# Maths in LaTeX

TeX was written with maths as a speciality. Maths can be displayed in two forms: inline and block (or display). Maths mode uses a different font (similar to the text italic) with totally different spacing between its characters. Within a paragraph, maths mode is entered surrounded with dollar signs. For example, `$x^2 + y^2 = z^2$` will display $x^2 + y^2 = z^2$. As you can see, simple maths is very easy.

The other way to display maths is in block mode. Unfortunately, there are many not-necessarily-consistent environments for doing this, and often the older/uglier methods are given as examples before the newer, more convenient ones. My rule-of-thumb: always use the amsmath package, and always use the `align` environment. My reasoning: you can do anything with the `align` environment combined with the `split` environment—all other environments provide either the same or lesser functionality.[1] See the second maths example document for full demonstrations of those two environments.

That said, the `\[...\]` environment is a nice shorthand, which allows a single line of displayed maths without an equation number.

## Basics

All of these will work in inline mode also, sometimes with different spacing. c.f. $\frac{A}{B}$ with the fraction example below.

Subscripts and superscripts: $x^y + y_z + a^{b+c} + d_{e+f} + j_l^k$

Fractions: $\dfrac{A}{B} \quad \dfrac{A \times B}{C \times D}$

(Note the multiplication symbol: $\times$ = `\times`)

Brackets: $f\{x\} = x \cdot (y + z) = [x \cdot y + x \cdot z]$

Preceded with the `\left` and `\right` commands, delimiters—$(), [], \{\}, |$, etc.—are resized automatically to best fit:

Large brackets: $\left( \sum_{i=0}^{n} \left\{ \frac{x_i}{y_i} \right\} \right)$

[1] With one notable exception (of which I know): there is no way to right align a single line, as in the `multline` env.

Greek letters: $\alpha\beta\gamma\cdots\chi\psi\omega \quad \Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Phi\Psi\Omega$

Integrals: $\int_0^\infty x\,\mathrm{d}x, \quad \iint xy\,\mathrm{d}A, \quad \iiint xyz\,\mathrm{d}V$

`\mathrm{d}` is used to change the font of the 'd' symbol to upright roman, which is proper for this case because it is not a variable. Notice how limits on the integrals are simply sub- and super-scripts.

Derivatives: $\dfrac{\mathrm{d}y}{\mathrm{d}x}, \quad \dfrac{\partial y}{\partial x}$

Other functions: $\sin(n\pi) \quad \sqrt{x+y} \quad \lim_{x\to 0} x \quad \sum_{i=0}^{n} x_i$

There is a huge amount that can be done in maths mode, and this document is only the most brief of introductions. Refer to Herbert Voss's `mathmode.pdf` for a very comprehensive reference, as well as the amsmath documentation and the various beginners guides.

For the definitive reference of symbols that you can use, refer to "The Comprehensive LaTeX Symbol List". You can get it from:
`http://www.ctan.org/tex-archive/info/symbols/comprehensive/`

The next example maths document illustrates the `align` and `split` environments, followed by a document on arrays and matrices.