Scientific Communication: TeX, Quarto, RMarkdown
Winter Institute in Data Science

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2024-01-03

Scientific Communication

LaTeX

Quarto

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- is replicable, portable
- automates frequently-used or tedious operations
- (usually) separates content and formatting
- allows the author control . . .
- but supplies legible defaults and structure that allow the reader (and author) to focus on content

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- ▶ RMarkdown: (a `knitr` extension)
- ▶ Quarto: (better cross-language integration)

$\text{\LaTeX}$

LaTeX

From the LaTeX Project (https://www.latex-project.org):

> *LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents. LaTeX is available as free software.*

Consider

```
(E_i ^100 x_i) / (x^2 + theta sqrt(z))
```

Convey ideas, procedures, results clearly

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On the other hand,

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- ▶ Historically: difficult, bad spacing, etc. on WYSIWYGs
- ▶ Now, macOS's Pages *requests* your LaTeX

Replicable, portable

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You could open/compile the first LaTeX document.

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`.doc` is actually 4 different file formats!

Automates frequently-used, tedious operations

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In LaTeX, the { } enclose arguments:
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In LaTeX, the [ ] enclose (opt) further params:
\command[param1,param2]{arg1}

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4. Include `.bib` file name, so LaTeX/`knitr` finds refs
5. (Include `.bst` to adjust reference style)

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Write "One should read `\cite{moore2015}`.", then add

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\bibliographystyle{apsa-leeper}
\bibliography{my_bib}
```

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Don't compile a bibliography, or reformat it.

Write "One should read \cite{moore2015}.", then add

```
\bibliographystyle{apsa-leeper}
\bibliography{my_bib}
```

Which will render as "One should read Moore (2015)".

and

Moore, Ryan T. "Overcoming Barriers to Heterogeneous-Group Learning in the Political Science Classroom". *PS: Political Science & Politics*, 48(1):149–156, 2015.

LaTeX

To build documents into `.pdf`, need an installation of TeX.

You need a TeX engine for processing.

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Or `tinytex`.

Or Overleaf.

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R → RStudio analogous to `TeX build` → `TeX editor`

tinytex

If you don't have a TeX build, try `tinytex`.

(See http://www.ryantmoore.org/files/ht/httinytex.pdf)

tinytex

If you don't have a TEX build, try tinytex.

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```
install.packages("tinytex")
library(tinytex)
tinytex::install_tinytex()
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If you don't have a TEX build, try tinytex.

(See http://www.ryantmoore.org/files/ht/httinytex.pdf)

```r
install.packages("tinytex")
library(tinytex)
tinytex::install_tinytex()
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Or, just create .html files instead, and print to .pdf.

Resources

- ▶ "The Not So Short Introduction to $\LaTeX\,2_\varepsilon$" (Oetiker, et al.)
- ▶ "The Comprehensive $\LaTeX$ Symbol List" (Pakin $\approx$ 15,000!)
- ▶ Detexify http://detexify.kirelabs.org/classify.html
- ▶ Overleaf (https://www.overleaf.com)

Quarto

First, a quick example!

► Create `.qmd` file
  ► RStudio ⇝ File ⇝ New file ⇝ Quarto Document
► Add name, title to preamble
► Render
► Edit, render

Quarto's Markup

Quarto's document markup is

- light
- legible
- literate
- LaTeX

Quarto: light

1. no huge build over R

Quarto: light

1. no huge build over R
2. less "ink"

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1. Item 1
2. Item 2

Quarto: light

1. no huge build over R
2. less "ink"

```
1. Item 1
2. Item 2
```

vs.

```
\begin{enumerate}
\item Item 1
\item Item 2
\end{enumerate}
```

Quarto: legible

```
I am **serious**
```

vs.

```
I am \bf{serious}
```

or

```
I am {\bf serious}
```

Quarto: legible

```
I am **serious**
```

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or

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I am {\bf serious}
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(Better for tables, figures, etc. Harder to see/adjust aspects of presentation)

Quarto: literate

► Code in these notes is run, output is recreated

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Look, three plus four is 7.

Quarto: literate

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- ▶ Programming (data analysis) is **in** the text document

Look, three plus four is 7.

What I typed above:

```
Look, three plus four is `r 3 + 4`.
```

RMarkdown: literate

This literacy is great for papers: analysis is *in* your paper. No copy-paste, update figure, etc.

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Often want to *see* the code and the (somewhat more) raw results.

That makes this literacy perfect for reports ("notebooks").

Quarto: LaTeX

In a paper, format the math *and* do the calculation:

Look: $3 + 4 = 7$.

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In a paper, format the math *and* do the calculation:

Look: $3 + 4 = 7$.

Above I typed:

```
Look: $3 + 4 = `r 3 + 4`$.
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In a paper, format the math *and* do the calculation:

Look: $3 + 4 = 7$.

Above I typed:

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Look: $3 + 4 = `r 3 + 4`$.
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(Warning: formatting the line above was a challenge.)

Valid LaTeX will almost always render well.

Quarto

For more formatting and chunk options, download the full

http://www.ryantmoore.org/files/class/introPolResearch/
PS_Rmd_template_full.Rmd

or the simpler

http://www.ryantmoore.org/files/class/introPolResearch/
PS_Rmd_template_simple.Rmd

.qmd vs. the Console

Render .qmd file:

- ▶ R runs the code from top to bottom of .qmd file

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Render .qmd file:

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Render .qmd file:

- ► R runs the code from top to bottom of .qmd file
- ► Does not run other code; does **not** look in Console's workspace

- ► .qmd file needs to be entirely self-contained
- ► Set working directory, read data, create intermediate objects, etc. *within* the .qmd file

`.qmd` vs. the Console: Beware Green Arrow

```
17
18 ⏷   ```{r cars}
19    summary(cars)
20    ```
```

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► If you click, R looks in current workspace for objects, prints results to console or plotter, and reprints them in the confines of your .qmd

.qmd vs. the Console: Beware Green Arrow

- ▶ If you click, R looks in current workspace for objects, prints results to console or plotter, and reprints them in the confines of your `.qmd`
- ▶ Behavior is "notebook-like". However, objects are not really *in* your `.qmd` file, can be created out of order, are not part of the compiled/knit output

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- ▶ When you compile/knit to create an output file, only code that is run is code in your .qmd file, from top to bottom

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- ▶ When you compile/knit to create an output file, only code that is run is code in your .qmd file, from top to bottom
- ▶ This notebook-like feature is an aspect of RStudio that is not *inherent* in .qmd (which could be compiled from a command line outside of RStudio, e.g.). To avoid confusion about the state, render .qmd file and look at output, rather than using green arrow.

.qmd + the Console: Love the Green Bar
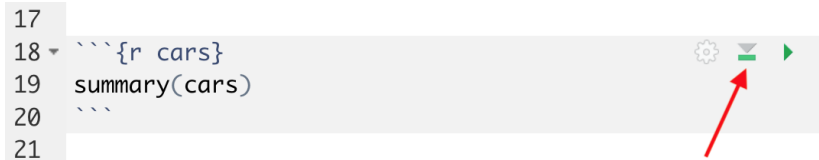
```
17
18 ▾    ```{r cars}
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`.qmd` + the Console: Love the Green Bar

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```

"Run all chunks above" at Console.

LaTeX

(I know, you're wondering ...)

LaTeX

(I know, you're wondering . . .)

How do I format LaTeX in LaTeX?

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How do I format LaTeX in LaTeX?

```
\LaTeX
```

LaTeX

(I know, you're wondering . . .)

How do I format LaTeX in LaTeX?

```
\LaTeX
```

How to format "LaTeX is great."?

LaTeX

(I know, you're wondering ...)

How do I format LaTeX in LaTeX?

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\LaTeX
```

How to format "LaTeX is great."?

With a space in LaTeX: `\LaTeX~ is great.`

With a space in RMarkdown: `\LaTeX\ is great.`

The Core Transformation Functions Quiz

Load the `gss_cat` data in the `forcats` package:

```r
library(forcats)
data("gss_cat")
```

Create a `.qmd` file, write code[1] in chunks to

1. Sort `gss_cat` by the values of `tvhours` (largest first).
   Store this as `gss_cat`, and show the first 10 rows.
2. Create a new var `birthyear` – each resp's `year` minus `age`
   – and attach it as column of `gss_cat`. Show
   `summary(gss_cat$birthyear)` and dimensions of `gss_cat`.
3. Create df `gss_cat_tv`, which has only the rows of `gss_cat`
   where `tvhours > 3`?
4. Calculate the mean value of `tvhours` in `gss_cat` within
   categories of `relig`. Sort this summary.

[1] `filter()`, `arrange()`, `group_by()`, `ungroup()`, `select()`, `rename()`, `mutate()`, `transmute()`, `summarise()`