Intermediate LaTeX

Weiliang Qiu*
6356 Agricultural Road
UBC
Vancouver BC
V6T 1Z2

Eugenia Yu
6356 Agricultural Road
UBC
Vancouver BC
V6T 1Z2

September 18, 2017

*supported by UBC Stats Dept.

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Abstract

This is the abstract ...

1 Introduction

LaTeX is a document processing system in which you specify the content and layout(style) separately. That is, a LaTeX file includes commands that define the structure, and the process requires a compiler to format the final result.

The basic structure and principles of a LaTeX document will be given in Sections 3 and 4. Section 5 shows how to split a larger document into smaller parts for easier file management. Special symbols, fonts and lists will be discussed in Sections 6 to 8. We will talk about how to type math, create tables and insert figures in Sections 9 and 10. This document ends with examples of handling errors in Section 12.

2 The Edit/Compile/Preview Process with Bibliography

1. Use any text editor (e.g. gvim, emacs) to input bibliography information in the file, e.g. mybib.bib.
2. Use any text editor (e.g. gvim, emacs) to input content and LaTeX commands in the file, e.g. sample.tex. Include the following latex commands just before `\end{document}`:

```
\bibliographystyle{plain}
\bibliography{mybib}
```

3. Compile the LaTeX file by using the command: **latex sample.tex**
4. Compile the bib file by using the command: **bibtex sample**
5. Compile again the LaTeX file by using the command: **latex sample.tex**
6. Compile once more the LaTeX file by using the command: **latex sample.tex**
7. Display the sample.dvi file by the command: **xdvi sample**
8. Convert the dvi file to a postscript file with the command: **dvips -o psfilename.ps sample.dvi**
9. Print the sample.dvi file by the Unix command: **dviprint sample** or **dvips sample.dvi | lpr -d sample.dvi**

The commands *latex sample.tex* and *bibtex sample* produce a number of files including:

example.aux Used for cross-referencing and in compiling the table of contents, list of figures, and list of tables.

example.log Contains everything printed on the terminal when LaTeX is executed, plus additional information and some extra blank lines.

example.dvi This is the DeVice Independent (DVI) format output of what LaTeX thinks your document should look like.

example.bbl This file is written by BibTeX, not by LaTeX, using information on the *aux* file. It is read by the `\bibliography` command.

3 LaTeX Document Structure

```
\documentclass{article}
      preamble
      \begin{document}
      body
      \end{document}
```

4 General Principles

1. All input, both text and formatting commands is in "ASCII" text.
2. Spaces and line breaks are not important. A blank line starts a new paragraph, however.
3. All commands start with a backslash:
   e.g. `\documentclass`
4. Braces are used for "arguments":
   e.g. `\begin{document}`
5. Square brackets are used for "optional arguments":
   e.g. `\documentclass[11pt]{article}`
6. Commands are case sensitive.
   e.g. `\documentclass` but not `\DocumentClass`

5 Splitting the Source File into Parts

LaTeX source documents can be split into several parts by using the `\includeonly` and `\include` commands.

```
\documentclass{article}
        :
        \includeonly{file1,file2,file3}
        :
       \begin{document}
          :
          :
          \include{file1}
          \include{file2}
          \include{file3}
          :
       \end{document}
```

In every of the included files (*file1.tex, file2.tex, file3.tex*), do not include `\documentclass{}`, preamble, `\begin{document}` and `\end{document}`.

6 Special Symbols

Some text characters must be generated by control sequences (i.e., quotes, `{}, [], \`, etc.). The special symbols include `$ & % # _ { } ~ ^ \`. Use a backslash in front of the symbols to correctly display the first seven symbols. in the above list To display the last three, use `\verb` command, e.g. `\verb2\2`. The double backslash `\\` is used to start a new line.

7 Fonts

Since LaTeX is a formatter, all changes in the format of text must be explicitly expressed. Table 1 shows the different font types[1].

8 Lists

There are basically three types of lists in LaTeX:

- itemization ("bullets") - `\begin{itemize}`

[1] The font effect might depend on the type size of the document.

Table 1: Font Effects.

What you type	What you see
`{\bf hello}`	**hello**
`{\em hello} is the same as {\it hello}`	*hello* is the same as *hello*
`{\underline {hello}}`	hello
`{\tiny hello}`	hello
`{\scriptsize hello}`	hello
`{\footnotesize hello}`	hello
`{\small hello}`	hello
`{\normalsize hello}`	hello
`{\large hello}`	hello
`{\Large hello}`	hello
`{\LARGE hello}`	hello
`{\huge hello}`	hello
`{\Huge hello}`	hello

- enumeration (1, 2, 3, ...) - `\begin{enumerate}`
- description - `\begin{description}`

All lists in LaTeX have the same general format:

```
\begin{list-type}
  \item list-entry
  \item next-list-entry
\end{list-type}
```

8.1 The Itemize Environment

One can have lists within lists by using the `\subitem` or nested itemize environments.

```
\begin{itemize}
  \item
   item one
   \subitem
    subitem one
   \subitem
    subitem two
 \item
```

```
   item two
\end{itemize}

\begin{itemize}
  \item
   item one
   \begin{itemize}
    \item
    subitem
  \end{itemize}
  \item
   item two
\end{itemize}
```

8.2 The Enumerate Environment

```
\begin{enumerate}
  \item
   item one
  \item
   item two
\end{enumerate}
```

8.3 The Description Environment

Description lists are similar to enumerated or itemized lists. In a description list, each item has both a term and a description.

```
\begin{description}
  \item[Step 1]
    Step 1 of the algorithm
  \item[Step 2]
    Step 2 of the algorithm
\end{description}
```

9 Typing Math in LaTeX

To type math expressions in the running text, use either of the two short forms `\(...)\` or `$...$`, e.g. `$\hat{\beta}$`.

One can also use the **displaymath**, **equation** and **eqnarray** environments:

1. **displaymath**:

   e.g.

$$\text{logit}(p) = \log(\frac{p}{1-p}) \qquad \text{is the definition of logit of } p$$

2. **equation**:

   e.g.

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \tag{1}$$

   The **equation*** environment is the same as the **equation** environment except it does not generate equation numbers.

   e.g.

$$Y_{ij} = \mu + \alpha_i + \beta_j + \epsilon_{ij}, \qquad \epsilon_{ij} \sim N(0, \sigma^2)$$

   Big delimiters are most often used with array.

   e.g.

$$\left(\begin{array}{c} y \\ z \end{array} \right) \tag{2}$$

   The `\left` and `\right` commands must come in matching pairs, but the matching delimiters need not be the same.

   e.g.

$$\left. \frac{\partial f(x,y)}{\partial x} \right|_{x=x_0} = y \tag{3}$$

   We can type text in math mode by using the `\mbox` command.

   e.g.

$$x = \begin{cases} y & \text{if } y > 0 \\ z + y & \text{otherwise} \end{cases} \tag{4}$$

3. **eqnarray**:

   The **displaymath** and **equation** environments make one-line formulas. A sequence of equations or inequalities is displayed with the **eqnarray** environment. By default, an equation number is put in every single line. Use the `\nonumber` command in each of the lines you want to suppress an equation number.

   e.g.

$$\begin{aligned} x &\ll y_1 + \cdots + y_n \\ &\leq z \end{aligned} \tag{5}$$

   The **eqnarray*** environment is the same as the **eqnarray** environment except it does not generate equation numbers.

   e.g.

$$\begin{aligned} A \xrightarrow{a'} B \xrightarrow{b'} C \\ \vec{x} \stackrel{\text{def}}{=} (x_1, \ldots, x_n) \end{aligned}$$

   For multiline formula, sometimes it is desirable to have one equation number and put the equation number in the middle line of the equations. In this case, we can combine the **equation** environment and the **split** environment.

   e.g.

$$\begin{aligned} H_0 &: \mu_1 = \mu_2 \\ H_1 &: \mu_1 \neq \mu_2 \end{aligned} \tag{6}$$

   We cannot use the `\bf` command in math mode. Instead we use `\mathbf` for English characters and `\boldsymbol` for both English characters and Greek letters.

   e.g.

$$\begin{cases} \mathbf{Y}_i = \mathbf{X}_i\boldsymbol{\beta} + \mathbf{Z}_i\boldsymbol{b_i} + \boldsymbol{e_i} \\ \boldsymbol{b_i} \sim \mathrm{N}(0, \mathbf{D}), \boldsymbol{e_i} \sim \mathrm{N}(0, \mathbf{R}_i), \boldsymbol{b_i} \perp \boldsymbol{e_i} \end{cases} \tag{7}$$

   Sometimes it might be useful to use the **align**, **gather** and **multline** environments.

4. **align**:

$$x + y < 2 \tag{8}$$
$$x + y > 3 \tag{9}$$
$$x + y \leq 15 \tag{10}$$
$$x + y \geq 20000000000000000000 \tag{11}$$

Comparing to the result from using **eqnarray**:

$$x + y < 2 \tag{12}$$
$$x + y > 3 \tag{13}$$
$$x + y \leq 15 \tag{14}$$
$$x + y \geq 20000000000000000000 \tag{15}$$

5. **gather**:

$$x + y < 2 \tag{16}$$
$$x + y > 3 \tag{17}$$
$$x + y \leq 15 \tag{18}$$
$$x + y \geq 20000000000000000000 \tag{19}$$

6. **multline**:

$$x + y < 2$$
$$x + y > 3$$
$$x + y \leq 15$$
$$x + y \geq 20000000000000000000 \tag{20}$$

Comparing to the result from using **split**:

$$\begin{aligned} x + y &< 2 \\ x + y &> 3 \\ x + y &\leq 15 \\ x + y &\geq 20000000000000000000 \end{aligned} \tag{21}$$

10 Tables and Figures

To create tables, you will need the **table** and the **tabular** environments. Table 2 gives the anova table of a 1-way anova, and Table 3 shows an example of using `\multicolumn` and

Table 2: Anova Table.

Source of Variation	SS	df	MS	F-ratio
Treatment	SST	2	MST	$\frac{MST}{MSE}$
Error	SSE	30	MSE	

Table 3: A sample table with the use of multicolumn and multirow commands.

β_C = -0.001721					
Parameter values used for simulation		Method # 1		Method # 2	
β_{T1}	β_{T2}	$\hat{\beta}_{time\times group}$ (values in 10^{-4})	(SE)	$\hat{\beta}_4 + \hat{\beta}_5$ (values in 10^{-4})	(SE)
	-0.001	7.71	3.05	7.38	2.78
-0.001721	-0.0014	3.56	2.83	3.21	2.73
	-0.001721	0.45	2.99	0.07	2.70

`\multirow` commands.

To insert graphics into LaTeX, use the **figure** environment. Figure 1 shows the histogram of a random sample of 100 observations from the standard normal distribution.

11 Centering and "Flushing"

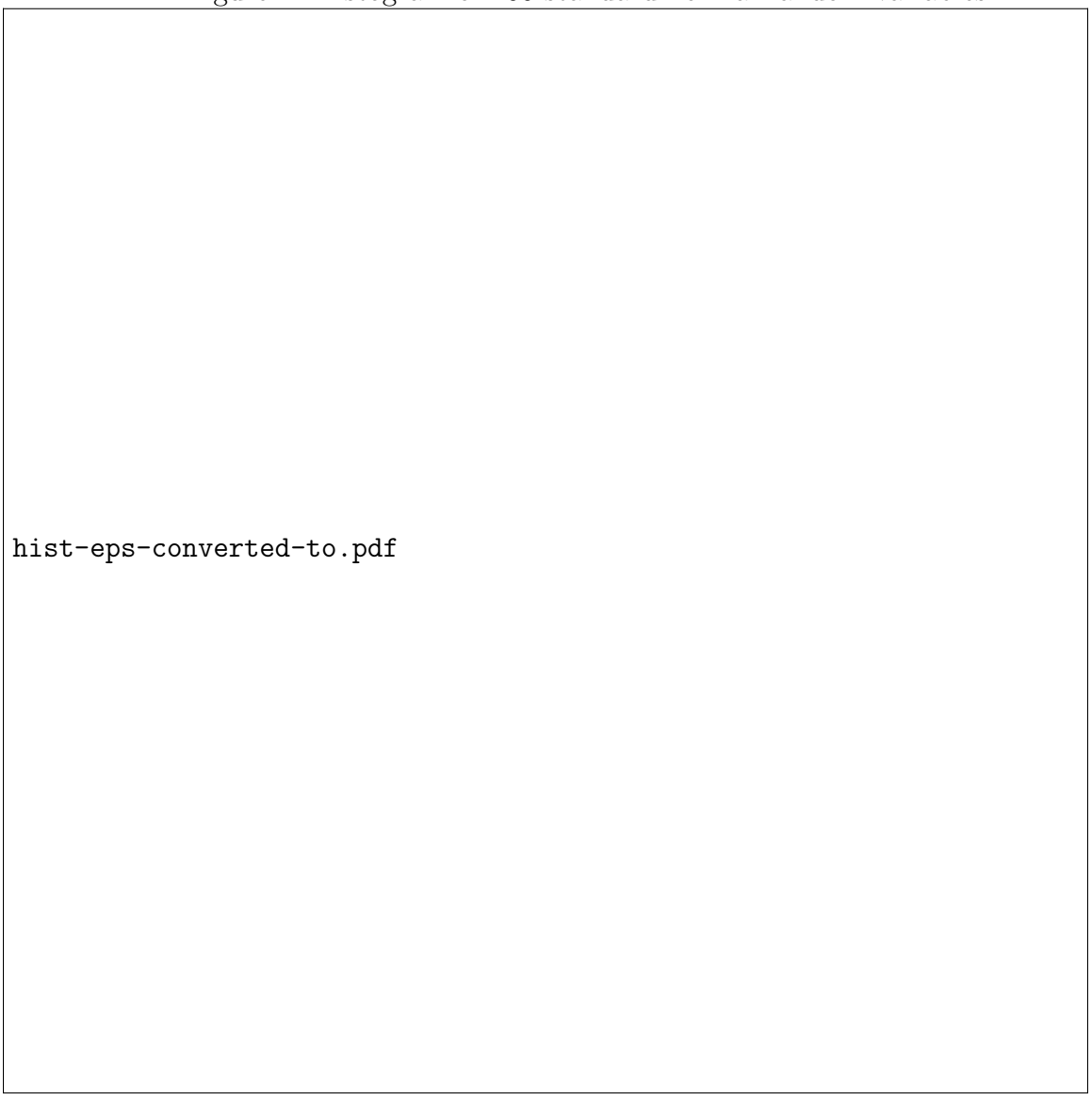
There are several LaTeX environments to control the alignment of text.

```
Center: \begin{center} ... \end{center}
Right Align: \begin{flushright} ... \end{flushright}
Left Align: \begin{flushleft} ... \end{flushleft}
```

The following declarations can be used at the beginning of the body to produce alignment effect for the entire document. Be sure to put the declaration immediately after the `\begin{document}` command. These declarations will be turned off as soon as they encounter a `\end{...}` command.

```
\centering
\raggedleft
\raggedright
```

Figure 1: Histogram of 100 standard normal random variables.



12 Errors in Running LaTeX

When you compile a LaTeX file that contains syntax errors, LaTeX will print out error messages, indicate which line contains an error, and print a "?" prompt. You can either enter letter "x" to exit (quit the compilation) or enter "E" to edit the LaTeX file.

Appendices

A Appendix 1

This is the appendix.

For further information on LaTeX, please refer to (Lamport, 1986) or [**?**, **?**].

B Appendix 2

Also there are many web sites providing useful information on LaTeX. For example

1. A short math guide for LaTeX:
   `http://www.ams.org/tex/short-math-guide.html`
2. The LaTeX homepage:
   `http://www.latex-project.org/`
3. Hypertext Help with LaTeX:
   `http://www.giss.nasa.gov/latex/`