Chapter 6. Mathematics and Numbers

EQUATIONS

Mathematical equations can present difficult and costly problems of type composition. Because equations often must be retyped and reformatted during composition, errors can be introduced. Keep in mind that typesetters will reproduce what they see rather than what the equation should look like. Therefore, preparation of the manuscript copy and all directions and identification of letters and symbols must be clear, so that those lacking in mathematical expertise can follow the copy.

If your equations are drawn from calculations in a computer language, translate the equation syntax of the computer language into standard mathematical syntax. Likewise, translate variables into standard mathematical format. If you need to present computer code, do that in an appendix.

Position and Spacing

The position and spacing of all elements of an equation must be exactly as they are to appear in printed form.

Place superscript and subscript letters and symbols in the correct positions.

Put a space before and after most mathematical operators (the main exception is the solidus sign for division). For example, plus and minus signs have a space on both sides when they indicate a mathematical operation but have no space between the sign and the number when used to indicate positive or negative position on the number line (e.g., $5 - 2 = 3$; a range from -15 to +25 kg).

No space is left between variables and their quantities or between multiplied quantities when the multiplication sign is not explicitly shown. No space is left between an expression and its power (or any superscripted or subscripted modifier). No space is left after trigonometric functions.

See the CSE (2006) style manual for further rules, examples, and exceptions.

Special Characters

Single letters that denote mathematical constants, variables, and unknown quantities in text and in equations are set in italic, except Greek letters, which are not italicized. Vectors and matrices are set in boldface roman type. Two- or three-letter variables (e.g., EC for electrical conductivity) should be set in roman type.

Special characters should be treated the same in the text, equations, tables, and figures.

Call attention to unusual symbols and modification of symbols that may be lost or distorted during file conversion or exchange. Carefully distinguish between primes and apostrophes; the uppercase letter O and the numeral zero; the lowercase letter l, uppercase letter I, and the numeral 1; the degree symbol and a superscripted zero or letter o; and rho (ρ) and the letter p.

Simplifying Equations

Use in-line fractions (i.e., with a solidus rule, as in *x/y*) as much as possible, especially in the text. Show the necessary aggregation by using fences (i.e., parentheses, brackets, and braces). Use the sequence {[( )]}.

In display fractions, align the rules with the main signs of the equation or formula. In complex equations, use horizontal rules for the main fractions and slant rules in numerators, denominators, and exponents. Some display equations can be reformatted as in-line equations. Thus, $a/(bcd)$ and $a/(b - c)$ and $(a/b) - (c/d)$ can easily substitute for

$$\frac{a}{bcd} \text{ and } \frac{a}{b-c} \text{ and } \left(\frac{a}{b}\right)-\left(\frac{c}{d}\right)$$

Use the same techniques to simplify a complex display equation.

For large numbers in text, tables, or figures, standard scientific notation is preferred instead of computer exponentials (e.g., 7.0×10^{-3} instead of 7.0 E-03). Computer exponentials may be used for presentation of software-generated data in tables and figures. SI prefixes are usually preferable to scientific notation when expressing units.

Integrals, Summations, and Limits

With single integral signs, the upper and lower limits should always be placed to the right of the integral sign, never above and below. In text, this can be accomplished by stacking supers and subs ($\int_{\infty}^{0}$). For summations, the limits above and below are customary in display equations; in text, however, the right-side position is required.

Roots

As practical, use negative exponents or the solidus instead of display fractions and fractional powers instead of the radical sign. For example,

$$\frac{\cos\dfrac{1}{x}}{\sqrt{a+\dfrac{b}{x}}}$$

can be written more efficiently as

$$\frac{\cos\,(1/x)}{[a + (b/x)]^{1/2}}$$

Nonetheless, considerations of space should not override clarity. The previous equation can be further condensed to fit within the text line as $[\cos\,(1/x)]/\{[a + (b/x)]^{1/2}\}$, but this is not necessarily the best presentation. Consider your readers.

Numbering Equations

It is not necessary to number all displayed equations, but they are usually numbered in papers that have a substantial number of equations or more than one that is referred to within the text. If equations are numbered, place the numbers in brackets at the right margin. Abbreviate text citations in the form Eq. [1], Eq. [4] and [5], Eq. [7–19], and so forth.

Exponential Functions

For lengthy or complex exponents, the symbol exp is preferred, particularly if such exponentials appear in the body of the text. Thus, $\exp(a^2 + b^2)^{1/2}$ is preferable to $e^{(a^2 + b^2)^{1/2}}$. The larger size of symbols permitted by this usage also makes reading easier.

NUMBERS

Reported data should include no more significant digits than the precision of the experimental methods warrants. Often, more than three significant digits of data from agronomic research cannot be justified. An acceptable rule is to round treatment means to one-tenth of their estimated standard error. For example, if the estimated standard error is 1.43, the means should be rounded to the nearest 0.1, and if the standard error is 18.4, the means should be rounded to the nearest 1.0.

The decimal separator in ASA, CSSA, SSSA publications is a comma. In text, four-digit numbers are set solid (e.g., 1000). In tables and text, a comma separates every three digits in numbers of five digits or greater, to the left of the decimal point (e.g., 10,000). In tables, if any value in a column has five digits or greater, the whole column displays the comma; otherwise, the values are set solid. (For an example, see Table 5–2.)

Dates, page numbers, percentages, time, numbers preceded by capitalized nouns, and numbers followed by units of measure are expressed as numerals (e.g., Table 1, Chapter 1, 2%, Journal Article no. 1, Treatment 3, 1 g, 5 s).

A numeral is used for a single number of 10 or more, except when the number is the first word of the sentence. Numerals are used to designate the numbers nine and below when two or more numbers are used and any of them are greater than nine: ". . . 2, 5, and 20 pots were planted," but "a group of 12 plants was incubated at three temperatures."

Ordinal numbers are treated like cardinal numbers: third, fourth, 33rd, 100th, except in references, where digits are preferred (e.g., 5th ed., 7th Congress).

For large numbers ending in zeros, use a word or prefix for part of the number (e.g., 1.6 million, not 1,600,000; 23 μg, not 0.000023 g).

A zero is used before decimal numbers less than 1.0 (e.g., 0.1 and 0.5).

Use the connecting word 'to' rather than a dash in a range of numbers, except when the numbers are used in parentheses or in tables.

Do not use the ambiguous term *billion*, which means "thousand million" in some nations and "million million" in other nations.

Further Resources

More information on rules and suggestions in preparing mathematical copy can be found in *Scientific Style and Format* (CSE, 2006), including that manual's annotated bibliography, and in the bibliography at the back of this book.