118 Equations

DISPLAYED EQUATIONS are equations that are set after and before a line break; they are *broken out* from the text line. Your primary challenge in setting equations (be they displayed or in text) is likely to be finding and learning to use a text editor that can handle them. Here, we shall look at a few basic ideas for setting displayed equations.

Regarding the complex rules governing setting of mathematical expressions, Ronald Barry[273] gives this advice:

> The symbology of mathematical expressions has an immense scope, and adequate coverage might easily require an entire book. At the turn of the century, a candidate for a doctoral degree in mathematics was required to demonstrate at least a rudimentary knowledge of the 20 or so distinct areas of mathematics extant at that time. Today, there probably are about 3000 different areas of study in mathematics, and the field continues to expand, with no sign of slowing down; it is impossible for most people to be acquainted with more than a few of these areas, and even professional mathematicians are unlikely to be conversant with more than a few hundred of them. The practice nowadays, for any branch of mathematics that might conceivably be construed as being outside the mainstream, is for the author of a work on that subject to provide, at the beginning or end of the work, a glossary of terms used throughout

273. Personal communication, Palo Alto, CA, 1994.

> that work. I suspect that this approach will continue to be the optimum available technique for any reader who is not intimately familiar with the subject matter, and perhaps even for those readers who do possess such familiarity.

I heartily endorse Barry's advice: Provide a glossary or list of conventions used in any document for which the reader may find such a guide helpful.

You should set variables in italic type, and constants in roman type.

GOOD: $\sum_{0 \le k < n} \lfloor \sqrt{k} \rfloor .$

GOOD: $f_v(x) = (0 \le x < v) .$

GOOD: $\log_{10}\eta + C' + \frac{B'}{T} .$

GOOD: $F_C + F'_R = 0 .$

You should set mathematical expressions in figures in the same way as you set them in text. Do not, for example, set your variables in roman type in the figure label; do not set an expression in capital letters in the figure label, and set it in as lowercase letters in text. Figure 118.1 is an example of this mistake (the X and Y should be lowercase italic letters *(x* and *y),* rather than capitalized roman letters); we classify it as bad.

You should be consistent in whether you use end punctuation in displayed equations. I recommend that you do use it, because it gives your reader more information. You should set a period, comma, semicolon, or no punctuation at the end of a displayed equation, depending on where that equation falls within a sentence.

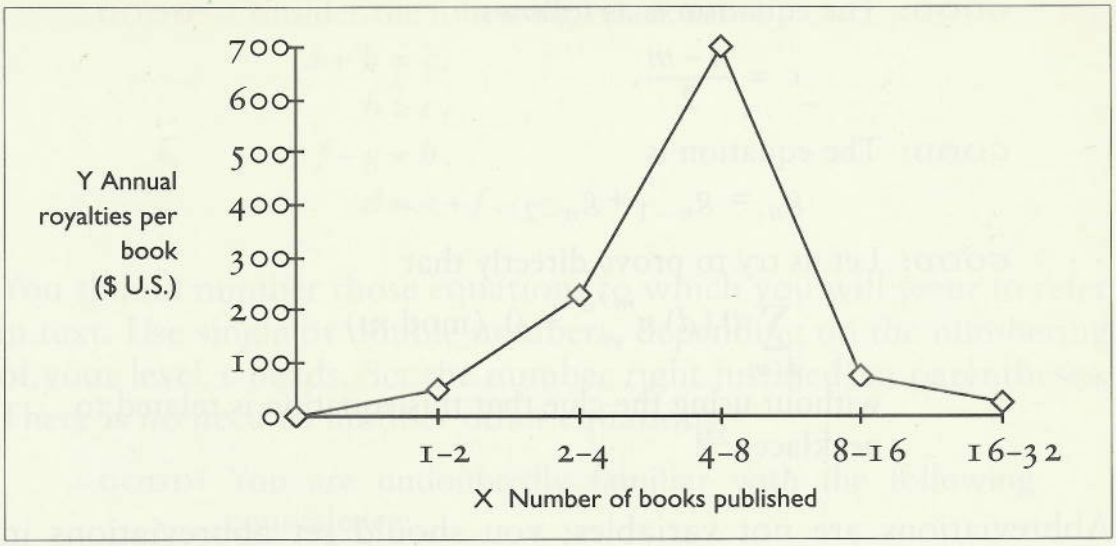

Figure 118.1 Graph of relationship of annual royalty amount to market glut. [Bad]

GOOD: Solve the recurrence

$$X_n = n, \qquad \text{for } 0 \le n < m;$$
$$X_n = X_{n-m} + 1, \qquad \text{for } n \ge m.$$

GOOD: We can see that

$$a - b = c,$$

given that

$$a = b + c.$$

You should set a colon before a displayed equation only when the words preceding the display call for a colon. At minimum, they should constitute a full sentence. Otherwise, you should set whatever punctuation is correct—a comma, semicolon, period, question mark, or exclamation mark each might be a candidate.

GOOD: The equation is as follows:

$$c = \frac{d-m}{2}.$$

GOOD: The equation is

$$g_n = g_{n-1} + g_{n-2}.$$

GOOD: Let us try to prove directly that

$$\sum_{d/m} \vartheta(d)\, n^{m/d} = 0 \pmod{m},$$

without using the clue that this equation is related to necklaces.[274]

Abbreviations are not variables; you should set abbreviations in roman type.

GOOD: $V_{\min} = k(\min(V_1, V_2) - V_b)$.

GOOD: The carrier density at the source end of the channel is denoted by N_s; that at the drain end is denoted by N_d.

GOOD: One way to use the notion of a standard regression coefficient in a measure of uncertainty importance is in $U_{\mathrm{SRC}}(x_j, y)$.

You should generally indent displayed equations, by a consistent distance, unless the design for your document specifies otherwise. When you have several equations in a display, you should align them on the equal-to sign (or equivalence, or greater than, and so on).

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274. This example was stolen, with bits and pieces from other examples in this segment, from Graham RL, Knuth DE, Patashnik O, *Concrete Mathematics*. Reading, MA: Addison-Wesley, 1989.

GOOD: Consider the following relations:

$$a + b = c,$$
$$b \geq c,$$
$$f - g \neq h,$$
$$d \approx e + f.$$

You should number those equations to which you will want to refer in text. Use single or double numbers, depending on the numbering of your level 1 heads. Set the number right justified, in parentheses. There is no need to number other equations.

GOOD: You are undoubtedly familiar with the following equivalence:

$$a^2 + b^2 = c^2. \tag{5.4}$$

GOOD: For sets A and B,

$$A \cup B \neq A \supseteq B. \tag{18}$$

When you *refer to numbered equations,* you should capitalize the word *equation,* and should not set parentheses around the number. It can be confusing to your reader to use words other than *equation* (such as *equivalence)* in these references, so I recommend that you avoid doing so when practical.

GOOD: Equation 4.3 is the general case, valid for $n > 1$.

GOOD: Using Equation 6 and our common sense, we obtain the following:

$$\sqrt{a - b/c} + \sqrt{d} \neq \phi \pm \varphi. \tag{9}$$