A short example of how to use LaTeX for scientific reports

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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.**

I. Introduction

LaTeX is a typesetting program; given an input file with formatting instructions (e.g intro.tex), the program will create your document in one of several formats (DVI, Postscript or PDF). 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 VII). 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.

II. Running LaTeX

The files to accompany this paper are at: http://www.damtp.cam.ac.uk/user/eglen/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.ps: example postscript image.
4) sigmoid.pdf: example PDF image.

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

```
latex intro                     ## Run latex 1st time.
bibtex intro                    ## Extract required references
latex intro                     ## Run latex 2nd time.
latex intro                     ## Probably need to run latex a 3rd time.
xdvi intro                      ## View the DVI (device independent) file.
dvips -o intro.ps intro         ## Create a postscript file for printing.
```

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 idea of how many times you need to run latex to resolve all your references.

If instead you would like to generate PDF files (see Section V for a discussion of file formats for included images), you can try the following shorter sequence:

```
pdflatex intro
bibtex intro
pdflatex intro
pdflatex intro
xpdf intro.pdf                  ## View the resul
```

Whether you prefer to generate DVI or PDF is up to you. The xdvi viewer has some nice features, such as it can reload your document easily and has a "magnifying glass" that is activated by the mouse. On the other hand, xpdf will display the document more accurately as it will be printed.

III. Tables

Tables are relatively straightforward to generate. Note that tables and figures are not always placed exactly where you wish, 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 I and Table II for examples.

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

TABLE I
Fictional minimal and maximal temperatures recorded in Cambridge over several years.

IV. Bibliography management

Scientific reports normally require a section where your references are listed. 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.

	ϕ (µm)	α	δ_{12} (µm)
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 II
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 µM). THE FINAL COLUMN GIVES THE MAXIMUM LIKELIHOOD ESTIMATE OF δ_{12} ASSUMING THAT THE INTERACTION BETWEEN TYPES IS SIMPLE INHIBITION.

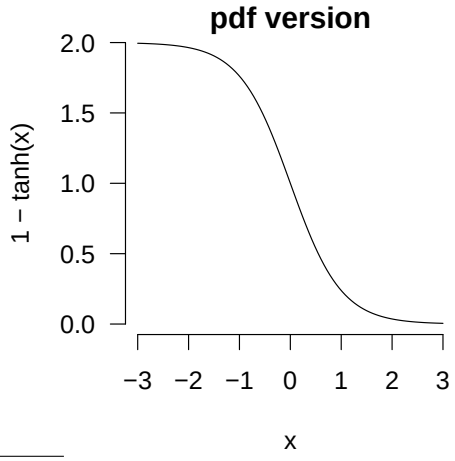

Fig. 1. Example of a sigmoidal curve generated by the R programming environment. The title above the curve indicates whether you have included the postscript or the pdf version of the figure.

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 III
EXAMPLES OF DIFFERENT CITATION COMMANDS AVAILABLE IN THE NATBIB PACKAGE.

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 files 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 III for some examples.

V. GRAPHICS

LaTeX can include images in one of several format, depending on whether you use latex (postscript format required) or pdflatex (either jpeg, png or pdf required). Figures can be included either at their natural size, or you can specify e.g. the figure width. 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 so that this document compiles under both latex and pdflatex.

VI. 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:

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

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

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

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

VII. 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.