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Scientific Computing 372
LaTeX §2: Setting mathematics

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Schedule

1. Introduction and setting text
2. Setting mathematics
3. Standard environments
4. Tables and figures
5. Boxes and new environments
6. $\mathcal{AMS}$-LaTeX
7. Beamer and PGF

Setting mathematics

Mathematics in **display style**

There are three equivalent ways to **display** mathematics, i.e., to put it on a line of its own.

1. Type the math between `$$` characters.
2. Type it between the `\[` and `\]` commands. (preferred)
3. Place it in the `displaymath` environment, i.e., between `\begin{displaymath}` and `\end{displaymath}`

Example

```
Sometimes we want to
display an equation,
such as
\[x + y = z,\]
on a line of its own.
```

Sometimes we want to display an equation, such as

$$x + y = z,$$

on a line of its own.

Setting mathematics

Mathematics in **text style**

There are three equivalent ways of writing mathematics in normal running text:

1. Type the math between `$` characters. (preferred)
2. Type it between the `\(` and `\)` commands.
3. Place it in the `math` environment, i.e., between `\begin{math}` and `\end{math}` commands.

Example

```
Sometimes we want to put
an equation, such as $x
+ y = z$, in the normal
running text.
```

Sometimes we want to put an equation, such as $x + y = z$, in the normal running text.

Setting mathematics

The standard mathematics font

The standard font in the mathematics environment is **math italics**, which is treated differently from the usual italics you get with the `\emph{`⟨text⟩`}` command.

Example

```
Compare $different$ to
\emph{different}.  Also
note what happens to
$two words$ as opposed
to \emph{two words}.
```

Compare $different$ to *different*. Also note what happens to $two words$ as opposed to *two words*.

Setting mathematics

Math formatting commands

The appearance of math text can also be changed. Be careful, however: Some commands only affect letters, and not symbols. Note also that the `\boldmath` and `\unboldmath` switches must appear in text mode, not in math mode.

Example

```
Compare \boldmath
\[ a + \pi x - \rho \]
\unboldmath to
\[ a + \mathbf{\pi x}
- \rho. \]
```

Compare

$$\boldsymbol{a} + \boldsymbol{\pi x} - \boldsymbol{\rho}$$

to

$$a + \pi\mathbf{x} - \rho.$$

Setting mathematics

Subscripts, superscripts, and primes

Make subscripts with _, superscripts with ^, and primes with '.

Example (subscripts, superscripts, and primes)

```
$x_{a}^{2} + x^{4}_{b}
= x^{y^{k}}$, $f'(x) =
2x$, and $f(x) = x^{2}$
```

$x_a^2 + x^4_b = x^{y^k}$, $f'(x) = 2x$, and $f(x) = x^2$

Example (roots)

Note the optional argument.

```
$\sqrt{xy + z} \neq
\sqrt[n]{\frac{x}{y} +
z} \neq \sqrt[3]{x +
yz}$
```

$\sqrt{xy + z} \neq \sqrt[n]{\frac{x}{y} + z} \neq \sqrt[3]{x + yz}$

Setting mathematics

Fractions

For fractions, use the command `\frac{`⟨num⟩`}{`⟨denom⟩`}`, where ⟨num⟩ and ⟨denom⟩ are the numerator and denominator, respectively.

Example (fractions)

```
The fraction $\frac{
\frac{x}{y} + z}{w}$
is in text style.  The
same fraction
\[ \frac{\frac{x}{y} +
z}{w}, \]
looks different in
display style.
```

The fraction $\frac{\frac{x}{y}+z}{w}$ is in text style. The same fraction

$$\frac{\frac{x}{y} + z}{w},$$

looks different in display style.

Setting mathematics

Example (dots)

`$a \ldots z$`	$a \ldots z$
`$a \cdots z$`	$a \cdots z$
`$\vdots$`	$\vdots$
`$\ddots$`	$\ddots$

Example (calligraphy)

`$\mathcal{A B C D}$`	$\mathcal{A B C D}$

Example (negation)

We may strike through any mathematics symbol by prefacing it with `\not`.

`$5 \not\leq 2$.`	$5 \not\leq 2$.

Setting mathematics

Greek letters and other symbols

Refer to the tables in Chapter 3 of *The Not So Short Introduction Introduction to LaTeX 2ε*.

Example (Greek letters)

```
\TeX\ is pronounced
$\tau \epsilon \chi$.
```

TEX is pronounced $\tau\epsilon\chi$.

Example (predefined math functions)

```
Compare
$log(10^{\circ})$ to
$\log(10^{\circ})$
```

Compare $log(10^\circ)$ to $\log(10^\circ)$

Setting mathematics

Example (symbols with subscripts and superscripts)

```
\[\sum_{k=1}^{10} x^{k}
\not= \int^{b}_{a} x^{2}
\,dx \]
but
\[\lim_{x \to 0}
x^{2} = 0 \]
```

$$\sum_{k=1}^{10} x^k \not= \int_a^b x^2\,dx$$

but

$$\lim_{x \to 0} x^2 = 0$$

Example (parenthetic symbols)

$$( ) [ ] \{ \} \lfloor \rfloor \lceil \rceil \langle \rangle / \backslash | \| \uparrow \downarrow \updownarrow \Uparrow \Downarrow \Updownarrow$$

These are stretched with `\left` and `\right`. Therefore, they must occur in pairs.

```
Simplify: $\left(
\frac{\frac{a}{b}+
c}{d+e}
\right\}(d+e]$
```

Simplify: $\left(\frac{\frac{a}{b}+c}{d+e}\right\}(d+e]$

Setting mathematics

Example (donning a hat)

```
$\widehat{x - y} = z$
```

$$\widehat{x - y} = z$$

Example (lines and braces)

```
$\overline{\underline{
\overbrace{\overline{x}
+ \underline{y}}^{abc}
= \underbrace{z+w+
v}_{def}}}$
```

$$\overline{\underline{\overbrace{\overline{x} + \underline{y}}^{abc} = \underbrace{z + w + v}_{def}}}$$

Example (stacking symbols)

```
$a \stackrel{f'}
{\longrightarrow} b$
```

$$a \stackrel{f'}{\longrightarrow} b$$

Setting mathematics

Spacing between symbols

`\,`	thin space	`\:`	medium space
`\!`	negative thin space	`\;`	thick space

Example (spaces)

```
$\sqrt{2} \, \, x$
$n/ \! \log(n)$
$\int\!\!\int z
\, dx \, dz$
```

$\sqrt{2} \, \, x$
$n/ \! \log(n)$
$\int\!\!\int z \, dx \, dz$

Example (Math styles)

```
Note the difference
between text style,
$\sum^{10}_{k=1}x^{k}$,
and display style,
${\displaystyle
\sum^{10}_{k=1}x^{k}}$.
```

Note the difference between text style, $\sum^{10}_{k=1}x^{k}$, and display style, ${\displaystyle \sum^{10}_{k=1}x^{k}}$.

Last thoughts

- This is not the last word on mathematics in LaTeX
- $\mathcal{AMS}$-TeX was used by the American Mathematical Society
- $\mathcal{AMS}$-LaTeX runs on top of LaTeX
- It incorporates many of the ideas developed for the AMS
  - More symbols
  - Advanced, easily adjustable environments
  - Enhanced support for user-defined operators
- Scientific journals frequently use these features
- We will look at the $\mathcal{AMS}$-LaTeX packages in Section 6