A short example of how to use LaTeX in scientific reports

Stephen J. Eglen
Department of Applied Mathematics and Theoretical Physics
University of Cambridge
Wilberforce Road
Cambridge CB3 0WA U.K.

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Abstract

The purpose of this short document is to provide a brief overview of the facilities that latex offers for formatting scientific reports. Furthermore, the source files for regenerating this report are freely available so that users can easily start writing their own reports using LaTeX.

1 Introduction

LaTeX is a typesetting program; given an input file with formatting instructions (e.g intro.tex), the program will create your text document in one of several formats (usually PDF, but also DVI and Postscript). It is therefore not a WYSIWYG word processor. LaTeX is known as a logical markup language, similar for example to HTML, so that you describe a piece of text as a "section heading" rather than saying that it should be formatted in a certain way. It has excellent facilities for typesetting mathematics, and handles large documents (such as theses) well. The aim of this document is not to provide an overview of LaTeX, since many other guides have already been written (see Section 8). Instead, it has been written primarily to provide simple workable examples that you can cut and paste to help you get started with LaTeX. The examples have been selected to be those most likely to be useful when writing a scientific report. This document is best read by comparing the source code with the resulting output.

2 Running LaTeX

The files to accompany this paper are at: `http://www.damtp.cam.ac.uk/user/sje30/texintro`. Get the following files and put them into a new directory.

1. `intro.tex`: the main LaTeX document.

2. `example.bib`: a short bibliography.

3. `sigmoid.pdf`: example PDF image.

Change directory to where you stored the files and type the following (ignoring comments placed after ##):

```
pdflatex intro                ## Run latex 1st time
bibtex intro                  ## Find references
pdflatex intro                ## Run to resolve references
pdflatex intro                ## sometimes twice!
xpdf intro.pdf                ## View the resulting PDF
```

You will notice that you run latex several times here; this is so that references can be resolved, and references can be extracted from your bibtex file. After running latex, you will be told if you need to run it again to resolve references. After a while, you will get the hang of how many times you need to run latex to resolve all your references. Or leave it to the machine/editor to do it for you with tools like *latexmk*.

3 Tables

Tables are relatively straightforward to generate. Note that tables and figures are not always placed exactly where you wish for them, as they can `float` to other parts of the document. Rather than trying to battle with latex as to where they are placed, concentrate first on getting the right content and let latex worry about the positioning. Instead, use labels to your tables to refer to them. See Table 1 and Table 2 for examples.

year	min temp (C)	max temp (C)
1970	-5	35
1975	-7	29
1980	-3	30
1985	-2	32

Table 1: Fictional minimal and maximal temperatures recorded in Cambridge over several years.

	ϕ (um)	α	δ_{12} (um)
W81S1			
$h_{11}(u)$	67.94	7.81	
$h_{22}(u)$	66.27	5.40	
$h_{12}(u)$			18
M623			
$h_{11}(u)$	112.79	3.05	
$h_{22}(u)$	65.46	8.11	
$h_{12}(u)$			20

Table 2: Summary of parameter estimates for the univariate functions $h_{11}(u)$, $h_{22}(u)$ and the bivariate function $h_{12}(u)$. For the univariate fits, α and ϕ are least-square estimates (assuming δ was fixed at 15 um). The final column gives the maximum likelihood estimate of δ_{12} assuming that the interaction between types is simple inhibition.

4   Bibliography management

Scientific reports normally require a references section where your references are cited. Bibtex is an excellent system for maintaining references, especially for large documents. Each reference needs a unique key; you can then refer to the reference in your LaTeX document by using this key within a cite command.

Take care when formatting your references, especially when it comes to writing authors names and the case of letters in journal titles. In our examples, the references are found in `example.bib`. As an example of a citation, see (Ihaka and Gentleman, 1996) or (Ihaka and Gentleman, 1996; Venables and Ripley, 1999).

Bibtex is flexible enough to format your references in a wide number of different styles to suit your needs. In this file I have used the "natbib" package, which is suitable for the Natural Sciences. Depending on the type of cite command you get (and the package that you use for citations), you can get different styles of citation. See Table 3 for some examples.

5   Graphics

Create your images for pdflatex as either pdf (preferred for vector formats), png or jpeg. Figures can be included either at their natural size, or you can specify e.g. how wide you wish the figure to be. Figure 1 shows an example image which intentionally looks slightly different depending on whether you compile the document with latex or pdflatex. Note that in this example the suffix of the image file is not included, in which case pdflatex will look for a file with a supported suffix.

6   Mathematics

LaTeX can format mathematics with ease, either in line, such as $x \times y$, or on separate lines, such as:

$$x^2 + y^2 = z^2$$

If you are writing several lines of equations, you can use statements like the following:

command	result
`\citep{ihaka1996}`	(Ihaka and Gentleman, 1996)
`\citet{ihaka1996}`	Ihaka and Gentleman (1996)
`\citep[see][p. 300]{ihaka1996}`	(see Ihaka and Gentleman, 1996, p. 300)
`\citeauthor{ihaka1996}`	Ihaka and Gentleman
`\citeyear{ihaka1996}`	1996

Table 3: Examples of different citation commands available in the natbib package.
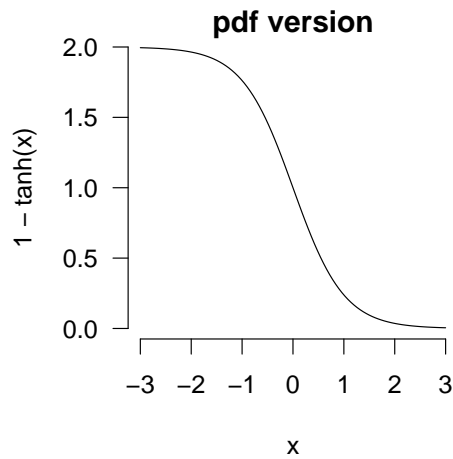
pdf version

Figure 1: Example of a sigmoidal curve generated by the R programming environment. The title above the curve indicates whether you have included the postscript or the pdf version of the figure.

$$b(t) = s(t) - \int_0^T a(t') \cdot i(T - t')dt' \tag{1}$$

$$a(t) = \int_0^T b(t) \cdot e(T - t')dt' \tag{2}$$

$$g(t) = b(t) * e(t)$$

By using labels on certain equations, we can refer to equations by number, such as equation (2).

7 Including text "as-is"

In your reports you may wish to sometimes include text "as-is", with no subsequent markup from LaTeX. There are several ways to achieve this, using verbatim commands. For example `longest_word = 99` is verbatim text, as is the following paragraph:

```
one two three
four five
six
```

See the *listings* package for sophisticated ways of formatting code written in different computing languages. Finally, if you would like to include the contents of a file, use `\verbatiminput` from the *verbatim* package, as used here to list our bibtex references:

7.1 Contents of bibliography

```
@Comment{This is an example bibtex file which shows how to format a few}
@Comment{different styles of references.}

@Book{venables1999,
  author =  {V. T. Venables and B. D. Ripley},
  title =  {Modern Applied Statistics with S-Plus},
  publisher =  {Springer},
  year =  {1999}
}

@article{ihaka1996,
  author =     {R. Ihaka and R. Gentleman},
  title =      {R: A Language for Data Analysis and Graphics},
  journal =    {Journal of Computational and Graphical Statistics},
  year =       1996,
  volume =     5,
```

```
    pages =      {299--314}
}
```

8 Summary

This short guide should give you a flavour of what can be done with LaTeX. It is by no means complete, or supposed to be self-explanatory. It is, however, hopefully enough to get you started! Try experimenting by editing the source file and then recompiling this document. As mentioned earlier, there are many guides for latex. Two that I can recommend are `http://www.andy-roberts.net/misc/latex/index.html` and " The (Not So) Short Introduction to LaTeX2e" (`http://ctan.tug.org/tex-archive/info/lshort/english/lshort.pdf`).

References

R. Ihaka and R. Gentleman. R: A language for data analysis and graphics. *Journal of Computational and Graphical Statistics*, 5:299–314, 1996.

V. T. Venables and B. D. Ripley. *Modern Applied Statistics with S-Plus*. Springer, 1999.