

Exercises for L^AT_EX Level 3

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February 2008

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1 Before you start

We will be using OSS Watch Ubuntu Linux today for the exercises. The CD runs a ‘live’ version of Linux which does not change the hard disk. The OSS Watch version of Ubuntu Linux contains most of the commonly used features of \LaTeX although some of the more obscure mathematical symbols may not be available. \TeX and \LaTeX work equally well on Windows, Macintosh and many other operating systems. These exercises were prepared using the OSS Watch Live Ubuntu CD and a memory stick. I made frequent backups!

More information about Ubuntu can be found at <http://www.ubuntu.com/> and information about OSS Watch can be found at <http://www.oss-watch.ac.uk/>.

The slides and notes for today’s course can also be viewed and downloaded from http://www.stats.ox.ac.uk/people/support_staff/srh/latex.

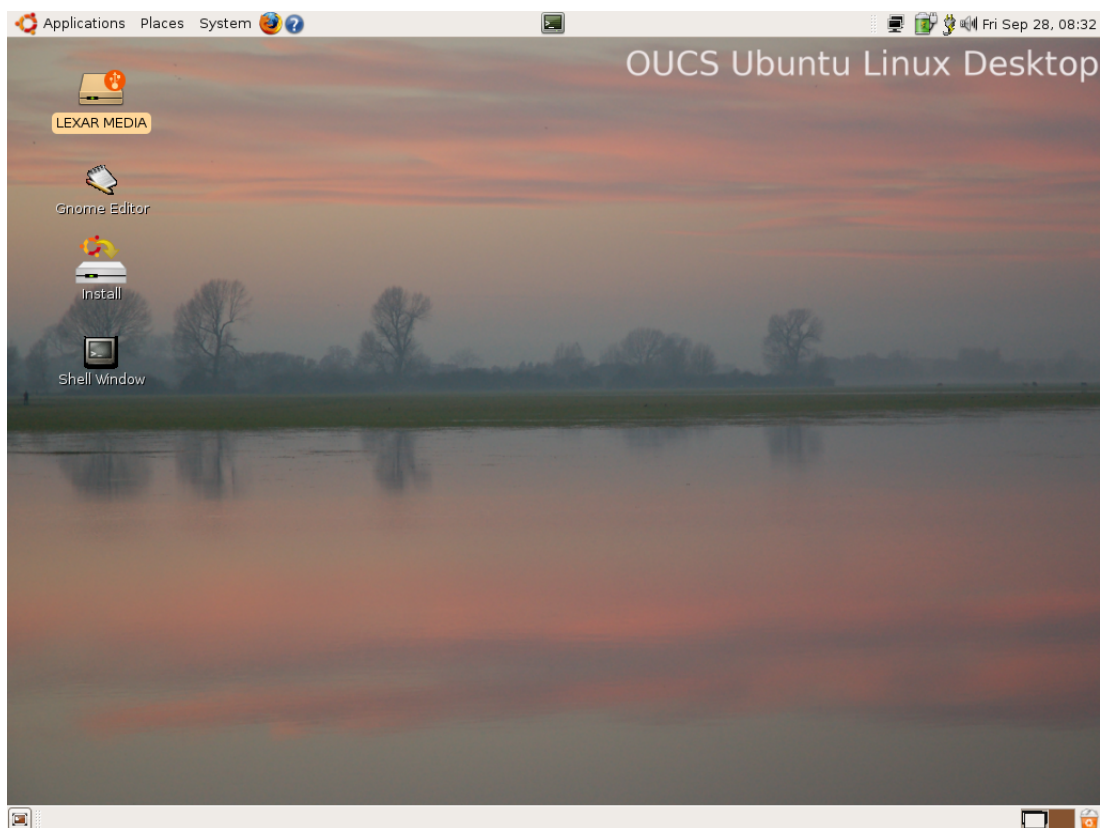


Figure 1: The OSS Watch Ubuntu start-up screen

If a browser window opens describing the work of OSS Watch close it.

We now need to open a command tool window before beginning the exercises. Click on the picture of a monitor in the middle of the panel at the top of your screen. Your screen should now look like Figure 2. Commands are entered after the prompt `ubuntu@ubuntu: ~$` and are always ended by pressing the `< enter >` key. Note that the `~` will change if you change directory.

Using the command tool you will start editing, compiling and viewing \LaTeX files. You need to go through the following steps in order to create \LaTeX document. It is worth reading this section carefully before starting the first exercise.

Editing If you are familiar with an editor then use that one, otherwise use the `emacs` editor.

To use `emacs` to create a new file called `test.tex`, enter `emacs test.tex &`. Make sure you

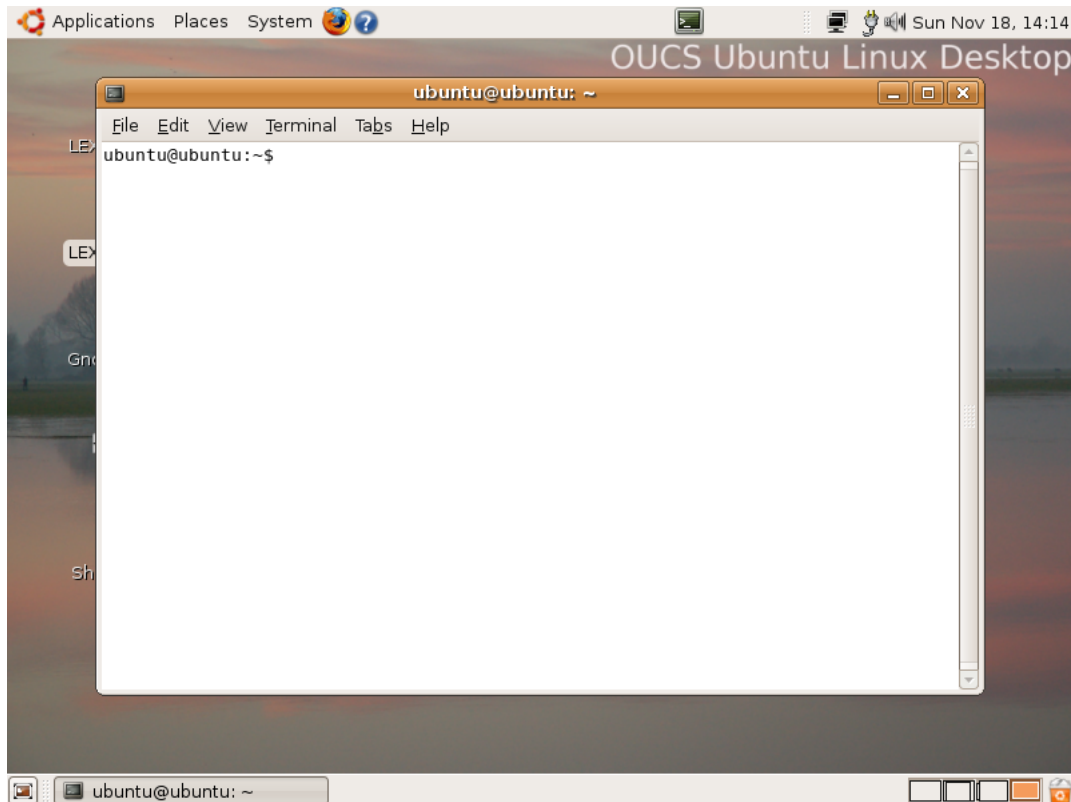


Figure 2: A command window

include the `&` at the end of the line as this allows you to continue entering commands in the command tool window.

Every time you type information into the file or make changes to it you need to save the file either by using the `emacs` File menu or by using `Control-X Control-S` (that is hold down the control key and press X then S). The newly opened `emacs` window will be used to enter the \LaTeX document.

Running \LaTeX To compile the `test.tex` in file use

```
latex test.tex
```

in the command tool window. You will see some diagnostic output which should end with

```
Transcript written on test.log.
```

Viewing the output To see what your file looks like after it has been compiled use

```
xdvi test &
```

in the command tool window.

This window updates automatically whenever you recompile the `test.tex` file.

PDF files It is possible to compile `.tex` files directly into PDF format. Use

```
pdflatex test.tex
```

and to view the file use

```
xpdf test.pdf &
```

The choice of `latex` and `xdvi` or `pdflatex` and `xpdf` is largely determined by the type of graphics files (if any) you will be including in your document. If you know that you will be using PostScript graphics then you must use `latex` and `xdvi`, if your pictures are in JPG/PDF/PNG format then use `pdflatex` and `xpdf`.

2 Exercises

For the first exercise you will create a very simple \LaTeX file, compile it and view it. Call this file `first.tex`.

2.1 A simple example

▷ **Exercise 1** We are now going to input, compile and view a simple file. Type these lines into a file. The instructions will assume that `emacs` is being used but you can use a different editor if you prefer.

```
\documentclass{article}
\begin{document}
\section{Introduction}
Hello there.

Goodbye now.
\end{document}
```

Compile and view the file by using

```
latex first.tex
xdvi first.dvi &
```

and then by using

```
pdflatex first.tex
xpdf first.pdf
```

Now change the file so that it contains a mistake — perhaps by leaving out a closing `}`. Now compile the file again and see what happens. Depending on the error you have introduced you may see something like this:

```
Runaway argument?
{document Hello there.
! Paragraph ended before \begin was complete.
<to be read again>

                                \par
1.4
```

Type `X` to quit. In general if a your \LaTeX compilation is stuck typing `X` or `Control-C` will force it to quit.

2.2 A longer document

This exercise uses a sample `.tex` file which you will download.

▷ **Exercise 2** Close all the open windows apart from the command tool window. Now download the sample file using

```
wget http://www.stats.ox.ac.uk/pub/susan/latex/sample.tex
```

and enter

```
emacs sample.tex &
```

then compile and view the file.

▷ **Exercise 3** Now we are going to make some changes this file. Remember that you will need to save the file and compile it using `latex sample.tex` after each change.

1. Change `documentclass` from `article` to `report` and then to `book`. You might want to include `\chapter{Introduction}` immediately after `\begin{document}`

2. Change the documentclass font size option from 12pt to 11pt .
3. Add `\usepackage{parskip}` to the preamble. How does the paragraph formatting change?
4. Add `\usepackage{times}` to the preamble. The font should now look different.
5. Change the color from red to green.
6. Swap the emphasised and bold text.

2.3 Typesetting Text

▷ **Exercise 4** We will now typeset some simple sentences. You should have a copy of “The Not So Short Introduction to L^AT_EX2_ε” which we will be using for reference for the rest of these exercises. See chapter 2 “Typesetting Text”. You should also have a short document called “Helpful Hints” which contains instructions on how to typeset many characters.

Start a new section in your document. Typeset the following. The “Helpful Hints” handout will be useful for these answers.

I entered the room and—horrors—I saw both my father-in-law and my mother-in-law.

The winter of 1484–1485 was one of discontent.

Look carefully at the lengths of the hyphens and dashes in these examples. Make sure your answers look the same.

Frank wondered, “Is this a girl that can’t say ‘No!’?”

Look carefully at the quotation marks in this example. Make sure your answers look the same.

Does Æschylus understand Œdipus?

*As a general rule a space is needed after a L^AT_EX command if it starts with a letter (A-Z or a-z). A space is **not** needed if the command is a single punctuation mark.*

They took some honey and plenty of money wrapped up in a £5 note.

The command for a pounds sign is `\pounds` followed by a space.

Élèves, refusez vos leçons! Jetez vos chaînes!

Can you take a ferry from Öland to Åland?

▷ **Exercise 5** Give your document a title. You will need to include

```
\title{Your title}
\author{Your name}
\date{A date}
\maketitle
```

immediately after the `\begin{document}` . To add a table of contents use `\tableofcontents` after the title. Note that you will need to rerun `latex sample.tex` twice in order for entries in the table of contents to be displayed.

▷ **Exercise 6** Lists. Using the `itemize` , `enumerate` and `description` environments typeset the following

1. You can mix list environments as much as you like
 - But it might start to look silly

- With different symbols

2. So do remember

Stupid things will not become smart because they are in a list.

Smart things, though, can be presented beautifully in a list.

▷ Exercise 7 Typeset the following table

Vegetable Production

Vegetable	Comments	Weight
Carrots	Good early crop, then carrot fly.	7kg
Lettuce	Slow to start, then bolted.	1kg
French beans	Excellent.	12kg

▷ Exercise 8 If you have time, try this more complicated table.

Currencies 1 Jan 2001

London:	New York:
£: \$ 1.8672	£: \$ 1.8655
£: DM 2.8369	\$: DM 1.5175
£: FFr 9.69080	\$: FFr 5.1845

2.4 Mathematics

If you will be needing to typeset mathematical formulae then try as many of these exercises as possible. Answers can be downloaded from <http://www.stats.ox.ac.uk/~hutchins/latex/Answers.pdf>

▷ Exercise 9 Typeset the following: $C(n, r) = n! / (r!(n - r)!)$. Note the spacing in the denominator.

▷ Exercise 10 Typeset the equation $a + b = c - d = xy = w/z$ as in-line and displayed mathematical text.

▷ Exercise 11 Typeset the equation $(fg)' = f'g + fg'$ as in-line and displayed mathematical text.

▷ Exercise 12 Typeset $\alpha\beta = \gamma + \delta$ as in-line and displayed mathematical text.

▷ Exercise 13 Typeset $\Gamma(n) = (n - 1)!$ as in-line and displayed mathematical text.

▷ Exercise 14 Typeset: $x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$.

▷ Exercise 15 Typeset: $2 + 4 + 6 + \dots + 2n = n(n + 1)$.

▷ Exercise 16 Typeset: $\vec{x} \cdot \vec{y} = 0$ if and only if $\vec{x} \perp \vec{y}$.

▷ Exercise 17 Typeset: $\vec{x} \cdot \vec{y} \neq 0$ if and only if $\vec{x} \not\perp \vec{y}$.

▷ Exercise 18 Typeset: $(\forall x \in \mathbb{R})(\exists y \in \mathbb{R})$ such that $y > x$.

▷ Exercise 19 Typeset the following: $\frac{a+b}{c} = \frac{a}{b+c} = \frac{1}{a+b+c} \neq \frac{1}{a} + \frac{1}{b} + \frac{1}{c}$.

▷ Exercise 20 Typeset: What are the points where $\frac{\partial}{\partial x} f(x, y) = \frac{\partial}{\partial y} f(x, y) = 0$?

▷ Exercise 21 Typeset each of the following: e^x e^{-x} $e^{i\pi} + 1 = 0$ x_0 x_0^2 x_0^2 2^{x^x} .

▷ Exercise 22 Typeset: $\nabla^2 f(x, y) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$.

▷ Exercise 23 Typeset the following expression: $\lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}} = e$.

▷ Exercise 24 Typeset: The cardinality of $(-\infty, \infty)$ is \aleph_1 .

▷ Exercise 25 Typeset: $\lim_{x \rightarrow 0^+} x^x = 1$.

Here is a hint to make integrals look a little nicer: look at the difference between $\int_0^x f(t) dt$ and $\int_0^x f(t) dt$. In the second case there is a little extra space after $f(t)$, and it looks nicer; \backslash , was used to add the additional space.

▷ Exercise 26 Typeset the following integral: $\int_0^1 3x^2 dx = 1$.

▷ Exercise 27 Typeset the following: $\sqrt{2}$ $\sqrt{\frac{x+y}{x-y}}$ $\sqrt[3]{10}$ $e^{\sqrt{x}}$.

▷ Exercise 28 Typeset: $\|x\| = \sqrt{x \cdot x}$.

▷ Exercise 29 Typeset: $\phi(t) = \frac{1}{\sqrt{2\pi}} \int_0^t e^{-x^2/2} dx$.

▷ Exercise 30 Typeset the following: \underline{x} \overline{y} $\overline{x+y}$.

▷ Exercise 31 Typeset $\lceil [x] \rceil \leq \lceil [x] \rceil$.

▷ Exercise 32 Typeset: $\sin(2\theta) = 2 \sin \theta \cos \theta$ $\cos(2\theta) = 2 \cos^2 \theta - 1$.

▷ Exercise 33 Typeset:

$$\int \csc^2 x dx = -\cot x + C \quad \lim_{\alpha \rightarrow 0} \frac{\sin \alpha}{\alpha} = 1 \quad \lim_{\alpha \rightarrow \infty} \frac{\sin \alpha}{\alpha} = 0.$$

▷ Exercise 34 Typeset:

$$\tan(2\theta) = \frac{2 \tan \theta}{1 - \tan^2 \theta}.$$

▷ Exercise 35 Typeset:

$$\begin{bmatrix} aa & \cdots & az \\ \vdots & \ddots & \vdots \\ za & \cdots & zz \end{bmatrix}$$

▷ Exercise 36 Typeset:

A random variable Y has density

$$f(y; \theta, \phi) = \exp \left\{ \frac{y\theta - b(\theta)}{a\phi} + c(y; \phi) \right\}$$

and its moment-generating function is $M(t) = \exp[\{b(\theta + t a \phi) - b(\theta)\}/(a\phi)]$.

▷ Exercise 37 Typeset: If Y_{rc} , $r = 1, \dots, R$, $c = 1, \dots, C$ are random variables, show that

$$\sum_{r,c} (Y_{rc} - \bar{Y}_{..})^2 = \sum_{r,c} (\bar{Y}_{r.} - \bar{Y}_{..})^2 + \sum_{r,c} (\bar{Y}_{.c} - \bar{Y}_{..})^2 + \sum_{r,c} (Y_{rc} - \bar{Y}_{.c} - \bar{Y}_{r.} + \bar{Y}_{..})^2. \quad (1)$$

▷ Exercise 38 Typeset:

$$f(x_i | \lambda_i) = \lambda_i e^{-\lambda_i x_i}, \quad f(y_i | \lambda_i, \psi) = \lambda_i \psi e^{-\lambda_i \psi y_i}, \quad x_i, y_i \geq 0.$$

▷ Exercise 39 Typeset:

$$\frac{\partial G}{\partial t} = \lambda s(s-1) \frac{\partial G}{\partial s}.$$

▷ Exercise 40 Typeset:

1. Generate independent uniforms U and U_1 .
2. Set $\begin{cases} X = 1/(4U - 1), V = U_1/X^2 & \text{if } U < 0.5, \\ X = 4U - 3, V = U_1 & \text{otherwise.} \end{cases}$
3. If $V < 1 - 0.5|X|$ go to 5.
4. If $V \geq (1 + X^2/\nu)^{-(\nu+1)/2}$ go to 1.
5. Return X .

▷ Exercise 41 Typeset:

$$h_i(t) = \lim_{\epsilon \rightarrow 0} \frac{1}{\epsilon} \frac{\mathbb{P}(t < T_i \leq t + \epsilon)}{\mathbb{P}(T_i > t)}.$$

2.5 Advanced features

▷ Exercise 42 Cross references. Create a reference to your first section using `\ref` and `\label` commands.

▷ Exercise 43 Including pictures. You can download either an EPS or PNG file

```
wget http://www.stats.ox.ac.uk/pub/susan/latex/panic.png
```

or

```
wget http://www.stats.ox.ac.uk/pub/susan/latex/panic.eps
```

In the following examples, **panic.png** has been used. This means that the file should be compiled with **pdf_latex** and viewed with **xpdf**. Add the following line to the beginning of your file.

```
\usepackage{graphicx}
```

To include the graph found in the file, `panic.png` use

```
{\includegraphics[scale=.4]{panic.png}}
```



I have scaled the picture to .4 of the original size.

The basic command can be developed. You can centre the graph on the page with the following commands



```
\begin{figure}[ht]
\centering
{\includegraphics[scale=.4]{panic.png}}
\end{figure}
```

These commands produce a graph that is centred horizontally on the page. I have included [ht] after \begin{figure} to ensure that the graph appears where I want it.

▷ **Exercise 44** A simple bibliography. Download a very small bibliography file

```
wget http://www.stats.ox.ac.uk/pub/susan/latex/test.bib
```

In the preamble include \usepackage{natbib}. This uses both author–year and numerical citations. At the end of the .tex file, before \end{document} add

```
\bibliographystyle{plainnat}
\bibliography{test}
```

There are other bibliography styles but plainnat is available on the OSS Watch Knoppix CD.

Here are a few example citations.

Using \cite{Austen.09} produces Austen [1809].

Using \citep{Austen.09} produces [Austen, 1809].

Using \cite{Rumel.ZZ.86} produces Rummelhart et al. [1986].

Using \citep{Rumel.ZZ.86} produces [Rummelhart et al., 1986].

Using \citet{*}{Rumel.ZZ.86} produces Rummelhart, Hinton, and Williams [1986].

Using \citep*{Rumel.ZZ.86} produces [Rummelhart, Hinton, and Williams, 1986].

Note that each example produces a slightly different format for the citation.

To process a document containing citations you should run

```
latex test.tex
bibtex test.tex
latex test.tex
latex test.tex
```

at least! If a .bib file has citations in the citations, then a further run of bibtex and two more of latex are needed.

Finally, if you want an entry for the bibliography or references in the table of contents you need to add the line

```
\addcontentsline{toc}{section}{\numberline{}}\refname}
```

in the **article** class and

```
\addcontentsline{toc}{chapter}{\numberline{} \bibname}
```

3 Acknowledgements

I would like to thank Professor Brian Ripley for permission to use material from exercises he devised for the Department of Statistics as part of an introductory \LaTeX course.

References

J. Austen. *Pride and Prejudice*. William Collins, Edinburgh, 5 edition, 1809.

D. E. Rumelhart, G. E. Hinton, and R. J. Williams. Learning Representations by Backpropagating Errors. *Nature*, 323:533–536, 1986. [Reprinted in Anderson and Rosenfeld (1988)].