

Getting Started with Quarto

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This is a short introduction to using Quarto (`.qmd` files) on problem sets and labs. Before using this guide, read the *Using the Statistical Software R* guide available at ryantmoore.com/teaching.html.

1 Background

Quarto is a useful format for integrating plain text information and code into one compiled document. It can be used to create reports, articles, slide presentations, and a variety of other formats for scientific communication. Quarto (`.qmd`) files can be rendered to create documents in HTML, PDF, or Microsoft Word. For this class, we recommend a package called `{tinytex}` to create the PDF files that you will submit to Canvas. Instructions for installing `{tinytex}` can be found via at <http://www.ryantmoore.org/files/ht/httinytex.pdf>.

1.1 `.R` files versus `.qmd` files

It can be easy to confuse the two types of files used in RStudio. Both `.R` and `.qmd` (or `.Rmd`) files can be used to write and run code, but they will each play a different role when performing data analysis.

A `.R` file will ...

- Accept only functions and scripts written in R
- Ignore anything that is commented out using the `#` symbol.
- Keep a record of your code as you work
- Allow you to run **one or more lines** of code at a time

A `.qmd` or `.Rmd` file will ...

- Accept both code and regular text
- Evaluate R code written in gray chunks (more on this later)
- Allow you to format the document around your code
- Compile **the entire document** before outputting your work

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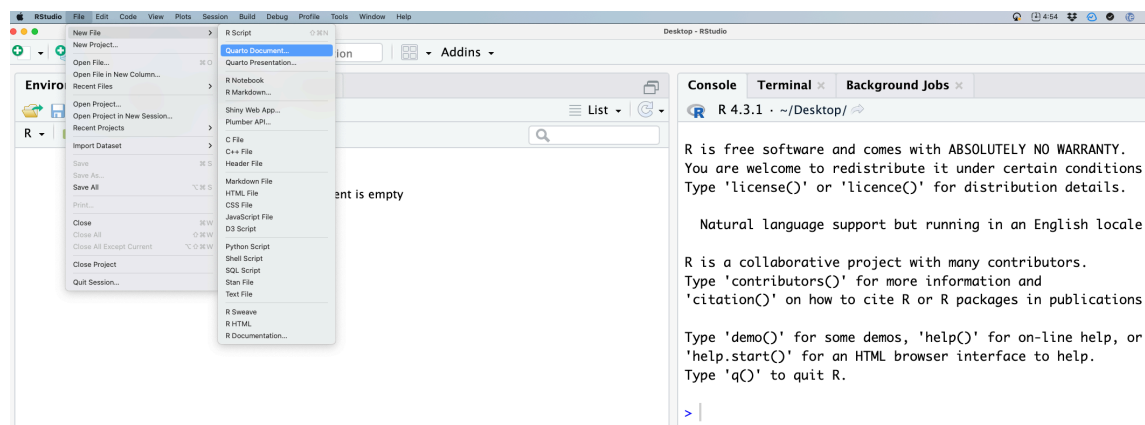
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2 Using Quarto

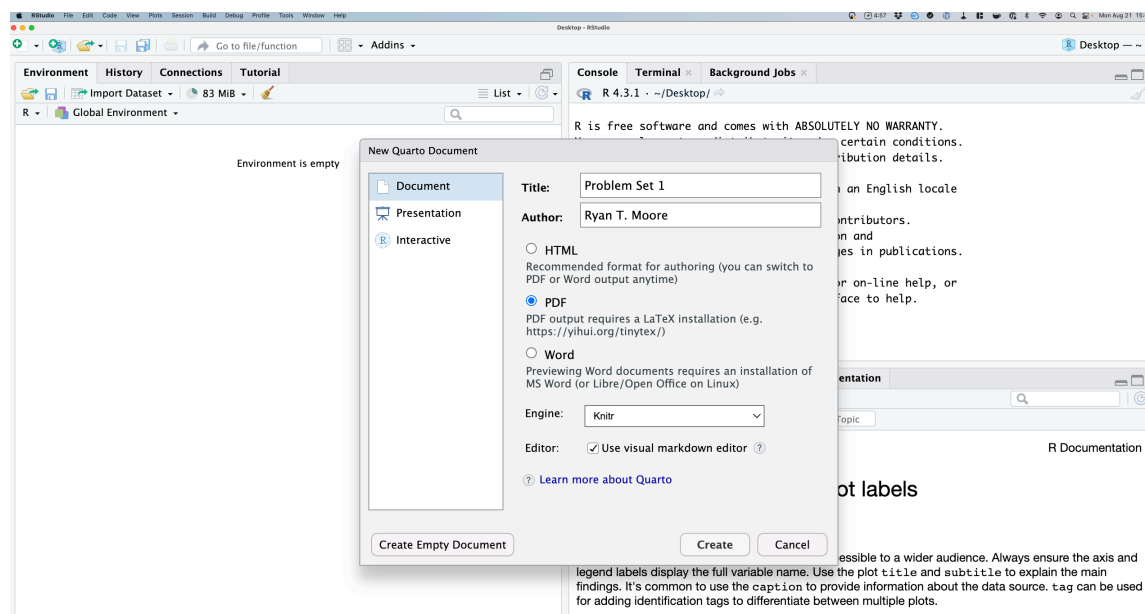
Now that you know the differences between a `.R` file and a `.qmd/.Rmd` file, it is important to recognize how they can be integrated into your workflow. This section will illustrate that process and explain how the two file types can work together.

2.1 Creating a `.qmd` file

Creating a `.qmd` is similar to creating a `.R` file. To begin, open RStudio and select `File > New File > Quarto Document`. (If you are creating a file for class, start by opening your `.Rproj` file, *then* creating a new Quarto document.)



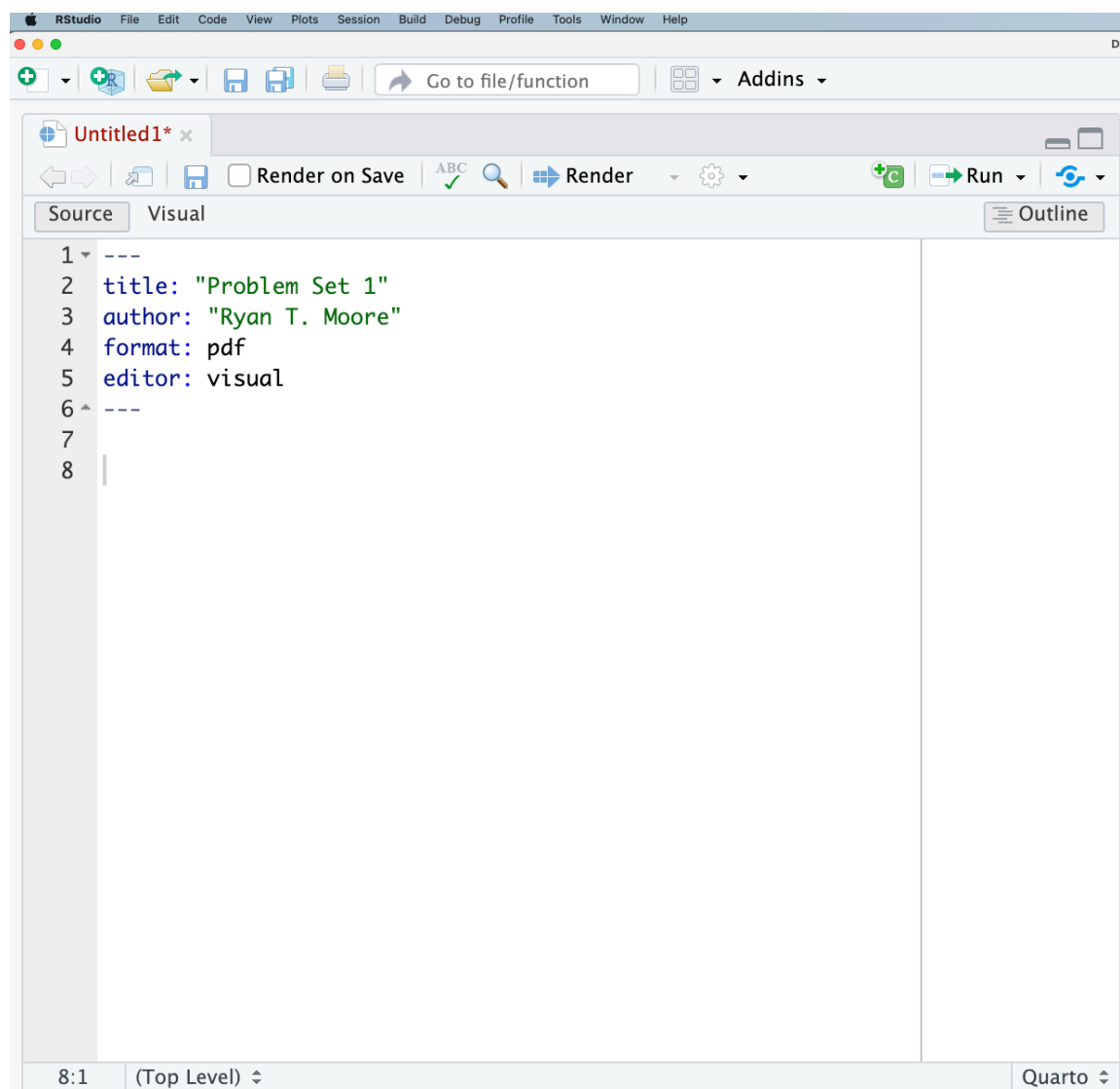
RStudio will ask you to give the document a title and select the default output. If you have `{tinytex}` installed, you should select PDF. Otherwise, choose HTML. Once you have filled in these fields, select Create.



2.2 Editing the .qmd

By default, the new .qmd starts in “Visual” editor mode. We recommend changing this to “Source” by clicking the “Source” button in the upper left hand corner. Then, change the header YAML tag from `editor: visual` to `editor: source`.

The default .qmd also includes some sample text to show you the kinds of information that can be entered. To remove this, simply delete lines 8 to 27. After you’ve done that, your file should look like this:



2.3 Saving and naming the .qmd file

Save the file using the save icon, File - Save, Cmd-S, or however you prefer to save files.

Give the file a good filename like `ps1_Moore.qmd`. No spaces.

Save the file to an appropriate directory/folder.

2.4 Customizing the YAML header

You can edit the header that is between the two sets of `---` (lines 1-6) above, but be careful. Spaces matter in this header.

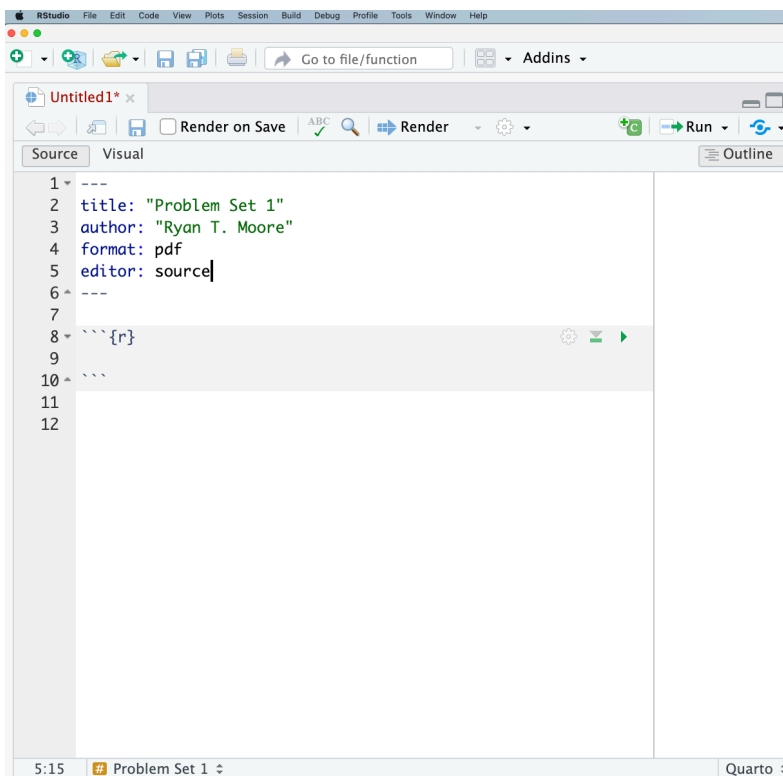
You might change the document class to `article` by adding `documentclass: article` to the header in a new line. This will produce a more standard U.S. article. You might also number your sections. To do these, add these lines to your YAML:

```
documentclass: article
format:
  pdf:
    number-sections: true
```

Note exactly 2 spaces in the successive lines above.

2.5 Adding content to an `.qmd` file

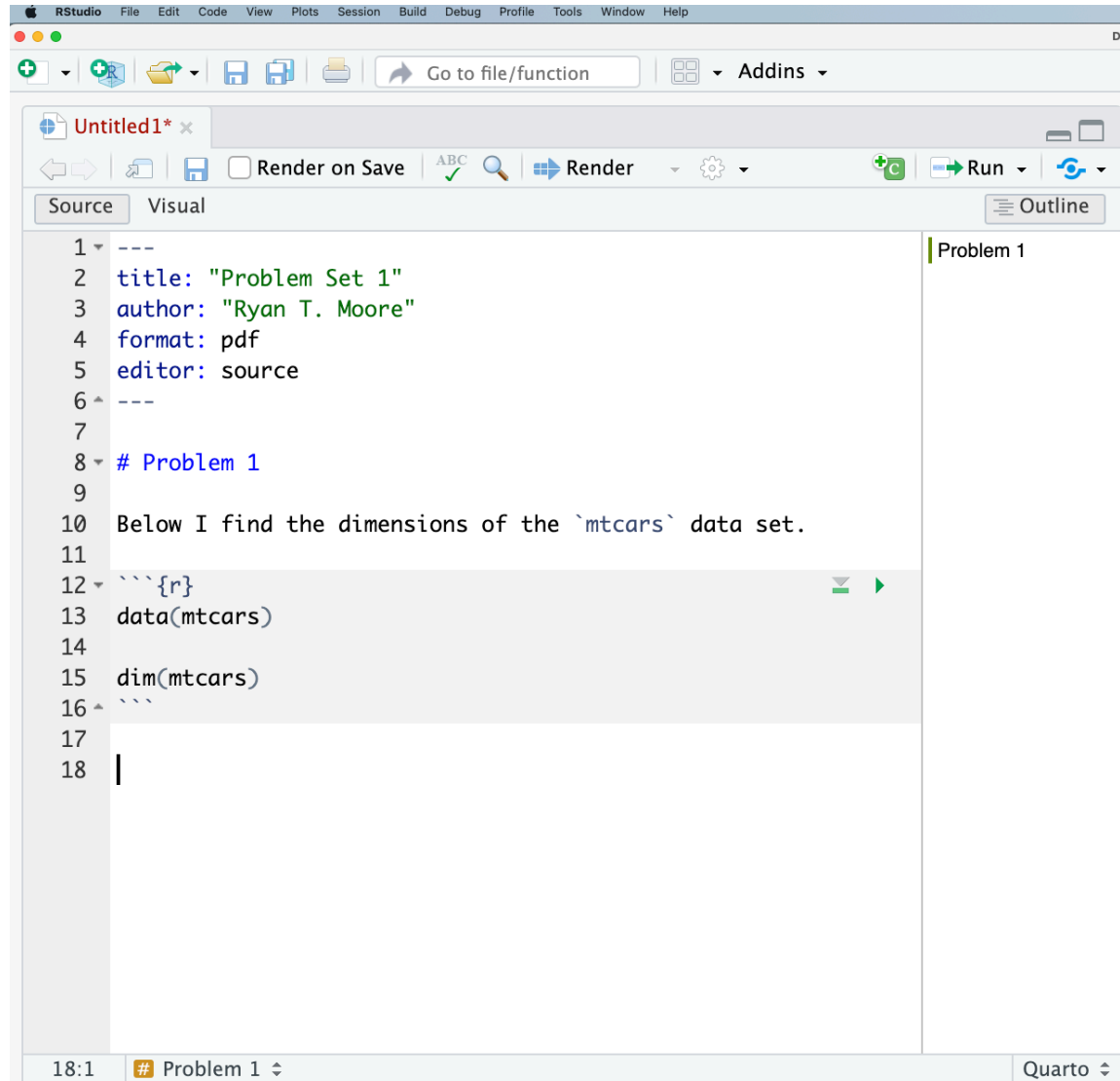
Your new `.qmd` file will accept both code and regular text. Anything you want R to evaluate (i.e. your code) should be placed inside a code *chunk*. To make a new chunk, select a blank line and type out three backticks followed by curly brackets that contain the letter `r`. Skip a few lines and type three more backticks to close the chunk. You can also add a chunk by selecting Code > Insert Chunk. Any lines inside a code chunk will appear gray.



Text can be added to your document normally by typing anywhere *outside* of a code chunk. There are numerous ways to customize your `.qmd` using `LATEX`, a document preparation system commonly

used in social science. To learn more, you can read the *Getting Started with L^AT_EX* guide via the URL at the top of this guide. For now, you can add a section header by using the # symbol.

Here is an example of how to format the answer to a problem set using these techniques:



There is another way to add code into an `.qmd`: inline code. This allows you to write sentences as you would normally, but also integrate the results of your code. This is done by putting your code inside of ``r `` instead of a regular chunk. Here's an example:

Instead of typing ...

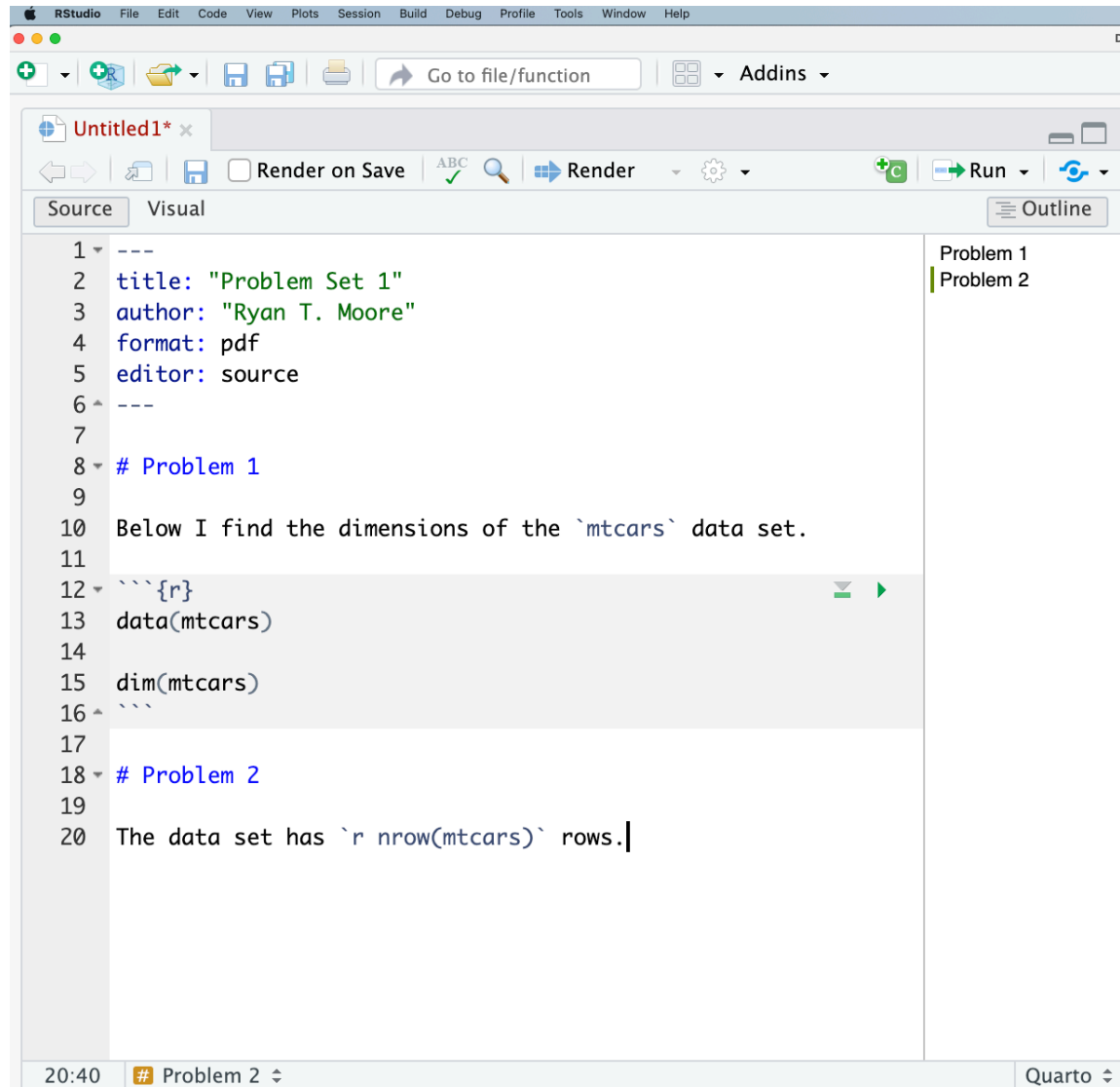
- The sum of 12 and 45 is 57.

You can type ...

- The sum of 12 and 45 is ``r 12 + 45``.

Both of which will output ...

- The sum of 12 and 45 is 57.



2.6 Compiling a .qmd file (“rendering”/“knitting”)

The last step in preparing your document is to compile the .qmd into a human-readable PDF; this is also called *rendering* or *knitting*. To do this, simply click on the **Render** button when you are ready. Recall that unlike a .R file, a .qmd will be read and evaluated all at once. If a single line is incorrect or has a missing character, RStudio will produce an error and the document will not be rendered. See Figure 1 for a finished PDF document after knitting:

With these techniques, you should be able to add both code and narrative response to your .qmd file and produce a well-formatted PDF. Remember that your narrative responses should be *outside*

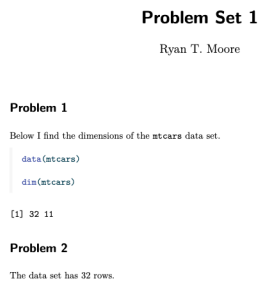


Figure 1: A rendered `.qmd` file (using the default document class)

of code chunks. For problem sets and labs, remember to always show the code used to reach your answer.¹ It's also helpful to use section headers and separate code chunks for each problem.

3 Optimizing Your Workflow

Quarto is great at creating a professional-looking work product that integrates all of your content. It may be difficult, however, to use a `.qmd` when solving problems and analyzing data. To solve this, we sometimes use both a `.R` and `.qmd` file when doing analysis. This achieves several goals:

- **Solve problems faster:** You can run your code line-by-line without having to wait for your whole file to be rendered.
- **Stay organized:** You can add hundreds of lines to your `.R` without worrying about cluttering your `.qmd`.
- **Archive your process:** You have a record of the work you did, the errors you made, and how you came to the solution.

You can think of R Script as your scrap paper and Quarto as the final product. Use comments to break up your `.R` file and then copy and paste your work in the `.qmd` after you've solved the problem. This is an iterative process; you should go back to your `.R` file any time you need to test the code in your `.qmd`.

Here are the steps:

¹In papers, you should not show your code.

1. Open RStudio
2. Create an `.R` file and name it according to your project
3. Create a `.qmd` file with a similar name
4. In your `.R` file, write, test, and edit code for each problem or section of analysis
5. Copy and paste the best code from your `.R` file into your `.qmd`. Use a separate code chunk for each problem part. (Even better: `source()` your `.R` file.)
6. Add text, graphs, and other formatting to your `.qmd`
7. Render your `.qmd`
8. Save your work
9. Repeat steps 4-8 until you've solved every problem!

4 Quarto vs. the Console: Beware the Green Arrow

When you knit a `.qmd` file, R runs the code from the top of the `.qmd` file to the bottom. It does not run other code, and it does **not** look in the Console's workspace. This means your `.qmd` file needs to be entirely self-contained. You need to set the working directory, read the data, create intermediate objects, etc. *within* the `.qmd` file itself.

RStudio provides a small green arrow to the right of your code chunks. When you click the green arrow, R looks in the current workspace for objects, prints the results to the console or plotter, and then reprints them in the confines of your `.qmd`. This behavior is “notebook-like”. However, the objects are not really in your `.qmd` file, in the sense that they are not part of the compiled/knit output. When you compile/knit to create an output file, the only code that is run is the 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, we recommend examining your output by knitting your `.qmd` file, rather than by using the green arrow.