An introduction to R Markdown

West Lab, Dept. Biological Sciences, UCT

Ruan van Mazijk

2019-01-24

Please refer to the pre-tut setup, if you haven’t already, before we begin.

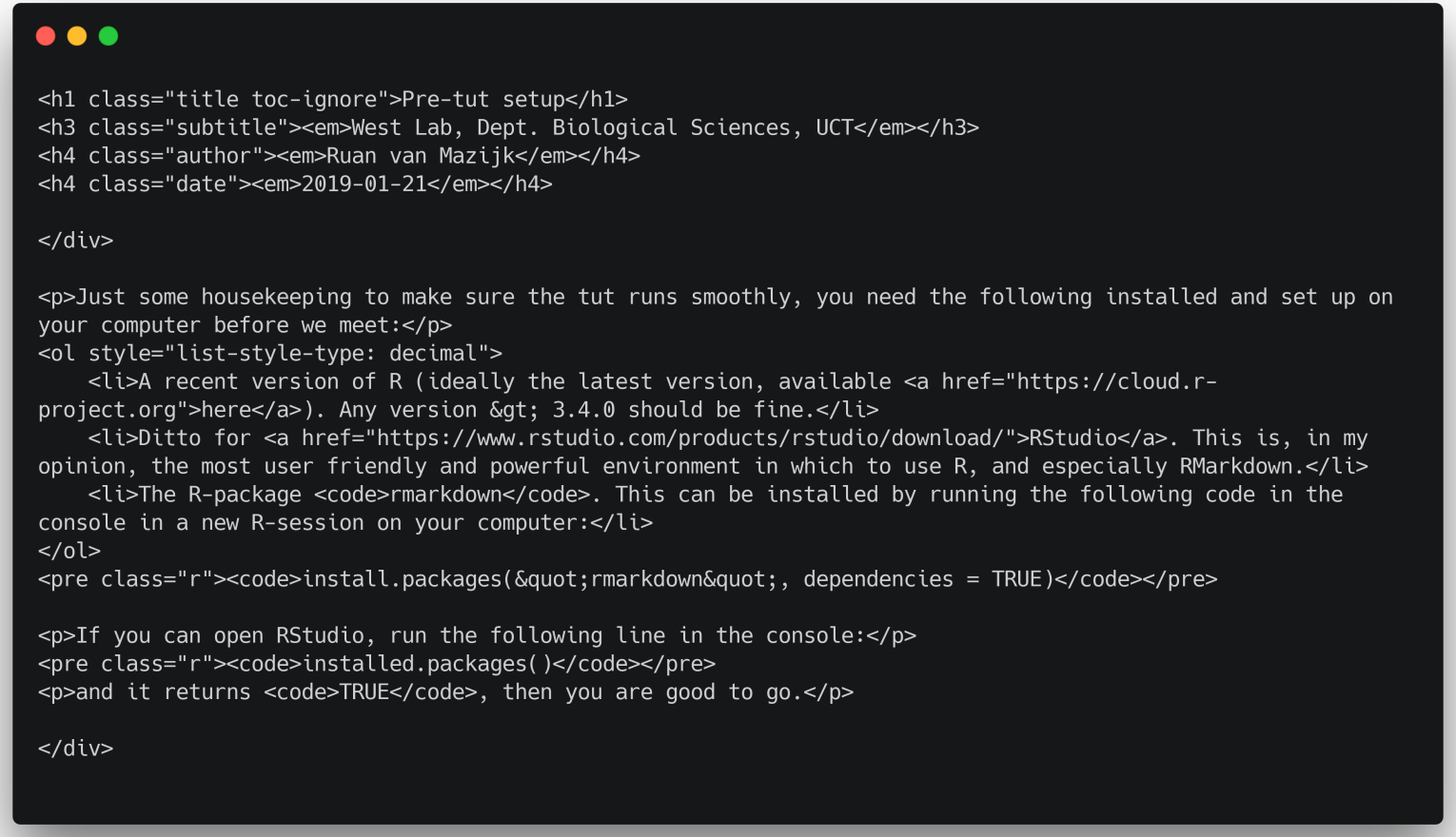
What is R Markdown?

R Markdown is a document preparation system, like MS Word, but completely different. Importantly, it works in plain-text and is highly accessible, open source, and makes it really easy to embed R-code in documents (e.g. to create figures or tables).

Document preparation systems

Document prep systems vary. There are those where what you **see** is what you **get** in the final document ("WYSIWYG"-systems; e.g. MS Word), and there are those where what you **see** is what you **mean** ("WYSIWYM"-systems; e.g. markup languages such as HTML, LaTeX).

R Markdown is based on the markup language "Markdown". Mark**down** was invented to be a simpler alternative to more complicated mark**up** languages like HTML and LaTeX. These markup languafes are often quite hard to read in raw-form and even harder to write. See for yourself:



```
<h1 class="title toc-ignore">Pre-tut setup</h1>
<h3 class="subtitle"><em>West Lab, Dept. Biological Sciences, UCT</em></h3>
<h4 class="author"><em>Ruan van Mazijk</em></h4>
<h4 class="date"><em>2019-01-21</em></h4>

</div>

<p>Just some housekeeping to make sure the tut runs smoothly, you need the following installed and set up on
your computer before we meet:</p>
<ol style="list-style-type: decimal">
    <li>A recent version of R (ideally the latest version, available <a href="https://cloud.r-
project.org">here</a>). Any version &gt; 3.4.0 should be fine.</li>
    <li>Ditto for <a href="https://www.rstudio.com/products/rstudio/download/">RStudio</a>. This is, in my
opinion, the most user friendly and powerful environment in which to use R, and especially RMarkdown.</li>
    <li>The R-package <code>rmarkdown</code>. This can be installed by running the following code in the
console in a new R-session on your computer:</li>
</ol>
<pre class="r"><code>install.packages(&quot;rmarkdown&quot;, dependencies = TRUE)</code></pre>

<p>If you can open RStudio, run the following line in the console:</p>
<pre class="r"><code>installed.packages()</code></pre>
<p>and it returns <code>TRUE</code>, then you are good to go.</p>

</div>
```

Figure 1: HTML

```
\normalsize \break

\hypertarget{biosketches}{%
\section*{Biosketches}\label{biosketches}}
\addcontentsline{toc}{section}{Biosketches}

\textbf{Ruan van Mazijk} is currently a Masters student at the
University of Cape Town, interested in phylogenetic systematics,
macroecology, community and functional ecology.

\textbf{Michael D. Cramer}

\textbf{G. Anthony Verboom}

\hypertarget{author-contributions}{%
\section*{Author contributions}\label{author-contributions}}
\addcontentsline{toc}{section}{Author contributions}

MDC and GAV conceived the study question, which RVM investigated under
their supervision for his BSc Hons project. The analyses and programming
work were largely devised by RVM, with input from the other authors, and
was carried out by RVM. RVM wrote the first draft of the manuscript and
all authors contributed equally thereafter.

\hypertarget{figures}{%
\section*{Figures}\label{figures}}
\addcontentsline{toc}{section}{Figures}

\begin{figure}[H]
\includegraphics[width=18cm]{/Users/ruanvanmazijk/Cape-vs-SWA/manuscript/figures/fig-1-roughness}
\caption{(ref:roughness)}\label{fig:roughness}
\end{figure}
```

Figure 2: LaTeX

The benefits of R Markdown

What R Markdown does is extend Markdown by making R-code (and other programming languages) executable from within the document's source file, allowing the results to show up in the final document (e.g. figures or tables), thereby "weav[ing] together narrative text and code to produce elegantly formatted output" (https://rmarkdown.rstudio.com).

It also adds a bit more functionality to Markdown with simple syntax for in-text references, equations, and more.

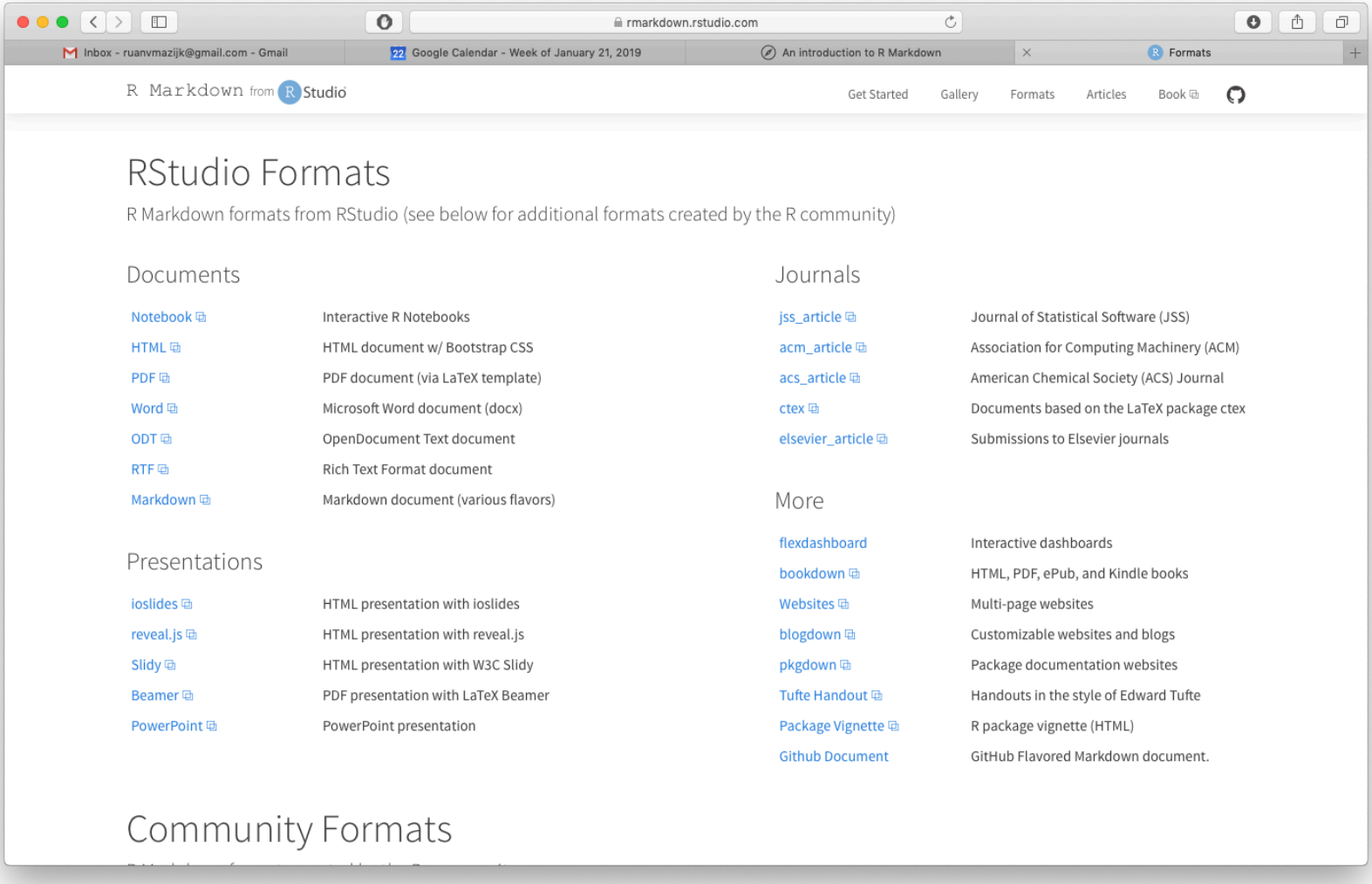
And, best of all, it makes the results of any analysis fully reproducible!

How does R Markdown work?

R Markdown takes the file you write (e.g. `analysis.Rmd`), converts it to plain markdown using the R-package `knitr`, then converts it any of the output formats you choose, using the open source software `pandoc`.

Figure 3: R Markdown flowchart (https://rmarkdown.rstudio.com/lesson-2.html)

Possible output formats



An R Markdown (`.Rmd`) file has two main components:

1. the YAML header
2. and the body

Example

`analysis.Rmd` might look like this:

```
---
title: My analysis
author: Ruan van Mazijk
date: 2019-11-15
output: html_document
---

# Introduction

Blah blah blah blah ...

# Methods

Etc. etc. etc. ...
```

Rendering your document

Use the output specified in the header

```
rmarkdown::render("analysis.Rmd")
```

Or over-ride it

```
rmarkdown::render("analysis.Rmd"
  output_format = "pdf_document"
)
```

Using Markdown-style markup

Headings

```
# A heading

## A sub-heading

### A sub-sub-heading

(Can go down 6 levels)
```

Unordered lists

```
- Item
- Item
- Item
  - Sub-item
  - Sub-item
    - Sub-sub-item
    - Etc.
```

Unordered lists cont.

- Item
- Item
- Item
  - Sub-item
  - Sub-item
    - Sub-sub-item
    - Etc.

Ordered lists

```
1. Item
2. Item
3. Item
   a. Sub-item
   b. Sub-item
      1. Sub-sub-item
      2. Etc.
```

Ordered lists cont.

1. Item
2. Item
3. Item
    a. Sub-item
    b. Sub-item
        1..b.1 Sub-sub-item
        2..b.2 Etc.

Simple tables

```
Column1 | Column2 | Column 3
--------|---------|---------
Row1    |         |
Row2    |         |
Row3    |         |
```

Simple tables cont.

Column1	Column2	Column 3
Row1		
Row2		
Row3		

Comments

```
<!--A comment-->
<!--(won't get rendered in any of the final output(s))-->
```

Citations

You need a `.bib` file, which looks like this (e.g. `example.bib`):

```
@article{West2018,
 author = {West, A.G. et al.},
 year = {2018},
 title = {A previous study},
 journal = {Nature},
 number = {50},
 volume = {49},
 pages = {340--346}
}
@article{West2017,
 ...
}
```

(Mendeley and other reference managing software can easily generate this file for you from your library.)

And link it to `analysis.Rmd` in the YAML header:

```
---
...
bibliography: example.bib
---
```

By adding the following heading to the end of `analysis.Rmd`:

```
# References
```

It will automatically produce the reference list!

Our study aligns with previous findings [@paper1; @paper2].

Our study aligns with previous findings (West 2018; West 2017).

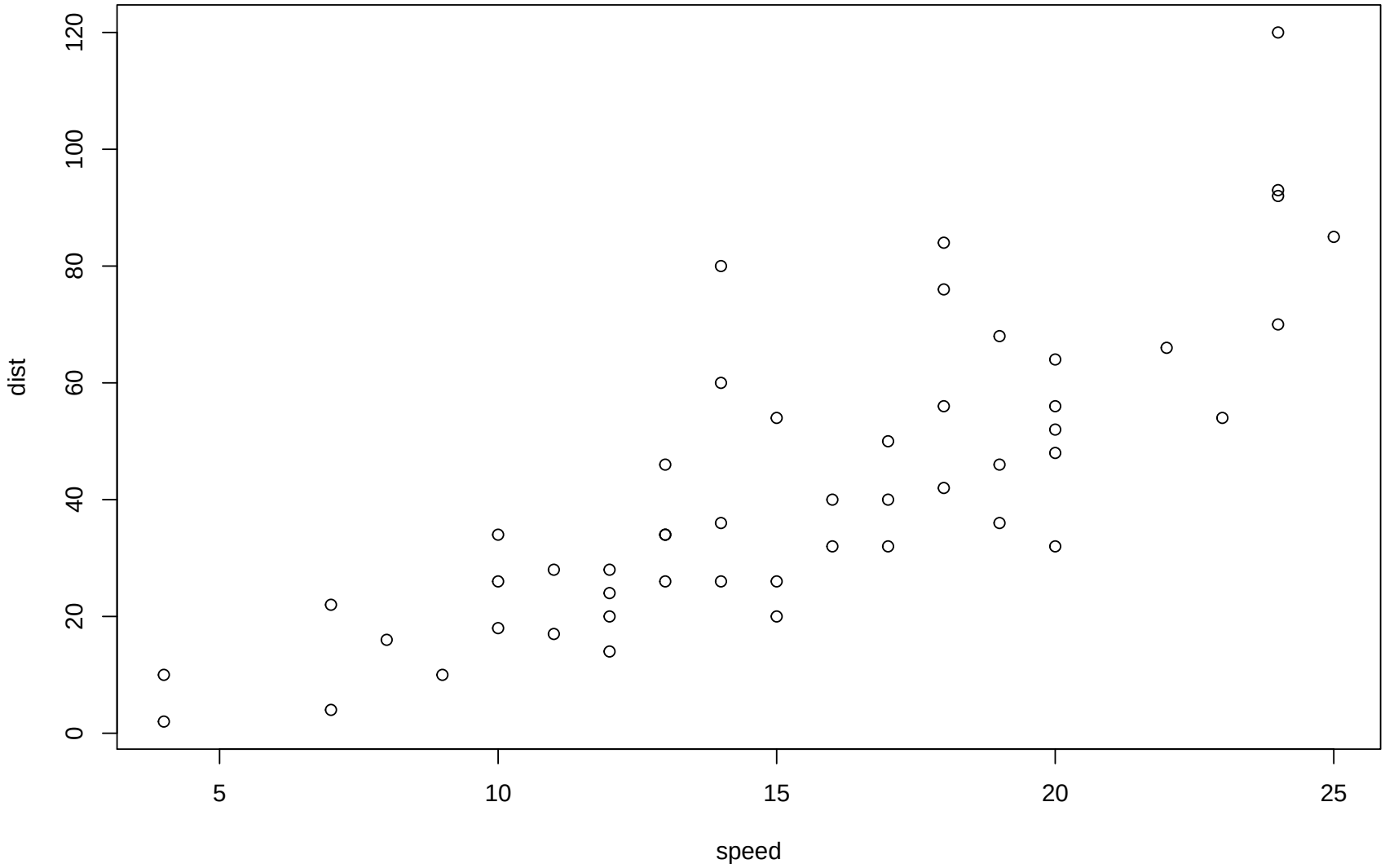
R-code

We can embed figures in our document. `echo=FALSE` tells R Markdown not to display the code chunk that generates the figure.

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

(Ignore the backslashes)

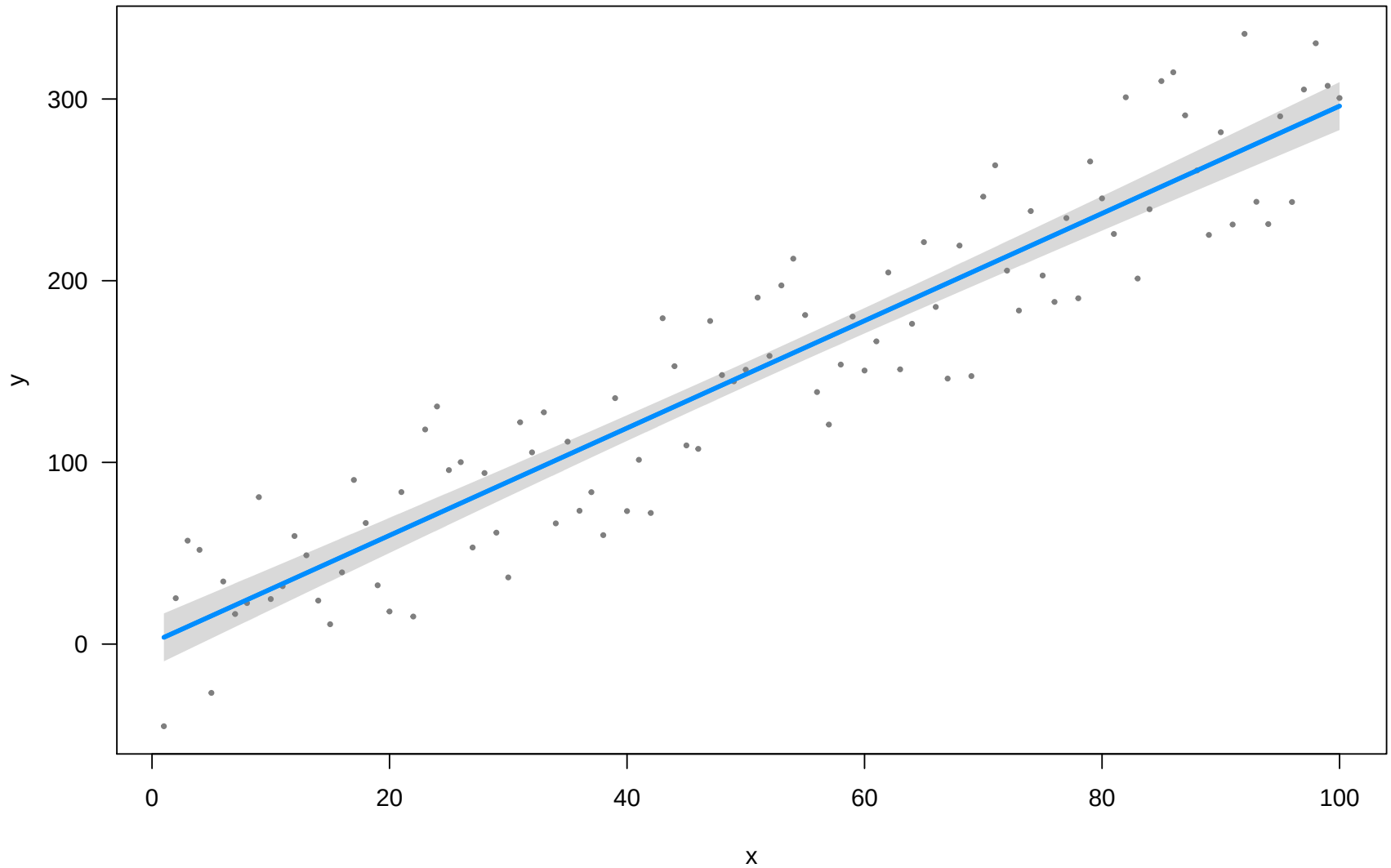
R-code cont.



Alternatively, we can set `echo=TRUE`:

```
\    ```{r, echo=TRUE}
\    x <- 1:100
\    y <- 3 * jitter(x, 100)
\    m <- lm(y ~ x)
\    visreg::visreg(m)
\    ```
```

```r
x <- 1:100
y <- 3 * jitter(x, 100)
m <- lm(y ~ x)
visreg::visreg(m)
```



A *live-coding* example!

…

Further reading

R Markdown “Getting Started” Tutorial. https://rmarkdown.rstudio.com/lesson-1.html.

R Mardown Cheatsheet. https://rmarkdown.rstudio.com/lesson-15.html.

R Markdown Reference Guide. https://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf.

Yihui, X., Allaire, J.J., Grolemund, G. (2018). R Markdown: The Definitive Guide. https://bookdown.org/yihui/rmarkdown/.

References

West, A.G. et al. 2017. “An Even Older Study.” *Nature* 32 (46): 189–203.

———. 2018. “A Previous Study.” *Nature* 49 (50): 340–46.