2.3 LaTeX exercises to try on your own

The answers to these exercises are in the next section.

Please download these two files for use in these exercises. Browse to **http://www.stats.ox.ac.uk/pub/susan/cdt** and save the two files

- `small.tex`
- `test.bib`

in your home directory. To be really organised you could create a new directory to keep them in.

The following exercises are designed to show many features of LaTeX. If possible try to do at least the following

- Exercises 1–6 on simple text typesetting.
- Some of the maths exercises.
- Exercise 41 on cross references
- Finally have a look at Section 2.3.4 on page 18 for how to includes graphs and images in documents.

Load `small.tex` into Texmaker. Remember that you should save the document and click on the green typeset button 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` option `12pt` to `11pt`
3. Add `\usepackage{parskip}` to the preamble. How does the paragraph formatting change?
4. Add `\usepackage{mathptmx}` to the preamble. The font should now look different as you are now using Times Roman.
5. Swap the emphasised and bold text.

2.3.1 Typesetting Text

▷ Exercise 1 We will now typeset some simple sentences. You should have a copy of *The Not So Short Introduction to LaTeX2e* which we will be using for reference for the rest of these exercises. Chapter 2 *Typesetting Text* is particularly helpful and Section 2.5, 'Helpful Hints' of this document has instructions on how to typeset many characters.

Start a new section in the document. Typeset the following sentences – there are some helpful suggestions just below if you get stuck.

> 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.

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

Does Æschylus understand Œdipus?

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

Élèves, refusez vos leçons! Jetez vos chaînes!

Can you take a ferry from Öland to Åland?

There are several features of LaTeX that are evident here.

hyphens Have you noticed that there are different lengths of hyphen? For example in the first sentence both — and - are used. These are typeset using `---` and `-` respectively.

quotes When typesetting speech make sure that you use `‘‘` and `’’` to produce open and close quotation marks. The `‘` character is usually found at the top lefthand side of the keyboard.

accents The ‘Helpful Hints’ section should help with these.

pounds To typeset the £ symbol use `\pounds`.

Finally, it can seem difficult to decide whether to put a space after a LaTeX command or not. A general rule is that if the command is a single non-alphanumeric then a space is not needed otherwise it is. For example to typeset naïve you need `na\"\i ve`. In this case `\"` puts a double dot (or diaeresis) over the letter “i” and `\i` prints an “i” without a dot like this: ı.

▷ Exercise 2 Give your document a title. You will need to include

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

immediately after `\begin{document}`. To include a table of contents add `\tableofcontents` after the title. You must have at least one section, subsection or chapter for the table of contents to appear. Note that you must run `pdfLaTeX` twice in order for entries in the table of contents to be displayed.

▷ Exercise 3 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.

[See section 2.11.1 of *The Not So Short Introduction to LaTeX2e* for more information about lists.]

▷ Exercise 4 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 5 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

[See section 2.11.6 for information about tables.]

2.3.2 Mathematics

If you will be needing to typeset mathematical formulae then try as many of these exercises as possible. I will be handing out answers at the end of the class.

There are several different ways of typesetting formulae. They can appear "inline" – that is within a paragraph – like this: $C(n,r) = n!/(r!\,(n-r)$ or separately like this:

$$C(n,r) = n!/(r!\,(n-r)!)$$

so the paragraph is broken up. Chapter 3 of *The Not So Short Introduction to LaTeX2e* describes the different ways displaying mathematics. The Helpful Hints document will also be useful for these exercises.

▷ Exercise 6 Typeset the following: $C(n,r) = n!/(r!\,(n-r)!)$. Note the spacing in the denominator.

▷ Exercise 7 Typeset the equation $a + b = c - d = xy = w/z$ as in-line and displayed mathematical text.

▷ Exercise 8 Typeset the equation $(fg)' = f'g + fg'$ as in-line and displayed mathematical text.

▷ Exercise 9 Typeset $\alpha\beta = \gamma + \delta$ as in-line and displayed mathematical text.

▷ Exercise 10 Typeset $\Gamma(n) = (n-1)!$ as in-line and displayed mathematical text.

▷ Exercise 11 Typeset: $x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$.

▷ Exercise 12 Typeset: $2 + 4 + 6 + \cdots + 2n = n(n+1)$.

▷ Exercise 13 Typeset: $\vec{x} \cdot \vec{y} = 0$ if and only if $\vec{x} \perp \vec{y}$.

▷ Exercise 14 Typeset: $\vec{x} \cdot \vec{y} \neq 0$ if and only if $\vec{x} \not\perp \vec{y}$.

▷ Exercise 15 Typeset: $(\forall x \in \mathbb{R})(\exists y \in \mathbb{R})$ such that $y > x$.

▷ Exercise 16 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 17 Typeset: What are the points where $\frac{\partial}{\partial x} f(x,y) = \frac{\partial}{\partial y} f(x,y) = 0$?

▷ Exercise 18 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 19 Typeset: $\nabla^2 f(x,y) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$.

▷ Exercise 20 Typeset the following expression: $\lim_{x \to 0} (1+x)^{\frac{1}{x}} = e$.

▷ Exercise 21 Typeset: The cardinality of $(-\infty, \infty)$ is $\aleph_1$.

▷ Exercise 22 Typeset: $\lim_{x \to 0^+} x^x = 1$.

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

▷ Exercise 23 Typeset the following integral: $\int_0^1 3x^2\,\mathrm{d}x = 1$.

▷ Exercise 24 Typeset the following: $\sqrt{2}$ $\sqrt{\frac{x+y}{x-y}}$ $\sqrt[3]{10}$ $e^{\sqrt{x}}$.

▷ Exercise 25 Typeset: $\|x\| = \sqrt{x \cdot x}$.

▷ Exercise 26 Typeset: $\phi(t) = \frac{1}{\sqrt{2\pi}} \int_0^t e^{-x^2/2}\,\mathrm{d}x$.

▷ Exercise 27 Typeset the following: $\underline{x}$ $\overline{y}$ $\overline{\underline{x+y}}$.

▷ Exercise 28 Typeset $\left\lceil \lfloor x \rfloor \right\rceil \leq \left\lfloor \lceil x \rceil \right\rfloor$.

▷ Exercise 29 Typeset: $\sin(2\theta) = 2\sin\theta\cos\theta$ $\cos(2\theta) = 2\cos^2\theta - 1$.

▷ Exercise 30 Typeset:

$$\int \csc^2 x\,\mathrm{d}x = -\cot x + C \qquad \lim_{\alpha \to 0} \frac{\sin\alpha}{\alpha} = 1 \qquad \lim_{\alpha \to \infty} \frac{\sin\alpha}{\alpha} = 0.$$

▷ Exercise 31 Typeset:

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

▷ Exercise 32 Typeset:

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

▷ Exercise 33 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 $M(t) = \exp[\{b(\theta + ta\phi) - b(\theta)\}/(a\phi)]$.

▷ Exercise 34 Typeset: If Y_{rc}, $r = 1,\ldots,R$, $c = 1,\ldots,C$ are random variables, show that

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

▷ Exercise 35 Typeset:

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

▷ Exercise 36 Typeset:

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

▷ Exercise 37 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 38 Typeset:

$$h_i(t) = \lim_{\epsilon \to 0} \frac{1}{\epsilon} \frac{\mathsf{P}(t < T_i \leqslant t + \epsilon)}{\mathsf{P}(T_i > t)}.$$

2.3.3 Cross references

▷ Exercise 39 Create a reference to your first section using `\ref` and `\label` commands. See section 2.8 of *The Not So Short Introduction to LaTeX2e* for details.

2.3.4 Including graphs in LaTeX documents

First a graph needs to be saved in the correct format. There are two separate conventions for graphics files.

postscript If your graphs or pictures are in postscript or encapsulated postscript format you must use `latex` and `dvips` to typeset and print documents.

jpg, pdf or png If you graphs or pictures are in JPG, PDF or PNG format then you must use `pdflatex` to typeset and print documents.

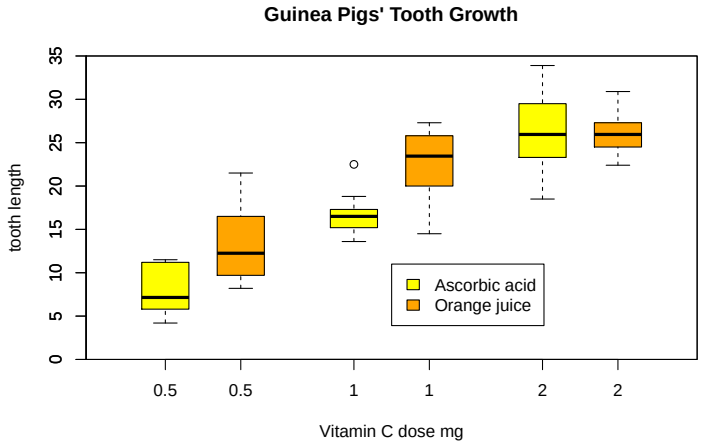
You cannot mix postscript and encapsulated postscript graphs or pictures with any other format

In the following example we will use a .png graph. Include the `GuineaPigPlot.pdf` file in your LaTeX document. To do this add the following line to the preamble of your LaTeX document, that is between the `\documentclass...` and the `\begin{document}`.

```
\usepackage{graphicx}
```

To include the graph found in the file, `GuineaPigPlot.pdf` insert the line

```
\includegraphics[width=0.6\textwidth]{GuineaPigPlot.pdf}
```



at the place in the text you would like the graph to appear.

Note that I have included `[width=0.6\textwidth]` which scales to 60% of the the page width. This is often useful because the standard size produced by some applications is rather large.

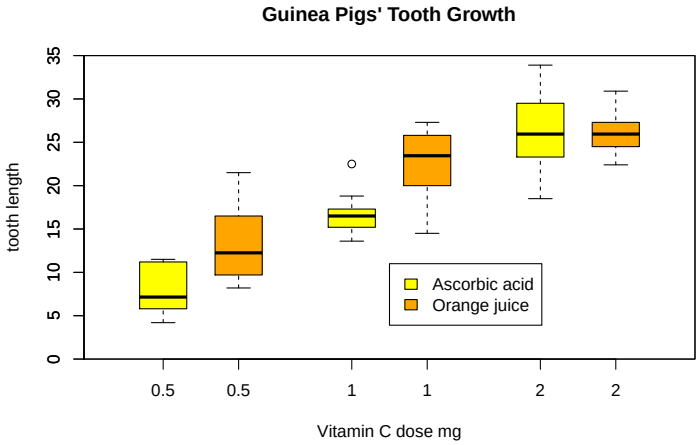
The basic method can be developed. You can centre the graph on the page with the following commands

```
\begin{figure}[ht]
\centering
\includegraphics[width=0.6\textwidth]{GuineaPigPlot.pdf}
\end{figure}
```

By enclosing the plot in a `figure` environment you are able to add extra features such as captions and labels for cross-references.

Including the command `\listoffigures` after `\tableofcontents` will produce a list of figures.

Figures are known as *floats* because they are floated to the nearest sensible position on a page when the `.tex` document is typeset. This means that placement of figures can cause problems; often they will appear at the end of a section of chapter particularly when there are a lot of figures and not much text. The option `[ht]` gives LaTeX the choice positioning



the figure either here or at the top of the page. The more choices you offer the less chance that all the pictures will end up on one page.

Here is an example of a centred graph with a caption. See Figure 10.

```
\begin{figure}[ht]
\centering
\includegraphics[width=0.6\textwidth]{GuineaPigPlot.pdf}
\caption{A centred graph with a caption.}
\end{figure}
```

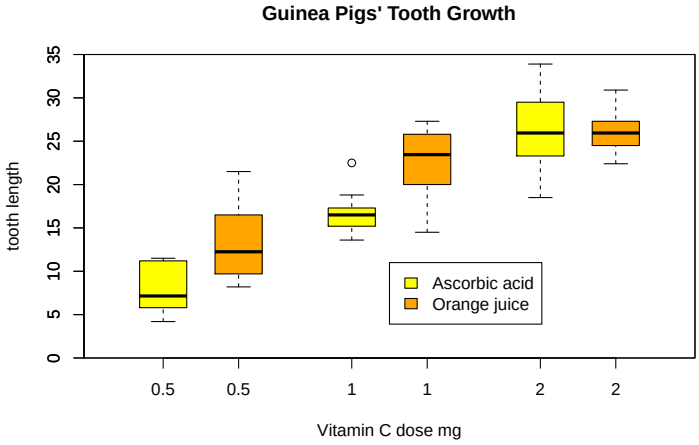


Figure 10: A centred graph with a caption.

There are many more options. Graphs can be rotated using `[angle=n]` where `n` is the angle of rotation. To include two graphs next to each other you need

```
\begin{figure}[ht]
\begin{center}
\includegraphics[width=5cm]{GuineaPigPlot.pdf}
\hspace{1cm}
\includegraphics[width=5cm]{GuineaPigPlot.pdf}
\caption{Two figures next to each other}
```

```
\end{center}
\end{figure}
```

which produces the output in figure 11.

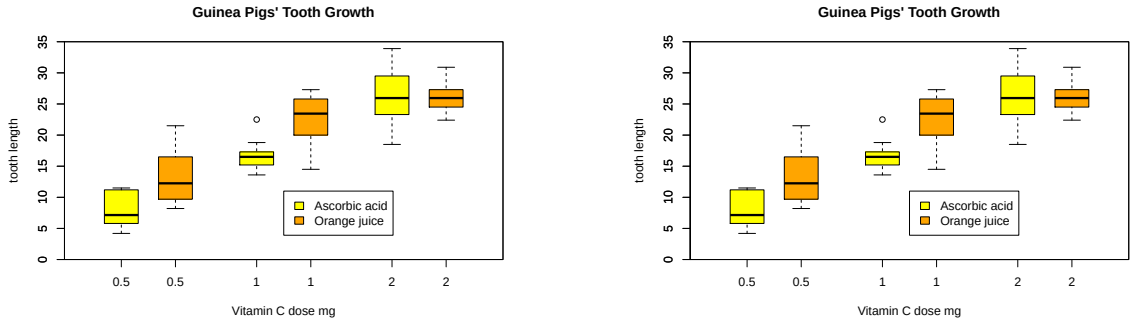


Figure 11: Two figures next to each other

To produce two figures next to each other with separate captions use:

```
\begin{figure}[ht]
\begin{center}
\begin{minipage}[b]{.5\textwidth}
\centering
\includegraphics[width=0.7\textwidth]{GuineaPigPlot.pdf}
\caption{Graph on the left}
\end{minipage}%
\begin{minipage}[b]{.5\textwidth}
\centering
\includegraphics[width=0.7\textwidth]{GuineaPigPlot.pdf}
\caption{Graph on the right}
\end{minipage}%
\end{center}
\end{figure}
```

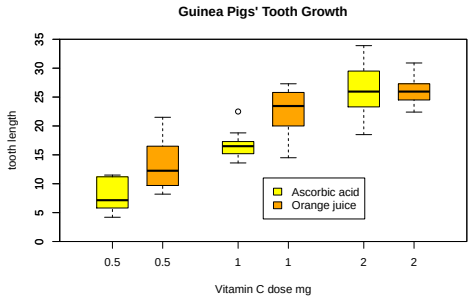


Figure 12: Graph on the left

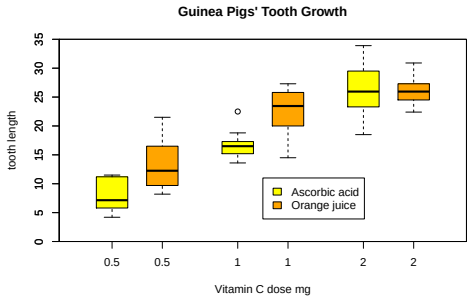


Figure 13: Graph on the right

You may have to experiment with the various `scale` and `width` options. Using `minipage` gives you much more flexibility.

2.3.5 Including R code

Sometimes tutors and supervisors will ask you to include your R code. This is a simple way to do it.

Add the following at the beginning of the file after `\usepackage{times}`.

```
\usepackage{zi4}
\usepackage[a4paper,left=3cm,right=3cm,top=3cm,bottom=3cm]{geometry}
```

These lines set the font for verbatim text, and change the dimensions of the page to make them large enough to hold standard length lines.

Then add this just before `\end{document}` at the end of the file.

```
\clearpage
\section*{Appendix}
\begin{verbatim}
Put your R code here.
\end{verbatim}
```

The Appendix should appear on a new page as in Figure 14.

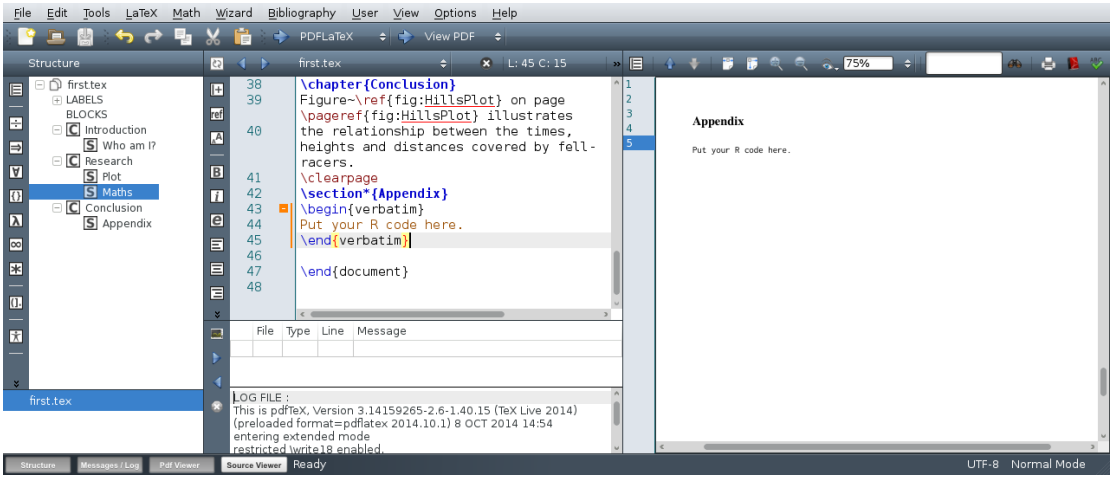


Figure 14: An Appendix with R code

What each line means.

`\clearpage`	Forces all figures, tables to be printed before beginning the next section and starts a new page.
`\section*{Appendix}`	Gives the section a title, but no number.
`\begin{verbatim} ... \end{verbatim}`	Typeset everything exactly as it appears.

2.4 Answers to LaTeX exercises

2.4.1 Typesetting Text

▷ Answer 1

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.

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

Does Æschylus understand Œdipus?

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

Élèves, refusez vos leçons! Jetez vos chaînes!

Can you take a ferry from Öland to Åland?

```
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.

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

Does \AE schylus understand \OE dipus?

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

\’El\‘eves, refusez vos le\c cons! Jetez vos cha\^\i nes!

Can you take a ferry from \"Oland to \AA land?
```

▷ Answer 2

Don’t forget to run LaTeX twice to make sure the table of contents is up to date.

▷ Answer 3

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.

```
\begin{enumerate}
\item You can mix list environments as much as you like
\begin{itemize}
\item But it might start to look silly
\item[-]With different symbols
\end{itemize}
\item So do remember
\begin{description}
\item[Stupid] things will not become smart because they are in a list.
\item[Smart] things, though, can be presented beautifully in a list.
\end{description}
```

▷ Answer 4

Vegetable Production

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

```
\begin{center}
\medskip

{\large \bf Vegetable Production}

\begin{tabular}{|l|l|r|} \hline
{\textsf Vegetable } & {\textsf Comments} & {\textsf Weight}\\
\hline \hline
Carrots & Good early crop, then carrot fly. & 7kg \\
Lettuce & Slow to start, then bolted. & 1kg \\
French beans & Excellent. & 12kg \\ \hline
\end{tabular}
\end{center}
```

▷ Answer 5

Currencies 1 Jan 1992

London:	New York:
£: $ 1.8672	£: $ 1.8655
£: DM 2.8369	$: DM 1.5175
£: FFr 9.969080	$: FFr 5.1845

```
\begin{center}
\medskip
{\Large \bfseries Currencies 1 Jan 1992}\\
\bigskip
\begin{tabular}{ll}
\sffamily \large London: & \sffamily\large New York:\\ \hline \hline
```

```
\pounds : \$ 1.8672 &\pounds : \$ 1.8655 \\
\pounds : DM 2.8369 &\$: DM 1.5175\\
\pounds : FFr 9.969080 &\$: FFr 5.1845
\end{tabular}
\end{center}
```

2.4.2 Mathematics

▷ Answer 6

$C(n,r) = n!/(r!\,(n-r)!)$.

```
$C(n,r)=n!/(r!\,(n-r)!).$
```

▷ Answer 7

This equation is in-line $a+b=c-d=xy=w/z$ and the following one is displayed.

$$a+b=c-d=xy=w/z$$

```
This equation is in-line $a+b=c-d=xy=w/z$ and the following
one is displayed. $$a+b=c-d=xy=w/z$$
```

▷ Answer 8

An in-line example: $(fg)' = f'g + fg'$ followed by one that is displayed:

$$(fg)' = f'g + fg'$$

```
An in-line example: $(fg)' = f'g + fg'$ followed by one
that is displayed: $$(fg)' = f'g + fg'$$
```

▷ Answer 9

In-line the equation is $\alpha\beta = \gamma + \delta$ and displayed

$$\alpha\beta = \gamma + \delta$$

```
In-line the equation is $\alpha\beta =\gamma+\delta$ and displayed
$$\alpha \beta = \gamma + \delta$$
```

▷ Answer 10

In-line the equation is $\Gamma(n) = (n-1)!$ and displayed

$$\Gamma(n) = (n-1)!$$

```
In-line the equation is $\Gamma (n) = (n-1)!$ and displayed
 $$\Gamma (n) = (n-1)!$$
```

▷ Answer 11

$x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$.

```
$x\wedge (y\vee z) = (x\wedge y) \vee (x\wedge z)$.
```

▷ Answer 12

$2 + 4 + 6 + \cdots + 2n = n(n + 1)$.

```
$2 + 4 + 6 + \cdots + 2n = n(n+1).$
```

▷ Answer 13

$\vec{x} \cdot \vec{y} = 0$ if and only if $\vec{x} \perp \vec{y}$.

```
$\vec x\cdot \vec y = 0$ if and only if $\vec x \perp \vec y$.
```

▷ Answer 14

$\vec{x} \cdot \vec{y} \neq 0$ if and only if $\vec{x} \not\perp \vec{y}$.

```
$\vec x\cdot \vec y \not= 0$ if and only if $\vec x \not\perp \vec y.$
```

or use $\vec{x} \cdot \vec{y} \neq 0$ which is `$\vec x\cdot \vec y \ne 0$`

▷ Answer 15

$(\forall x \in \mathbb{R})(\exists y \in \mathbb{R})$ such that $y > x$.

```
$(\forall x \in \mathbb{R}) (\exists y \in \mathbb{R})$ such that $y>x.$
```

Note that amssymb must be included in the usepackage declaration at the beginning of the file in order to use `\mathbb{R}`.

▷ Answer 16

$\frac{a+b}{c} \quad \frac{a}{b+c} \quad \frac{1}{a+b+c} \neq \frac{1}{a} + \frac{1}{b} + \frac{1}{c}$.

```
$\frac{a+b}{c}\quad \frac{a}{b+c}\quad \frac{1}{a+b+c} \not=
\frac{1}{a}+\frac{1}{b}+\frac{1}{c}.$
```

`\ne` could be used instead of `\not=`

▷ Answer 17

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

```
What are the points where $\frac{\partial}{\partial x}f(x,y)=\frac
{\partial}{\partial y}f(x,y)=0$?
```

▷ Answer 18

$e^x \quad e^{-x} \quad e^{i\pi} + 1 = 0 \quad x_0 \quad x_0^2 \quad {x_0}^2 \quad 2^{x^x}$.

```
$e^x \quad  e^{-x}  \quad e^{i\pi}+1=0 \quad x_0 \quad  x^2_0
\quad  {x_0}^2\quad  2^{x^x}$.
```

▷ Answer 19

$\nabla^2 f(x, y) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$.

```
$\nabla^2 f(x,y) = \frac{\partial^2 f}{\partial x^2}
+ \frac{\partial^2 f}{\partial y^2}$.
```

▷ Answer 20

$\lim_{x\to 0}(1+x)^{\frac{1}{x}}=e$.

```
$\lim_{x\to 0} (1+x)^{\frac{1}{x}}=e$.
```

▷ Answer 21

The cardinality of $(-\infty,\infty)$ is $\aleph_1$.

```
The cardinality of $(-\infty ,\infty)$ is $\aleph_1$.
```

▷ Answer 22

$\lim_{x\to 0^+} x^x = 1$.

```
$\lim_{x\to {0^+}} x^x = 1$.
```

▷ Answer 23

$\int_0^1 3x^2\,\mathrm{d}x = 1$.

```
$\int_0^1 \,3x^2\,\mathrm{d}x=1$.
```

▷ Answer 24

$\sqrt{2} \quad \sqrt{\frac{x+y}{x-y}} \quad \sqrt[3]{10} \quad e^{\sqrt{x}}$.

```
$\sqrt2 \quad \sqrt \frac{x+y}{x-y} \quad \root 3 \of {10}$
\quad $e^{\sqrt x}$.
```

▷ Answer 25

$\|x\| = \sqrt{x\cdot x}$.

```
$\|x\| = \sqrt{x\cdot x}$.
```

▷ Answer 26

$\phi(t) = \frac{1}{\sqrt{2_\pi}} \int_0^t \, e^{-x^{2}/2}\,\mathrm{d}x$.

```
$\phi(t) = \frac{1}{\sqrt{2_\pi}} \int_0^t \, e^{-x^{2}/2},\mathrm{d}x$.
```

▷ Answer 27

$\underline{x} \quad \overline{y} \quad \overline{\underline{x+y}}$.

```
$\underline x \quad \overline y \quad \underline{\overline{x+y}}$.
```

▷ Answer 28

$\left\lceil \left\lfloor x \right\rfloor \right\rceil \leq \left\lfloor \left\lceil x \right\rceil \right\rfloor$.

```
$\bigl \lceil \lfloor x\rfloor  \bigr \rceil
   \leq \bigl \lfloor \lceil x\rceil \bigr \rfloor$.
```

▷ Answer 29

$\sin(2\theta) = 2\sin\theta\cos\theta \quad \cos(2\theta) = 2\cos^2\theta - 1.$

```
$\sin(2\theta ) = 2 \sin\theta\cos\theta \quad \cos(2\theta)
 = 2\cos^2\theta - 1$.
```

▷ Answer 30

$$\int \csc^2 x \,\mathrm{d}x = -\cot x + C \qquad \lim_{\alpha\to 0} \frac{\sin\alpha}{\alpha} = 1 \qquad \lim_{\alpha\to\infty} \frac{\sin\alpha}{\alpha} = 0.$$

```
$$\int \csc^2x\,  \mathrm{d}x = -\cot x + C
\qquad \lim_{\alpha\to 0} \frac{\sin\alpha}{\alpha} = 1
\qquad \lim_{\alpha \to \infty} \frac{\sin\alpha}{\alpha} = 0.$$
```

▷ Answer 31

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

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

▷ Answer 32

$$\left[\begin{array}{ccc} aa & \cdots & az \\ \vdots & \ddots & \vdots \\ za & \cdots & zz \end{array}\right]$$

```
$$\left[
\begin{array}{ccc}
aa & \cdots & az \\
\vdots & \ddots & \vdots \\
za & \cdots & zz
\end{array}
\right]$$
```

▷ Answer 33

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 $M(t) = \exp[\{b(\theta + ta\phi) - b(\theta)\}/(a\phi)]$.

```
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)
 $M(t) = \exp[ \{b(\theta+ta\phi) - b(\theta)\}/(a\phi)]$.
```

▷ Answer 34

If Y_{rc}, $r = 1, \ldots, R$, $c = 1, \ldots, C$ are random variables, show that

$$\sum_{r,c}(Y_{rc} - \overline{Y}_{..})^2 = \sum_{r,c}(\overline{Y}_{r.} - \overline{Y}_{..})^2 + \sum_{r,c}(\overline{Y}_{.c} - \overline{Y}_{..})^2 + \sum_{r,c}(Y_{rc} - \overline{Y}_{.c} - \overline{e}Y_{..})^2. \qquad (2)$$

```
If $Y_{rc}$, $r=1,\ldots, R$, $c=1,\ldots, C$ are random variables,
show that
\begin{equation}
\label{linear.models.equation.1}
\sum_{r,c} (Y_{rc}-\overline Y_{..})^2
= \sum_{r,c} (\overline Y_{r.}-\overline Y _{..})^2 + \sum_{r,c}
(\overline Y_{.c}-\overline Y_{..})^2 + \sum_{r,c} (Y_{rc}
- \overline Y_{.c} - \overline e Y_{..})^2.
\end{equation}
```

▷ Answer 35

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

```
$$f(x_i\,|\,\lambda_i) = \lambda_i e^{-\lambda_i x_i}, \qquad
f(y_i\,|\,\lambda_i, \psi) = \lambda_i\psi e^{-\lambda_i\psi y_i},
\qquad x_i, y_i \ge 0.$$
```

You could use `\mid`, but the spacing would be larger.

▷ Answer 36

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

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

▷ Answer 37

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.

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

The amsmaths cases environment was used here.

▷ Answer 38

$$h_i(t) = \lim_{\epsilon \to 0} \frac{1}{\epsilon} \frac{\mathsf{P}(t < T_i \leqslant t + \epsilon)}{\mathsf{P}(T_i > t)}.$$

```
\renewcommand{\Pr}{\mathsf{P}}
$$h_i(t)=\lim_{\epsilon\to 0} \frac{1}{\epsilon}
\frac{\Pr(t<T_i\leqslant t+\epsilon)}{\Pr(T_i>t)}.$$
```

2.4.3 Cross references

▷ Answer 39

To create a cross reference to a figure you need to set a label with an arbitrary name

```
\label{Plot1}
```

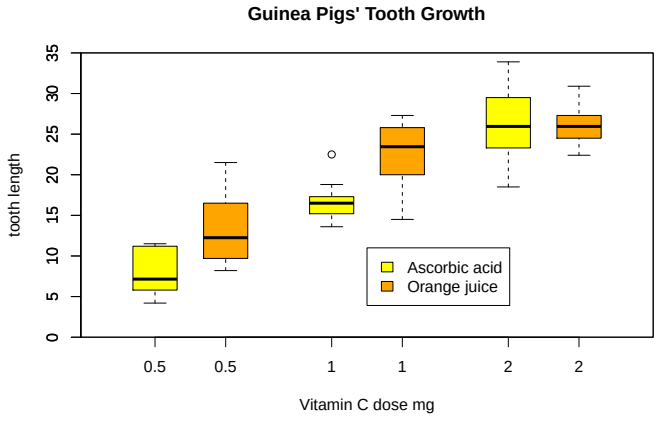


Figure 15: A plot with a reference

within the figure environment and then use

```
\pageref{Plot1}
```

to refer to it. So use

```
this plot is on page \pageref{Plot1}
```

to see " this plot is on page 30 ".

See page 30 for example. Note that you will see

```
LaTeX Warning: There were undefined references.
```

so run LaTeX twice to get the references resolved.

2.4.4 A simple bibliography

▷ Answer 40

Remember that you need to run LaTeX twice, then bibtex and then LaTeX twice again to get all the references sorted out.