are acceptable).

A few exceptions involve verbs that end in ‘p’, e.g., mapped, mapping or overlapping.

Words with ‘s’ or ‘z’. British usage (unlike American practice) allows two alternative spellings for many words, e.g.,

- maximise, maximisation, normalise, normalisation,...
- maximize, maximization, normalize, normalization,...

The ‘s’ and ‘z’ forms of such words are both considered acceptable, but the ‘s’ form is far more common in modern British usage. Whichever form is used, it is important to be consistent throughout any document - do not mix them! The safest practice is to use the ‘s’ form, because this avoids the risk of misspelling certain words in which ‘s’ must be used anyway, e.g., analyse or exercise.

Punctuation

A common construction in mathematical writing is an ‘if ..., then ...’ statement:

If $f(x)$ is differentiable, then it is continuous.

Such constructions should always include a comma after the first clause and the word ‘then’ at the beginning of the second clause. Although the word ‘then’ is commonly omitted in informal writing or speech, its inclusion in a mathematical context improves the clarity of the sentence, and in some cases it eliminates a possible ambiguity. For example, a statement like

If $a < b$ and $b < c$, then $a < c$ and $c > a$.

can be confusing if the word ‘then’ is omitted!

Another common construction in mathematical writing is a subordinate clause introduced by the word ‘where’, which usually defines something in the preceding clause of the sentence:

Here $E = mc^2$, where E is the energy...

Consider $f'(x)$, where f' denotes the derivative of f .

In such constructions, there should always be a comma before the word ‘where’. These examples involve non-restrictive clauses, i.e., clauses whose omission would not essentially change the meaning of the main clause (although they do give additional information by defining or clarifying something in the main clause).

In contrast, a restrictive subordinate clause is one that is essential to the meaning of the sentence, and which cannot be omitted without changing its meaning. In this case, there should be no comma. Example:

Find all points x where $f(x) = 0$.

In practice, subordinate clauses introduced by ‘where’ are most often of the first type and therefore require a comma. Exactly the same rules apply if the word ‘where’ is replaced by some other word or words. Examples:

Find all points x at which $f(x) = 0$.

$F(x)$ is stationary at the point $x = 0$, at which its derivative vanishes.

Another common situation is a subordinate clause introduced by ‘which’ or ‘that’, and the same important rule of English grammar applies. Consider the following two examples:

This theorem, which was first proved by Euler, states that...

The theorem that we require for this proof is...

In the first example, the subordinate clause introduced by the word ‘which’ is non-restrictive (it is merely a remark and can be omitted without changing the meaning of the sentence) and is therefore surrounded by commas. In the second example, the subordinate clause introduced by the word ‘that’ is restrictive (it specifies a particular theorem and cannot be omitted without changing the meaning of the sentence), so that commas must not be used. Failure to follow this rule of commas can completely change the intended meaning of a sentence.

In informal or colloquial usage, the relative pronouns ‘which’ and ‘that’ are sometimes used interchangeably in such constructions. However, in formal writing it is generally considered best to maintain this distinction – use ‘which’ for non-restrictive clauses (with commas!) and ‘that’ for restrictive clauses (without commas!).

In constructions like the last example above, the word ‘that’ is often omitted, especially in

informal writing or colloquial speech: “The theorem we require...” However, in formal writing it is always best to include the word ‘that’. Further examples of this kind, which occur frequently in examination questions, are the following:

State any assumptions that you make.

Suppose that ...

Hyphens

The use of hyphens in compound adjectives makes the meaning much clearer:

first-order differential equation

finite-dimensional space

For example, if we write ‘finite dimensional space’ (without the hyphen), the literal meaning would be a dimensional space that is finite, rather than one with a finite number of dimensions. Although the reader would probably still understand from the context what is meant if the hyphens were omitted in such cases, sometimes a hyphen is essential to avoid serious ambiguity. For example, a ‘little-used car’ is a car that has not been used much, whereas a ‘little used car’ is a used car that is small in size!

Hyphens are often used in words containing various prefixes:

multi-parameter, non-negative, semi-infinite

The hyphens are especially important in cases like the last two examples, where closing up the word with no hyphen would lead to an ugly doubled letter.

Bibliography

H. W. Fowler, *A Dictionary of Modern English Usage*. This is the traditional reference, but it is becoming rather dated, and it is not an easy book to read or to use to check particular questions of style.

A useful modern reference is the European Commission’s *English Style Guide*, which is available online here:

http://ec.europa.eu/translation/writing/style_guides/english/style_guide_en.pdf

It covers many of the same aspects of style as in the present document, with very similar recommendations.

I acknowledge the *AIP Style Manual* from the American Institute of Physics, from which I have drawn a few tips when writing this document (excluding, of course, purely American spellings and other conventions).

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