Introduction to Biostatistical Computing

A bit more on LaTeX

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What is TEX/LATEX?

TEX is a programming language (and also a typesetting system) written by Donald Knuth; released in 1978

LATEX is a macro package facilitating the use of of TEX

Installation

Windows MiKTeX `http://www.miktex.org/`

OSX MacTex `http://www.tug.org/mactex/`

Linux/UNIX TeX Live `http://www.tug.org/texlive/`

Minimal LaTeX document

```
\documentclass{article}

\begin{document}

Hello World!

\end{document}
```

A usual LaTeX document

```
\documentclass{article}   |
\usepackage{color}        |
\usepackage{graphicx}     |
                          |   Preamble (options)
\title{A Title}           |
\author{John Doe}         |
\date{\today}             |
                          |
\begin{document}          |

\maketitle

Hello World!

\end{document}
```

\documentclass[options]{class}

Can be used with or without options

```
\documentclass[10pt]{article}           % 10pt|11pt|12pt
\documentclass[final]{article}          % draft|final
\documentclass[a4paper]{article}        % a4paper|a5paper|letterpaper|...
\documentclass[twoside]{book}           % oneside|twoside
\documentclass[openright]{book}         % openright|openany
\documentclass[notitlepage]{article}    % notitlepalge|titlepage
\documentclass[onecolumn]{article}      % onecolumn|twocolumn
\documentclass[a4paper,oneside,12pt]{article} % combined  with comma
```

Sectioning and table of content

- Section are declared using

  `\section{Section's title}`
- Other sectioning commands are
  - `\chapter`
  - `\part`
  - `subsection`
  - `subsubsection`
  - `\paragraph`
- A `\tableofcontents` command produces a table of contents

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LaTeX Commands and Newcommands

Various builtin commands (macros) in LaTeX

- Commands start with \
- May have arguments, e.g., `\section{Newcommands}`
- or none, e.g., `\LaTeX` (that produces LaTeX)

In addition, the user may define his own commands. Useful for nasty expressions that appear often

- `\newcommand{\keyword}{definition}`
- A `newcommand` definition may appear anywhere in a .tex file (though usually defined in the preamble)
- A `\newcommand` keyword may not contain numbers

Newcommands

Example

```
\newcommand{\com}{My command}
My first newcommand \com
```

- My first newcommand My command

```
\newcommand{\Z}{\mathbb{Z}}
For $k \in \Z$
```

- For $k \in \mathbb{Z}$. Note that it works in math mode

```
\newcommand{\Z}{\ensuremath{\mathbb{Z}}}
Both $\Z$ and \Z{} work
```

- Both $\mathbb{Z}$ and $\mathbb{Z}$ work

Newcommands with arguments

- User-defined commands may receive arguments

```
\newcommand{\keyword}[n]{definition}
```

where `n` is the number of arguments (1-9)

- One refers to arguments in the definition using `#k`, $k = 1, \ldots, n$
- Default values for possible optional arguments can be given using the form

```
\newcommand{\keyword}[n][default]{definition}
```

- Existing commands may be redefined using `\renewcommand` in a similar way

Newcommand with arguments

```
\newcommand{\norm}[1]{\lVert#1\rVert}
$\norm{f + g} \leq \norm{f} + \norm{g}$
```

- $\|f + g\| \leqslant \|f\| + \|g\|$

```
\newcommand{\subvec}[3]{\ensuremath{#1_{#2},\ldots,#1_{#3}}}
\subvec{a}{1}{n}
\subvec{a}{ij}{kl}
```

- $a_1, \ldots, a_n$
- $a_{ij}, \ldots, a_{kl}$

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Tables

The `tabular` Environment

- Columns separated by `&`
- Rows separated by `\\`
- Environment argument is column formatting specification

`c`	centered
`l`	flush left
`r`	flush right
`p{2.5cm}`	limit column width (left aligned)

- A `|` `tabular`'s environment puts a vertical line at the specified place
- The `\hline` command draws a horizontal line
- The `\cline{i-j}` command draws a horizontal line between the ith and jth columns

Tables

The `tabular` Environment

```
\begin{tabular}{lccc}
        & Coef & SE    & p-value \\
Age     & 0.01 & 0.002 & 0.5     \\
Gender & 2    & 1     & 0.23    \\
\end{tabular}
```

	Coef	SE	p-value
Age	0.01	0.002	0.5
Gender	2	1	0.23

```
\begin{tabular}{l|ccc}
        & Coef & SE    & p-value \\
\hline
Age     & 0.01 & 0.002 & 0.5     \\
Gender & 2    & 1     & 0.23    \\
\hline
\end{tabular}
```

	Coef	SE	p-value
Age	0.01	0.002	0.5
Gender	2	1	0.23

Tables

The tabular Environment

- Text spanning multiple column is typeset using `\multicolumn{num}{align}{text}`
  - `num` specifies the number of merged column
  - `align` specifies the alignment (`l`, `c`, `r`)

```
\begin{tabular}{l|ccc}
  & \multicolumn{3}{c}{Regression} \\
  \cline{2-4}
  & Coef & SE    & p-value          \\
  \hline
  Age    & 0.01 & 0.002 & 0.5       \\
  Gender & 2    & 1     & 0.23      \\
  \hline
\end{tabular}
```

	Regression		
	Coef	SE	p-value
Age	0.01	0.002	0.5
Gender	2	1	0.23

Tables

The booktabs package

The booktabs package define the new commands

- `\toprule` to be used just after `\begin{tabular}`
- `\midrule` to be used after variable definition
- `\bottomrule` to be used just before `\end{tabular}`
- `\cmidrule` equivalent to `\cline`

```
\begin{tabular}{lccc}
\toprule
& \multicolumn{3}{c}{Regression} \\
\cmidrule(r){2-4}
& Coef & SE    & p-value          \\
\midrule
Age    & 0.01 & 0.002 & 0.5      \\
Gender & 2    & 1     & 0.23     \\
\bottomrule
\end{tabular}
```

	Regression		
	Coef	SE	p-value
Age	0.01	0.002	0.5
Gender	2	1	0.23

Tables

Nicer Figures with `xtable`

```
library(xtable)

my_xtable <- function(x, file = "",
                      rownames = FALSE,
                      colnames = TRUE, ...) {
    tab <- xtable::xtable(x, ...)
    print(tab, floating = FALSE, hline.after = NULL,
          add.to.row = list(pos = list(-1,0, nrow(x)),
              command = c('\\toprule\n ',
                  '\\midrule\n ',
              '\\bottomrule\n')),
          file = file,
          include.rownames = rownames,
          include.colnames = colnames)
}
```

Tables

Nicer Figures with `xtable`

```
fit_lm <- lm(life ~ log(phys) + log(tv), data = tele)
my_xtable(summary(fit_lm)$coefficients,
          rownames = TRUE)
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	90.62	4.36	20.81	0.00
log(phys)	-2.26	0.75	-3.02	0.00
log(tv)	-2.92	0.59	-4.94	0.00

Tables with the **stargazer** package

```
fit_lm2 <- lm(life ~ log(tv), data = tele)
stargazer(fit_lm2, fit_lm, title = "Results",
          ci = TRUE, font.size = "scriptsize")
```

Table : Results

	Dependent variable:	
	life	
	(1)	(2)
log(phys)		−2.259***
		(−3.724, −0.794)
log(tv)	−4.260***	−2.916***
	(−5.103, −3.416)	(−4.073, −1.758)
Constant	77.887***	90.622***
	(75.496, 80.279)	(82.085, 99.159)

Tables with the **texreg** package

```
texreg(list(fit_lm2, fit_lm),
       booktabs = TRUE, dcolumn = TRUE,
       use.packages = FALSE)
```

	Model 1	Model 2
(Intercept)	77.89***	90.62***
	(1.22)	(4.36)
log(tv)	−4.26***	−2.92***
	(0.43)	(0.59)
log(phys)		−2.26**
		(0.75)
R^2	0.73	0.79
Adj. R^2	0.72	0.77
Num. obs.	38	38

Graphics

- Graphics file are imported using the `graphicx` package and the command `\includegraphics{file}`
- `pdflatex` allows JPG, PNG or PDF graphic formats

```
\includegraphics{graphics/MagrittePipe.jpg}
```

Graphics

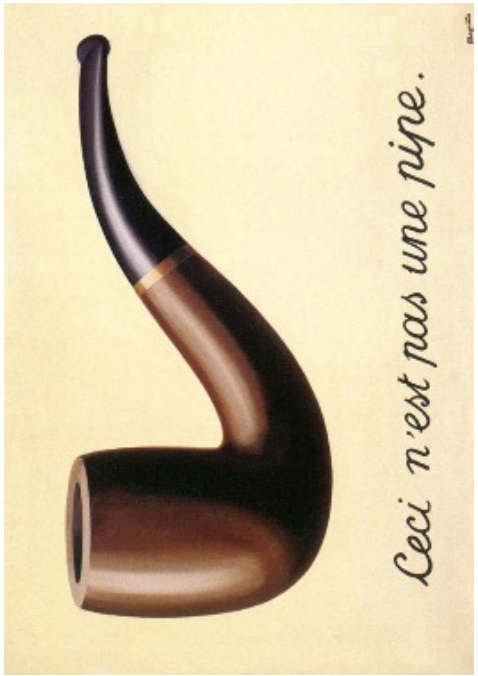
Width of figure

- Optional argument in `\includegraphics[width = opt]{file}`
  - `Xunit`: e.g, 5cm, 4in
  - `width=\linewidth`: width of a line in the local environment
  - `width=\textwidth`: width of the text in a page
- Also `width=.5\linewidth` or `width=.5\pagewidth`

Graphics

Rotation

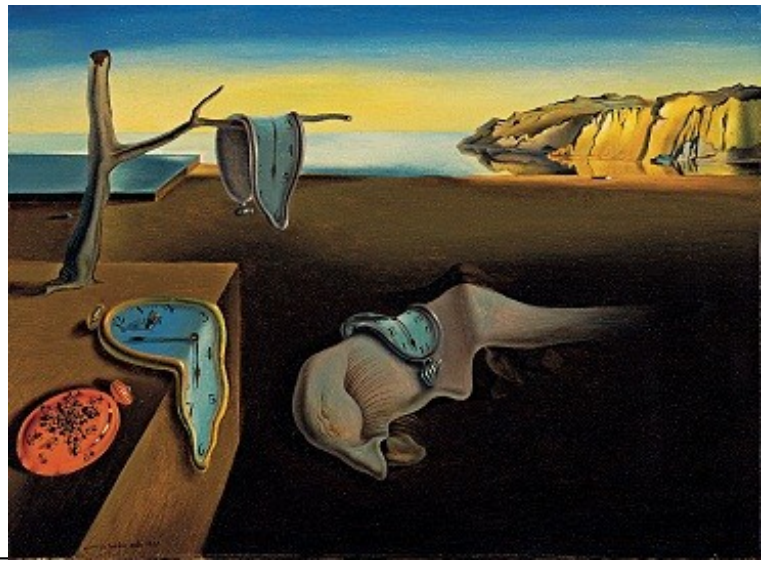
```
\includegraphics[angle=90]{graphics/
        MagrittePipe.jpg}
```



Graphics

Multiple Figures (no floating)

```
\includegraphics[width = .4\linewidth]{graphics/MagrittePipe}
\hrulefill
\includegraphics[width = .4\linewidth]{graphics/The_Persistence_of_Memory.jpg}
```



Floating Objects

- Sentences are broken across pages but pictures and tables cannot be split. They must be “floated” to convenient places. These objects are named *floating objects*
- LaTeX provide two “floating” environments

  `table` `\begin{table} ... \end{table}` usually combined with the `tabular` environment

  `figure` `\begin{figure} ... \end{figure}` usually for graphics
- Optional arguments *suggests* a position for a float

  `h` here

  `t` top of the page

  `b` bottom of the page

  `p` separate page of floats

  `!` strong recommendation

Floating Objects

`figure` environment

```
\begin{figure}[ht]
  \centering
  \includegraphics[width=.5\linewidth]{graphics/MagrittePipe}
\end{figure}
```

Floating Objects

`figure` environment

```
\begin{figure}[ht]
  \centering
  \includegraphics[width=.3\linewidth]{graphics/MagrittePipe}
  \caption{{\em The Treachery of Images} from Ren\'e Magritte}
  \label{fig:Magritte}
\end{figure}

Ren\'e Magritte painted Figure~\ref{fig:Magritte}
```

Figure 1 : *The Treachery of Images* from René Magritte

René Magritte painted Figure 1

Floating Objects

The subcaption package

The subcaption package permits to define subfloats within a single float

Example

```
\begin{figure}
  \begin{subfigure}[b]{0.45\linewidth}
    \centering
    \includegraphics[width = \linewidth]{graphics/MagrittePipe}
    \caption{{\em The Treachery of Images} from Ren\'e
      Magritte}\label{sfig:magritte}
  \end{subfigure}
  \begin{subfigure}[b]{.45\linewidth}
    \centering
    \includegraphics[width = \linewidth]{graphics/The_Persistence_of_Memory.jpg}
    \caption{{\em The Persistence of Memory} from Salvador
      Dal\'i}\label{sfig:dali}
  \end{subfigure}
  \caption{Two surrealist paintings}\label{fig:surreal}
  \end{figure}

  Do you prefer painting~\ref{sfig:magritte} or \ref{sfig:dali} from
  the two paintings presented in Figure~\ref{fig:surreal}
```

Floating Objects

The `subcaption` package

(a) *The Treachery of Images* from René Magritte

(b) *The Persistence of Memory* from Salvador Dalí

Figure : Two surrealist paintings

Do you prefer painting 2a or 2b from the two paintings presented in Figure 2

Floating Objects

knitr and subcaption

knitr ($\geqslant$ 1.5) supports the subcaption package

- Needs

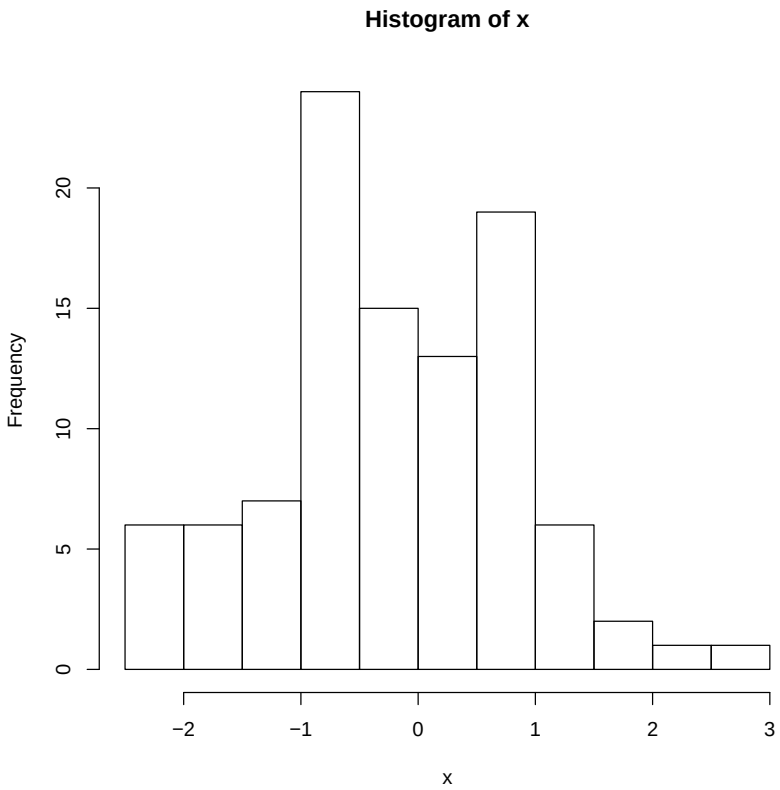
  ```
  \newcommand{\subfloat}[2][need a sub-caption]{\subcaptionbox{#1}{#2}}
  ```

  in the preamble

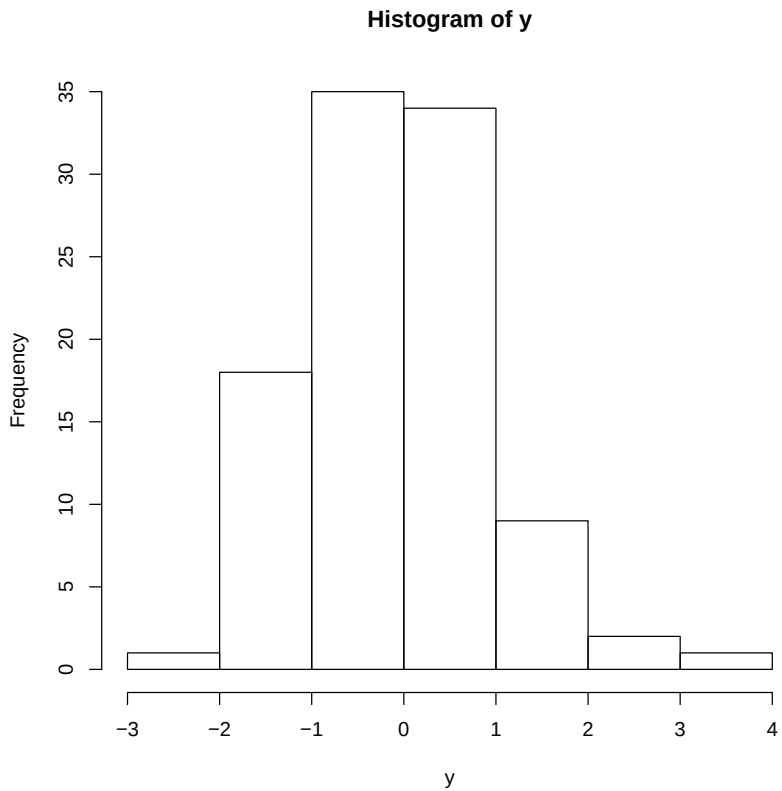
```
<<subfig, echo=FALSE, fig.cap = "Two histograms",
   fig.subcap=c("Histogram for x", "histogram for y"),
   out.width=".45\\linewidth">>=
set.seed(11111)
x <- rnorm(100)
y <- rnorm(100)

hist(x)
hist(y)
```

Floating Objects

knitr and `subcaption`



(a) Histogram for x



(b) histogram for y

Figure : Two histograms

Floating Objects

The `table` environment

```
\begin{table}[h]
  \caption{A table}\label{tab:tab_reg}
\begin{tabular}{lccc}
\toprule
& \multicolumn{3}{c}{Regression} \\
\cmidrule(r){2-4}
& Coef & SE    & p-value          \\
\midrule
Age    & 0.01 & 0.002 & 0.5      \\
Gender & 2    & 1     & 0.23     \\
\bottomrule
\end{tabular}
\end{table}
```

Table : A table

	Regression		
	Coef	SE	p-value
Age	0.01	0.002	0.5
Gender	2	1	0.23

In a lot of publications, table captions are above the respective tables

Floating Objects

Useful table environment

The `sidewaystable` environment is provided by the package `rotating`

```
\begin{sidewaystable}[h]
  \caption{A table}\label{tab:tab_side}
  \begin{tabular}{lccc}
    \toprule
    & \multicolumn{3}{c}{Regression} \\
    \cmidrule(r){2-4}
    & Coef & SE    & p-value         \\
    \midrule
    Age    & 0.01 & 0.002 & 0.5      \\
    Gender & 2    & 1     & 0.23     \\
    \bottomrule
\end{tabular}
 end{sidewaystable}
```

For tables that spread over several pages, one can use the `longtable` environment provided by the `longtable` package

Floating Objects

Tips and Tricks

- Think about using, e.g., `[!h]` to "force" LaTeX to put the figure *here*
- If that does not work, move the figure around
- By default, LaTeX requires that there be half a page of text on each page of floats
  - smaller graphics
  - Override this behaviour through obscure options. See `http://www.stat.berkeley.edu/users/spector/latex2e.pdf` p.35 (never personally tested)