

Basics of L^AT_EX

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1 Introduction

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

2 The Edit/Compilation/Preview Process

1. Use any text editor (e.g. gvim, emacs) to input content and L^AT_EX commands in the file, e.g. `sample.tex`.
2. Compile the file with the Unix command: **latex sample.tex**

The command produces a number of files:

sample.aux This file contains information generated by L^AT_EX on where to find things such as table of contents entries. Usually you can just ignore it.

sample.log This file contains a detailed log of what L^AT_EX did while processing your file. If you encounter errors that you just can't figure out, look in here for additional information which may help.

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

3. Display the sample.dvi file with the command: **xdvi sample.dvi** or simply **xdvi sample**
4. Convert the dvi file to a postscript file with the command: **dvips -o psfilename.ps sample.dvi**
5. Print the sample.dvi file with the command: **dviprint sample** or **dvips sample.dvi | lpr -d sample.dvi**

3 \LaTeX Document Structure

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

4 General Principles

1. All input, both text and formatting commands are 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 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.

6 Fonts

Since \LaTeX is a formatter, all changes in the format of text must be explicitly expressed.

| What you type | What you see |
|--|--|
| <code>{\bf hello}</code> | hello |
| <code>{\em hello}</code> is the same as <code>{\it hello}</code> | <i>hello</i> is the same as <i>hello</i> |
| <code>{\underline {hello}}</code> | <u>hello</u> |
| <code>{\tiny hello}</code> | hello |
| <code>{\scriptsize hello}</code> | hello |
| <code>{\footnotesize hello}</code> | hello |
| <code>{\small hello}</code> | hello |
| <code>{\normalsize hello}</code> | hello |
| <code>{\large hello}</code> | hello |
| <code>{\Large hello}</code> | hello |
| <code>{\LARGE hello}</code> | hello |
| <code>{\huge hello}</code> | hello |
| <code>{\Huge hello}</code> | hello |

7 Lists

There are basically three types of lists in \LaTeX :

- itemization (“bullets”) - `\begin{itemize}`
- enumeration (1, 2, 3, ...) - `\begin{enumerate}`
- description - `\begin{description}`

All lists in L^AT_EX have the same general format:

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

7.1 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}
```

7.2 The Enumerate Environment

```
\begin{enumerate}
```

```

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

```

7.3 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}

```

8 Typing Math in L^AT_EX

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.

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

2. equation:

e.g.

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

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

e.g.

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

Big delimiters are most often used with array.

e.g.

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

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

e.g.

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

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

e.g.

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

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.

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

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

e.g.

$$A \xrightarrow{a'} B \xrightarrow{b'} C$$

$$\vec{x} \stackrel{\text{def}}{=} (x_1, \dots, x_n)$$

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.

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

9 Tables and Figures

To create tables, you will need the `tabular` environment.

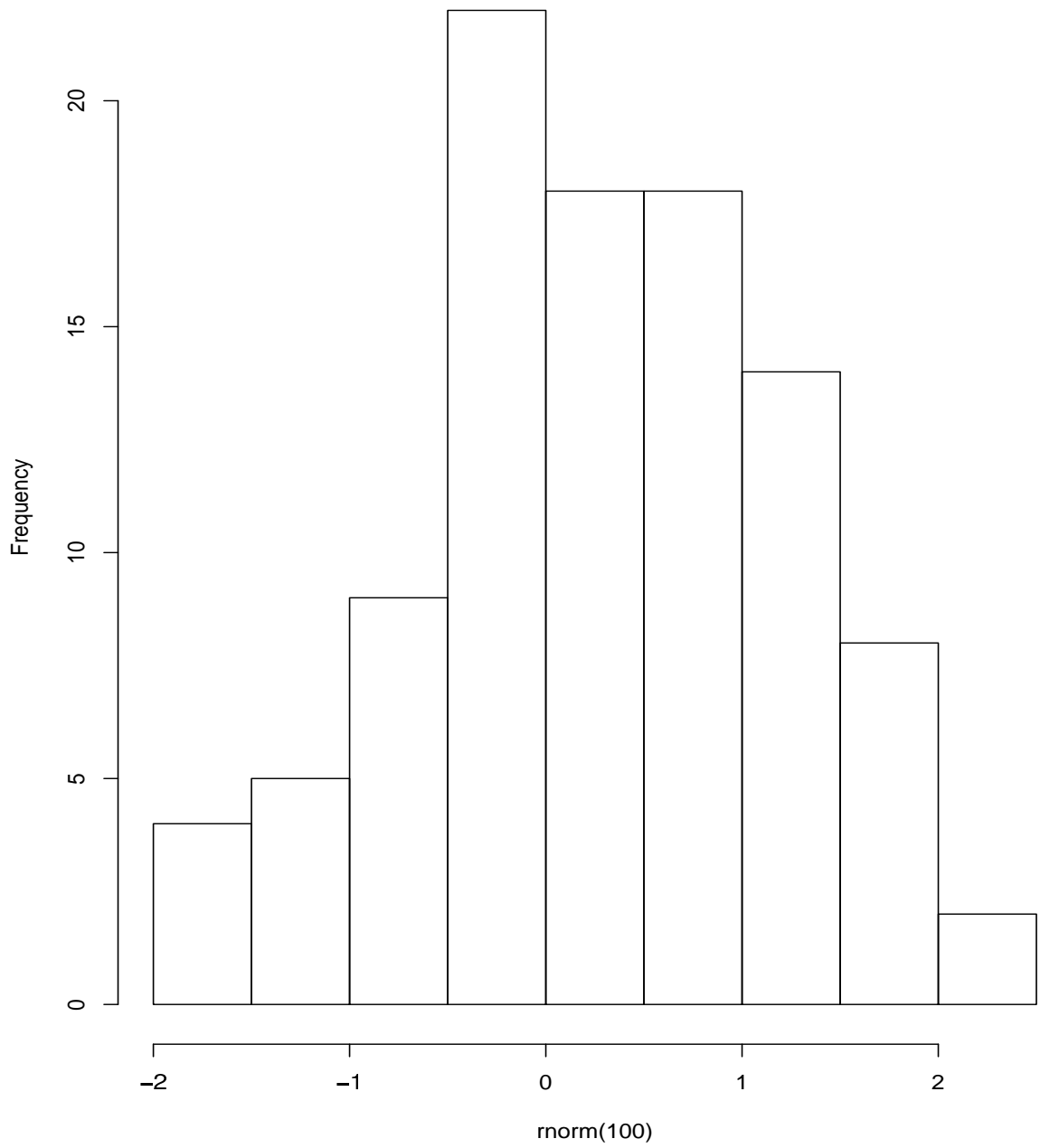
| Source of Variation | SS | df | MS | F-ratio |
|---------------------|-----|----|-----|-------------------|
| Treatment | SST | 2 | MST | $\frac{MST}{MSE}$ |
| Error | SSE | 30 | MSE | |

To insert graphics into \LaTeX , use the `figure` environment.

10 Centering and “Flushing”

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

Histogram of rnorm(100)



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`

11 Errors in Running L^AT_EX

When you compile a L^AT_EX file that contains syntax errors, L^AT_EX 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 L^AT_EX file.