

Mathematics in \LaTeX

Matthew Bennett
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Math Mode

Before you can enter math commands, you must be in “math mode”.

To enter math commands in the same line as your text, such as $x^2 - 11 = 0$ use a single $\$$ and another $\$$ to exit math mode.

For a more formal look, use the $\$$ $\$$ symbol to begin and end the line offset math mode. This will offset the math symbols onto a separate line and center it on the page. For instance

$$\sin^2 x + \cos^2 x = 1$$

will break the text and automatically center.

Math text will automatically eliminate spaces and italicize all text. If we type regular text in math mode, it will *probablynotlookright*. We can use the `\text{}` command while in math mode to generate normal text, such as h (the hypoteneuse) $= a^2 + b^2$.

Subscripts and Superscripts

To raise something to a power, prefix the power with the carat command.

`x^y` produces

$$x^y$$

.

Similarly, to produce a subscript, prefix it with an underscore command.

`x_d` produces

$$x_d$$

.

List of Greek Symbols

<code>\alpha</code>	<code>\theta</code>	<code>\tau</code>	
<code>\beta</code>	<code>\vartheta</code>	<code>\pi</code>	<code>\upsilon</code>
<code>\gamma</code>	<code>\gamma</code>	<code>\varpi</code>	<code>\phi</code>
<code>\delta</code>	<code>\kappa</code>	<code>\rho</code>	<code>\chi</code>
<code>\epsilon</code>	<code>\lambda</code>	<code>\varrho</code>	<code>\psi</code>
<code>\varepsilon</code>	<code>\mu</code>	<code>\sigma</code>	<code>\omega</code>
<code>\zeta</code>	<code>\nu</code>	<code>\varsigma</code>	<code>\omicron</code>
<code>\eta</code>	<code>\xi</code>		
<code>\Gamma</code>	<code>\Lambda</code>	<code>\Sigma</code>	<code>\Pi</code>
<code>\Delta</code>	<code>\Xi</code>	<code>\Upsilon</code>	<code>\Omega</code>
<code>\Theta</code>	<code>\Pi</code>	<code>\Phi</code>	

$\alpha\beta\gamma\delta\epsilon\zeta\eta\theta\iota\kappa\lambda\mu\nu\xi\psi\omega\pi\rho\sigma\tau\upsilon\varphi\chi\psi\omega\eta\xi\Gamma\Lambda\Sigma\Psi\Delta\Xi\Upsilon\Omega\Theta\Pi\Phi$

List of Binary Operators

<code>\pm</code>	<code>\cap</code>	<code>\diamond</code>
<code>\mp</code>	<code>\cup</code>	<code>\bigtriangleup</code>
<code>\times</code>	<code>\uplus</code>	<code>\bigtriangledown</code>
<code>\div</code>	<code>\sqcap</code>	<code>\triangleleft</code>
<code>\ast</code>	<code>\sqcup</code>	<code>\triangleright</code>
<code>\star</code>	<code>\vee</code>	<code>\lhd</code>
<code>\circ</code>	<code>\wedge</code>	<code>\rhd</code>
<code>\bullet</code>	<code>\setminus</code>	<code>\unlhd</code>
<code>\cdot</code>	<code>\wr</code>	<code>\unrhd</code>
<code>+</code>	<code>-</code>	

± ∩ ⊕ ∓ ∪ Δ ⊖ × ⊞ ∇ ⊗ ÷ ∏ ◁ ⊙ ∗ ⊔ ▷ ∘ ∗ ∨ ◁^b ○ ∘ ∧ ▷^b † • ∖ ≤^b ‡ ∙ ≥^b ∏ + −

List of Relational Symbols

<code>\leq</code>	<code>\geq</code>	<code>\equiv</code>	<code>\m</code>
<code>\prec</code>	<code>\succ</code>	<code>\sim</code>	<code>\p</code>
<code>\preceq</code>	<code>\succeq</code>	<code>\simeq</code>	<code>\m</code>
<code>\ll</code>	<code>\gg</code>	<code>\asymp</code>	<code>\p</code>
<code>\subset</code>	<code>\supset</code>	<code>\approx</code>	<code>\b</code>
<code>\subseteq</code>	<code>\supseteq</code>	<code>\cong</code>	<code>\J</code>
<code>\sqsubset^b</code>	<code>\sqsupset^b</code>	<code>\neq</code>	<code>\s</code>
<code>\sqsubseteq</code>	<code>\sqsupseteq</code>	<code>\doteq</code>	<code>\f</code>
<code>\in</code>	<code>\ni</code>	<code>\propto</code>	<code>=</code>
<code>\vdash</code>	<code>\dashv</code>	<code><</code>	<code>></code>
<code>:</code>			

$\leq \geq \equiv \models \prec \succ \sim \perp \preceq \succeq \approx \ll \gg \asymp \cong \simeq \neq \sqsubset \sqsupset \sqsubseteq \sqsupseteq \vdash \in \ni \propto \dashv \langle \rangle :$

<http://www.math.harvard.edu/texman/node21.html> lists all symbols available.

Equation environment

The latex equation environment automatically enters math mode, numbers the equation, and centers the text on the page. Here we have used the equation environment with a forward reference to Einstein's famous equation. 1

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

Align environment

The align environment automatically enters math mode, numbers the equation, and centers the text on the page, just like the equation environment. Additionally, multiple lines may be aligned and numbered.

```
\begin{align}
x&=y & X&=Y & a&=b+c\\
x&=y & X&=Y & a&=b\\
x+x&=y+y & X+X&=Y+Y & ab&=cb
\end{align}
```

$$x = y \qquad X = Y \qquad a = b + c \qquad (2)$$

$$x = y \qquad X = Y \qquad a = b \qquad (3)$$

$$x + x = y + y \qquad X + X = Y + Y \qquad ab = cb \qquad (4)$$

Smart symbols

Some symbols will increase or decrease their size to match the other symbols associated with them.

$$c^2 = \sqrt{a^2 + b^2}$$

$$c^2 = \sqrt{a^2 + b^2} \quad (5)$$

$$\int_a^b \frac{\sqrt{\sum x^2 + y^2 + z^2}}{6} ds$$

$$\int_a^b \frac{\sqrt{\sum sx^2 + y^2s^2 + z^z}}{6} ds \quad (6)$$

Smart Parenthesis

You can use smart parenthesis, a type of smart symbol, to automatically size the parenthesis in math mode to other smart symbols.

`$$ \left(\sum a_i^2\right)^{1/2} $$`

$$\left(\sum a_i^2\right)^{1/2}$$

You can also use

`\left[, \right], \left\{,`
`\right\}.`

Cases

```
\delta_{ij} =  
\begin{cases}  
1& i=j},\\  
0& \text{Everywhere else}.  
\end{cases}
```

$$\delta_{ij} = \begin{cases} 1 & i = j, \\ 0 & \text{Everywhere else.} \end{cases}$$

Mathematical Nightmares

Multiple integrals can be produced with `int`, `iint`, `iiint`, or `idotsint`.

`\idotsint f(x_1, x_2, \ldots) dx_1\ dx_2\ldots`

$$\int \cdots \int f(x_1, x_2, \dots) dx_1 dx_2 \dots$$

Continued Fractions can be done by using `cfrac` (similar to `frac`).

`\cfrac{1}{\sqrt{2}+ \cfrac{1}{\sqrt{2}+ \cfrac{1}{\sqrt{2}+\dots}}}`

$$\frac{1}{\sqrt{2} + \frac{1}{\sqrt{2} + \frac{1}{\sqrt{2} + \dots}}}$$

Custom commands

```
\providecommand{\abs}[1]{\lvert#1\rvert}
```

This provides an absolute value command `abs` that can be used in math mode as follows to produce $|x - 5|$

```
 $\abs{x - 5}$ 
```

Named Theorems, Propositions, and other stuff

First define the name for a theorem.

```
\newtheorem{prop}{Proposition}
```

After the theorem has been named, use as follows:

```
\begin{prop}
```

If the sea is sweet, then I am the King of England.

```
\end{prop}
```

Output is as follows:

Proposition

If the sea is sweet, then I am the King of England.