

# Reporting Using R and Markdown:

## Part 2: Markdown

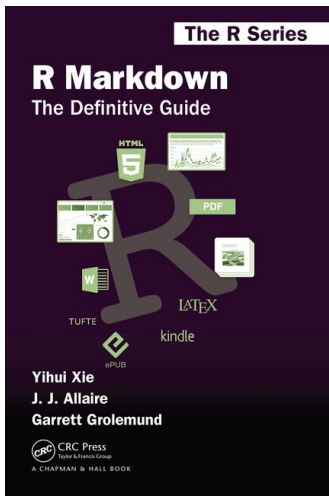
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# Markdown

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# Preliminaries



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**R Markdown. The Definitive Guide**  
1st Edition  
CRC Press, 2018

ISBN 978-1-138-35933-8

Content available on the Web:  
<https://bookdown.org/yihui/rmarkdown/>



Matt Cone

## **The Markdown Guide**

<https://www.markdownguide.org/book>

Content available on the Web:

<https://www.markdownguide.org/>

# Typographical Terminology

Symbol	Name
. ,	Period, Comma
: ;	Colon, Semicolon
( )	Parentheses
[ ]	(Square) brackets
{ }	(Curly) braces
< >	Angle brackets
- _	Minus sign or hyphen, Underscore
—	en dash (“Halbgeviertstrich” or “Gedankenstrich”)
—	em dash (“Geviertstrich”)
~	Tilde
/ \	(Forward) slash, Backslash
^	Caret
*	Asterisk
’ ”	Feet symbol, Inch symbol
“ ”	Quotation marks
’	Apostrophe
`	Backtick

# R Markdown

We will use R Markdown within RStudio:

`https://rmarkdown.rstudio.com/`

RStudio offers export to

- HTML
- Word
- PDF (requires  $\text{\LaTeX}$ )
- HTML slides
- PDF slides (requires  $\text{\LaTeX}$ )

# R Markdown

R Markdown documents begin with the following header:

```
---  
title: ""  
author: ""  
date: ""  
output: html_document  
---
```

→ Open file `Empty.Rmd`



# General Rule

## General Rule in Markdown:

Add an

Empty Line

Before and After

Everything You Create!

Text using Markdown syntax	Corresponding HTML produced by a Markdown processor
<p>Heading</p> <p>=====</p> <p>Sub-heading</p> <p>-----</p> <p>Paragraphs are separated by a blank line.</p> <p>Two spaces at the end of a line produces a line break.</p> <p>Text attributes <i>_italic_</i>, <b>**bold**</b>, <code>`monospace`</code>.</p> <p>Horizontal rule:</p> <p>---</p> <p>Strikethrough:</p> <p>--<del>strikethrough</del>--</p> <p>Bullet list:</p> <ul style="list-style-type: none"><li>* apples</li><li>* oranges</li><li>* pears</li></ul> <p>Numbered list:</p> <ol style="list-style-type: none"><li>1. lather</li><li>2. rinse</li><li>3. repeat</li></ol> <p>An [example](http://example.com).</p> <p>(Icon-pictures.png "icon")</p> <p>&gt; Markdown uses email-style &gt; characters for blockquoting.</p> <p>Inline &lt;abbr title="Hypertext Markup Language"&gt;HTML&lt;/abbr&gt; is supported.</p>	<p>&lt;h1&gt;Heading&lt;/h1&gt;</p> <p>&lt;h2&gt;Sub-heading&lt;/h2&gt;</p> <p>&lt;p&gt;Paragraphs are separated by a blank line.&lt;/p&gt;</p> <p>&lt;p&gt;Two spaces at the end of a line produces a line break.&lt;/p&gt;</p> <p>&lt;p&gt;Text attributes &lt;em&gt;italic&lt;/em&gt;, &lt;strong&gt;bold&lt;/strong&gt;, &lt;code&gt;monospace&lt;/code&gt;.&lt;/p&gt;</p> <p>&lt;p&gt;Horizontal rule:&lt;/p&gt;</p> <p>&lt;hr /&gt;</p> <p>&lt;p&gt;Strikethrough:&lt;/p&gt;</p> <p>&lt;del&gt;strikethrough&lt;/del&gt;</p> <p>&lt;p&gt;Bullet list:&lt;/p&gt;</p> <ul style="list-style-type: none"><li>&lt;li&gt;apples&lt;/li&gt;</li><li>&lt;li&gt;oranges&lt;/li&gt;</li><li>&lt;li&gt;pears&lt;/li&gt;</li></ul> <p>&lt;p&gt;Numbered list:&lt;/p&gt;</p> <ol style="list-style-type: none"><li>&lt;li&gt;lather&lt;/li&gt;</li><li>&lt;li&gt;rinse&lt;/li&gt;</li><li>&lt;li&gt;repeat&lt;/li&gt;</li></ol> <p>&lt;p&gt;An &lt;a href="http://example.com"&gt;example&lt;/a&gt;.&lt;/p&gt;</p> <p>&lt;p&gt;&lt;img alt="Image" title="icon" data-bbox="455 825 495 845" /&gt; (Icon-pictures.png "icon")&lt;/p&gt;</p> <p>&lt;p&gt;&lt;div&gt;&gt; Markdown uses email-style &gt; characters for blockquoting.&lt;/div&gt;&lt;/p&gt;</p> <p>&lt;p&gt;Inline &lt;abbr title="Hypertext Markup Language"&gt;HTML&lt;/abbr&gt; is supported.&lt;/p&gt;</p>

# Structure of the Document

# Headings

**Headings** can be created using the # symbol.

You can use up to 6 heading levels.

From heading level 6 on, the style does not change.

```
# Heading level 1  
  
## Heading level 2  
  
### Heading level 3  
  
...
```

# Headings

An alternative for **Headings with only two levels**:  
any number of = and - on the line below the text.

```
Heading level 1
```

```
=====
```

```
Heading level 2
```

```
-----
```

or:

```
Heading level 1
```

```
=
```

```
Heading level 2
```

```
-
```

# Paragraphs

**Paragraphs** are created by using a blank line.

Text of paragraph 1, like lorem Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt labore et dolore magna aliqua.

In paragraph 2, it goes on like ut enim ad minim veniam, ab exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in dolore.

Paragraph 3: Esse cillum dolore eu fugiat nulla pariatur. cupidatat non proident, sunt in culpa qui officia deserunt.

# Horizontal Rules

**Rules (or Lines)** are created by three or more  
hyphens ---,  
underscores \_\_\_\_,  
or asterisks \*\*\*.

Some text.

---

---

\*\*\*

Continue text.

# Style Elements

# Emphasis

As **Emphasis**, only **bold** and *italic* are possible.

Make a word *italic* using one `*asterisk*` or one `_underscore_`.

Make a word **bold** using two `**asterisks**` or two `__underscores__`.



# Strong Emphasis

**bold** and *italic* can be combined.

```
***Important***
```

```
___Important___
```

```
__*Important*__
```

```
**_Important_**
```

# Subscript and Superscript

R Markdown allows for <sub>subscript</sub> and <sup>superscript</sup>

The expression to **Subscripted** is enclosed in two tildes ~ ~

The expression to **Superscripted** is enclosed in two carets ^ ^

**No Spaces** allowed!

H~2~0 is water and C~6~H~12~O~6~ is glucose.

2^64^ is a lot!

~Hell~Earth~Heaven~

# Dashes

As in Word and  $\text{\LaTeX}$ , the **En Dash** is accessed by two adjacent minus symbols --

For the **Em Dash**, use three minus symbols ---

Open 9--5 (Mon--Fri).

95%-confidence interval: 1.03--2.80

Price: 18.---;

Europeans -- refined as they are -- use the en dash.

American typographers---real men---use the em dash.

# Strikethrough

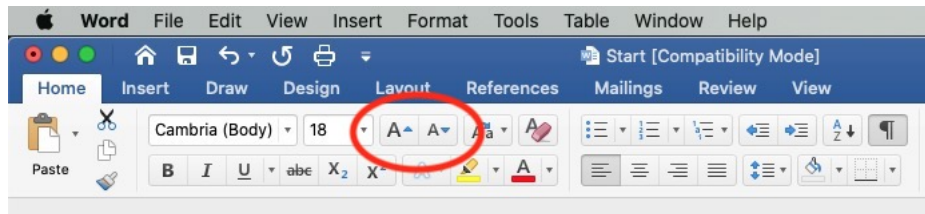
Perhaps useful when exchanging and editing documents is the **Strikethrough** (~~ before and after a word).

The world is ~~flat~~ round.

# Font Size

In Markdown, it is not possible to control font size.

- A **HTML Document** can be viewed in a browser which allows “**Zooming.**”
- In **Word**, fonts can be adjusted in size whilst maintaining scalar relationships via the **Increase Font Size** and **Decrease Font Size** buttons.



# Blockquotes

To create a blockquote, add an **Angle Bracket** > in front of a paragraph.

Multiple paragraphs require a > on the empty line.

Note: Nested blockquotes (>>) appear only in HTML.

The following quote is from the lost novel of Kleist:

```
> Lorem ipsum dolor sit amet, consectetur adipiscing eo,  
> sed do eiusmod tempor incididunt ut labore et dolore:  
>  
>> Exercitation ullamco laboris nisi ut aliquip ex ea  
>> commodo consequat. Duis aute irure dolor in reprehensi  
>  
> Finis terrae hic advenit.
```

And so on.

# Lists, Tables, Images, Footnotes

# Organize Items: Ordered Lists

**Ordered Lists** start with a number, followed by a period.

From then on, the numbers do not have to be ordered.

Without any text in between, the numbers increase.

1. First item
2. Second item
3. Third item

1. First item
1. Second item
1. Third item

1. First item
7. Second item
4. Third item



# Organize Items: Ordered Lists

With text in between, the numbering starts anew.

Again:

1. First item
2. Second item
3. Third item

Then, we have

1. First item
1. Second item
1. Third item

Followed by

1. First item
7. Second item
4. Third item

# Organize Items: Ordered Lists

The ordering starts with the first encountered number!

Try this:

```
13. First item
2. Second item
3. Third item
```

```
1. First item
1. Second item
1. Third item
```

```
7. First item
20. Second item
4. Third item
```

# Organize Items: Ordered Lists

**Nested Ordered Lists** can be created by inserting **4 Spaces** for **Indentation**.

1. First item
  1. First subitem
  2. Second subitem
  3. Third subitem
2. Second item
  1. First subitem
  2. Second subitem
1. Third item
  6. First subitem
  1. Second subitem
  1. Third subitem

# Organize Items: Unordered Lists

For an **Unordered List**, use hyphens `-`, asterisks `*`, or plus signs `+`.

The result is the same: `-`, `*`, and `+` are exchangeable.

**Nesting** is achieved by **Indentation with 4 Spaces**.

```
- Mangos
+ Oranges
* Apples
    + Granny Smith
    - McIntosh
    * Gala
- Strawberries
    * red
    * green
```

# Organize Items: Unordered Lists

After two levels of nesting, the symbols in the result repeat.

Test:

- Holla
  - die
    - Waldfee!
      - yawn...

# Organize Items in Lists

**Ordered Lists** and **Unordered Lists** can be mixed:

Insert 4 spaces for indentation.

1. First item
  - This here
  - + That yonder
2. Second item

Like last year.

- Proceed as follows:
  1. Lather
  2. Rinse
  3. Repeat
- \* Infinite loop

# Tables

**Tables** are created by a separate block with the **Pipe Symbol |** **Between Words**, acting as column separator.

**Hyphens** on line 2 lead to a **Header**.

A nice table:

Col 1	Col 2	
-----	-----	
word	number	
booktitle	Quite long	

Continue text.

# Tables

**“Cell Widths” Do Not Matter**, no aligning is required.

Pipes are **Optional at the Beginning or the End**.

Short, but the same:

```
Col 1 | Col 2
```

```
-|-
```

```
word | number
```

```
booktitle | Quite long
```

Continue text.



# Alignment Within Tables

A colon `--` at the left end of the hyphens for the heading aligns the text in the column to the left.

A colon `--:` at the right end of the hyphens aligns the column to the right.

Colons at both ends `--:` center the text.

```
Col 1 | Col 2 | Col 3
  :--: | ----: | :----
a | uno | 451
ebcudo | doubletriplet | 887-x-23
```

# Inserting Pictures

**Images with a Caption** can be inserted everywhere.

**Syntax:** ``

As an option, you can add a caption to the image within the brackets `[]`.

Even if there is no caption, the brackets are required.

```
![Mark and Dawn in Summer 1999.](Zalp.jpg)
```

# Footnotes and References

A **Footnote** appears as a superscript number while the text is added at the bottom of the page.

- In HTML, the number is a link; by clicking the number/link, the cursor jumps to the content of the footnote.
- In Word, the number is a text element. Hovering over it displays the content of the footnote.

## Syntax: Insertion of the Footnote

Within brackets, a caret followed by an identifier: [*^identifier*]

- The identifier can be a number or a word; no spaces, no tabs.
- Identifiers are turned automatically into increasing numbers.

## Example:

... running text with a footnote,<sup>[1]</sup> followed by more<sup>[^NoteGenes]</sup> and a reference.<sup>[^Xiao2019]</sup> ...

# Footnotes and References

The text of the footnote can be put almost anywhere in the document (not in lists, tables, or quotes).

## Syntax: Footnote Text

- The identifier is repeated, followed by a colon [*^identifier*]:
- If there are paragraphs, the text is indented with 4 spaces.

```
... running text with a footnote,[^1] followed by more[^NoteGenes]
and a reference.[^Xiao2019] ...
```

```
[^1]: Just a small note.
```

```
[^NoteGenes]: Here, genes are explained.
```

```
[^Xiao2019]: Xiao L, BRAC-5 in Cancer. JAMA 2019. 47(1):12--19.
```

```
The text could continue here.
```

# Footnotes and References

Example with paragraphs:

This is a simple footnote,<sup>2</sup> and this one is longer.<sup>big</sup>

<sup>2</sup>: Cf. Thomson and Thompson (1934).

<sup>big</sup>: We can have paragraphs and style elements.

Use `**4 spaces**` as `_indentation_`.

Another paragraph in the footnote.

HERE, the main text continues.

# Links and Email Addresses

# Inserting Links

To insert a link, enclose the **Link Text in Brackets** [], followed by the **URL in Parentheses** ().

Note: “Tooltip titles” (the little box with explanatory text that shows when the mouse hovers over a link) appear only in HTML.

Bold and italic can be added.

```
R is on [CRAN] (https://cran.r-project.org/).
```

```
R is on [CRAN] (https://cran.r-project.org/ "Official Home of R").
```

```
Use *[R] (https://cran.r-project.org/)*.
```

```
Use **[R] (https://cran.r-project.org/)**.
```

```
Use ***[R] (https://cran.r-project.org/)***.
```

# Links and Email Addresses

**Displayed Links and Email Addresses** can be marked in the text using **Angle Brackets** `<>`.

Bold and italic can be applied.

For further questions, visit `<https://rmarkdown.rstudio.com/>`  
or write directly to `<franz.klammer@downhill.at>`.

For anything else, mail to `***<bundesrat@bundeshaus.ch>***`.



# Mathematical Expressions

# R Markdown: Mathematical Expressions

R Markdown offers many of  $\text{\LaTeX}$ 's mathematical typesetting features.

RStudio displays the resulting expression live in a floating window.

Word can not process all symbols that HTML or PDF can.

**Inline-Syntax:** Enclose the expression within two dollar signs  $\$ \$$

**Formula-Syntax:** Use two dollar signs on each side  $\$ \$ \$ \$$

The identity  $e^{i\pi} + 1 = 0$  is attributed to Euler.

Binominal density function

$$f(k; n, \pi) = \binom{n}{k} \pi^k (1 - \pi)^{n - k}$$

# Frequently Used Formatting and Symbols

Symbol	Output
<code>a^2</code>	$a^2$
<code>e^{c + d}</code>	$e^{c+d}$
<code>x_i</code>	$x_i$
<code>y_{j, k}</code>	$y_{j,k}$
<code>\ldots</code>	$\dots$
<code>a \cdot b</code>	$a \cdot b$
<code>x_1 \cdots x_n</code>	$x_1 \cdots x_n$
<code>\sum_{i = 1}^n</code>	$\sum_{i=1}^n$
<code>\prod_{i = 1}^n</code>	$\prod_{i=1}^n$
<code>\frac{a + b}{cd}</code>	$\frac{a+b}{cd}$
<code>\leftarrow</code>	$\leftarrow$
<code>\rightarrow</code>	$\rightarrow$
<code>\alpha \ldots \omega</code>	$\alpha \dots \omega$
<code>A \ldots \Omega</code>	$A \dots \Omega$

# R Markdown: Mathematical Formulas

- For further examples, please refer to the **R Markdown Book**:  
<https://bookdown.org/yihui/rmarkdown/markdown-syntax.html>
- For an excellent overview on mathematical typesetting in  $\text{\LaTeX}$ , we recommend Chapter 3 in **Tobias Oetiker's Introduction**:  
<https://tobi.oetiker.ch/lshort/lshort.pdf>
- Also extremely helpful to find  $\text{\LaTeX}$  symbols:  
<http://detexify.kirelabs.org/classify.html>

# Escaping Control Characters

# The Great Escape

To **Display the Symbols Used for Controlling Markdown**, use the backslash `\` as an escape character.

Character	Name
<code>\</code>	backslash
<code>`</code>	tick mark
<code>*</code>	asterisk
<code>_</code>	underscore
<code>{ }</code>	curly braces
<code>[ ]</code>	brackets
<code>( )</code>	parentheses
<code>#</code>	number sign (or hash)
<code>+</code>	plus sign
<code>-</code>	minus sign (hyphen)
<code>!</code>	exclamation mark
<code> </code>	pipe

# Escaping: Examples

`\*` makes text *\*italic\**.

`\>` at the beginning is possible.

Symbol | Name

-|-

`\|` | pipe

Use `\![]` to insert a picture.

The dot product `\<a, b\>` should not be a link.

Nifty, the `\\`, innit?

# The Whole World in Your Hands

Since Markdown is converted to HTML, you can use **All HTML Character Entities** directly:

<https://dev.w3.org/html5/html-author/charref>

```
&copy; &reg; &trade;
```

```
&Cconint; &rarrpl;
```

```
&ndash; &mdash;
```

```
&blk14;
```

```
&Ascr; &Bfr; &Copf; &Dcy;
```



# References

# References

- Cone, Matt (2018). *The Markdown Guide*. URL: <https://www.markdownguide.org/book>.
- Xie, Yihui, J. J. Allaire, and Garrett Grolemond (2018). *R Markdown. The Definitive Guide*. CRC Press. ISBN: 978-1-138-35933-8. URL: <https://bookdown.org/yihui/rmarkdown/>.

Le Reste. . .

# Line Breaks

**Line Breaks** are a bit tricky:

Add **2 Spaces** after the last word of the line you want to break.

```
This_line_ends_here.  
```

```
And_goes_on_verbosely_on_this_line.
```

```
Without_the_spaces
```

```
this_part_will_be_wrapped_back_up.
```

# Displaying Code

To show **Code in Monospace Font** and with a **Grey Background**, use **4 Spaces for Indentation**.

Note: R Markdown does not produce line numbers.

Some Code:

```
int main(void)
{
    printf("hello, world\n");

    return 0;
}
```

A classic.

# Displaying Code In-line

Within normal text, use **Backtick Marks** ``` before and after.

In Python, type ``print("Error!")``, without ``\n``.

# Escaping: Examples

The backtick is escaped with the backslash `\`.

Ticks within code are escaped by outer double ticks.

The `\`` symbol is used for code.

In R, use `\`paste(`hello`)\``