Intro to Quarto

Welcome!

Housekeeping!

- Be kind and curious!
- Slack and Zoom chat
- Ask questions

Schedule (Day 1)

Time	Activity
10:30–11:30	Welcome + Intro to Quarto
11:30–12:30	Creating basic websites
12:30–13:30	*Break*
13:00–15:00	Advanced website features

Schedule (Day 2)

Time	Activity
10:30–11:00	Publishing
11:00–12:30	Customization and branding
12:30–13:30	*Break*
13:00–15:00	Interactivity

About me

Andrew Heiss

andrewheiss.com @andrew.heiss.phd
@andrewheiss andrewheiss

- Assistant professor of public policy, Georgia State University
- Data visualization, statistics, and causal inference

Meeting you where you are

This course is designed for someone who:

- Knows some R or Python
- Maybe has an idea for a website
- Is relatively new to Quarto
- Wants to customize Quarto output

You'll learn:

- What Quarto is and how to use it
- How to create and publish websites with Quarto
- How to customize Quarto output

Course structure

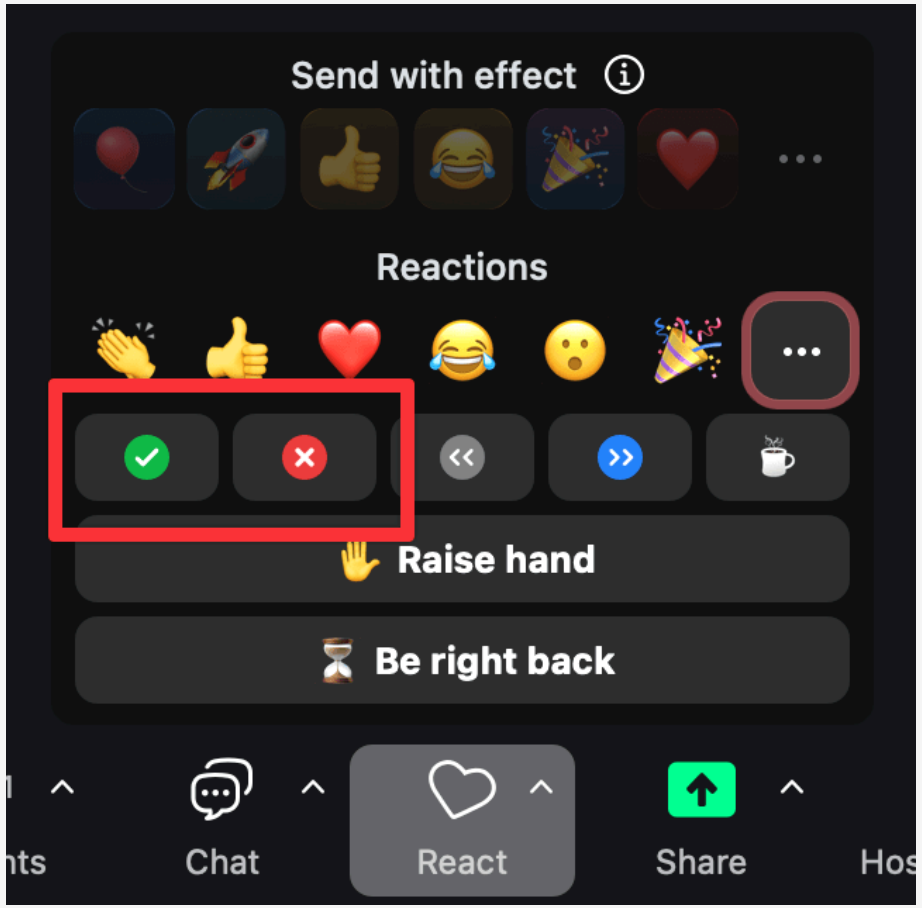
My turn

- Lecture segments
- Feel free to just watch, take notes, browse docs, or tinker around with the code

Your turn

- Exercises for you to do
- Work on your own or with others

Getting help



Use Zoom reactions

- ✖ =
  “I’m stuck and need help!”
- ✔ =
  “I finished the exercise”

Ask longer, more detailed questions in Slack

Your turn

Introduce yourself:

- Name
- Professional affiliation
- On a scale of 1–10, how well do you know...
  - Quarto?
  - R?
  - Python?
  - HTML and CSS?
- What do you hope to get out of this course?

04:00

Introduction to Quarto

Quarto is an...

open-source
scientific and technical
publishing system
built on Pandoc.

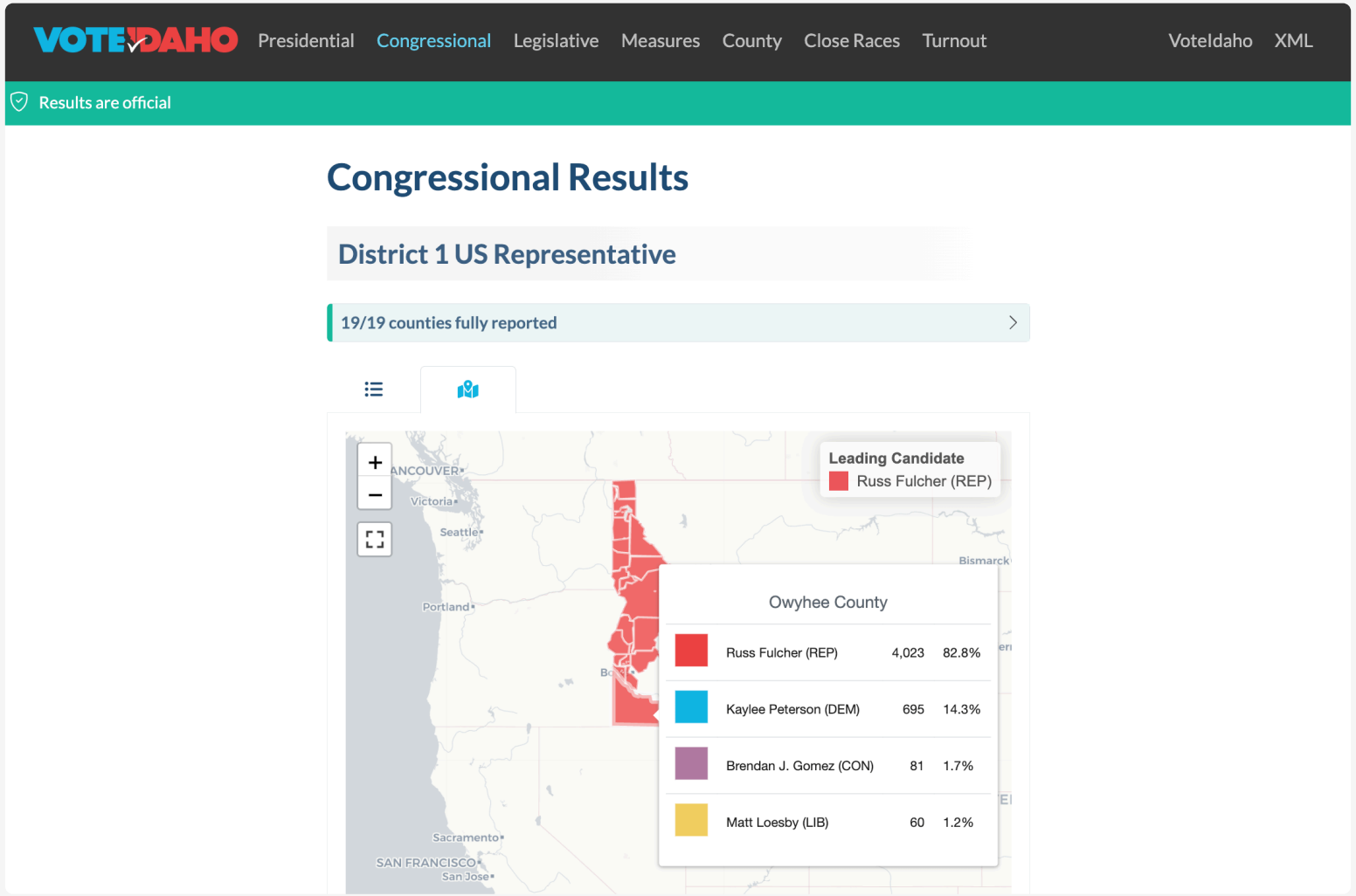
With Quarto...

...you can **weave** together **narrative** and **code** to produce elegantly formatted output such as documents, web pages, blog posts, books, dashboards, and more.

- Create dynamic content with Python, R, Julia, and Observable
- Edit documents in your favorite editor
- Publish technical content in HTML, PDF, Microsoft Word, and more
- Share content by publishing to the internet

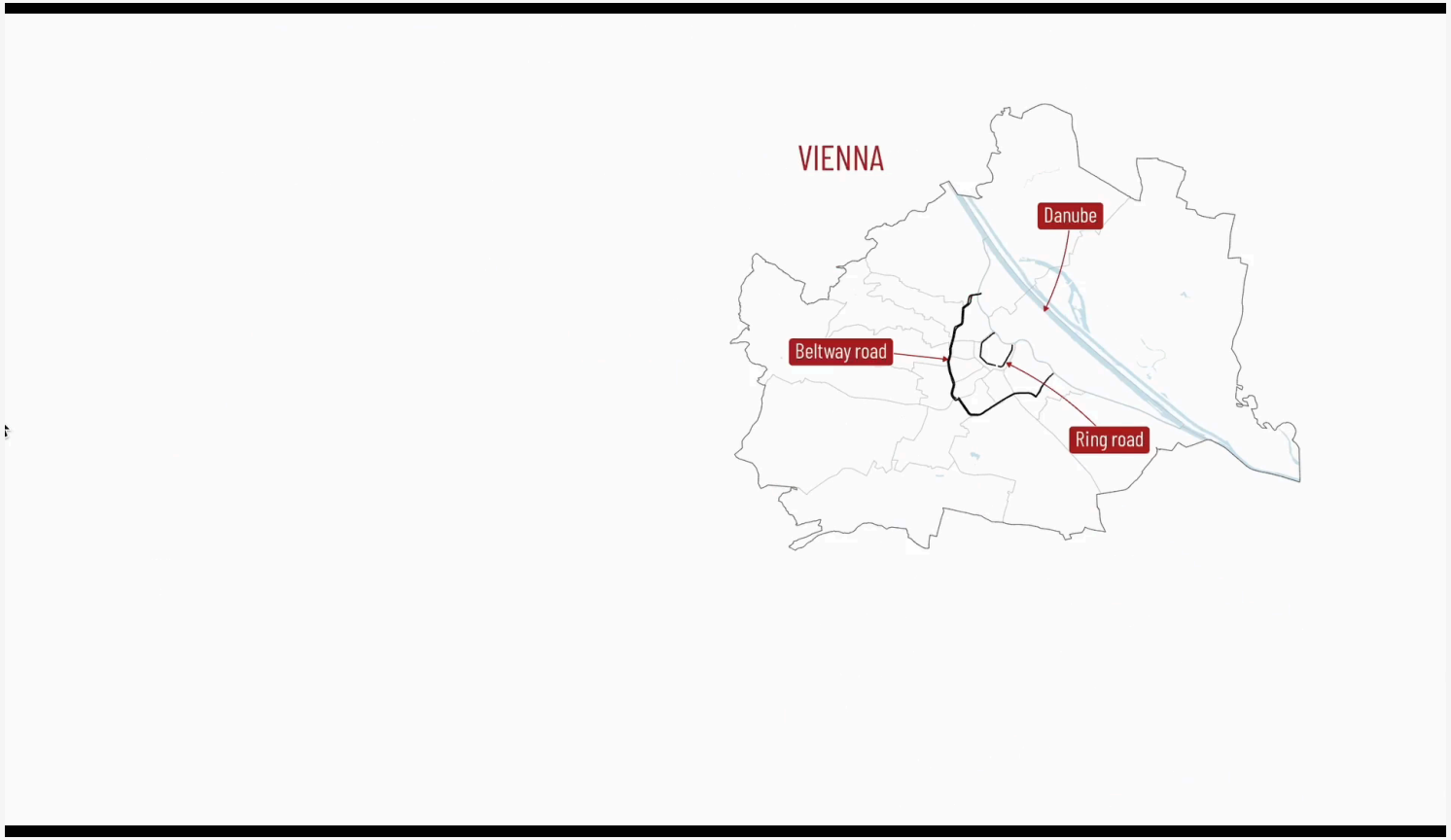
Display data and results

2024 Idaho election results, by Gabe Osterhout and Andrew Heiss



Walk through a story

Council Housing & Neighborhood Income Inequality in Vienna by Tamara Premrov and Matthias Schnetzer (European Centre for Social Welfare Policy and Research, Austria)

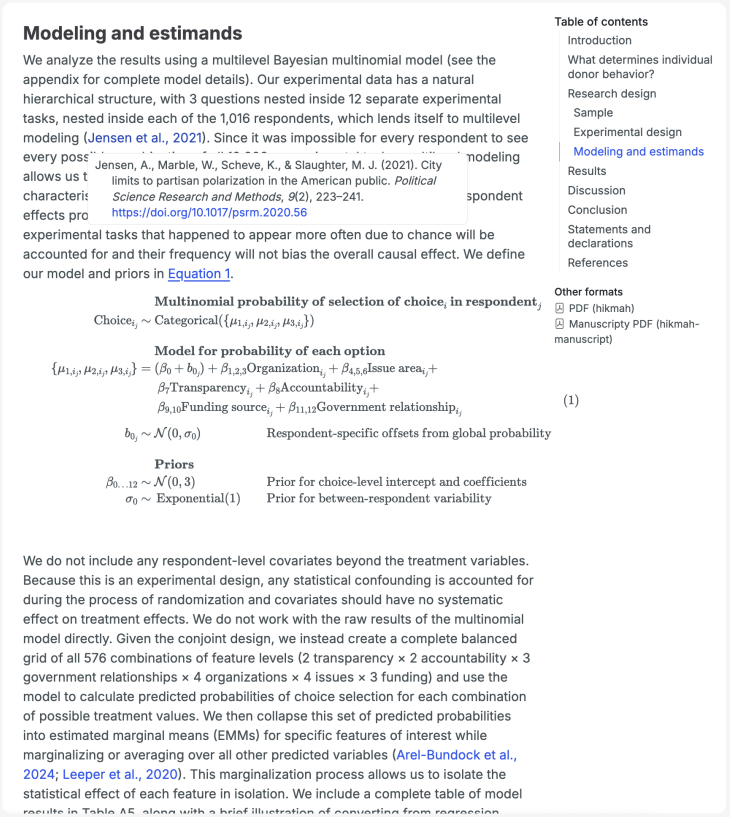


Publish papers

Navigating Hostility: The Effect of Nonprofit Transparency and Accountability on Donor Preferences in the Face of Shrinking Civic Space

by Suparna Chaudhry, Marc Dotson, and Andrew Heiss

HTML | PDF | Word



Modeling and estimands

We analyze the results using a multilevel Bayesian multinomial model (see the appendix for complete model details). Our experimental data has a natural hierarchical structure, with 3 questions nested inside 12 separate experimental tasks, nested inside each of the 1,016 respondents, which lends itself to multilevel modeling (Jensen et al., 2021). Since it was impossible for every respondent to see every poss… modeling allows us t… characteris… spondent effects pro…

Jensen, A., Marble, W., Scheve, K., & Slaughter, M. J. (2021). City limits to partisan polarization in the American public. *Political Science Research and Methods*, *9*(2), 223–241. https://doi.org/10.1017/psrm.2020.56

experimental tasks that happened to appear more often due to chance will be accounted for and their frequency will not bias the overall causal effect. We define our model and priors in Equation 1.

Multinomial probability of selection of choice$_i$ in respondent$_j$

$$\text{Choice}_{i_j} \sim \text{Categorical}(\{\mu_{1,i_j}, \mu_{2,i_j}, \mu_{3,i_j}\})$$

Model for probability of each option

$$\begin{aligned}\{\mu_{1,i_j}, \mu_{2,i_j}, \mu_{3,i_j}\} = (\beta_0 + b_{0_j}) + \beta_{1,2,3}\text{Organization}_{i_j} + \beta_{4,5,6}\text{Issue area}_{i_j} + \\ \beta_7\text{Transparency}_{i_j} + \beta_8\text{Accountability}_{i_j} + \\ \beta_{9,10}\text{Funding source}_{i_j} + \beta_{11,12}\text{Government relationship}_{i_j}\end{aligned} \quad (1)$$

$$b_{0_j} \sim \mathcal{N}(0, \sigma_0) \qquad \text{Respondent-specific offsets from global probability}$$

Priors

$$\begin{aligned}\beta_{0\ldots12} &\sim \mathcal{N}(0, 3) && \text{Prior for choice-level intercept and coefficients} \\ \sigma_0 &\sim \text{Exponential}(1) && \text{Prior for between-respondent variability}\end{aligned}$$

We do not include any respondent-level covariates beyond the treatment variables. Because this is an experimental design, any statistical confounding is accounted for during the process of randomization and covariates should have no systematic effect on treatment effects. We do not work with the raw results of the multinomial model directly. Given the conjoint design, we instead create a complete balanced grid of all 576 combinations of feature levels (2 transparency × 2 accountability × 3 government relationships × 4 organizations × 4 issues × 3 funding) and use the model to calculate predicted probabilities of choice selection for each combination of possible treatment values. We then collapse this set of predicted probabilities into estimated marginal means (EMMs) for specific features of interest while marginalizing or averaging over all other predicted variables (Arel-Bundock et al., 2024; Leeper et al., 2020). This marginalization process allows us to isolate the statistical effect of each feature in isolation. We include a complete table of model results in Table A5, along with a brief illustration of converting from regression…

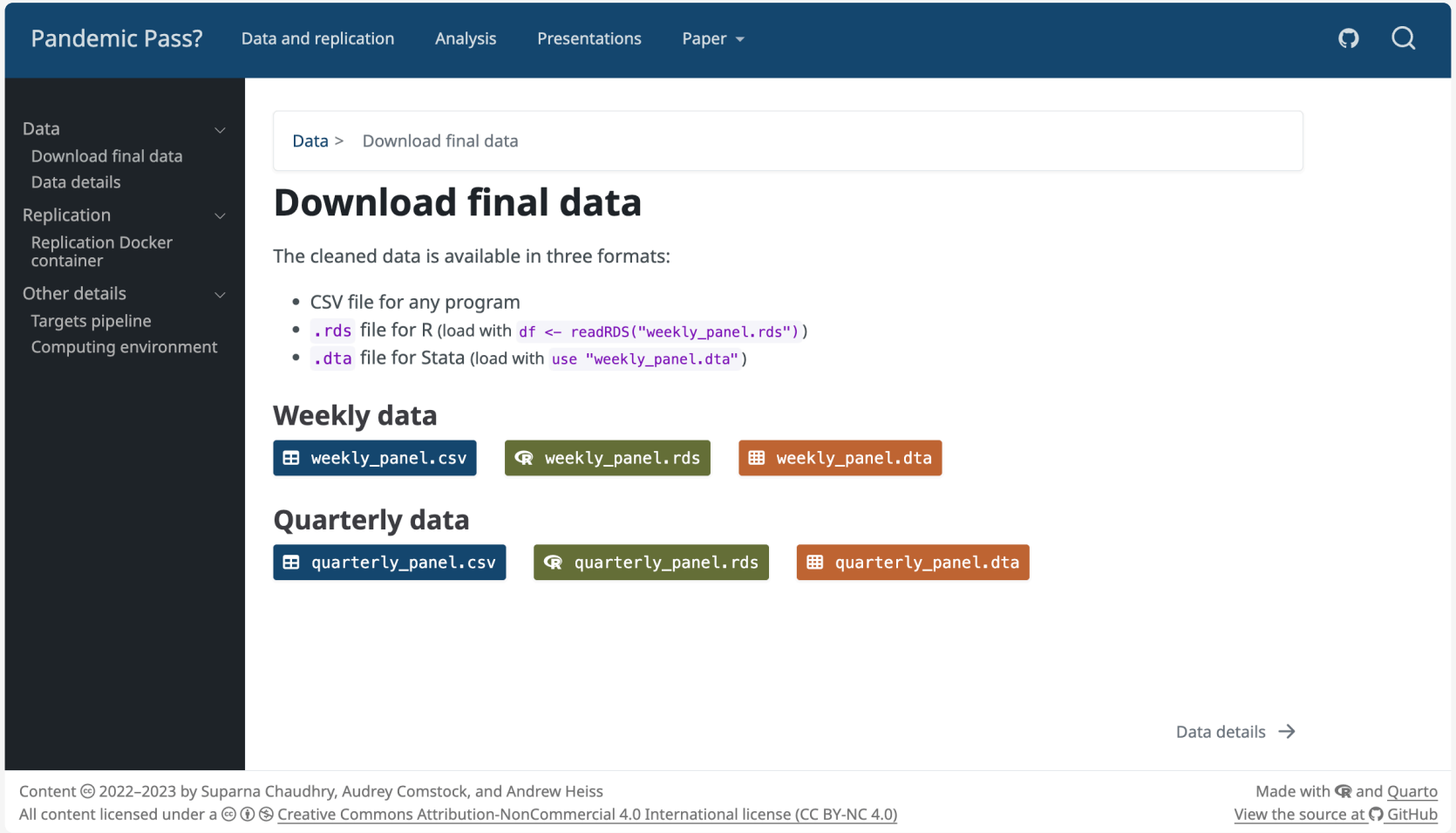
Table of contents

Other formats

- PDF (hikmah)
- Manuscripty PDF (hikmah-manuscript)

Share research

Pandemic Pass? Treaty Derogations and Human Rights Practices During COVID-19 by Suparna Chaudhry, Audrey Comstock, and Andrew Heiss

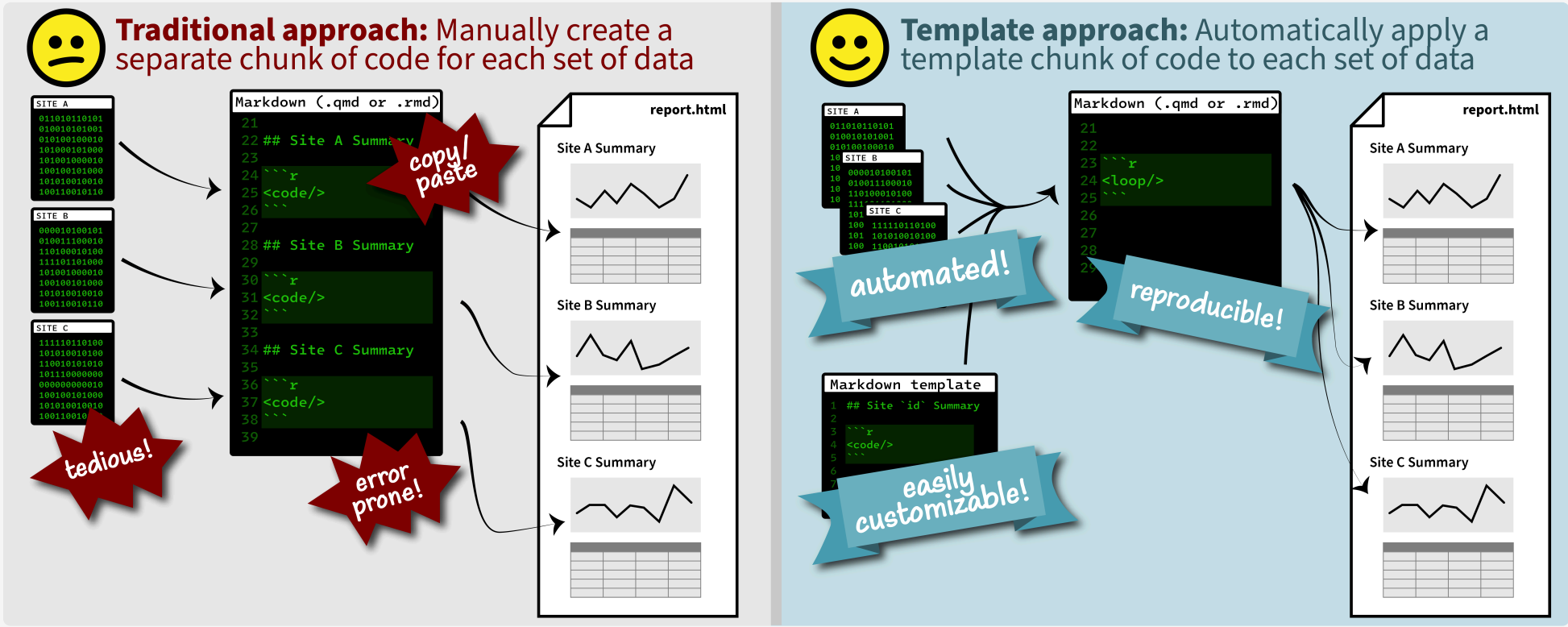


Teach classes

Data Science for the Social Sciences, Gov 50, Harvard University, taught by Matt Blackwell

Automate and reproduce your output

Duplicating Quarto elements with code templates to reduce copy and paste errors by Althea A. Archer (United States Geological Survey)



Get your team on the same page

We Converted Our Documentation to Quarto by Melissa Van Bussel (Statistics Canada)

- Website for R/Python User Group
- Training resources
- Presentations

Gapminder Report

Health and Wealth Around the World

Gapminder data, 1952–2007

Introduction

This analysis shows trends in life expectancy and GDP per capita for 142 countries from XXXX to YYYY. The data was originally collected by Hans Rosling and the Gapminder foundation.

Continent-level trends

Average life expectancy increased substantially between XXXX and YYYY. Asia saw the biggest average increase (see Table 1).

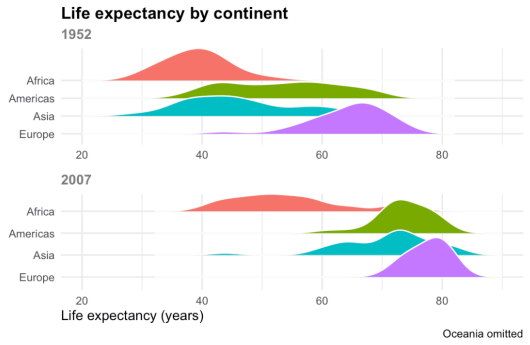


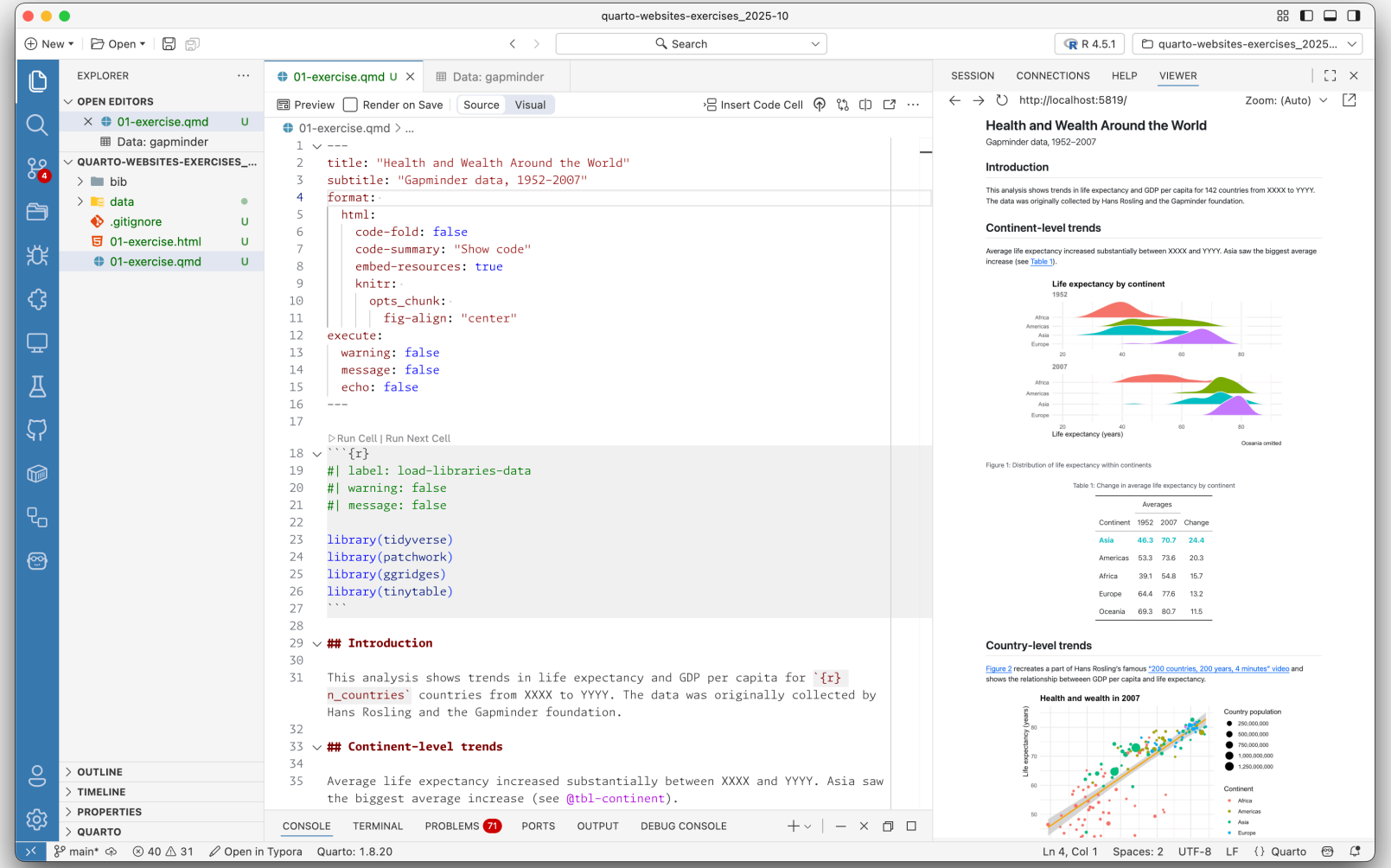
Figure 1: Distribution of life expectancy within continents

Table 1: Change in average life expectancy by continent

	Averages		
Continent	1952	2007	Change
Asia	**46.3**	**70.7**	**24.4**
Americas	53.3	73.6	20.3
Africa	39.1	54.8	15.7
Europe	64.4	77.6	13.2

This is what you'll work on today!

“Literate programming”



Why Quarto?

- Multilingual and independent of computational systems
- Quarto comes **“batteries included”** straight out of the box
- Consistent expression for core features
- Extension system
- Enable “single-source publishing”—create Word, PDFs, HTML, etc. from one source
- Use defaults that meet accessibility guidelines

Quarto formats

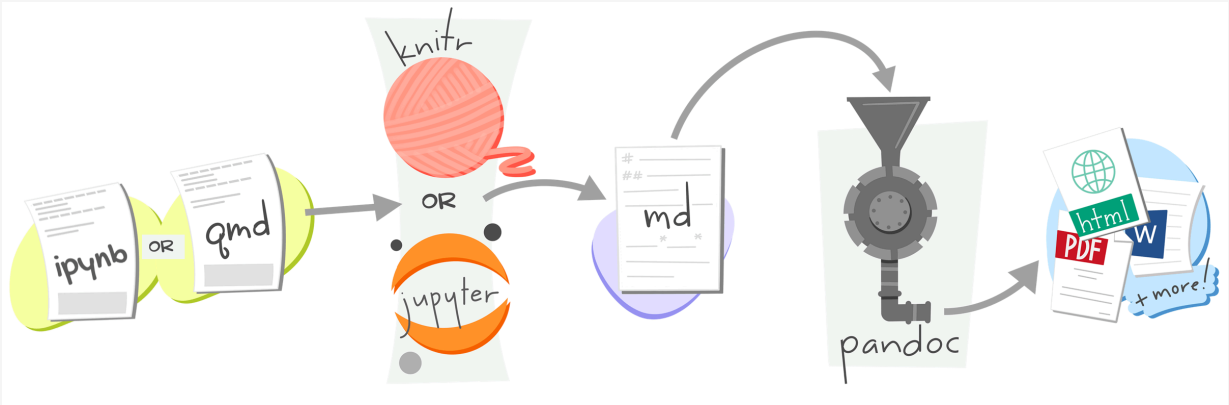
Feature	Quarto
Basic formats	**html**, **pdf**, **docx**, **typst**
Beamer	**beamer**
PowerPoint	**pptx**
HTML slides	**revealjs**
Advanced layout	**Quarto Article Layout**
Cross references	**Quarto Crossrefs**
Websites & blogs	**Quarto Websites**, **Quarto Blogs**
Books	**Quarto Books**
Interactivity	**Quarto Interactive Documents**
Journal articles	**Journal Articles**
Dashboards	**Quarto Dashboards**

How it works

Quarto is a command line interface (**CLI**) that renders plain text formats (`.qmd`, `.rmd`, `.md`) OR mixed formats (`.ipynb`/Jupyter notebook) into static PDF/Word/HTML reports, books, websites, presentations and more.

```
Usage:   quarto
Version: 1.8.24

Description:

  Quarto CLI

Options:

  -h, --help     - Show this help.
  -V, --version  - Show the version number for this program.

Commands:

  render          [input] [args...]     - Render files or projects to various document types.
  preview         [file] [args...]      - Render and preview a document or website project.
  serve           [input]               - Serve a Shiny interactive document.
  create          [type] [commands...]  - Create a Quarto project or extension
  create-project  [dir]                 - Create a project for rendering multiple documents
  convert         <input>               - Convert documents to alternate representations.
  pandoc          [args...]             - Run the version of Pandoc embedded within Quarto.
  typst           [args...]             - Run the version of Typst embedded within Quarto.
  run             [script] [args...]    - Run a TypeScript, R, Python, or Lua script.
  add             <extension>           - Add an extension to this folder or project
  install         [target...]           - Installs an extension or global dependency.
```

Under the hood



- `jupyter` or `knitr` evaluates Python, Julia, R, or Observable code and returns a `.md` file along with the evaluated code
- Quarto applies Lua filters + CSS/LaTeX which is then evaluated alongside the `.md` file by Pandoc and converted to a final output format

Illustration by Allison Horst

Environment options

You have a couple options for following along today:

1. **Posit Cloud** (RStudio in the cloud)
2. **Local installation** (RStudio, Positron, or VS Code on your computer)

Your turn

Go to the course website and click on `Setup` in the sidebar.

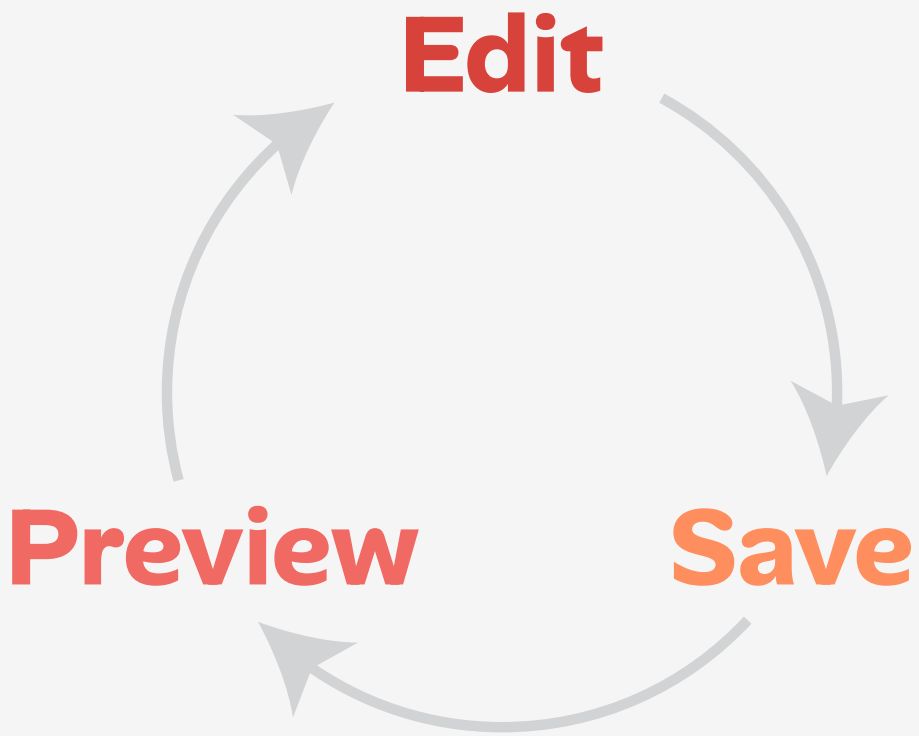
andhs.co/quarto-websites-2025

Follow the instructions for either Option 1 or Option 2.

05:00

Quarto workflow

- Open a `.qmd` file.
- Preview/render the document.
- Make a change and preview/render again.

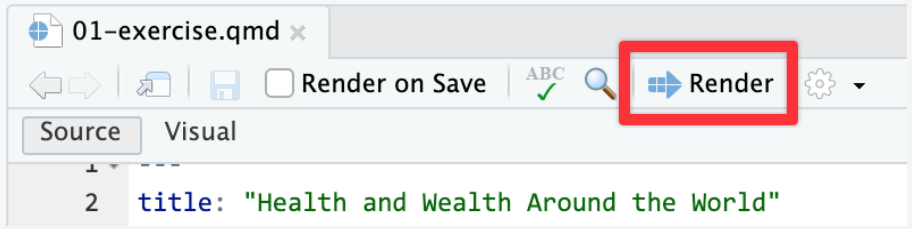


Render/preview

RStudio | Positron / VS Code | Terminal

⌘⇧K

Ctrl + Shift + K



Your turn

- Open `01-exercise.qmd`
- Preview/render the document
  - If you're using Posit Cloud, you might be asked to allow pop-ups
- Edit the title and preview the document again.

05:00

Quarto documents

Anatomy of a Quarto document

`.qmd` file format with three components:

1. **YAML**: Metadata
2. **Text**: Markdown
3. **Code**: R, Python, Observable, and Julia

Weave it all together, and you have beautiful, powerful, and useful outputs!

Anatomy of a Quarto document

Metadata: YAML

my-document.qmd

```
1 ---
2 title: "My Cool Document"
3 format: html
4 ---
```

- “Yet another markup language”
- Metadata of your document
- Starts and ends with `---`
- Uses key-value pairs in the format `key: value`

Anatomy of a Quarto document

Text: Markdown

my-document.qmd

```
1 ---
2 title: "My Cool Document"
3 format: html
4 ---
5
6 This analysis explores data from the Gapminder foundation.
```

- Markdown is a lightweight language for creating formatted text
- Quarto is based on Pandoc and uses its variation of markdown as its underlying document syntax

Anatomy of a Quarto document

Text: Markdown

my-document.qmd

```
1 The `gapminder.csv` dataset contains data from
2 the [**Gapminder foundation**](https://www.gapminder.org/).
```

↓

> The `gapminder.csv` dataset contains data from the **Gapminder foundation**.

Anatomy of a Quarto document

Text: Markdown

Markdown syntax	Output
`*italics* and **bold**`	*italics* and **bold**
`superscript^2^ / subscript~2~`	superscript^2 / subscript$_2$
`~~strikethrough~~`	~~strikethrough~~
`` `verbatim code` ``	`verbatim code`

General Markdown guide

Anatomy of a Quarto document

Code

my-document.qmd

````
---
title: "My Cool Document"
format: html
---

The `gapminder.csv` dataset contains data from the [**Gapminder foundation*

```{r}
library(tidyverse)

df <- read_csv("data/gapminder.csv")

ggplot(df, aes(x = gdpPercap, y = lifeExp)) +
  geom_point(aes(size = pop, color = continent)) +
  scale_x_log10()
```
````

Anatomy of a Quarto document

Code

my-document.qmd

````
---
title: "My Cool Document"
format: html
---

The `gapminder.csv` dataset contair

```{r}
library(tidyverse)

df <- read_csv("data/gapminder.csv"

ggplot(df, aes(x = gdpPercap, y = l
  geom_point(aes(size = pop, color
  scale_x_log10()
```
````

- Code chunks begin and end with three backticks
- Code chunks are identified with a programming language in between {}

Anatomy of a Quarto document

Inline code executes code *within Markdown*

my-document.qmd

````
```{r}
countries <- 147
```

There are `{r} countries` in the dataset.
````

↓

> There are 147 countries in the dataset.

Anatomy of a Quarto document

Code can include optional chunk options, in YAML style, identified by `#|` at the beginning of the line

my-document.qmd

````
The `gapminder.csv` dataset contains data from the [**Gapminder foundation*

```{r}
#| label: fig-neat-plot
#| echo: false
#| fig-width: 6
#| fig-height: 3.8
#| fig-cap: "My neat plot"

library(tidyverse)

df <- read_csv("data/gapminder.csv")

ggplot(df, aes(x = gdpPercap, y = lifeExp)) +
  geom_point(aes(size = pop, color = continent)) +
  scale_x_log10()
```
````

Anatomy of a Quarto document

Code can include optional chunk options, in YAML style, identified by `#|` at the beginning of the line

Option	Description
`eval`	Evaluate the code chunk
`echo`	Include the source code
`warning`	Include warnings
`include`	Include code and results

Other chunk options

Your turn

- Open `01-exercise.qmd` and run some of the code chunks (in order!).
- Add `#| include: false` to the second chunk and preview again. Switch it back to `true` or remove it. Preview again.
- In the YAML area, add an `author` field and add your name. Preview again.
- Change `code-fold` to be true. Preview again.
- Edit the first paragraph to:
  1. Make something bold
  2. Make “the Gapminder foundation” link to `https://www.gapminder.org`
  3. Replace `XXXX` and `YYYY` with inline code instead of hardcoded values. The first code chunk creates R objects named `first_year` and `last_year`—use those.

05:00

Authoring Quarto

Images and links

Markdown syntax	Output
`<https://quarto.org>`	https://quarto.org
`[Quarto](https://quarto.org)`	Quarto

```
![](earth.jpg)
```

Tables

```
| Right | Left | Default | Center |
|------:|:-----|---------|:------:|
|    12 | 12   | 12      |   12   |
|   123 | 123  | 123     |  123   |
|     1 | 1    | 1       |   1    |
```

↓

Right	Left	Default	Center
12	12	12	12
123	123	123	123
1	1	1	1

Tables

```
| Right | Left | Default | Center |
|------:|:-----|---------|:------:|
|    12 | 12   | 12      |   12   |
|   123 | 123  | 123     |  123   |
|     1 | 1    | 1       |   1    |

: Table Column Widths {tbl-colwidths="[10,30,30,30]"}
```

↓

Table Column Widths

Right	Left	Default	Center
12	12	12	12
123	123	123	123
1	1	1	1

Citations

my-document.qmd

```
---
title: "My Cool Document"
format: html
bibliography: references.bib
---

Computers are neat [@Lovelace:1842].
```

↓

Computers are neat (Lovelace 1842).

References

Lovelace, Ada Augusta. 1842. “Sketch of the Analytical Engine Invented by Charles Babbage, by LF Menabrea, Officer of the Military Engineers, with Notes Upon the Memoir by the Translator.” *Taylor’s Scientific Memoirs* 3: 666–731.

Citations

my-document.qmd

```
---
title: "My Cool Document"
format: html
bibliography: references.bib
csl: apa.csl
---

Computers are neat [@Lovelace:1842].
```

↓

Computers are neat (Lovelace, 1842).

References

Lovelace, A. A. (1842). Sketch of the analytical engine invented by Charles Babbage, by LF Menabrea, officer of the military engineers, with notes upon the memoir by the translator. *Taylor's Scientific Memoirs*, 3, 666–731.

Citations

my-document.qmd

```
---
title: "My Cool Document"
format: html
bibliography: references.bib
csl: chicago-notes-bibliography.csl
---

Computers are neat [@Lovelace:1842].
```

↓

Computers are neat[1].

Footnotes

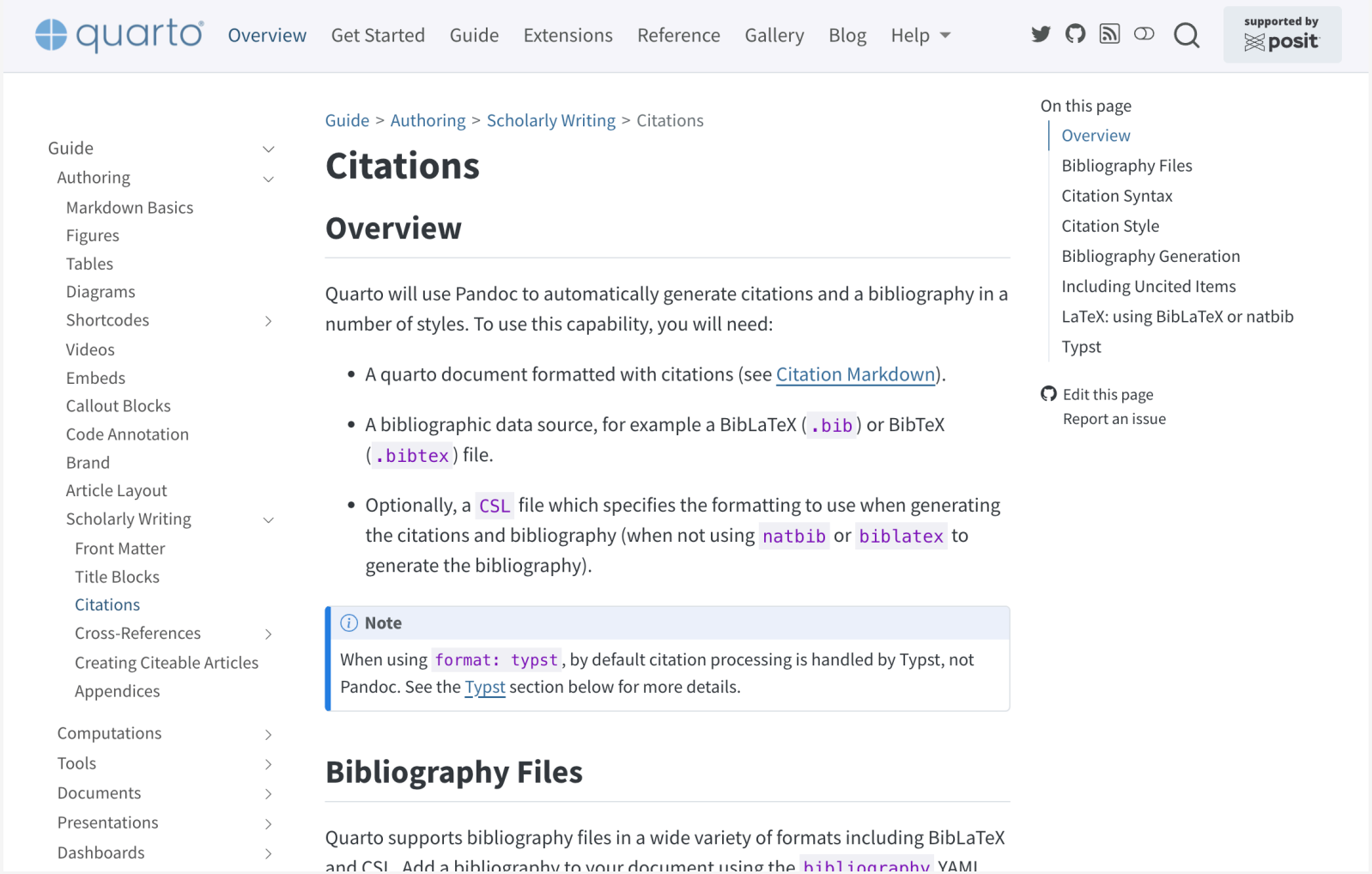
1. Ada Augusta Lovelace, “Sketch of the Analytical Engine Invented by Charles Babbage, by LF Menabrea, Officer of the Military Engineers, with Notes Upon the Memoir by the Translator,” *Taylor’s Scientific Memoirs* 3 (1842): 666–731.↩

Citations

Zotero + **Better BibTeX** can manage references and export them for Quarto

10,000 bibliographic styles are available at **https://www.zotero.org/styles**

Don’t memorize this stuff!



Quarto.org > Guide > Authoring > Scholarly Writing > Citations

Cross references

my-document.qmd

````
See @fig-neat-plot for more details.

```{r}
#| label: fig-neat-plot
#| fig-cap: "My neat plot"

# Plot code here
```
````

↓

> See Figure 1 for more details.

...

> Figure 1: My neat plot

Don’t memorize this stuff!

Cross References

Overview

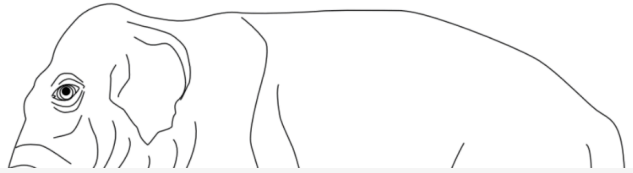
Cross-references make it easier for readers to navigate your document by providing numbered references and hyperlinks to various entities like figures and tables. Every cross-referenceable entity requires a label—a unique identifier prefixed with a cross-reference type e.g. `#fig-element`. For example, this is a cross-referenceable figure:

```
![Elephant](elephant.png){#fig-elephant}
```

The presence of the label (`#fig-elephant`) makes this figure referenceable. This enables you to use the following syntax to refer to it elsewhere in the document:

```
See @fig-elephant for an illustration.
```

Here is what this would look like rendered to HTML:



Edit this page
Report an issue

Quarto.org > Guide > Authoring > Scholarly Writing > Cross-References

Divs and Spans

For further customization, you can add classes, attributes, and other identifiers to content using divs and spans.

Divs

```
::: {.border}
This adds the "border" class to some content.
:::
```

Spans

```
[This is some text]{.class style="color: #cccccc;"}
```

Learn more: https://quarto.org/docs/authoring/markdown-basics.html#sec-divs-and-spans

Divs

Callout blocks

my-document.qmd

```
:::{.callout-tip}

Note that there are five types of callouts, including:
`note`, `tip`, `warning`, `caution`, and `important`.

:::
```

Tip

Note that there are five types of callouts, including: `note`, `tip`, `warning`, `caution`, and `important`.

Learn more: https://quarto.org/docs/authoring/markdown-basics.html#callout-blocks

Divs

Multiple columns

my-document.qmd

```
::: {layout-ncol=2}

![](earth.jpg)

Photo by [The New York Public Library](https://unsplash.com/@nypl) on [Unsp
:::
```

Photo by **The New York Public Library** on **Unsplash**

Divs

Tabsets

my-document.qmd

```
::: {.panel-tabset}
## R

`library(dplyr)`

## Python

`import pandas as pd`
:::
```

R | Python

```
library(dplyr)
```

Spans

my-document.qmd

```
1 This is text that is [red]{style="color:red;"}.
```

This is text that is red.

Changing formats

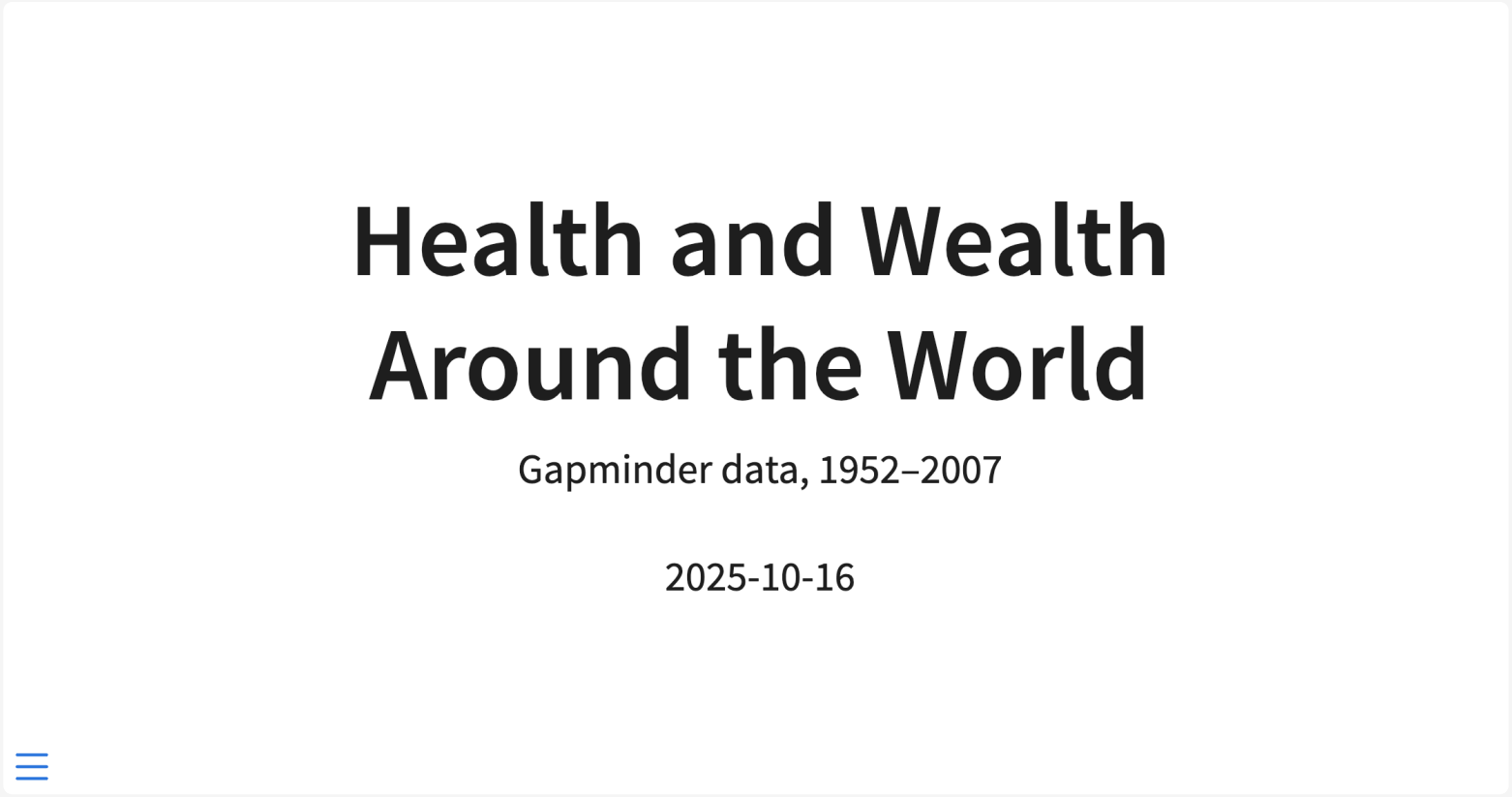
my-document.qmd

```
---
title: "My Cool Document"
format: html
---
```

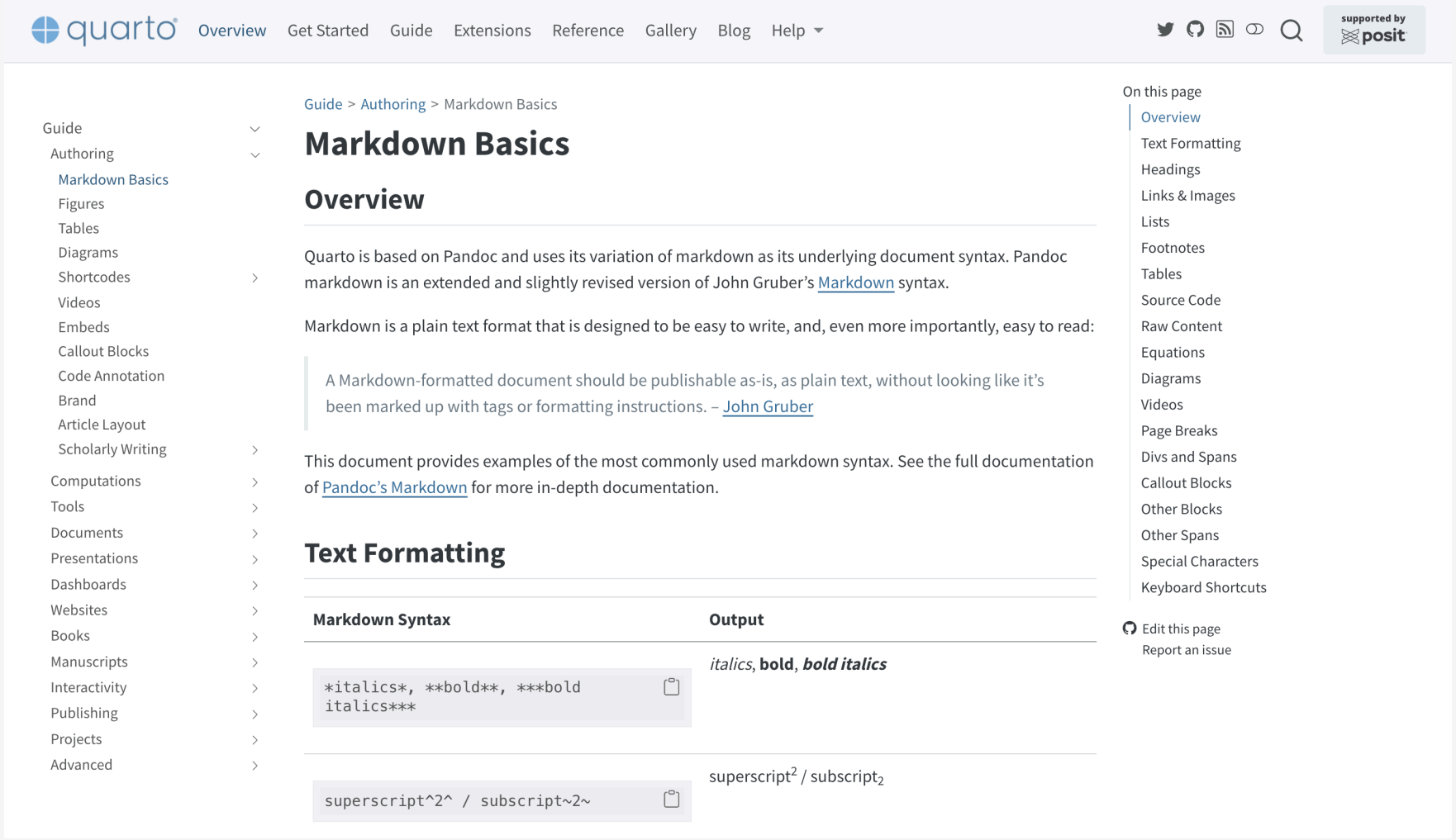
Changing formats

my-document.qmd

```
---
title: "My Cool Document"
format: revealjs
---
```



Don’t memorize this stuff!



Quarto.org > Guide > Authoring

Your turn

- Add an `important` callout box to the introduction summarizing the report's findings. Preview the file.
- Change the caption for the first plot. Preview again.
- Change some text color to `#ec008b`. Preview again.
- Edit the "Average life expectancy increased..." paragraph to say "According to Figure 1, average life expectancy increased...", **BUT** do it without typing "Figure 1". Preview again.
- In the first paragraph, add a citation to something in `bib/references.bib`. Preview again.
- Change the bibliography style to APA. Preview again.

05:00

What’s next?

Course outline

- ✅ ~~Intro to Quarto~~
- Creating basic websites
- Advanced website features
- Publishing
- Customization and branding
- Interactivity