

LaTeX Crash Course

Meeting 2: Maths and Formulas

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June 25, 2021

LaTeX is famous for its abilities to typeset mathematical texts beautifully. You need to call the `amsmath` package. For some features also `amsmath` (mathematical fonts), `amssymb` (more symbols) and `amsthm` (enhanced theorem environments) can be useful. More information is found [here](#).

There are two ways to insert mathematical content. First, you can insert it in the main text, between two dollar signs: `$a+b$` inserts the string “ $a+b$ ” in your text, without line breaks, indentation, etc. Alternatively, you can create formulas separated by white space from the main text, using the `equation` or `align` environments, or simply the double dollar sign: `$$ \dots $$`. The latter command has the disadvantage that you cannot refer to it. Two examples with simple and double dollar sign:

- Einstein’s most famous formula is $E = mc^2$.
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$$E = mc^2.$$

Symbols

Philosophers love Greek letters. They count as mathematical symbols and so you insert them with `α` , `β` , etc., and you get α , β , etc. For upper case letters, use `\Alpha` , etc.

For arrows, operators, relations, etc., your text editor should have a huge graphical menu somewhere. LaTeXila and TexStudio have this feature. Alternatively, if you want to insert a symbol without knowing it or looking it up, you can use the website [this website](#). It allows you to draw symbols and suggests LaTeX code that corresponds to your drawing. You can then copy and paste it into your LaTeX document.

Specific Formats

Fractions `$$\frac{x+y}{a-b}$$` produces

$$\frac{x+y}{a-b}$$

Double fractions are possible.

Subscripts and superscripts `x_y` inserts x_y and `x^y` inserts x^y .

Sums and Integrals For summing up the first N square numbers, one uses `\sum_{i=1}^N i^2`. The output is $\sum_{i=1}^N i^2$, or, if you use the double dollar sign,

$$\sum_{i=1}^N i^2 = \frac{n(n+1)(2n+1)}{6}.$$

Analogous for integrals with the command `\int`.

Text in Math Environments

Use the `\text{}` command. For example, `x_{\text{min}}` produces x_{\min} while the “normal” `x_{min}` would produce x_{min} . Finally, `\ldots` produces these lower dots: ... They usually look better in mathematics environments than simply typing three dots. (...)

Equations

You can use either `\begin{equation}` or `\begin{align}` to insert an equation. For a variety of reasons, this is preferable to the quick and dirty `$$`. So you can write

$$E = mc^2 \tag{1}$$

You can add labels to equation and align environments with the usual `\label{eqn:123}` command and refer to this equation later in the document with `\ref{eqn:123}`.

The above equation is a *numbered equation*. If you don't like numbers, call the `equation*` environment (but then it is hard to refer to...). Finally, the command

`\tag{Name of Equation}` can be used to name equations, e.g.,

```
\begin{equation}
  3 \cdot 0 = 0 \tag{Local Cologne Truth}
\end{equation}
```

produces

$$3 \cdot 0 = 0 \tag{Local Cologne Truth}$$

Aligning Equations

Sometimes you want to align content horizontally, e.g., for expressing an “if and only if” condition. The `align` or `align*` environment does the job.

```
\begin{align*}
  a &\geq b \quad \text{if and only if} \quad & -a &\leq -b
\end{align*}
```

$$a \geq b \quad \text{if and only if} \quad -a \leq -b$$

Sometimes you also want to align content across multiple lines. In that case, you can either use the `align/align*` or the `eqnarray/eqnarray*` environment.

```
\begin{eqnarray*}
x &=& \sum_{i=0}^{\infty} \frac{1}{2^{(i+1)}} \quad \\
&=& \sum_{i=1}^{\infty} \frac{1}{2^i} \quad \\
&=& 1
\end{eqnarray*}
```

produces

$$\begin{aligned} x &= \sum_{i=0}^{\infty} \frac{1}{2^{(i+1)}} \\ &= \sum_{i=1}^{\infty} \frac{1}{2^i} \\ &= 1 \end{aligned}$$

You can also use this for having multiple-line content on the right hand side of the equation. In this case, you start the second line with `&&` to make sure that you begin right of the equality sign.

Case Distinctions

Philosophers often use mathematics that involves case distinctions. We can do this elegantly in LaTeX with the `cases` environment:

```

\begin{equation}
f(x) =
\begin{cases}
x & \text{if } x > 0 \\
-x^2 & \text{else}
\end{cases}
\end{equation}

```

This code produces this result:

$$f(x) = \begin{cases} x & \text{if } x > 0 \\ -x^2 & \text{else} \end{cases} \quad (2)$$

Other Environments

You can also define environments for theorems, lemmas, and any other mathematical stuff. Add the command `\newtheorem{theorem}{Theorem}` to your preamble (analogous for lemma, corollary, proposition, etc.). Then you can use `theorem` environments in the body of your document:¹

```

\begin{theorem}[Fermat's Last Theorem]\label{thm:fermat}
There is no natural number  $N \geq 3$  such that for natural
numbers  $a$ ,  $b$  and  $c$ :
\begin{equation}
a^N + b^N = c^N \tag{Fermat's Theorem}
\end{equation}
\end{theorem}

```

which produces the following output:

Theorem 1 (Fermat's Last Theorem). *There is no natural number $N \geq 3$ such that for natural numbers a , b and c :*

$$a^N + b^N = c^N \quad (\text{Fermat's Theorem})$$

With `\ref{thm:fermat}` you can refer to the (numbered) theorem as usual. For eliminating numbering, just use `\newtheorem*` in the preamble.

¹For embedding LaTeX code into your document, call the `verbatim` package and write the code into a `verbatim` environment.

Logic

If you are a logician, you may need more sophisticated stuff like environments for tableaux, sequent calculus, natural deduction, and so on. I won't elaborate on this in detail, but I suggest that you familiarize yourself with the package `bussproofs` which has the useful `prooftree` environment. This is good for Gentzen-style sequent calculus and natural deduction. The package `prooftrees`, by contrast, is useful if you want to build tableaux. Check the site

<https://www.logicmatters.net/latex-for-logicians/> for further information.