

Further Exercises

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1 Equations

There are different environments for typesetting equations. For simple inline equations (ie ones that appear within the text) such as $e = mc^2$ use `\(e=mc^2\)`.

For displayed, single line equations like

$$e = mc^2$$

use `\[e=mc^2\]`

For a single line, numbered equation like

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

use

```
\begin{equation}
e=mc^2
\end{equation}
```

To typeset multiple equations like this

$$\int \csc^2 x \, dx = -\cot x + C \tag{2}$$

$$\lim_{\alpha \rightarrow 0} \frac{\sin \alpha}{\alpha} = 1 \tag{3}$$

$$\lim_{\alpha \rightarrow \infty} \frac{\sin \alpha}{\alpha} = 0. \tag{4}$$

use

```
\begin{align}
\int \csc^2 x \, dx &= -\cot x + C \\
\lim_{\alpha \to 0} \frac{\sin \alpha}{\alpha} &= 1 \\
\lim_{\alpha \to \infty} \frac{\sin \alpha}{\alpha} &= 0.
\end{align}
```

Note the use of `&` before the `=` sign to make the equations line up and `\\` at the end of the first two lines. If numbering is not needed then replace

```
\begin{align} ... \end{align}
```

by

```
\begin{align*} ... \end{align*}
```

Because \LaTeX doesn't break long equations you will need to do this yourself. So this long equation

$$\begin{aligned}
(1+x)^n &= 1 + nx + \frac{n(n-1)}{2!}x^2 \\
&+ \frac{n(n-1)(n-2)}{3!}x^3 \\
&+ \frac{n(n-1)(n-2)(n-3)}{4!}x^4 \\
&+ \dots
\end{aligned}
\tag{5}$$

is typeset with

```

\begin{align}
\left(1+x\right)^n &= 1 + nx + \frac{n\left(n-1\right)}{2!}x^2 \\
&+ \frac{n\left(n-1\right)\left(n-2\right)}{3!}x^3 \notag \\
&+ \frac{n\left(n-1\right)\left(n-2\right)\left(n-3\right)}{4!}x^4 \notag \\
&+ \dots \notag
\end{align}

```

This equation is numbered on the first line, subsequent numbers are suppressed with `\notag`.

For you: using google (or your search engine of choice) see if you can find out how to start numbering the equations at 3, so that the first equation looks like this:

$$e = mc^2 \tag{3}$$

2 Including pictures

Most \LaTeX documents will include graphs, pictures and other images that were created by applications, such as R or Matlab. Alternatively you can store screenshots via Microsoft Paint. See http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/working_with_r/figures for more information about producing figures in R.

It is vital to know the format of the files where graphs, images, pictures etc are stored. The format of the files that you will be including will determine how you compile your \LaTeX document.

The simple piece of information you need to know is that you can use *either* (encapsulated) PostScript (EPS) pictures *or* PDF/JPG/PNG pictures but *not* both in any one document. Depending on which format you choose there is a different compilation and viewing method.

- If your pictures are in EPS format then the latex file is compiled with `latex` which produces a `.dvi` file. The `.dvi` file is then compiled with `dvips` to

produce a PostScript file for printing. The .dvi file can be previewed but a PostScript file is needed for printing.

- If your pictures are in one of PDF PNG or JPG format then you need to compile with pdf_latex which produces a .pdf file for both viewing and printing. This table may help:

Picture format	Compilation	Printing
.eps or .ps	latex ⇒ DVI	latex ⇒ PS
.jpg or .pdf or .png	latex ⇒ PDF	

Table 1: Picture formats, compilation, printing

In T_EXnicCenter if you look in the Output Profile box you should see a menu of options. These are the L^AT_EX command(s) run when you click on the Build button.

If you have chosen the wrong type of build then usually your pictures and graphs will just disappear. Download the two pictures EPS format picture and PNG format picture from <http://www.stats.ox.ac.uk/pub/susan/latex/>. Using the instructions in *Introduction to L^AT_EX for Statistics 2007* create two .tex files and include the EPS format picture in one and the PNG format picture in the other. Make sure you can see the pictures after you have compiled the files.

3 Typesetting tables

3.1 A simple example

Seeds	Cost
Broad beans	90p
Carrots	80p
Pumpkins	£1.50p

```
\begin{tabular}{lr}
Seeds & Cost \\
Broad beans & 90p \\
Carrots & 80p \\
Pumpkins & \pounds 1.50p
\end{tabular}
```

3.2 The table environment

To produce a table like this:

use

Table 2: A simple table

Seeds	Cost
Broad beans	90p
Carrots	80p
Pumpkins	£1.50p

```
\begin{table}[h]
\caption{A simple table}
\begin{center}
\begin{tabular}{lr}
Seeds & Cost \\
Broad beans & 90p \\
Carrots & 80p \\
Pumpkins & \pounds 1.50p
\end{tabular}
\end{center}
\end{table}
```

3.3 Drawing a line

... and a table like this:

Table 3: Using boxes

Seeds	Cost
Broad beans	90p
Carrots	80p
Pumpkins	£1.50p

use

```
\begin{table}[h]
\caption{Using boxes}
\begin{center}
\begin{tabular}{|l|r|} \hline
Seeds & Cost \\ \hline \hline
Broad beans & 90p \\ \hline
Carrots & 80p \\ \hline
Pumpkins & \pounds 1.50p \\ \hline
\end{tabular}
\end{center}
\end{table}
```

3.4 Changing alignment

The heading 'Cost' would look better if it was centered, rather than right-aligned. To change the alignment of one entry only to make a table like this: use

Table 4: Centering the header

Seeds	Cost
Broad beans	90p
Carrots	80p
Pumpkins	£1.50p

```
\begin{table}[h]
\caption{Centering the header}
\begin{center}
\begin{tabular}{|l|r|} \hline
Seeds & \multicolumn{1}{|c|}{Cost} \\ \hline
Broad beans & 90p \\ \hline
Carrots & 80p \\ \hline
Pumpkins & \pounds 1.50p \\ \hline
\end{tabular}
\end{center}
\end{table}
```

3.5 A much bigger table

It is sometimes necessary to create a table that spreads over more than one page and which is better typeset in landscape rather than portrait. This is particularly useful for wide tables. This means that the page is rotated by 90°.

Table 5: A long table

Seeds	Cost
Broad beans	90p
Carrots	80p
Pumpkins	£1.50p

```

\newpage
\begin{landscape}
\begin{table}
\caption{A long table}
\begin{center}
\begin{longtable}{|l|r|} \hline
Seeds & \multicolumn{1}{|c|}{Cost} \\ \hline
Broad beans & 90p \\ \hline
Carrots & 80p \\ \hline
Pumpkins & \pounds 1.50p \\ \hline
\end{longtable}
\end{center}
\end{table}
\end{landscape}
\newpage

```

Other features to note include

- Tables are included in a `\begin{table} ... \end{table}` environment.
- `\listoftables` is then used to generate a list of tables after the table of contents.

4 Useful packages

Many packages are available in \LaTeX . These add features or change the behaviour of existing packages. We will be looking at just a few commonly used packages in this set of exercises. This is definitely not a definitive list – there are many, many more!

`amsmath`, `amssymb` These packages allow more complex formulae and equations to be typeset and give a richer environment for doing this.

`fancyhdr` The basic headers provided by \LaTeX are rather limited. The `fancyhdr` package adds more information in the header and footer and extends the customisations you can make, allowing you, for example, to add your name to the footer of each page. To use it

1. Add `\usepackage{fancyhdr}` to the preamble.
2. Add `\pagestyle{fancy}` just after the `\maketitle`.

Note that you only start to see the effect of using `fancyhdr` on the second page of a chapter or section, so make sure your document is long enough.

`graphicx` This is the standard package to include when you are including images, pictures and graphs in your document.

`hyperref` This is a useful package if you are creating a PDF document which will be available on line. It makes links, including items in the table of contents and web links clickable.

`listing` For making listings of code look nice.

`longtable` This allows long tables to be typeset, including the ability to split them across pages.

`landscape` Typeset some pages in landscape (ie rotated by 90°).

`parskip` Change the way paragraphs are typeset. Without `parskip` the first line of all but the first paragraph of a section is indented. When using `parskip` there is a blank line between paragraphs and there is no indentation.

5 Getting help

See our `LATEX` FAQ web page http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/latex_faq

Other useful links include Nicola Talbot's `LaTeX` pages (<http://theoval.sys.uea.ac.uk/~nlct/latex/index-noframe.html>) particularly `LaTeX` for Complete Novices and Using `LaTeX` to Write a PhD Thesis on the Tutorials page.

Books

1. Leslie Lamport: *L^AT_EX, A document preparation system*, 2nd edition, Addison-Wesley, (Reading, Massachusetts, 1994)
2. Michel Goossens, Frank Mittelbach and Alexander Samarin: *The L^AT_EX Companion*, Addison-Wesley, (Reading, Massachusetts, 1994)
3. Michel Goossens, Frank Mittelbach and Sebastian Rahtz: *The L^AT_EX Graphics Companion*, Addison-Wesley, (Reading, Massachusetts, 1997)