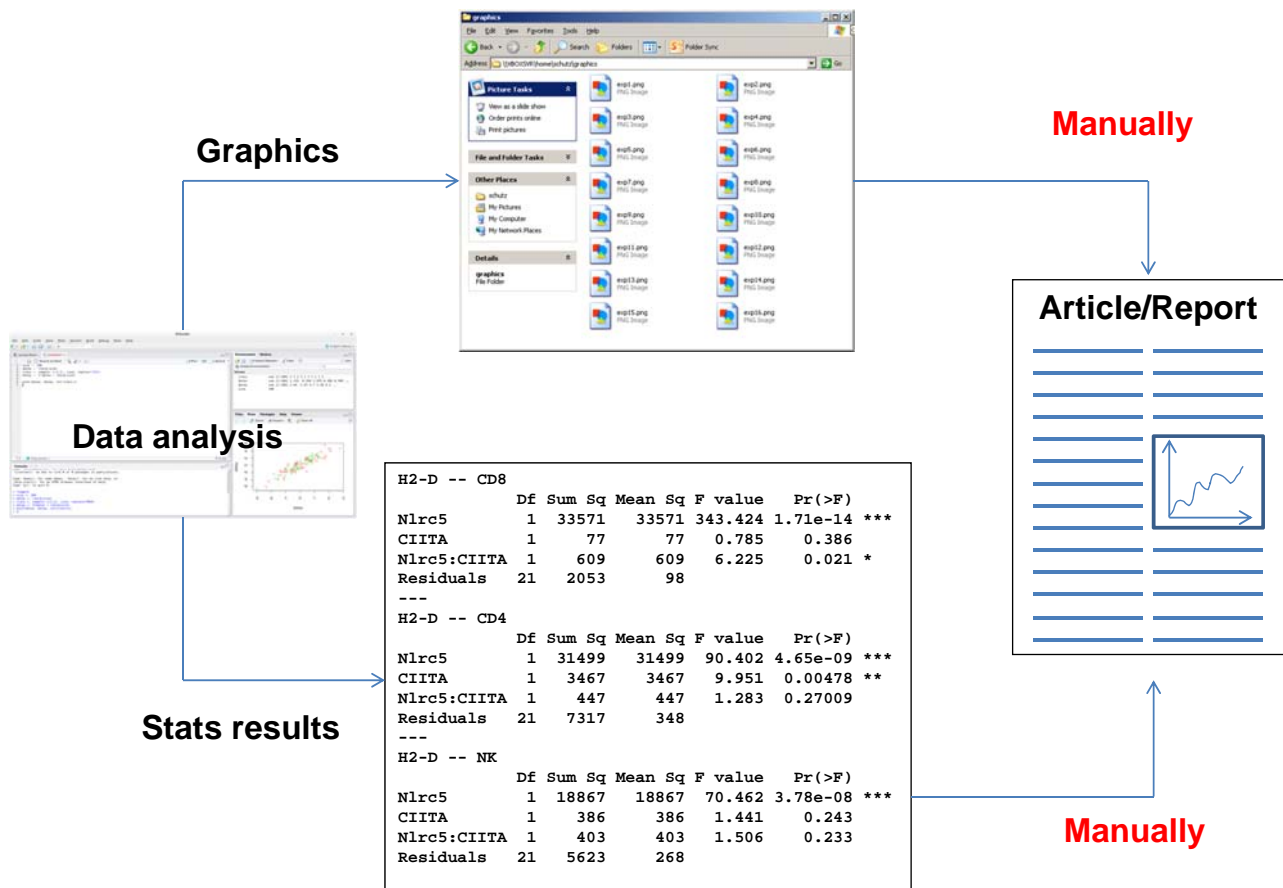


# How most reports are created



# Dynamic documents

## *Dynamic documents*

- Based on the idea of **literate programming**
- Combine program code and explanation/documentation in same document (Donald Knuth, 1984)
- Documents in which the information is always up-to-date
- Writing report step by step while processing the data, in the same file
- Integrate your results in a report: *write the R code directly with the text, and later integrate the results directly into the text.*

**Literate programming** is an approach to programming introduced by Donald Knuth in which a program is given as **an explanation of the program logic in a natural language, such as English**, interspersed with **snippets of macros and traditional source code**, from which a compilable source code can be generated.

[https://en.wikipedia.org/w/index.php?title=Literate\\_programming&oldid=623826432](https://en.wikipedia.org/w/index.php?title=Literate_programming&oldid=623826432)



Home

Objects

Options

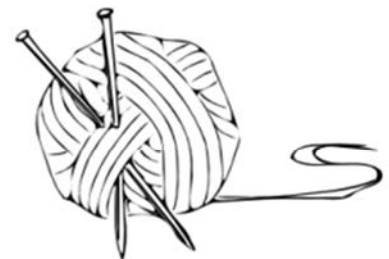
Hooks

Patterns

Demos

# knitr

Elegant, flexible and fast dynamic report generation with R



---

## Overview

---

The knitr package was designed to be a transparent engine for dynamic report generation with R, solve some long-standing problems in Sweave, and combine features in other add-on packages into one package (`knitr`  $\approx$  `Sweave` + `cacheSweave` + `pgfSweave` + `weaver` + `animation::saveLatex` + `R2HTML::RweaveHTML` + `highlight::HighlightWeaveLatex` + `0.2 * brew` + `0.1 * SweaveListingUtils` + more).

<http://yihui.name/knitr/>

## *Why use knitr ?*

- all-in-one: analysis, documenting, formatting, reporting
- no annoying and error-prone copy-pasting
- modifying input data or code: changes are directly reflected in report
- easy to display underlying code in report when needed
- split code in chunks, but can still access all previously defined
- variables (single R session)
- flexible: code externalization, child documents, caching,...

## *What we need to use knitr*

- R Studio provides most of what is needed to use knitr, starting with the `knitr` R package
- In order to create PDFs, a TeX distribution may be required (eg TeX Live).

## *Documentation and references*

- Knitr website: <http://yihui.name/knitr/>
- Knitr-examples on github:  
<https://github.com/yihui/knitr-examples>
- Knitr book:  
<https://github.com/yihui/knitr-book>
- Example of published documents:  
<http://rpubs.com>
  
- Book: "R Markdown: The definitive guide"  
<https://bookdown.org/yihui/rmarkdown/>

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## **How to write the actual report ?**

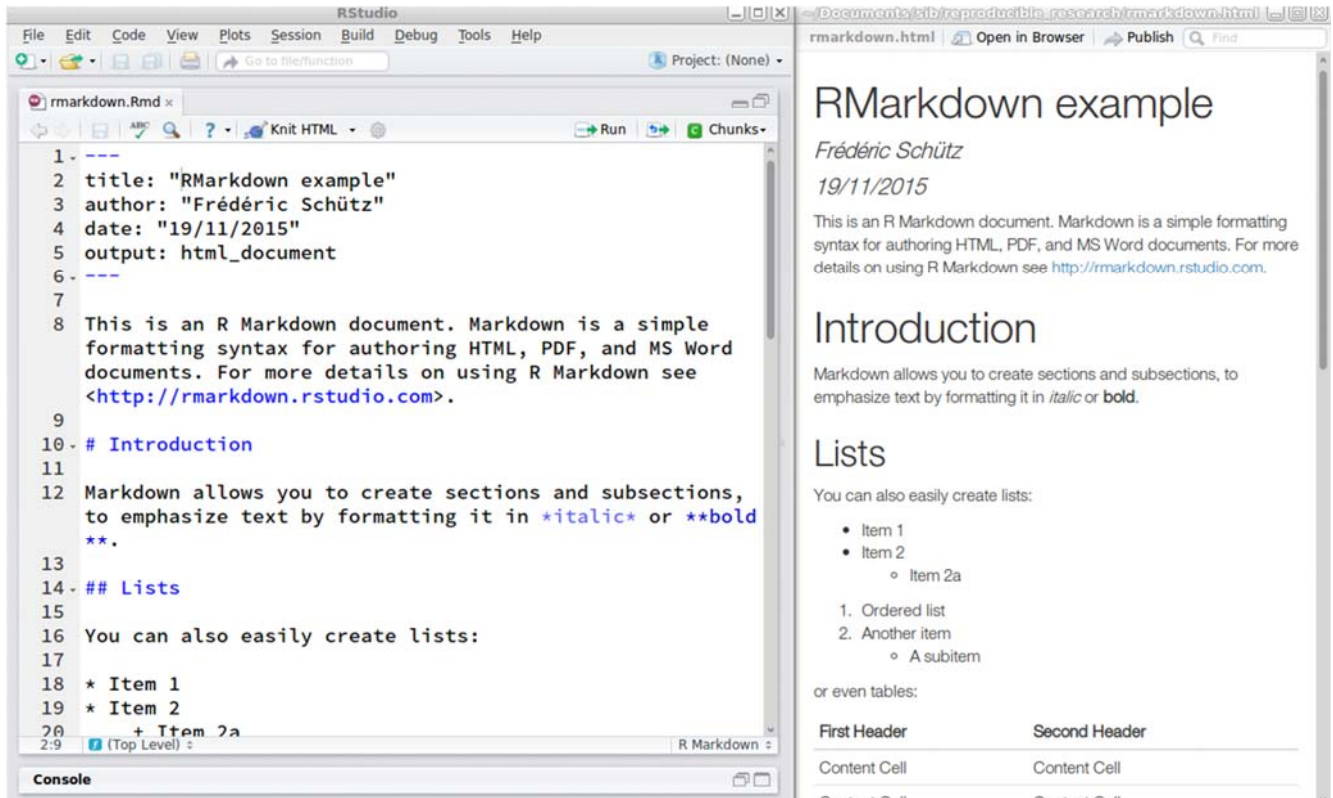
# Markdown and R Markdown

## *Markdown and RMarkdown*

Markdown is a simple plain text format that allows you to specify the layout of a document, and which can easily be converted to different formats afterwards.

R Markdown combines the core syntax of markdown (easy-to-write plain text format) with embedded R code chunks that are run so their output can be included in the final document.

# R Markdown v2 (<http://rmarkdown.rstudio.com/>)



The screenshot shows the RStudio interface with an R Markdown document open. The document is titled "RMarkdown example" and is authored by "Frédéric Schütz" on "19/11/2015". The output format is set to "html\_document". The document content includes an introduction to R Markdown, a section on lists, and a table.

```
1 ---
2 title: "RMarkdown example"
3 author: "Frédéric Schütz"
4 date: "19/11/2015"
5 output: html_document
6 ---
7
8 This is an R Markdown document. Markdown is a simple
9 formatting syntax for authoring HTML, PDF, and MS Word
10 documents. For more details on using R Markdown see
11 <http://rmarkdown.rstudio.com>.
12
13 # Introduction
14
15 Markdown allows you to create sections and subsections,
16 to emphasize text by formatting it in italic or bold
17 **.
18
19 ## Lists
20
21 You can also easily create lists:
22
23 * Item 1
24 * Item 2
25   + Item 2a
26
27
28
29
```

The rendered HTML output shows the following structure:

## RMarkdown example

Frédéric Schütz  
19/11/2015

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

## Introduction

Markdown allows you to create sections and subsections, to emphasize text by formatting it in *italic* or **bold**.

## Lists

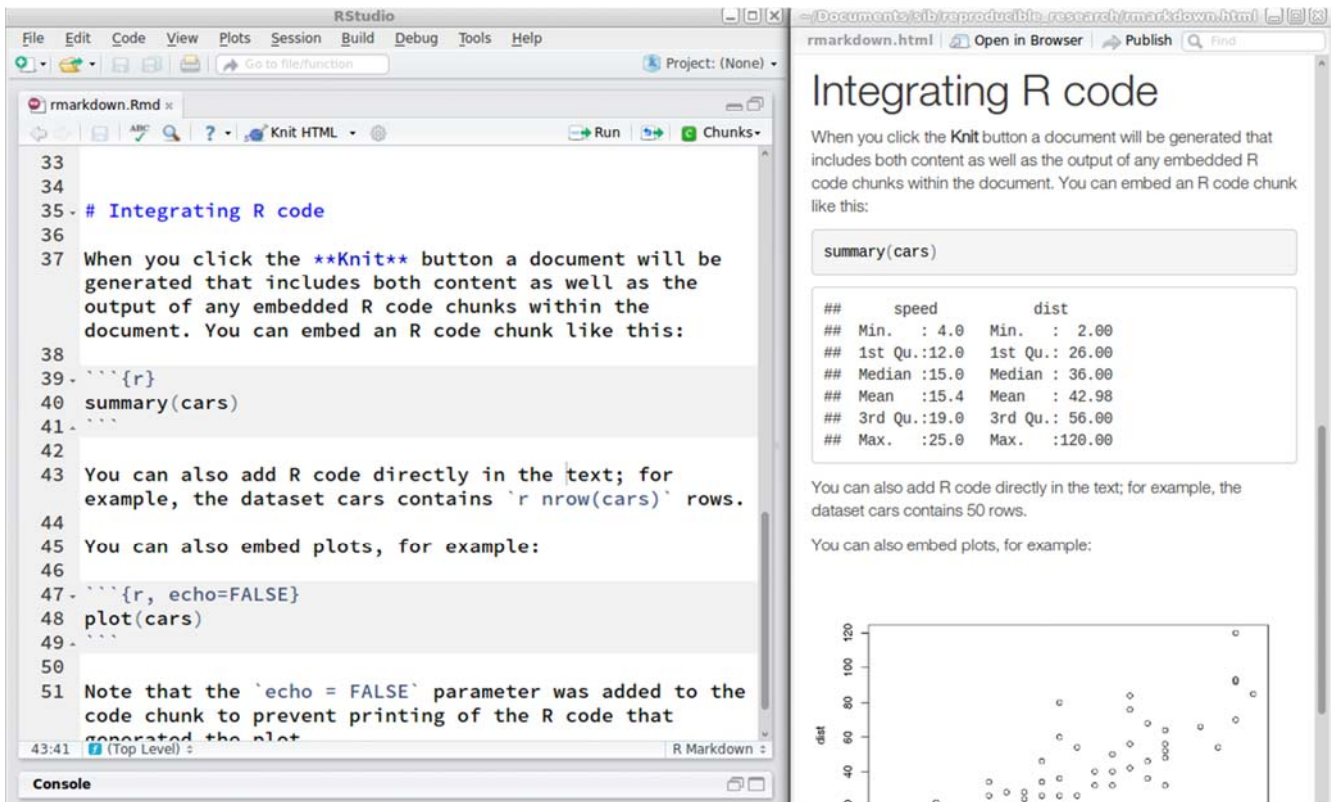
You can also easily create lists:

- Item 1
- Item 2
  - Item 2a

1. Ordered list
2. Another item
  - A subitem

or even tables:

First Header	Second Header
Content Cell	Content Cell
Content Cell	Content Cell



The screenshot shows the RStudio interface with an R Markdown document open. The document is titled "Integrating R code" and contains an R code chunk that generates a summary of the 'cars' dataset and a scatter plot of distance vs. speed.

```
33
34
35 # Integrating R code
36
37 When you click the Knit button a document will be
38 generated that includes both content as well as the
39 output of any embedded R code chunks within the
40 document. You can embed an R code chunk like this:
41
42 ```{r}
43 summary(cars)
44 ```
45
46 You can also add R code directly in the text; for
47 example, the dataset cars contains `nrow(cars)` rows.
48
49 You can also embed plots, for example:
50
51 ```{r, echo=FALSE}
52 plot(cars)
53 ```
54
55 Note that the `echo = FALSE` parameter was added to the
56 code chunk to prevent printing of the R code that
57 generated the plot
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```

## *R Markdown example*

```
---  
title: "Untitled"  
author: "Frédéric Schütz"  
date: "23/01/2015"  
output: html_document  
---
```

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

---

## *R Markdown example (continued)*

```
` `{r}  
summary(cars)  
` `
```

You can also embed plots, for example:

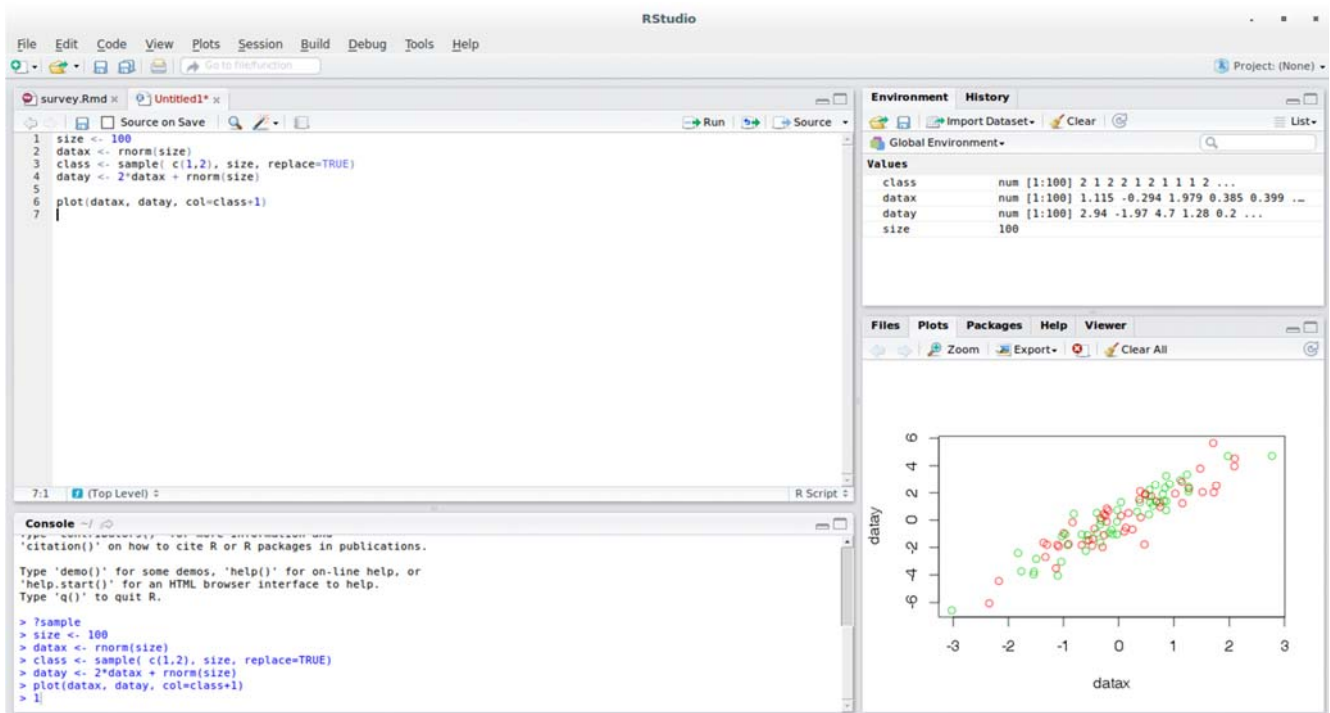
```
` `{r, echo=FALSE}  
plot(cars)  
` `
```

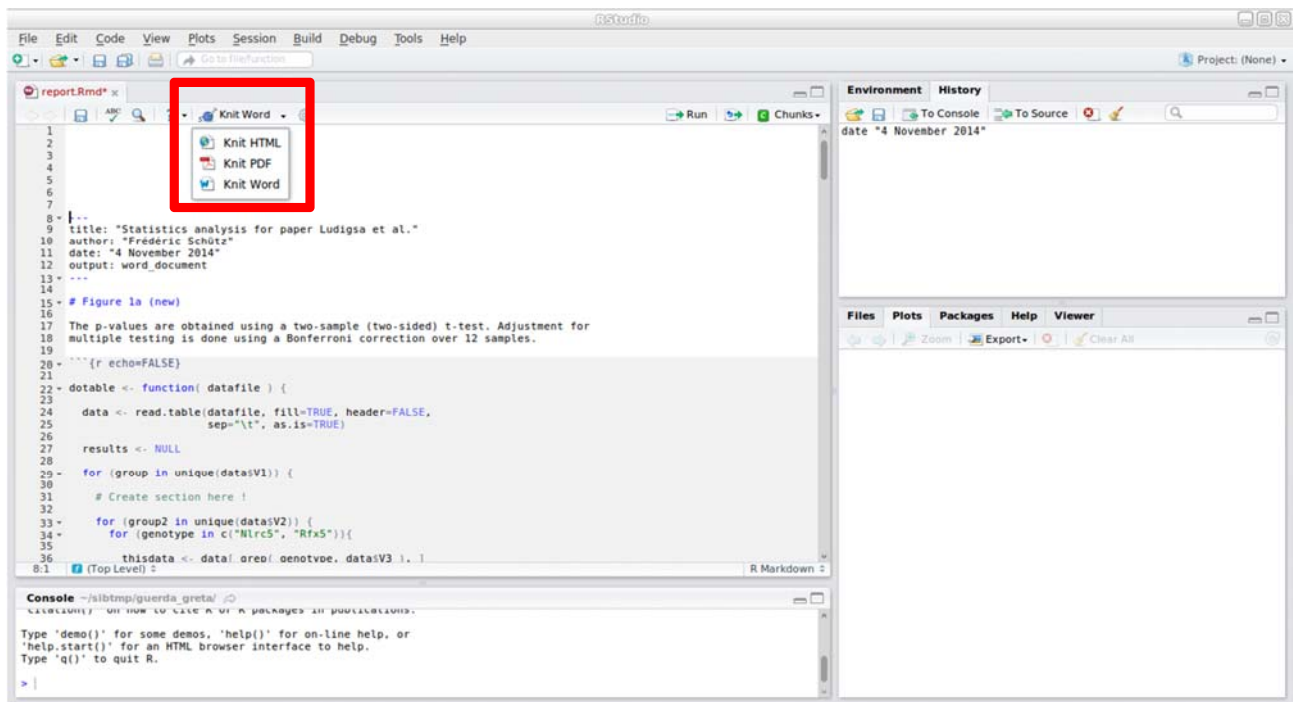
Note that the ``echo = FALSE`` parameter was added to the code chunk to prevent printing of the R code that generated the plot.



- Emphasis: *\*italic\**      **\*\*bold\*\***  
                  \_italic\_      \_\_bold\_\_
- Headers  
  # Header 1  
  ## Header 2  
  ### Header 3
- Unordered List:  
  \* Item 1  
  \* Item 2  
    + Item 2a  
    + Item 2b
- Ordered list:  
  1. Item 1  
  2. Item 2  
  3. Item 3  
    + Item 3a  
    + Item 3b

## RStudio





## *R Code chunks*

- R code placed in *chunks* will be evaluated and printed  

```
```\r\summary(cars$dist)\summary(cars$speed)\```
```
- Inline R Code  
There were ``r` nrow(cars)`` cars studied
- Links: use a plain http address or add a link to a phrase:  

```
http://example.com
```

```
[linked phrase](http://example.com)
```
- Images on the web or local files in the same directory:  

```
![alt text](http://example.com/logo.png)
```

```
![alt text](figures/img.png)
```

# What if markdown is not enough ?

## Limitations of RMarkdown

RMarkdown is a **simple** plain text format; it allows you to specify a simple layout.

If you want more control over the final result, you can use knitr with another formatting language.

In particular, you can embed R chunks in LaTeX code (in a similar way to what is done with Rmarkdown)

## *How can we write the report with LaTeX ?*

- Write .Rnw files, and generate PDF reports using LaTeX (can be done within R Studio)
- Keep the general structure of standard LaTeX document:

```
\documentclass{...}  
\usepackage{...}  
\begin{document}  
...  
\end{document}
```
- Use the same LaTeX packages/configurations as usual
- Add R chunks in the LaTeX code

## *How can we write the report with LaTeX ?*

- Add R chunks in the LaTeX code
- A chunk starts with a header line:

```
<<mychunk>>=
```

- ... and is closed with a @ sign
- Example:

```
<<mychunk>>=  
hist(x)  
@
```

## *Storing the session information*

```
> library(affy)
> sessionInfo()
R version 2.15.1 (2012-06-22)
Platform: x86_64-pc-linux-gnu (64-bit)

locale:
 [1] LC_CTYPE=en_AU.UTF-8      LC_NUMERIC=C
 [3] LC_TIME=en_AU.UTF-8      LC_COLLATE=en_AU.UTF-8
 [5] LC_MONETARY=en_AU.UTF-8  LC_MESSAGES=en_AU.UTF-8
 [7] LC_PAPER=C               LC_NAME=C
 [9] LC_ADDRESS=C            LC_TELEPHONE=C
[11] LC_MEASUREMENT=en_AU.UTF-8 LC_IDENTIFICATION=C

attached base packages:
[1] stats      graphics  grDevices  utils      datasets  methods   base

other attached packages:
[1] affy_1.34.0      Biobase_2.16.0    BiocGenerics_0.2.0

loaded via a namespace (and not attached):
[1] affyio_1.24.0      BiocInstaller_1.4.7  preprocessCore_1.18.0
[4] zlibbioc_1.2.0
```

## Exercises

- Using RStudio, start a new .Rmd (R Markdown file).
- Look at the template that was provided, change the R code
- Create an HTML, a Word and a PDF file from this Markdown code
- Make sure you know how to do at least the following: sections, lists, create a table from R, insert a graphic from R.
- Note: you may need to install a TeX distribution to generate PDF; you can also generate a Word document, and print/convert it to PDF afterwards
- Make sure to include information about the current R session (R version, packages loaded) in the final document
- Adapt an R script of your choice (ideally one you would use in your work) in a Markdown report