

The Graduate/Staff Guide to LaTeX

on the
SUN Computer Network

Department of Mathematics and Statistics

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1 HOW TO CREATE A LATEX FILE

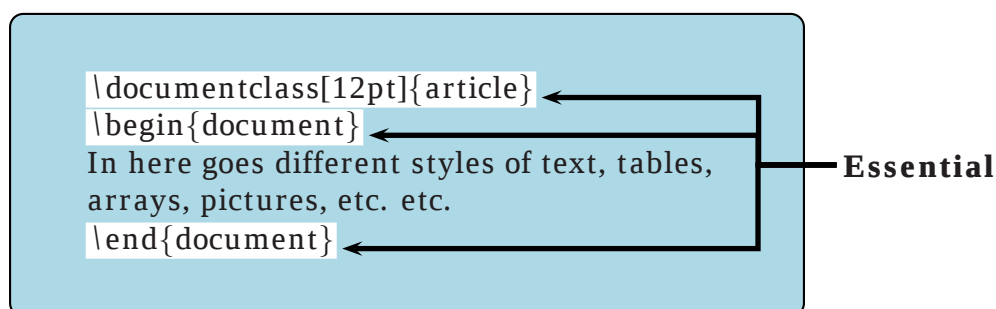
1.1 Introduction

Latex is a type setting language, and is easier to use than one might think from first appearances.

The department is currently running the version LaTeX 2e, This will handle files written in the previous version Latex 2.09, but all references here are in terms of LaTeX 2e. In some cases the old format is incompatible with the new format so keep this in mind when you experiment with the options.

We will go through a few simple examples in the next few subsections.

1.2 The Minimum file



To make things easier for you, we have included copies of all sample files on the department web page for easy download. Start off by down loading sample file 1.

i.e. netscape <http://www.math.canterbury.ac.nz/latex.shtml> &

Download Sample file 1 by following the instructions given on the web page, it should be downloaded as latsam1.tex.

Note all latex files should have the extension .tex.

Now you will need to run latex via entering the following two commands in an X-window

```
latex latsam1.tex
```

```
dvips latsam1.dvi
```

```
dvips -f -o latsam1.ps latsam1.dvi1
```

You have now processed a latex document. Now to view it type

```
ghostview latsam1.ps &
```

Now each time you modify the document and wish to view your changes, you will have to retype the latex and dvips commands. Typing **r** on the ghostview window will update it to the latest postscript file, as will deiconising it.

Note 1: Spaces are ignored by LaTeX, see later lesson as to how to add spaces.

Note 2: Single carriage returns are ignored in LaTeX, double carriage returns are regarded as being a new paragraph, to create a new line use either `\\` or `\newline`.

Note 3: The above dvips command assumes you do not have your printer environment set, otherwise the file will go straight to the printer (the printer environment is automatically set in the undergraduate labs). To set the printer environment type `setenv PRINTER rm404`

¹For using when printer environment set

2 Editing LaTeX files

Currently the most used editor for editing LaTeX files is Xemacs because of it being built with a LaTeX interface allowing one to easily see LaTeX structures and allowing one to easily add LaTeX code.

See Lesson 2 on the latex.shtml web page for a brief tutorial.

i.e. netscape <http://www.math.canterbury.ac.nz/latex.shtml#lesson2>

3 Fonts/Text

3.1 Fonts/Text Styles

There are several different fonts you can use. A simple example is as follows.

```
\documentclass[12pt]{article}
\begin{document}
\textbf{\Large This bit is large and bold}
\end{document}
```

We have created a few sample files which can be downloaded from the latex webpage.

i.e. netscape <http://www.math.canterbury.ac.nz/latex.shtml#lesson3>

There are several font styles and sizes that you can use, the main ones used are as follows.

Font Style		Font Size	
LaTeX code	Output	LaTeX code	Output
<code>\textup{test}</code>	test	<code>{\tiny test}</code>	test
<code>\textup{test}</code>	test	<code>{\tiny test}</code>	test
<code>\textit{test}</code>	test	<code>{\scriptsize test}</code>	test
<code>\textsl{test}</code>	test	<code>{\footnotesize test}</code>	test
<code>\textsc{test}</code>	TEST	<code>{\small test}</code>	test
<code>\textbf{test}</code>	test	<code>{\normalsize test}</code>	test
<code>\textrm{test}</code>	test	<code>{\large test}</code>	test
<code>\texttt{test}</code>	test	<code>{\Large test}</code>	test
<code>\textsf{test}</code>	test	<code>{\LARGE test}</code>	test
Grey Shadings		<code>{\huge test}</code>	test
<code>{\lightgray test}</code>	test	<code>{\Huge test}</code>	test
<code>{\gray test}</code>	test	Font Style and Size Combined	
<code>{\darkgray test}</code>	test	<code>{\tiny \textsc{test} plus}</code>	TEST plus

3.2 Using Coloured Fonts

Colour is mainly for presentations, keep in mind most of our printers are grey scale printers, and colour printing is expensive. But using greyscale within a paper or thesis can add aesthetics at no extra printing cost, but note photocopying may not come out the way you were expecting, so do test before running off 200 copies. As for sending as FAXs don't bother, some are set as black and white only.

The grayscales - black, darkgray, gray, lightgray, and white, and the colours - red, green, blue, cyan, magenta, and yellow are all predefined in Pstricks. Which means that you can use `\blue` in the same way you might use `\large`, these commands can also be combined. They differ from the normal font commands in the following ways.

1. The colour commands can be used in and out of maths mode.
2. The colour commands affect whatever is in their scope (e.g. lines), not just characters.
3. The scope of colours does not extend across pages.
4. The colour commands are not as robust as font commands when used inside box macros.
5. They can become difficult to read when printing on a gray scale printer²

For example

```
\documentclass[12pt]{article}
\usepackage{pstricks}
\begin{document}
\noindent {\blue This is blue}
{\darkgray This is darkgray}
\end{document}
```

You can define colours for your use throughout your document via the commands

```
\newgray{darkergray}{0.3}
\newcmykcolor{tancmyk}{0 0.42 1 0}
\newrgbcolor{tanrgb}{0.98 0.67 0.33}
```

²A printer that can only produce shades of gray

for example

```
\documentclass[12pt]{article}
\usepackage{pstcol}
\newgray{darkergray}{0.3}
\newcmymkcolor{tan}{0 0.42 1 0}
\newrgbcolor{redish}{0.98 0.67 0.33}
\begin{document}
{\textcolor{darkergray}{This will show up dark gray}}
\textcolor{tan}{This will show up as tan}
\textcolor{redish}{This will show up redish}
\end{document}
```

gray: One can specify any shade of gray from white (denoted as 1) all the way to black (denoted as 0).

cmymk: equals cyan + magenta + yellow + black.

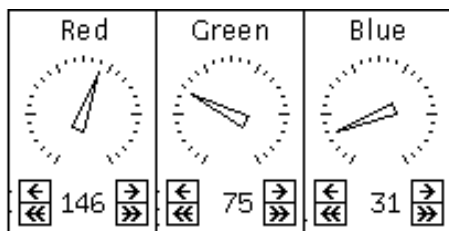
rgb: equals red + green + blue

To create your own rgb colours include at the beginning of your document

```
\newrgbcolor{colour}{rgb}{num1,num2,num3}
```

Where **num1,num2,num3** is a red-green-blue specification with each number being between 0 and 1. To select the colour you wish you may wish to use xv via the following method

1. Type **xv &**
2. Move the mouse onto the xv window
3. Hit the **e** key on your keyboard, this will bring up the graphics editor
4. Click on 
5. Click on one of the colour rectangles which has the colour you want (click on **random** again if necessary).
6. Select the numbers corresponding and divide those by 255



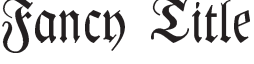
146, 46, 3 becomes 0.5725 0.2941 0.0118
or `\newrgbcolor{brown}{0.573 0.294 0.012}`

A sample file is available off the web page.

i.e. netscape <http://www.math.canterbury.ac.nz/latex.shtml#lesson4>

3.3 FANCY FONTS

You can insert fancy fonts by including the style files and textpath.sty in `\usepackage{}`, that is `\usepackage{amsfonts, textpath}`.

Fancy Heading	Method
	<pre>\psset{linestyle=none} \pstextpath[c]{\pscurve(0,0)(1,0.3) (2,0.2)(3,-.1)(4,.1)(5,-.3)(6,-.2)}% {\Huge \$\mathbb{M}OUSE\$ \$\mathbb{M}OUSE\$}</pre>
	<pre>\psset{linestyle=none} \pstextpath[c]{\pscurve(0,0)(1,0.3) (2,0.2)(3,-.1)(4,.1)(5,-.3)(6,-.2)}% {\Huge \$\mathfrak{A}ssignment\$}</pre>
	<pre>\newcommand\gothfamily{\usefont{U}{ygoth}{m}{n}} \DeclareTextFontCommand{\textgoth}{\gothfamily} \begin{document} ... {\huge \textgoth{Fancy Title}}</pre>
	<pre>\newcommand\frakfamily{\usefont{U}{yfrak}{m}{n}} \DeclareTextFontCommand{\textfrak}{\frakfamily} \begin{document} ... {\huge \textfrak{Fancy Title}}</pre>
	<pre>\newcommand\swabfamily{\usefont{U}{yswab}{m}{n}} \DeclareTextFontCommand{\textswab}{\swabfamily} \begin{document} ... {\huge \textswab{Fancy Title}}\}</pre>
	<pre>\newcommand\initfamily{\usefont{U}{yinit}{m}{n}} \DeclareTextFontCommand{\textinit}{\initfamily} \begin{document} ... {\textinit{HI}}\}</pre> Note text must be all in capitals
	<pre>\newcommand\swabfamily{\usefont{U}{yswab}{m}{n}} \DeclareTextFontCommand{\textswab}{\swabfamily} \begin{document} ... {\huge \textswab{Fancy Title}}\}</pre>

3.4 Using Postscript Style Fonts

If you have used the information so far to print a LaTeX document the printer would have produced output in cm (computer modern) fonts.

Several years ago Mark Hickman set up a font style which is called postscript which is essentially New Century Schoolbook. This is a heavier style than cm and is very useful for documents such as this one, or class notes or handouts that are to be photocopied or reduced, since the result does not degrade as much as the lighter cm version.

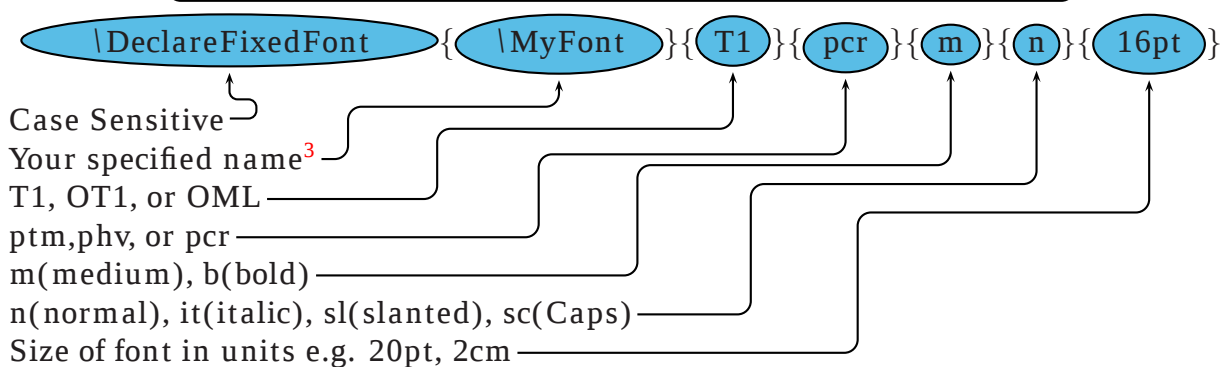
To produce documents in this NCS or postscript style include **postscript** into your `\usepackage{}` statement.

You can make your own postscript fonts, that being vector based rather than bitmap, making them easily scaleable to whatever size you like. The available Adobe postscript fonts are Times (ptm), Helvetica (phv) and Courier (pcr).

Times	Helvetica	Courier
16pt normal	16pt normal	16pt normal
12pt normal	12pt normal	12pt normal
6pt normal	6pt normal	6pt normal
12pt Bold	12pt Bold	12pt Bold
12pt Bold	12pt Bold	12pt Bold
12pt Bold	12pt Bold	12pt Bold
12pt Bold	12pt Bold	12pt Bold
12pt Bold	12pt Bold	12pt Bold
12pt <i>Italics</i>	12pt <i>Italics</i>	12pt <i>Italics</i>
12PT ITALICS	12PT ITALICS	12PT ITALICS
12pt <i>Italics</i>	12pt <i>Italics</i>	12pt <i>Italics</i>

Example:

```
\documentclass[12pt]{article}
\DeclareFixedFont{\MyFont}{T1}{pcr}{m}{n}{16pt}
\begin{document}
{\MyFont This is Courier 16pt}
\end{document}
```



³ Make sure it is unique

The Computer Modern Fonts that are available are

- CM Bold (cmb10)
- CM Bold Extended (cmbx5, cmbx6, cmbx7, cmbx8, cmbx9, cmbx10, cmbx12).
- CM Bold Extended Slanted (cmbxsl10)
- CM Bold Extended Text Italic (ccmbxiti10)
- CM Caps and Small Caps (cmcsc10)
- CM Dunhill (cmdunh10)
- CM Funny Roman (cmff10)
- CM Fibonacci (cmfib8)
- CM Italic Typewriter (cmitt10)
- CM Roman (cmr5, cmr6, cmr7, cmr8, cmr9, cmr10, cmr12, cmr17)
- CM Slanted (cmsl8, cmsl9, cmsl10, cmsl12)
- CM Slanted Typewriter (cmslitt10)
- CM Sans Serif (cmss8, cmss9, cmss10, cmss12, cmss17)
- CM Sans Serif Bold Extended (cmssbx10)
- CM Sans Serif Demibold Condensed (cmssdc10)
- CM Sans Serif Italic (cmssi8, cmssi9, cmssi10, cmssi12, cmssi17)
- CM Sans Serif Quotation Style (cmssq8)
- CM Sans Serif Quotation Italic Style (cmssqi8)
- CM Typewriter Caps and Small Caps (cmtcsc10)
- CM Typewriter Extended (cmtex8, cmtex9, cmtex10)
- CM Text Italic (cmti7, cmti8, cmti9, cmti10, cmti12)
- CM Typewriter (cmitt8, cmitt9, cmitt10, cmitt12)
- CM Unslanted Text Italic (cmu10)
- CM Variable Typewriter (cmvtt10)
- CM Bold Symbols (cmbsy10)
- CM Inch (cminch)
- CM Math Extension (cmex10)
- CM Math Italic (cmmi5, cmmi6, cmmi7, cmmi8, cmmi9, cmmi10, cmmi12)
- CM Symbols (cmsy5, cmsy6, cmsy7, cmsy8, cmsy9, cmsy10)

`\font\ts=cminch\ts\par {DON'T KNOCK IT, IT WORKS but this bit will not}`

(due to font size, I scaled it down to 20%, it is important to note that for the cminch font in particular the font is strictly uppercase, and commas and apostrophes do not.)

☞ `using \usepackage{pifont}`

☞ seeing the LaTeX companion for a full list of them.

☞ using the LaTeX interface in Xemacs.



```
\begin{dinglist}{43} %Similar to \begin{itemize}
\item using \verb#\usepackage{pifont}#
\item seeing the LaTeX companion for a full list of them.
\item using the LaTeX interface in Xemacs.
\end{dinglist}
```

`\dingline{36}` %creates a line of a repeated dingbat font, in this case
`%dingbat{36}`

3.6 Formatting Text

Formatting	LaTeX code
Paragraphing	Empty line
New line	<code>\\</code>
New line	<code>\newline</code>
New line	<code>\breakline</code>
New page	<code>\newpage</code>
Horizontal Space (2cm)	<code>\hspace*{2cm}</code>
Horizontal Space (2 Characters)	<code>\hspace*{2ex}</code>
Note further options are available for <code>hspace</code> , see a manual for details	
Vertical Space (2cm)	<code>\vspace*{2cm}</code>
Vertical Space (2 Characters)	<code>\vspace*{2ex}</code>
Note further options are available for <code>vspace</code> , see a manual for details	
Spacing between lines	<code>\renewcommand{\baselinestretch}{2.5}</code>
Maths Spacing	
Formatting	LaTeX code
Thin space	<code>\,</code> (backslash comma)
Negative thin space	<code>\!</code>
Medium space	<code>\:</code>
Thick space	<code>\;</code>

Note: If you use `\\` or `\newline` and latex gives an error, saying there is no line here to end, then use `\vspace` instead.

3.7 Itemising

You can itemise information as in the following example

Latex		Output
<pre>\begin{itemize} \item First Item \item Second Item \end{itemize}</pre>	⇒	• First Item • Second Item

See example files at <http://www.math.canterbury.ac.nz/latex.shtml#lesson5>

You can also replace the default item symbol via
`{\renewcommand{\labelitemi}{$\square$}}`

You can also place the itemise environment within another. See a text book for further examples.

3.8 Enumerating

You can number items as in the following example

(see further examples at <http://www.math.canterbury.ac.nz/latex.shtml#lesson6>)

Latex		Output
<pre>\begin{enumerate} \item First Item \item Second Item \end{enumerate}</pre>	⇒	1. First Item 2. Second Item

Latex		Output
<pre>\renewcommand{\theenumi}{\Roman{enumi}} \renewcommand{\labelenumi}{\blue \theenumi} \begin{enumerate} \item First Item \item Second Item \end{enumerate}</pre>	⇒	- I First Item - II Second Item

See a text book for further examples.

4 Including Mathematics

Within LaTeX you can use highly complicated formulas by inclosing them in a mathematics environment. See <http://www.math.canterbury.ac.nz/latex.shtml#lesson7> e.g. In the cases where you want the maths to be on the same line type

$$\boxed{\$ \backslash \mu = n * p \$} \quad \Rightarrow \quad \boxed{\mu = n * p}$$

or

$$\boxed{\backslash (\backslash \mu = n * p \backslash)} \quad \Rightarrow \quad \boxed{\mu = n * p .}$$

And if you wish for the mathematics to be on a separate line type

$$\backslash [\backslash \mu = n * p \backslash]$$

$$\mu = n * p$$

$$\$ \$ \backslash \mu = n * p \$ \$$$

$$\mu = n * p$$

The full list of mathematical operations is contained within the manuals, in general you will find that all commands tend to be logical in their names e.g α is `$\alpha$`, β is `$\beta$` and so on. An example of the mathematics capabilities is as follows.

$$\backslash [\backslash \lim_{n \rightarrow \infty} \backslash \int_0^t \backslash \beta \sum_{i=1}^n \frac{\alpha_n * (x+1)^n}{\sqrt{y-1}} dx \backslash \leq \backslash \int_0^t \backslash \tau \frac{(x-1)}{\sqrt{y+1}} dx, \backslash \text{forall } x \backslash \text{in } \backslash \{ \backslash \gamma, \backslash \Omega \} \backslash]$$

$$\lim_{n \rightarrow \infty} \int_0^t \beta \sum_{i=1}^n \frac{\alpha_n * (x+1)^n}{\sqrt{y-1}} dx \leq \int_0^t \tau \frac{(x-1)}{\sqrt{y+1}} dx, \forall x \in \{\gamma, \Omega\}$$

When using xemacs in writing your latex file, you will find a collection of greek letters on the right side of the window as shown on the right. Clicking on the top icon allows you access to further collections of icons all of which you can click and have the corresponding latex code appear in your document. This will save you having to remember them all initially.



4.1 Sample Array

Arrays are considered as mathematics hence they must be within a mathematics mode environment e.g. between `\[ \]`

```
\[
\begin{array}{|lcr|}
\hline
123.45 & 123.45 & 123.45 & 123 & 45 \\
5.6 & 5.6 & 5.6 & 5 & 6 \\
\hline
\end{array}
\]
```

123.45	123.45	123.45	123.45
5.6	5.6	5.6	5.6

Note: `{|lcr|}` is broken down into

- `|`, indicates a vertical line on the left side of the array, if this had been omitted there would be no line on the left side of the array.
- `l`, indicates that you want a column and it is to be left justified.
- `c`, indicates that you want a column and it is to be centred.
- `r`, indicates that you want a column and it is to be right justified.
- `|`, indicates a vertical line on the right side of the array, if this had been omitted there would be no line on the right side of the array.

In addition extra `|` may have been added between the columns, for instance `{|l|c|r|}`. Should you wish to alter the height of the rows of the array, use either `\def\arraystretch{1.5}` `\setlength{\extrarowheight}{5mm}`.

The `\hline` provides the horizontal lines.

4.2 Sample Equation

```
\begin{equation}
e^{i*pi}+1=0
\end{equation}
```

$$e^{i*pi} + 1 = 0 \quad (1)$$

Note: The equation is automatically numbered. To remove the numbering you must use `equation*`, and change the start of your document to

```
\documentclass[12pt]{article}
\usepackage{amsmath}
```

Note: The `usepackage` statement allows you to add additional macros to the existing latex set. You can add more as long as they don't conflict.

4.3 Sample Equation Array

```
\begin{eqnarray}
F(X_{2}|X_{1}) & = & \frac{SSR(X_{2}|X_{1})}{MSE(X_{1},X_{2})} \\
& & \nonumber \\
F(X_{3}|X_{1},X_{2}) & = & \frac{SSR(X_{3}|X_{1},X_{2})}{MSE(X_{1},X_{2},X_{3})}
\end{eqnarray}
```

$$F(X_2|X_1) = \frac{SSR(X_2|X_1)}{MSE(X_1, X_2)} \quad (2)$$

$$F(X_3|X_1, X_2) = \frac{SSR(X_3|X_1, X_2)}{MSE(X_1, X_2, X_3)} \quad (3)$$

The eqnarray is in three parts separated by &'s, and each line finished via a \\. The “& & \nonumber \\” is to give more of a gap between the two equations. Note: The \nonumber just before the \\ suppresses the numbering.

5 Cases

For situations like the below

Latex
<pre>\[f(x) = \begin{cases} sin(x), & \text{if } 0 \leq x \leq \pi \\ cos(x), & \text{if } \pi < x \leq 2 * \pi \\ \end{cases} \]</pre>



Output
$f(x) = \begin{cases} \sin(x), & \text{if } 0 \leq x \leq \pi \\ \cos(x), & \text{if } \pi < x \leq 2 * \pi \end{cases}$

6 Tables

It should be noted that tables are primarily for letters and words, and although mathematics can be included arrays are more suited to this purpose.

6.1 Simple Table

To start off with, we will look at a simple unlined table

Latex		Output
<code>\begin{tabular}{lcr}</code>		
<code>left & centred & right \\</code>		
<code>alignment & alignment & alignment</code>		
<code>\end{tabular}</code>		

⇒

left	centred	right
alignment	alignment	alignment

Note `{lcr}` informs LaTeX that you wish to have three columns, with the first left justified (l), the second centred (c), and the third right justified (r). The `&` between the items informs LaTeX where the border is between columns whilst the `\\` informs LaTeX that you wish to start a new row.

Now to look at a more complicated table where use is made of borders, spacing and special formatting.

Universities		
North Island:	Auckland Massey Victoria Waikato	City - Auckland City - Palmerston North City - Wellington City - Waikato
South Island	Canterbury Lincoln Otago	City - Christchurch City - Christchurch City - Dunedin

The complete program is not listed here due to its size, but an explanation of the key points are mentioned below, and the complete program can be down loaded as sample file `??`. Should you wish to know more details consult the LaTeX reference guides mentioned at the start of this chapter. Note this is to show you what latex can do, most people just stick to simple tables.

1 Specifying of colour in tables

There are two methods you can use, one is easier to use but depends on your printer driver being supported by `pstricks` (all the department printers are) and does not work with all table packages, while the second is not so easy but is supported by all printers and is compatible with other table packages. The first

is called colortab see page 14 the second called colortbl, has documentation available online in colortbl.dvi, found in the directory /usr/local/tex/texmf/doclatex/carlisle or from the book “The Latex Graphics Companion” by Goossens, Rahtz and Mittelbach, which gives a number of examples.

2 Selecting multiple columns

If you want to span something over more than one column, then use the multicolumn command, e.g. if you want to span something over three columns you can do that via `\multicolumn{3}{c}{Large title}`. See a manual for more details.

3 Inserting { within a table

This was done by having a tabular within another, and via the use of the delimiter `\{` (see a manual for a complete list of delimiters)

`$ \left\{ \begin{array}{l} x \\ y \end{array} \right\}`

$$\left\{ \begin{array}{l} x \\ y \end{array} \right\}$$

Not all options have been covered here, the reference guides will show you more.

6.2 Shading Areas (using pstricks)

You can make any area become shaded one colour as in the following example where I shade the area enclosing a table

```
\[\psframebox[fillstyle=solid,fillcolor=lightgray]{
\begin{array}{|c|c|c|c|}
\hline
\multicolumn{4}{|c|}{\mbox{\large \textbf{Table of Statistics}}}\ \\
\hline
& \textbf{A} & \textbf{B} & \textbf{C} \\
\hline
\textbf{Mean} & 15.25 & 13.55 & 16.63 \\
\hline
\textbf{Std} & 12.54 & 17.4 & 10.36 \\
\hline
\textbf{Minimum} & 0 & 0 & 0.57 \\
\hline
\textbf{Maximum} & 33.63 & 45.6 & 35.22 \\
\hline
\end{array}}
\]
```

Table of Statistics			
	A	B	C
Mean	15.25	13.55	16.63
Std	12.54	17.4	10.36
Minimum	0	0	0.57
Maximum	33.63	45.6	35.22

You can also create a table with each cell shaded according to your desires. First you will need to add **colortab** to your `\usepackage` statement, then you need to include within your LaTeX file definitions for the various shadings.

e.g.

```
\newgray{wh}{1} % white
\newgray{lg}{0.9} % light gray
\newgray{lmg}{0.8} % light-medium gray
\newgray{mg}{0.7} % medium gray
```

```
\newgray{mdg}{0.6} % medium-dark gray
\newgray{dg}{0.5}  % dark gray
```

As you can guess the closer the number is to 1, the lighter the colour, and the closer the number is towards 0, the darker the colour.

One can produce a multi-shaded table like the one below

White	Light Gray
Light Medium Gray	Medium Gray
Medium Dark Gray	Dark Gray

see the sample file ??

The table just has the additions of

```
\LCC
  \mdg  & \dg  \\
... & ...  \\
\ECC
```

around the rows of the tables

6.3 Inserting a multi-page Table

To insert a multiple page table you must firstly include

```
\usepackage{longtable}
```

then within the document

```
\begin{longtable}[c]{|l|c|c|}\hline
```

You can insert a title on your first page which differs from subsequent pages via

```
\hline \multicolumn{3}{|c|}{\large \textbf{Maths and Stats Dept}}\\
\hline \\ \textbf{Lecturer}&\textbf{Room}&\textbf{Extension}\\
\hline \endfirsthead
```

Next you may wish to define a heading which will appear at the top of the tables on each page, if so then you must place it before the main body of the table, and it needs to be of the form

```
\hline \textbf{Lecturer}&\textbf{Room}&\textbf{Extension}\\
\hline \endhead
```

Your heading can be for more than one row. If for example you want two rows then just add `\endhead` at the end of the second row and not at the end of the first row.

Similarly you can add rows to the bottom of the table on each page via

```
\multicolumn{3}{|l|}{\textbf{(*) = Stats, ($\ddagger$) = bio}}\\
```

```
\hline \endfoot
```

There is a `\endlastfoot` command which works similar to `\endfirsthead`

You then include the table itself in the standard format and then end with a `\end{longtable}` command. To force a table break, just insert `\newpage` at the place in the table you wish to break.

Note: `longtable` is for tables that are multi-page lengthwise, not widthwise.

Note: You may have to LaTeX more than once to get your `longtable` looking correct, this is similar to when making a contents file.

7 Formating the Document

7.1 Adding a Table of Contents

To prepare a contents page include the command `\tableofcontents`. This will create a file called `filename.aux`, so for instance with this documentation the file is called `guide2.aux`, which is due the the LaTeX file being called `guide2.tex`. Examining the file `guide2.aux`, one finds

```
\relax
\@writefile{toc}{\contentsline {section}{\numberline {1}INTRODUCTION}{1}}
\@writefile{toc}{\contentsline {section}{\numberline {2}WORD PROCESSING}{1}}
e.t.c.
```

When you run latex it will first search for a `.aux` file, use it to create a contents page and at the same time examine the LaTeX file and create a new `.aux` file. Hence in general you will have to run LaTeX twice before the table of contents will appear.

7.2 Adding an Index or Glossary

For indexing include a `\makeindex` statement before your `\begin{document}`, create your items for your index by the use of a `\index{item}` command, e.g. `factorials\index{factorials}`, now run LaTeX and a file `index.idx` will appear. This file needs to be converted into a different format which one achieves by typing **makeindex filename** e.g. for this document I typed **makeindex guide2** this will create the file `guide2.ind`. The file with the `.ind` suffix you will then include into your document with something of the form

```
\newpage
\input{guide2.ind}
```

Note: For Glossaries replace `index` with `glossary`, as the syntax is the same.

7.3 Sections

To start a new section type `\section{ the section title }`. Similar you can create subsections with `\subsection{Some title}` and subsubsections with `\subsubsection{Some title}`

7.4 Chapters

Chapters are not available in article style, but you can use them in report style. e.g.

```
\documentclass[12pt]{report}
\begin{document}
\tableofcontents
\chapter{Introduction}
```

```
Some text
\section{The Achievements of Mary Harding}
Some further text
e.t.c
\end{document}
```

This will result in the following

Contents

Introduction

1.1 The Achievements of Mary Harding . 1

Chapter 1

Introduction

Some text

The Achievements of Mary Harding

Some more text

7.5 Abstract and Acknowledgements

These can be placed as you would any text.

7.6 Appendix

To add appendices one only needs to do the following

```
\addcontentsline{toc}{section}{\LARGE \textbf{Appendices}}
\appendix
\section{Roads Travelled on Routes}
\section{Riccarton Road}
Gosh what a busy road.
```

Note: When inserting LaTeX commands within an `\addcontentsline`, a `\protect` statement may need to be inserted.

Note: You can modify the format of the appendix label but that may require constant modification of the .aux file.

e.g. `\renewcommand{\thesection}{Appendix \protect\hspace*{4cm} \thesection}` which may look great in the contents page but will look odd on the page the appendix is on.

7.7 Bibliography

When creating a bibliography there are several steps

- 1 Create a file (e.g. mybooks) containing your references in the format below

```
@book      {regress,
author     = {David G. Kleinbaum, Lawrence L. Kupper,
              Keith E. Muller},
year      = {1992},
title     = {Applied Regression Analysis and Other
              Multivariate Methods},
series    = {},
volume    = {},
publisher = {PWS-KENT Publishing Company},
address   = {},
note      = {Second Edition}
}
```

```
@mastersthesis {alistairswork,
author          = {Alistair K. Storm},
title           = {Computational Techniques for Polynomial
                  and Linear Regression},
school          = {Canterbury University},
year            = {1982}
}
```

Where the first line contains the type of reference e.g. book, mastersthesis, Article, phdthesis. (for further types of references see a manual. The second part of the line is the reference name, e.g. regress, alistairswork. This is so that we can distinguish it from other references. The rest of the labels should be self explanatory.

Note: the labels vary according to the type of reference, so consult a manual if unsure.

- 2 Insert the references in your document in the form
see page 3 Ref. `\cite{alistairswork}`
- 3 At the point you wish your bibliography to occur specify your bibtex file as per above i.e. "mybooks"
`\bibliography{mybooks}`
- 4 Just below add the style you wish your bibliography to be in, e.g. plain. For other styles see a manual. `\bibliographystyle{plain}`
- 5 Now you must run LaTeX, i.e. `latex yourfile.tex`
- 6 Now you must run bibtex, i.e. `bibtex yourfile.tex`
- 7 Then rerun LaTeX.

7.8 Page Numbering

Page numbering requires you specifying what type of numbering you want for the pages e.g.

`\pagenumbering{roman}` - Gives you roman digits (I, II, III,...)

`\pagenumbering{arabic}` - Gives you arabic digits (1, 2, 3,...)

And which page number less 1 that you wish to start at.

`\setcounter{page}{0}`

7.9 Headers

To create a header specify the page style you want e.g.

`\pagestyle{myheadings}`

And what you want included in the header e.g.

`\markright{Guide to Utilities (created on \today)}`

When double siding your pages you can use

`\pagestyle{myheadings}`

`\markboth{Left header}{right header}`

7.10 Footers

When adding a footer (generally frowned upon when doing a Thesis), find the portion of text and add a footnote statement. e.g. *the Wizard and his Staff*⁴

`\textit{the Wizard and his Staff}\footnote{A long bent thing ...}}`

7.11 Pagestyles

`\pagestyle{empty}` - No page numbers

`\pagestyle{plain}` - The default.

`\pagestyle{myheadings}` - Used when including headers

⁴A long bent thing with a sort of lump on the end

7.12 Page Referencing

There are two parts to page referencing,

- 1 Label what you want to refer to.
e.g. *It was Bill Cosby's Birthday*
It was Bill Cosby's Birthday `\label{Birthday}`
- 2 Then you have your reference using that label.
e.g. *Whose birthday is 12th July? Answer see page 19*
Whose birthday is 12th July?
Answer see page `\pageref{Birthday}`

8 Including Pictures

Before you can include a picture the file must be generic postscript format, unless you import your file from Microsoft or from an outside source, you will find all our postscript to be generic.

Packages like matlab allow you print to several types of postscript files, the one you will want is encapsulated postscript so in matlab you would type

```
print -deps filename.ps
```

Some software packages either store the postscript as a compact image (desirable) or as an image on an A4 page (undesireable), this you will need to keep in mind. There are several ways of importing postscript into your files, we will only look at one method, that being using `\usepackage{pstcol,graphicx}`



```
% Note must have \usepackage{pstcol,graphicx} at the
% beginning of the document.
\begin{pspicture}(0,0)(6cm,6cm) % This specifies the boundary for the
                                % picture environment with the (0,0)
                                % indicating the bottom left
                                % corner and the (6,6) indicating
                                % the top right corner
\rput(3,3){\includegraphics[height=6cm]{view1.ps}}
                                % The \rput(3,3) specifies where you
                                % wish the centre of the picture to
                                % lie within the boundaries. The
                                % [height=6cm] specifies the height you
                                % wish the picture to be, the width is
                                % then scaled accordingly, you can
                                % similarly specify only the width and
                                % the height will then be scaled
                                % accordingly. {view1.ps} specifies the
                                % name of the postscript file you
                                % wish to include.
\end{pspicture}
```

You can also stretch pictures via specifying widths as well as heights.

You can also take a sub-portion of a picture by reducing the size of the boundaries and replacing `pspicture` with `pspicture*`, i.e.

```
\begin{pspicture*}(2,2.5)(4,4.6)
\rput(3,3){\includegraphics[height=6cm]{view1.ps}}
\end{pspicture*}
```



8.1 Inclusion of colour photos

Whenever possible reduce it down to grayscale. But should you wish to have them in full colour be aware that to get good quality printing one needs about 300 dpi which for a 10cm wide image translates to around 7 megabytes. As your disk quota is limited, use one of the scratch areas for your photos. An easier alternative is to just leave a gap in your document and take the pages and photos to the library where they will copy them on for you. Should you be determined to proceed with the postscript option you can either print them using our colour printer, or take them elsewhere on a zip disk or CD, they will not fit on a floppy.

8.2 Using the figure environment

The figure environment is designed for easy adding of captions, the down side is that frequently your graphic is placed where it wants rather than where you. The alternative is that you insert all your own captions manually. But the syntax is as

```
\documentclass[12pt]{article}
\usepackage{graphicx}
\begin{document}
\begin{figure}[h]
\includegraphics[width=6cm]{normalcurve.ps}
\caption{This is a caption}
\end{figure}
\end{document}
```

8.3 Hints about tables and figures in LaTeX

Moving tables and figures in LaTeX (adapted from the TeX Users Group FAQ by Donald Arseneau, Piet van Oostrum et al from comp.text.tex)

Tables and figures have a tendency to surprise, by floating away from where they were specified to appear. This is in fact perfectly ordinary document design; any professional typesetting package will float figures and tables to where they'll fit without violating the certain typographic rules. Even if you use the placement specifier h for 'here', the figure or table will not be printed 'here' if doing so would break the rules. LaTeX uses the following order of tests until a placement is found. themselves are pretty simple,

- 1 If ! is specified, ignore most restrictions as described above and continue.
- 2 If h is specified, try to place the float at the exact position. If this fails and no other position was specified, change the specifier to t (for a possible placement on the next page).
- 3 If t is specified, try to place it on the top of current page.
- 4 If b is specified, try to place it on the bottom of the current page (or column) has ended.
- 5 If p is specified, try to place it on a float page (or float column) when the current page (or column) has ended.

- 6 Stage 3 and 4 are repeated if necessary at the beginning of each subsequent page, followed by 5 at its end.

In the worst case, LaTeX's rules can cause the floating items to pile up to the extent that you get an error message saying "Too many unprocessed floats"; this means that the limited set of registers in which LaTeX stores floating items is full. What follows is a simple checklist of things to do to solve these problems (the checklist talks throughout about figures, but applies equally well to tables).

- Are the placement parameters on your figures right? The default (tbp) is reasonable; you should never simply say 'h', for example, since that says "if it can't go here, it can't go anywhere", and as a result all subsequent floats pile up behind it.
- Can you perhaps prevent your figures from floating by adjusting LaTeX's placement parameters? Again, the defaults are reasonable, but can be overridden in case of problems.
- There is an additional parameter [H] which comes with the floats package which really forces the figure to appear next, but this could result in the figure appearing on the bottom of the next page and the figure after appearing above it, so do check.
- Are there places in your document where you could 'naturally' put a `\clearpage` command? If so, do: the backlog of floats is cleared after a `\clearpage`. (Note that the `\chapter` command implicitly executes `\clearpage`, so you can't float past the end of a chapter.)
- To clear the backlog, but not cause an ugly gap, use the LaTeX afterpage package (fragile but improving). i.e. `\afterpage{\clearpage}`. This will result in the current page being filled with text as usual, but then a `\clearpage` command will flush out all the floats before the next text will begin.
- You may find when using the command [H] that you meant "somewhere close" instead of "here". This can be achieved by `\afterpage{\clearpage\begin{figure}[H]...\end{figure}}` This ensures that the figure appears at the top of the next page. (The `\clearpage` stops any other figures drifting past the [H] figure).
- As a last resort, try the package morefloats; this 'simply' increases the number of floating inserts that LaTeX can handle at one time (from 18 to 36), but that may suit your needs.
- If you actually wanted all your figures to float to the end (e.g., for submitting a draft copy of a paper), don't rely on LaTeX's mechanism: get the package endfloat to do the job for you.

By default, LaTeX only allows up to 3 floats taking up to 0.7 of the page to be on a page with text. There are no such limits on figures placed on a 'float page' (a page with floats but no regular text), but LaTeX will not create a float page unless it can cover half of it with floats. This behaviour can be changed by placing lines like the following before `\begin{document}`

```
\renewcommand\floatpagefraction{.9}
\renewcommand\topfraction{.9}
\renewcommand\bottomfraction{.9}
\renewcommand\textfraction{.1}
\setcounter{totalnumber}{50}
\setcounter{topnumber}{50}
\setcounter{bottomnumber}{50}
```

The following variables control the vertical spacing with figures

```
\floatsep    separation between floats on a page with text
\intextsep    separation between floats and the text
```

plus the hidden parameters for float pages:

```
\@fptop    space at top of float page
\@fpbot    space at bottom of float page
\@fpsep    space between floats on a float page
```

The vertical space between a graphic and the caption below it is `\abovecaptionskip` (10pt default) and the vertical space below a caption is `\belowcaptionskip` (0pt).

8.4 The Subfigure Environment

To handle the situation where you have subfigures i.e. figure 1a, 1b etc, the subfigure environment is set up to handle it.

```
\documentclass[12pt]{article}
\usepackage{graphicx,subfigure}
\begin{document}
\begin{figure}[h]
\begin{center}
\subfigure[Roo]{\begin{pspicture}(0,0)(5,5)
{\scalebox{0.5}{\Kangaroo{red}}}\end{pspicture}}
\subfigure[Kanga]{\Kangaroo{blue}}
\end{center}
\caption{The Kangaroos of A. A. Milne}
\end{figure}
\end{document}
```

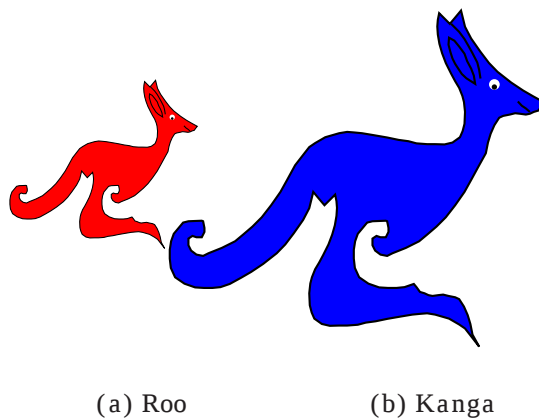


Figure 1: The Kangaroos of A. A. Milne

9 Making Slides (Overheads)

When preparing overheads you can either specify for yourself the font-size you would like, or use the slide class in LaTeX. The files will need to be of the form

```
\documentclass[10pt]{slides}
\begin{document}
{\setcounter{slide}{0}} % Sets first slide to be numbered slide 1.
\begin{slide}
This is your first slide
\end{slide}
\begin{slide}
This is the second slide
\end{slide}
\end{document}
```

The slide class automatically centres your text and pictures on the page, and increases the size of the font to the right size. The `\begin{slide} \end{slide}` is for creating separately numbered slides, and if one slide has too much on it, the text etc. will flow on to a new page but with the same slide number.

Whenever you include graphics in, try and have the fonts on your graphs the same size as the text. This can be done in matlab by typing `set(gca,'fontsize',20)`, where `gca` is the current axis. This you must type after the first plot, and before any subsequent plots or legends. If adding additional text to the graph, you must specify the fontsize as part of the command e.g. `text(0,0,'Spon','fontsize',20)`. In matlab you can also adjust the line thickness via `plot(x,y,'linewidth',2)`. With other packages there are similar means of adjusting the font size, if you only have the postscript file, then `psfrag` detailed elsewhere in this booklet should be able to help you.

10 Scaling anything (using pstricks)

10.1 Scaling to a specific size

You can also create your own sizes as in the following example
For width of 6cm and height 0.5cm

Height at 0.5cm and rest scaled accordingly

```
\scaleboxto(6,0.5){For width of 6cm and height 0.5cm} \\
\scaleboxto(0,0.5){Height at 0.5cm and rest scaled accordingly}
```

Or should you wish to create a pretty picture



```
\documentclass[12pt]{article}
\usepackage{pstricks,amssymb}
\begin{document}
\unitlength=1cm
\scaleboxto(2,0){
\KillGlue
\pspicture*(0,0)(5,5)
\psset{xunit=1cm}
\psset{yunit=1cm}
\rput(2.5,2.5){\scaleboxto(5,0){$\bigstar$}}
\rput(2,3){\white \scaleboxto(0,.25){$\backsim$}}
\rput(3,3){\white \scaleboxto(0,.25){$\backsim$}}
\rput(2.5,1.75){\white \scaleboxto(1,0.5){$\smallsmile$}}
\rput(2,2.5){\white \scaleboxto(1,0.5){$\circleddash$}}
\rput(3,2.5){\white \scaleboxto(1,0.5){$\circledcirc$}}
\endpspicture
\Don'tKillGlue
\end{document}
```

10.2 Scaling objects by a fixed factor

To scale anything by a fixed factor use the command `\scalebox`
 e.g.1 `\scalebox{2}{This is scaled by a factor of 2}`

This is scaled by a factor of 2

e.g.2 `\scalebox{0.5}{This is scaled by a factor of 0.5}`

This is scaled by a factor of 0.5

11 Surrounding Pictures with Text

You must put `\usepackage{graphicx,picinpar}` before the `\begin{document}` statement. The first line starts with a begin statement, then after the square brackets you must specify how many lines you wish to include the picture, in this case 2. Next you must specify the horizontal position you wish the picture to be at c(centred), l(left), or r(right). Follow this with an include graphics statement, insert your text and finish it with an end statement.

```
\begin{figwindow}[2,r,%
{\includegraphics[width=6cm,height=4cm]{colbuild.ps}},%
{Our Building}]
While mathematics and statistics are enjoyable and interesting
\linebreak subjects, they also have many important
...
and statistics to advanced fourth year courses in exciting new
\end{figwindow}
```

While mathematics and statistics are enjoyable and interesting subjects, they also have many important practical applications. These are not limited to engineers and scientists. There is in

fact, much in mathematics and statistics to interest a wide range of students. If you enjoyed these subjects at school then no matter what degree you are thinking of taking, they will have something to offer you.

At Canterbury, the Department of Mathematics and Statistics offers a wide variety and choice of courses, ranging from core level 100 papers in algebra, calculus and statistics to advanced fourth year courses in exciting new areas



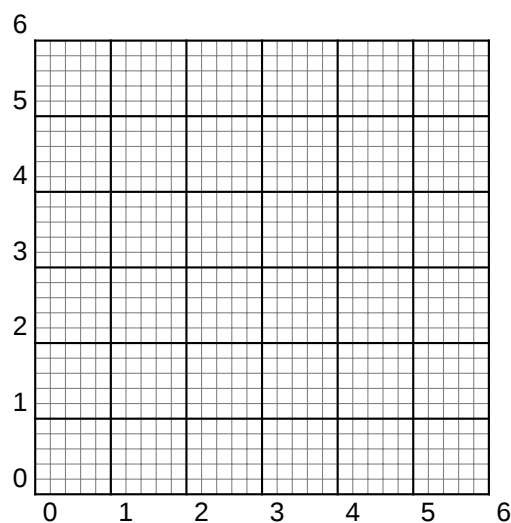
Figure 2: Our Building

12 Pstricks

Pstricks is a collection of tools for producing graphics

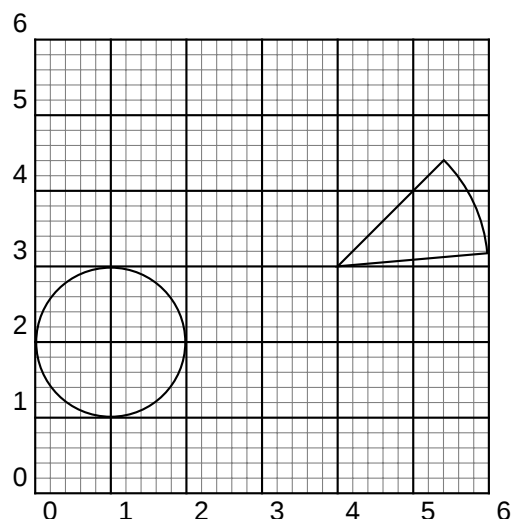
Start off by specifying the area you wish to use (default units are cm) and insert a grid (psgrid)

```
\begin{pspicture}(0,0)(6,6) \psgrid
\end{pspicture}
```

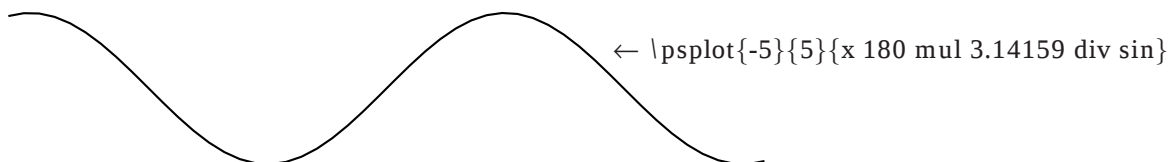


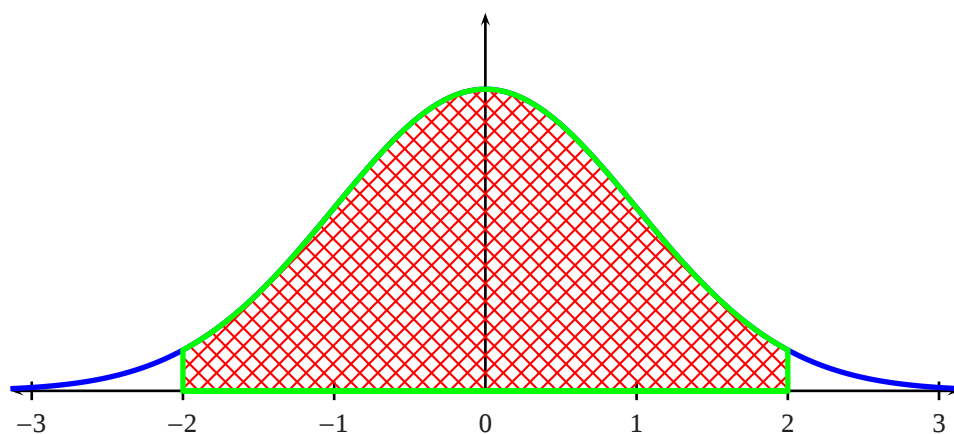
Now you can specify points where you wish to place objects

```
\begin{pspicture}(0,0)(6,6) \psgrid
\rput(1,2){\pscircle{1}}
\rput(4,3){\pswedge{2}{5}{45}}
\end{pspicture}
```



Using the psplot utility you can plot graphs using reverse polish notation





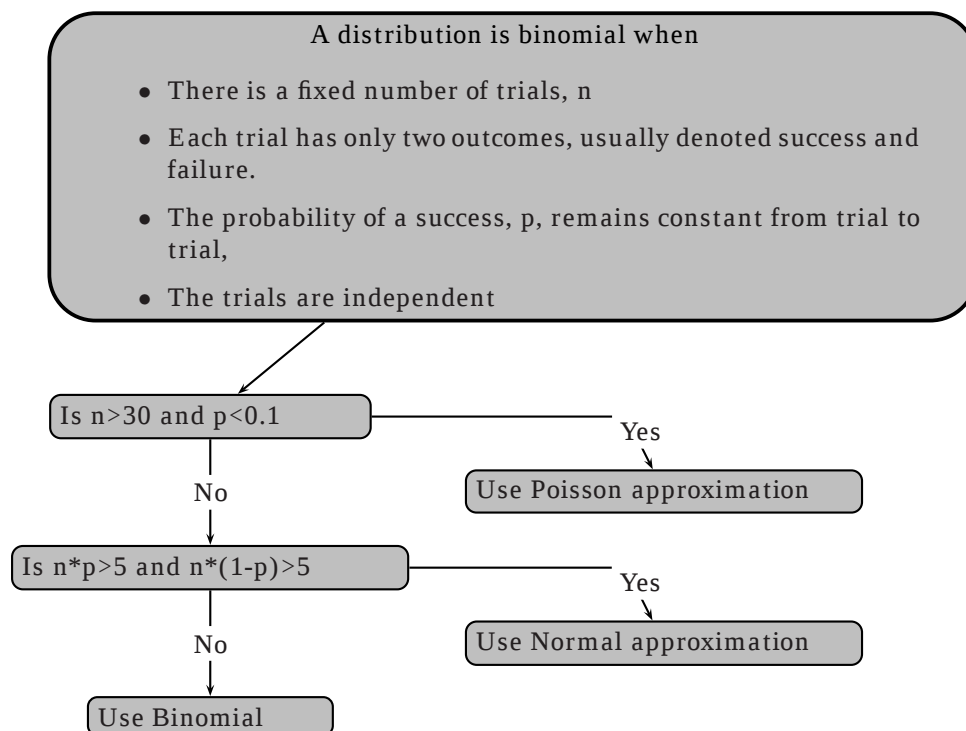
```

\radians
\psset{xunit=2cm,yunit=10cm,plotpoints=200}
\begin{pspicture}(-3.1415,0)(3.1415,0.5)
\psaxes[linewidth=1pt]{<->}(0,0)(-3.14,0)(3.14,0.5)
\psplot[linecolor=blue,linewidth=2pt]{-3.1415}{3.1415}{2.71828 x dup
mul neg 2 div exp 2 3.1415 mul sqrt div}
\pscustom[fillstyle=crosshatch,hatchcolor=red,linecolor=green,linewidth=2pt]{
\psline(2,0)(-2,0)
\psplot[linecolor=blue,linewidth=2pt]{-2}{2}{2.71828 x dup mul neg 2 div
exp 2 3.1415 mul sqrt div}
\psline(2,0)(-2,0)}
\end{pspicture}

```

12.1 Flow Charts

Including `pstricks` and `pst-node` in your `\usepackage{}` statement allows you to create nice flow charts such as the one below.



A simple example is

```

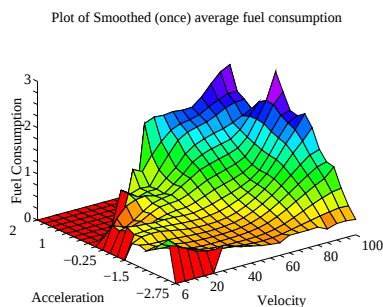
\lput(3cm, -8cm){\rnode{X}{\psframebox{Study}}} % Specifies that "Study"
                                                    % is to be surrounded by a box
                                                    % and placed at (3cm, -8cm) along
                                                    % from the pencil to the
                                                    % centre of "Study".
\lput(7, -6.7){\ovalnode{Y}{Pass Test}} % Specifies that "Pass Test"
                                                    % is to be surrounded by a
                                                    % circular node and placed
                                                    % at (7, -6.7) along from
                                                    % pencil to the centre of
                                                    % Pass Test.
\ncurve[angleB=180]{->}{X}{Y} % Specifies that there is to
                                % be a curve between X and Y
                                % such that the curve touches
                                % node Y at 180 degrees. The
                                % {->} signifies that you
                                % which to include an arrow.
                                % Specifies to put "Yes"
                                % within the line.
\lput*{0}{Yes}
Study -- Yes --> Pass Test
  
```

The diagram shows a rectangular box labeled "Study" at the bottom left. An arrow points from the right side of the box to an oval labeled "Pass Test" located at the top right. The arrow is labeled "Yes" above it.

13 PSFRAG

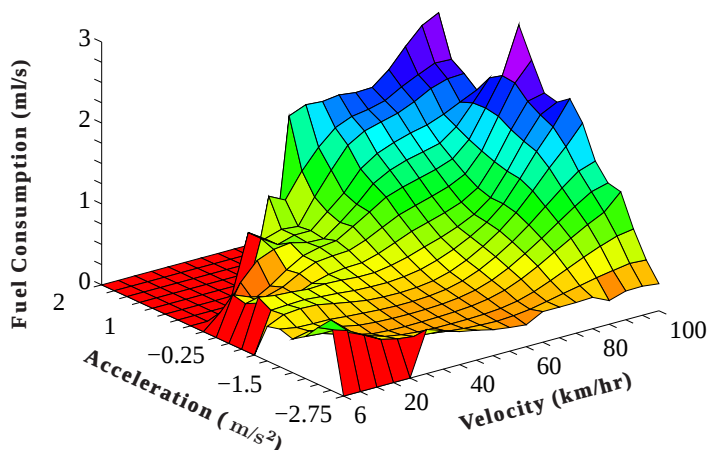
Psfrag is a program that allows you to modify the text in existing postscript pictures. The documentation for this package can be found in “/usr/local/tex/texmf/doc/latex/psfrag”. You must add to your `\usepackage{}` psfrag and you can then modify the existing text in your postscript to produce transformations as illustrated below, the corresponding LaTeX code follows

The Original Picture



The Modified Picture

Plot of Smoothed (once) average fuel consumption



```
\documentclass[12pt]{article}
\usepackage{graphicx,psfrag}
\begin{document}
\pspicture*(0,0)(17,8)
\rput(4,4){\includegraphics[height=4cm]{mesh.eps}} % ORIGINAL PICTURE
\psfrag{Acceleration}[b][br][0.8][335]{\begin{minipage}[h]{5cm}
{\textbf{Acceleration (} {\mathbf{m/s}}^2{\mathbf{)}}} \end{minipage}}
\psfrag{Velocity}[b][t][0.8][15]{\begin{minipage}[h]{5cm}{\hspace*{1.25cm}}
{Velocity (km/hr)} \end{minipage}}
\psfrag{Plot of Smoothed (once) average fuel consumption}[b][t][1][0]
{{Plot of Smoothed average fuel consumption}}
\psfrag{Fuel Consumption}[b][t][0.8]{\begin{minipage}[h]{5cm}
{\vspace*{-1cm} Fuel Consumption (ml/s)}
\end{minipage}}
\rput(12,4){\includegraphics[height=7cm]{mesh.eps}} % MODIFIED PICTURE
\end{document}
```

A psfrag statement consists of 5 parts. Part 1 is the text you want to modify, part 2 is the position of existing text, part 3 is the position of the modified text, part 4 is the angle of the modified text, and part 5 is the modified text.

14 Thesis Requirements

14.1 Page Borders

The spacing around your text on the page by latex has by default odd page left margin of 3cm, an even page left margin of 4.5cm and a top margin of 4.5cm. To obtain the required margins for a thesis include before your “\begin{document}”

```
\documentclass[12pt]{article}
\usepackage{postscript,twoside}
\setlength{\textwidth}{16.2cm}
\setlength{\textheight}{24.4cm}
\setlength{\oddsidemargin}{0cm}
\setlength{\evensidemargin}{-0.5cm}
\topmargin -0.5cm \headsep 1.3cm
```

14.2 Page numbering etc.

```
\markboth{Left header}{right header}
e.g. \markboth{\thesection}{\thesubsection}
```

14.3 Title page

```
\begin{titlepage}
\begin{center}
{\large \textbf{
University of Canterbury\\
Department of Mathematics and Statistics}}
\end{center}
\includegraphics[width=3cm]{coat1.ps}
\begin{center}
{\LARGE \textbf{ Fuel Consumption Models}} \\\
{\LARGE \textbf{ for Traffic Modelling by}} \\\
{\LARGE \textbf{ the Canterbury Regional Council}} \\\
\end{center}
\begin{center}
\textbf{
\rule[1ex]{6cm}{1pt} \\\
A thesis submitted in\\
partial fulfilment\\
of the requirements of\\
the Degree for\\
Master of Science in Statistics\\
at the\\
University of Canterbury\\
by\\
Julian Silvester Visch\\
\rule[1ex]{6cm}{1pt} \\\
Supervisor: Dr Easaw Chacko\\
1995}
\end{center}
\end{titlepage}
```

15 Latexing in Parts

With a large paper or thesis one can break it down into parts

e.g.

```
\documentclass[12pt]{article}
\usepackage{postscript,twoside}
\setlength{\textwidth}{16.2cm}
\setlength{\textheight}{24.4cm}
\setlength{\oddsidemargin}{0cm}
\setlength{\evensidemargin}{-0.5cm}
\topmargin -0.5cm \headsep 1.3cm
\includeonly{introduction,conclusion}
\begin{document}
\include{title}
\tableofcontents
\include{introduction}
\include{section1}
\include{section2}
\include{section3}
\include{conclusion}
\end{document}
```

introduction.tex

This is the introduction, note there is no documentclass or begin document statement as these are all present in the master file, the same goes for the end document statement. The introduction is just a chapter literally cut and pasted into a new file. This will make reading easier as well as processing as one can process all or a selection via the \includeonly statement.

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