

# Introduction to Biostatistical Computing

A bit more on  $\text{\LaTeX}$

Arthur Allignol

`arthur.allignol@uni-ulm.de`

# Table of Contents

## 1 Introduction

## 2 Tables, Graphics and Floats

# What is T<sub>E</sub>X/L<sup>A</sup>T<sub>E</sub>X?

T<sub>E</sub>X is a programming language (and also a typesetting system) written by Donald Knuth; released in 1978

L<sup>A</sup>T<sub>E</sub>X is a macro package facilitating the use of T<sub>E</sub>X

## Installation

Windows MiKTeX <http://www.miktex.org/>

OSX MacTeX <http://www.tug.org/mactex/>

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

# Minimal L<sup>A</sup>T<sub>E</sub>X document

```
\documentclass{article}
```

```
\begin{document}
```

```
Hello World!
```

```
\end{document}
```

# A usual $\text{\LaTeX}$ 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}    % notitlepage|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

# Table of Contents

1 Introduction

2 Tables, Graphics and Floats



# 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 `|` in `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 *i*th and *j*th 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{2-5}
& 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{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

	<i>Dependent variable:</i>	
	life	
	(1)	(2)
log(phys)		−2.259*** (−3.724, −0.794)
log(tv)	−4.260*** (−5.103, −3.416)	−2.916*** (−4.073, −1.758)
Constant	77.887*** (75.496, 80.279)	90.622*** (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*** (1.22)	90.62*** (4.36)
log(tv)	-4.26*** (0.43)	-2.92*** (0.59)
log(phys)		-2.26** (0.75)
R <sup>2</sup>	0.73	0.79
Adj. R <sup>2</sup>	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

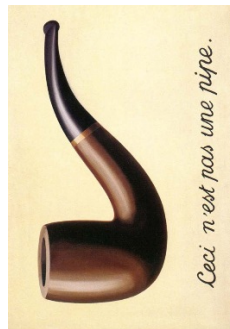
## Width of figure

- 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*
- $\text{\LaTeX}$  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}

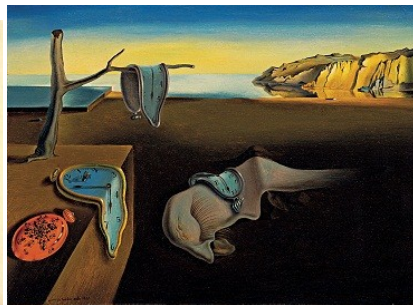


# Floating Objects

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** ( $\geq 1.5$ ) supports the subcaption package

- Needs

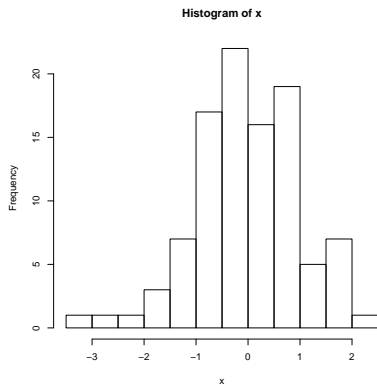
```
\newcommand{\subfloat}[2][need a sub-caption]{\subcaptionbox{#1}{#2}}
in the preamble
```

```
<<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)

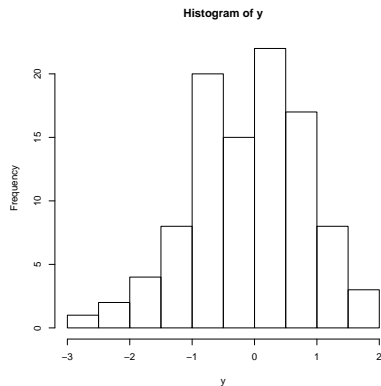
hist(x)
hist(y)
```

# 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”  $\text{\LaTeX}$  to put the figure *here*
- If that does not work, move the figure around
- By default,  $\text{\LaTeX}$  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)