Typing Mathematics

Math 351

It is standard practice to typeset mathematics using the packages `amssymb`, `amsmath`, and `amsthm`. These packages are maintained by the American Mathematical Society.

Mathematics is enclosed between between `\(` and `\)` symbols or between dollar signs. This produces inline "textstyle" mathematics. To place mathematics on its own centered line, similar to

$$\frac{d}{dx}\arcsin x = \frac{1}{\sqrt{1-x^2}},$$

you may use enclose mathematics within `\[` and `\]` or `\begin{equation*}` and `\end{equation*}`. This is known as "displaystyle". You can force inline mathematics to appear as displaystyle using `\begin{displaystyle}` and `\end{displaystyle}` and you can force displayed mathematics in textstyle using `\begin{textstyle}` and `\end{textstyle}`.

Taller inline text will increase the vertical space between lines. For example, consider $2^{3^{4^5}}$. If you prefer not to have this vertical space be adjusted, enclose the mathematics within `\smash{..math..}` like this: $\smash{2^{3^{4^5}}}$.

Most mathematics symbols are typeset using commands such as `$\Xi$`, which produces Ξ. These symbols need to be used in math mode, otherwise LaTeX may not compile. A list of mathematics symbols can be found on pages 75–82 of our text. The web site

http://detexify.kirelabs.org/classify.html

can also help in finding symbols. Use standard AMS packages whenever possible!

Sometimes the spacing between mathematics symbols should be adjusted. The spacing commands to be used in math mode, in order of longest space to smallest space, are:

`\qquad` `\quad` `\` `\;` `\:` `\,` `\!`

These produce spaces equal to the width of two capital M's, one capital M (one quad), the width of inter-word spacing, $\frac{5}{18}$ quad, $\frac{4}{18}$ quad, $\frac{3}{18}$ quad, and $-\frac{3}{18}$ quad. It is proper form to use `\,` before differentials in integrals, like this

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-(x^2+y^2)}\,dx\,dy = \int_0^{2\pi}\int_0^{\infty} e^{-r^2} r\,dr\,d\theta.$$

Here is the incorrect typesetting, without the proper spacing:

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-(x^2+y^2)}dxdy = \int_0^{2\pi}\int_0^{\infty} e^{-r^2}rdrd\theta.$$

In rare cases spacing can be adjusted using `\phantom{stuff}` which creates a space of the same length as the typeset length of `stuff`. You're probably doing things wrong if you're using `\phantom` frequently.

The most frequently encountered functions and operators in mathematics have pre-defined command names. For example:

$$\sin x, \cos x, \tan x, \arcsin x, \ln x$$

Use `\operatorname{..}` if a function or operator does not have a predefined command, like this: $\operatorname{erf} x$.

Parentheses of the correct size are given by `\left( .. \right)`. The parentheses do not have to be the same type. To suppress a parentheses, replace the parenthesis with a period. For example,

$$\left\{ x \in \mathbb{R} : \int_0^x \sin t\, dt \le 1 \right\}.$$

To display multi-line math example, use `\begin{align*}..\end{align*}`, where the `&` symbol controls where the alignment occurs and `\\` gives a new line. For instance, consider

$$\begin{aligned}\int_a^b x^n\,dx &= \frac{x^{n+1}}{n+1}\Big|_{x=a}^{x=b} \\ &= \frac{b^{n+1}}{n+1} - \frac{a^{n+1}}{n+1} \\ &= \frac{1}{n+1}(b^{n+1}-a^{n+1}).\end{aligned}$$

For long expressions that don't fit on one line, use `\begin{multline*}`, with the command `\\` denoting a new line:

$$\begin{aligned}\alpha+\beta+\gamma+\delta+\varepsilon+\zeta+\eta+\theta \\ +\iota+\kappa+\lambda+\mu+\nu+\xi+\pi+\rho \\ +\sigma+\tau+\upsilon+\varphi+\chi+\psi+\omega.\end{aligned}$$

Did you know that $1+2+\cdots+n = \binom{n+1}{2}$?

Here is a matrix gallery:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad \begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

These were created using `\begin{bmatrix} a & b \\ c & d \end{bmatrix}` and then replacing the "`b`" with a `v`, `p`, (nothing), and `V`.

By convention, matrices are not written in boldface, but vectors such as $\mathbf{x}$, are. To typeset a transpose, use the `\intercal` symbol, such as $\mathbf{x}^\intercal$.

Lastly, to typeset a function defined by cases, use `cases`, like this:

$$|x| = \begin{cases} -x & \text{if } x < 0, \\ x & \text{otherwise.} \end{cases}$$