

Lecture 2: R Markdown, Version Control with Git(Hub), and Other Productivity Tools

James Sears*

AFRE 891 SS 24

Michigan State University

*Parts of these slides are adapted from “[Advanced Data Analytics](#)” by Nick Hagerty and “[Data Science for Economists](#)” by Grant McDermott.

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Prologue

Prologue

Before we dive in, let's double check that we all have

- ☑ Installed **R**.
- ☑ Installed **RStudio**.
- ☑ Signed up for an account on **Github**
- ☑ Installed **Git** and **Github Desktop**
- ☑ Log into your Github account on Github Desktop

R Markdown

R Markdown

Before we dive into version control, let's chat about **R Markdown**.

R Markdown is a document type that allows for integration of R code and output into a Markdown document.

Resources:

- Website: rmarkdown.rstudio.com
- **R Markdown Cheatsheet**
- Book: **R Markdown: The Definitive Guide** (Yihui Xie, JJ Allaire, and Garrett Grolemund)

R Markdown

Before we dive into version control, let's chat about **R Markdown**.

R Markdown is a document type that allows for integration of R code and output into a Markdown document.

Other points:

- We'll be completing assignments using R Markdown.
- FWIW, my lecture slides and notes are all written in R Markdown too.
(E.g. This slide deck is built using the **xaringan** package with the metropolis theme.)

R Markdown: Getting Started

☒ Installed R.

☒ Installed RStudio.

☐ Add the `rmarkdown` package

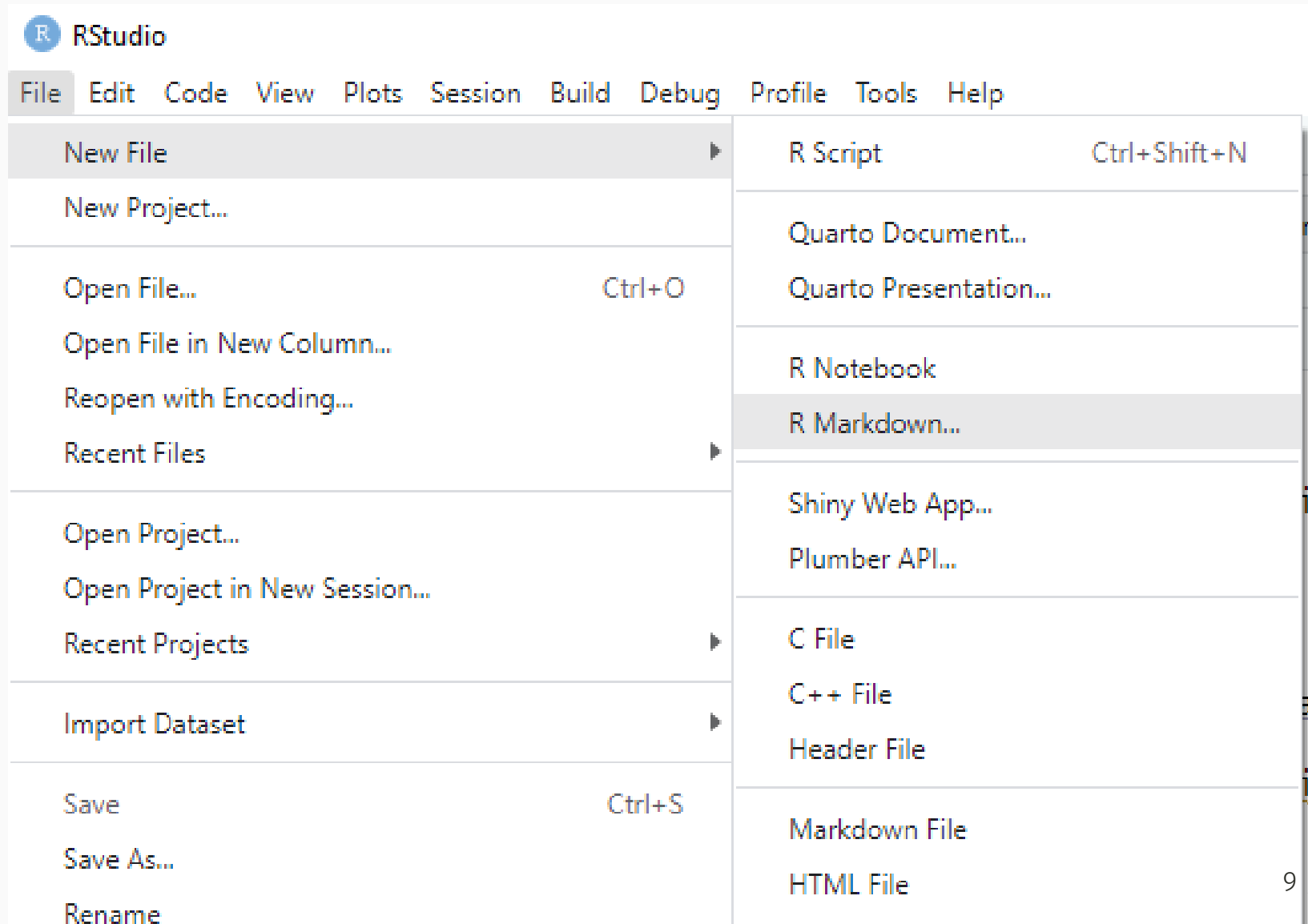
```
install.packages("rmarkdown")
```

☐ Install LaTeX

- If just for this, can use **TinyTex**


```
# Install only if you don't have LaTeX already  
install.packages("tinytex")  
tinytex::install_tinytex()
```



R Markdown: Creating a New .Rmd File





R Markdown: Creating a New .Rmd File

New R Markdown

 Document

 Presentation

 Shiny

 From Template

Title: Test R Markdown

Author: James

Date: 2024-01-10

☐ Use current date when rendering document

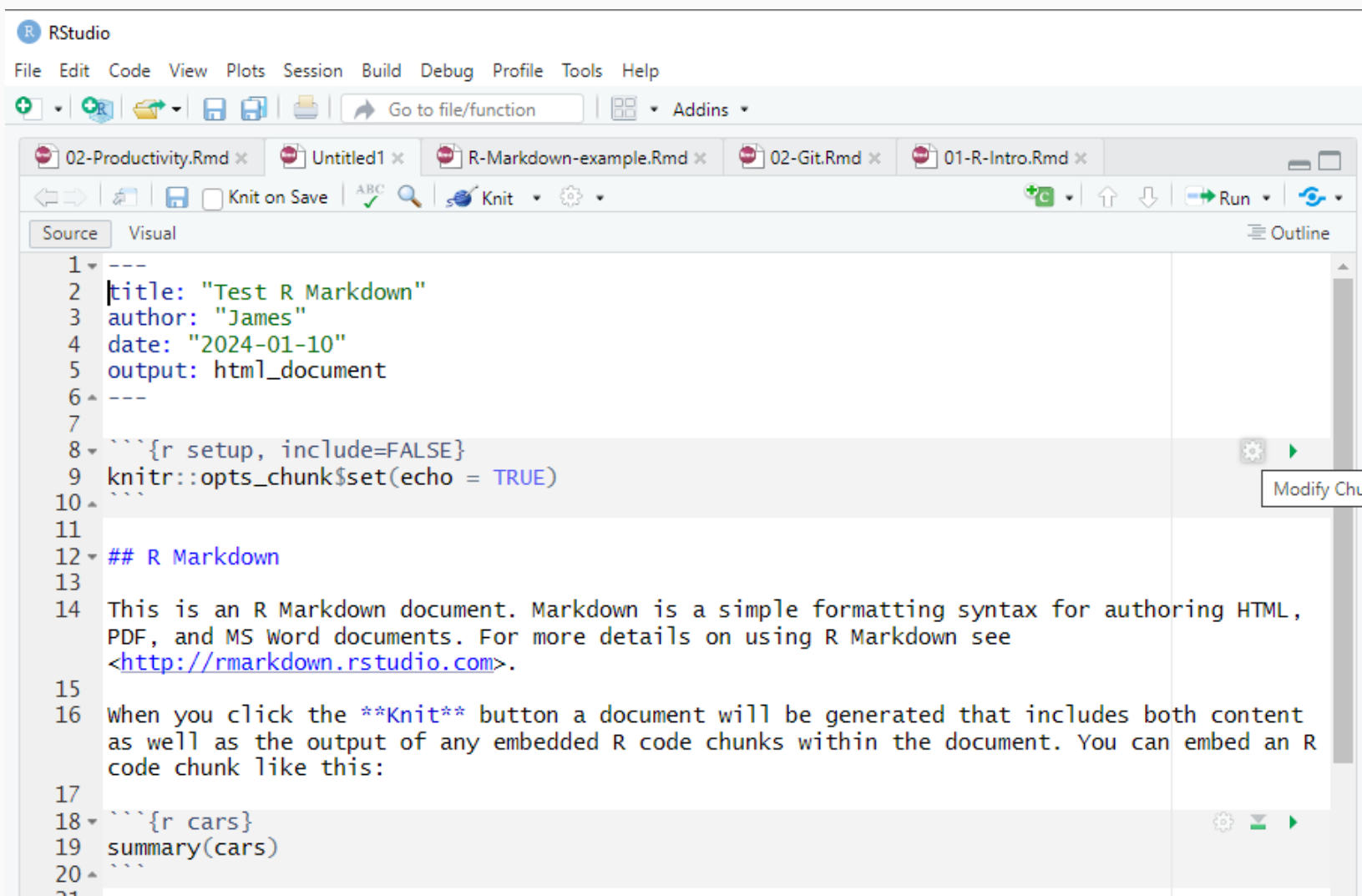
Default Output Format:

☒ HTML
Recommended format for authoring (you can switch to PDF or Word output anytime).

☐ PDF
PDF output requires TeX (MiKTeX on Windows, MacTeX 2013+ on OS X, TeX Live 2013+ on Linux).

☐ Word
Previewing Word documents requires an installation of MS Word (or Libre/Open Office on Linux).

R Markdown: Creating a New .Rmd File



R Markdown Components

R Markdown combines

1. **Markdown:** lightweight markup language
2. **LaTeX:** typesetting for math
3. **R:** include code and generate output

Let's do some practice: **open a new .Rmd file** and try adding content as we go

Markdown

Markdown allows for formatting text in a lightweight way

I highly recommend the handy **Markdown Guide** for more details

Markdown: Heading

Headings emphasize text and add chunks to your script

Largest heading with one leading # (slide title above)

Second Largest (##)

Third Largest (###)

Getting Smaller... (####)

Normal Text for comparison

Markdown: Text Format

Bold text with `**your text**`

Italicize with `*single asterisks*`

Add `code text` with grave accents (the back tick symbol)

- ```
- The shift output of the tilde key `~` on keyboard

End a line with two spaces to start a new paragraph

- or leave a line space between sentences

Can also start a new line with backslash (`\`)

Markdown: Text Format

Add superscripts² with ^carets^

Add ~~strikethroughs~~ with ~tildes~

Add a line break (horizontal rule)

with ***

Markdown: Text Format

Draw **tables** using | and -

Col A	Col B	Col C
This	is	a
Table		wow

Markdown: Lists

Add an **ordered list** with **1.**

1. First Item
2. Second Item
3. No need to change the number - keep using 1. It will automatically update.

Add an **unordered list** with *** or -**

- A thing
- Another related thing
 - Indent to nest
 1. Can mix ordered and unordered

Markdown: Inputs

Add a **link** with `[]()`

- `[text label](URL)`
- Add direct link with `<link>` <https://www.markdownguide.org>

Add an image with ``

- `![alt text](URL)`

practice by adding `images/smile.png`:



R Markdown: LaTeX

Another advantage of R Markdown is that it integrates \LaTeX functionality for typesetting math.

Add an **inline equation** with $\text{\$TeX\$}$

$$\textit{Var}(X) = \sum_{i=1}^n \frac{(x_i - \bar{x})^2}{n} \quad Y_{it} = \beta_0 + \beta_1 X_{it} + \epsilon_{it}$$

Add multiple rows of LaTeX with

$\text{\$}$

LaTeX lines here

$\text{\$}$

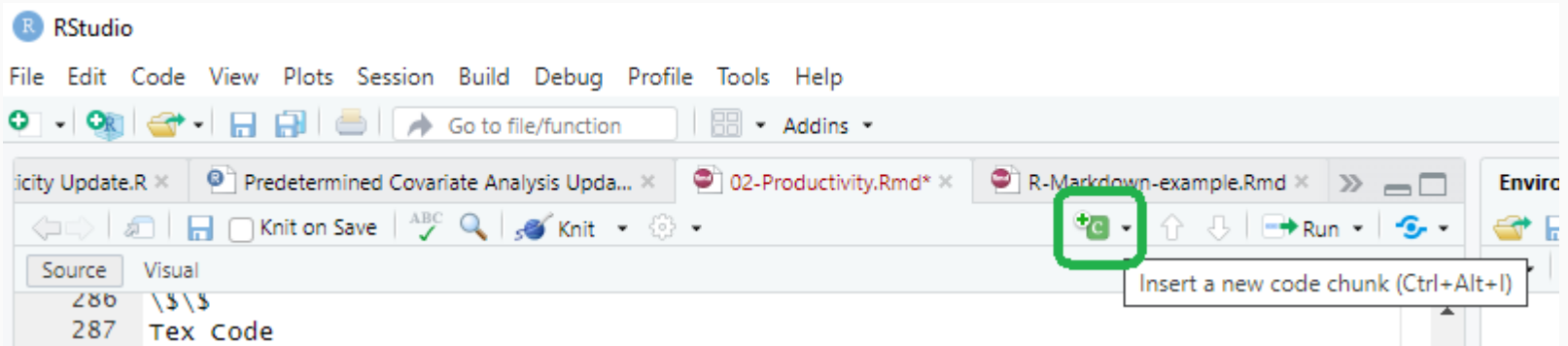
Use the **standard LaTeX commands** for symbols/characters

R Markdown: R Code

R code is primarily executed with **code chunks**

Add a chunk with

- Cmd + Option + I (Ctrl + Alt + I on PC)
- The **Insert** button in the UI
- Manually type



R Markdown: R Code Chunks

307

308 ▾ ```{r}

309

310 ▴ ```

311



Code chunks allow us to add as many lines of code as we want

- Output will appear underneath after executing the full chunk
- Can customize whether it runs, how output is displayed
- Can run manually
 - Line by line with `Cmd/Ctrl + Enter`
 - Entire chunk with `Run Entire Chunk` button

R Markdown: R Code Chunk Options

You can **add chunk options** in brackets after `r` and separated by commas.

Some commonly-used options include:

- **Chunk label** (`ex_chunk`)
- `include = FALSE` will run the chunk but hide it from the final document
- `eval = FALSE` will display code without evaluating it
- `results = 'hide'` runs code but hides output from the final document

```
52
53 ```{r sum, echo = FALSE, warning = FALSE}
54 2+2
55
56 ```
57
```

R Markdown: R Code Chunk Options

You can **add chunk options** after `r` and separated by commas.

Some commonly-used options include:

- `echo = FALSE` runs the code but hides the chunk from the final document
- `error = FALSE` (`warning = FALSE`) will hide error (warning) messages generated by the code
- LOTS of options for output figures: figure size (`fig.width`, `fig.height`, `fig.dim`), output document scale (`out.width`, `out.height`), alignment (`fig.align`), caption (`fig.cap`)

Learn more **[about chunk options here](#)**

R Markdown: R Code

You can call R objects from earlier chunks **inline** with

`< r <`

```
four = 2+2
```

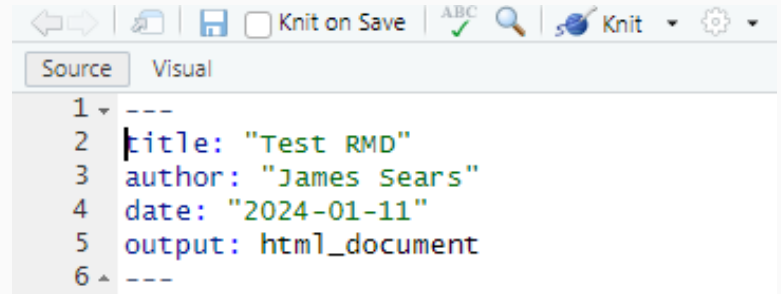
This can output in line with text: $2 + 2 = 4$

R Markdown File Organization

1. Header

RStudio automatically builds the R Markdown file from a template, which begins with a **header**

- Title
- Author
- Date
- Output Format
 - Main options¹: HTML
(`html_document`), PDF
(`pdf_document`), LaTeX
(`latex_document`), or Word
(`word_document`)



```
1 ---  
2 title: "Test RMD"  
3 author: "James Sears"  
4 date: "2024-01-11"  
5 output: html_document  
6 ---
```

1: See **CH 3 of "R Markdown: The Definitive Guide"** for more on how to customize output formats

2. R Setup

By default, RStudio adds a **setup** code chunk next.

```
8  ```{r setup, include=FALSE}
9  knitr::opts_chunk$set(echo = TRUE)
10 ```
11
```

- Can set global options
- Useful as your preamble
- For **R Notebooks**, this will automatically be run and is the only place where you can change your working directory

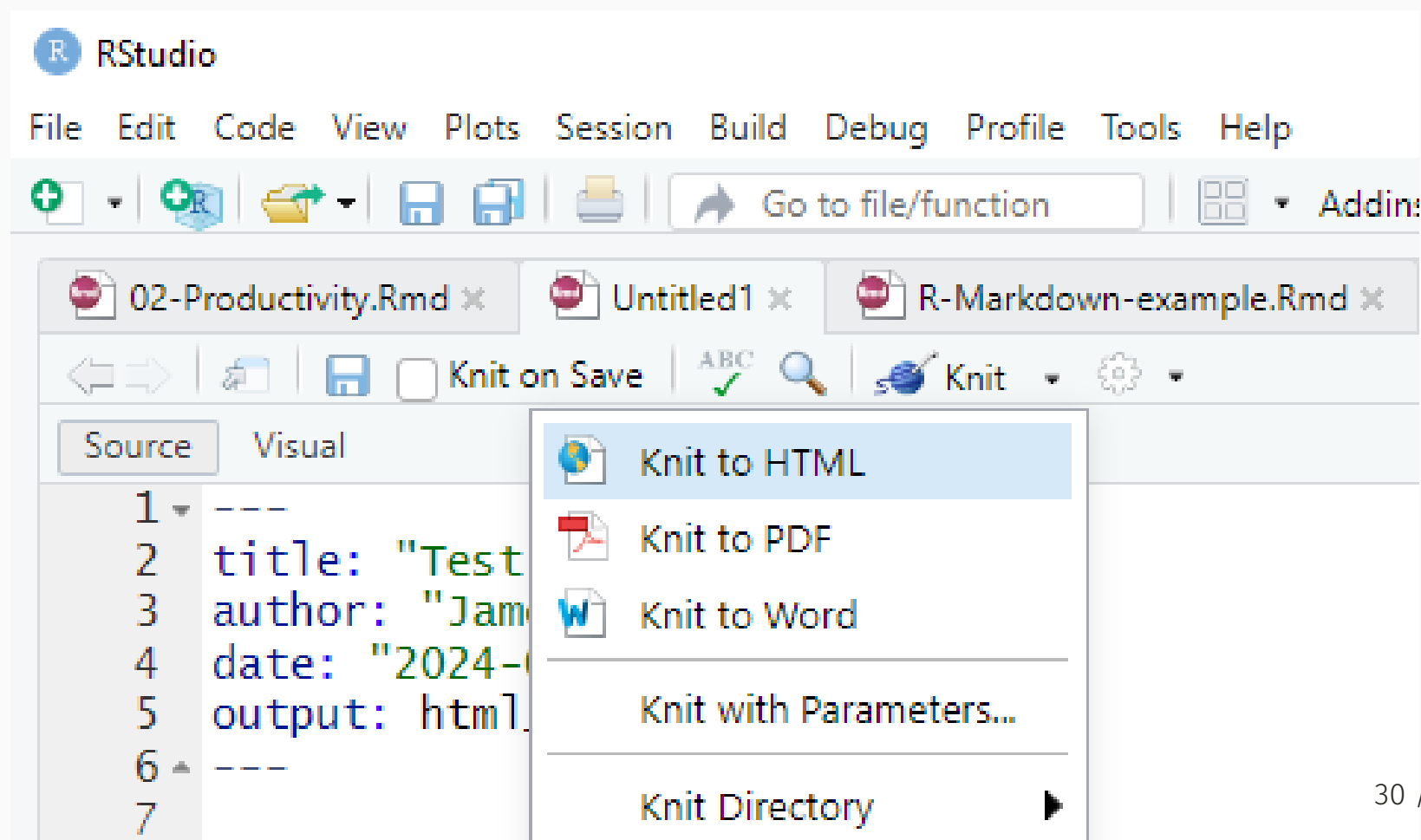
3. Contents

From here on you can build the report/notebook as needed for the task.

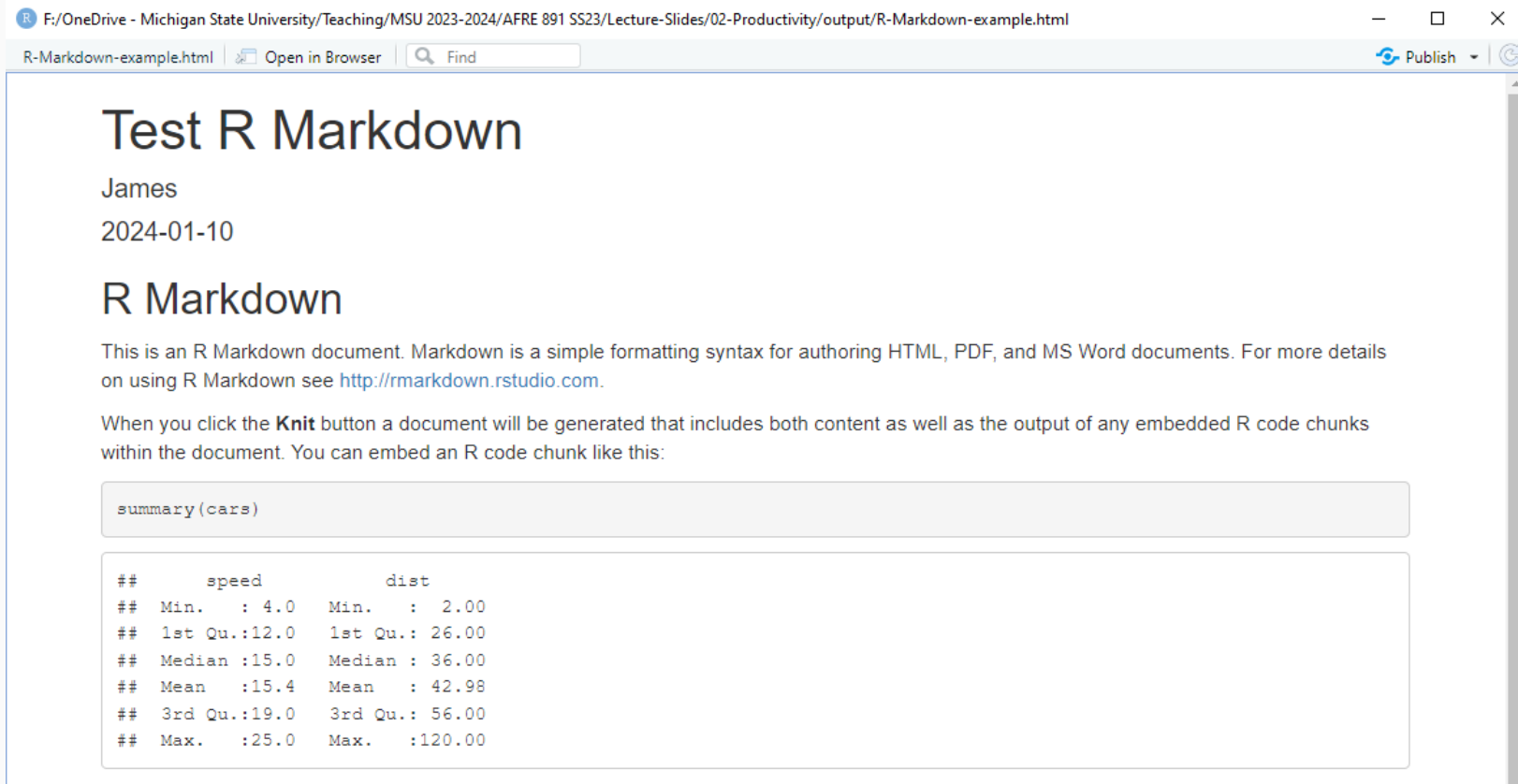
- Add any writing and outside graphics or **bibTeX citations**
- Add code chunks to carry out desired analysis
- Employ sections and formatting to structure the document as desired

Compiling/Knitting

When you are ready to compile your final document, use the **Knit** button or **Ctrl/Cmd + Shift + K**



R Markdown: Knit to Compile Output



The screenshot shows a web browser window displaying an R Markdown document. The browser's address bar shows the file path: `F:/OneDrive - Michigan State University/Teaching/MSU 2023-2024/AFRE 891 SS23/Lecture-Slides/02-Productivity/output/R-Markdown-example.html`. The browser's tab is labeled `R-Markdown-example.html`. The document content includes a title, author, date, a section header, an introductory paragraph, a paragraph about the **Knit** button, and an R code chunk with its output.

Test R Markdown

James

2024-01-10

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

##	speed	dist
## Min.	: 4.0	Min. : 2.00
## 1st Qu.:	12.0	1st Qu.: 26.00
## Median :	15.0	Median : 36.00
## Mean :	15.4	Mean : 42.98
## 3rd Qu.:	19.0	3rd Qu.: 56.00
## Max.	:25.0	Max. :120.00

Markdown Practice!

Markdown Practice

1. Create a new R Markdown file named "R-Markdown-Ex.RMD"
2. In the setup chunk, load the `dslabs` and `tidyverse` packages
 - Use the `data()` function to read in the `divorce_margarine` dataset
3. Add a header labeled "Correlation vs. Causation" and a text explanation below for why we often want to differentiate between the two
4. Add a code chunk with the label `plot`
 - Type the following code:

```
ggplot(divorce_margarine) +  
  geom_point(aes(x = margarine_consumption_per_capita,  
                 y = divorce_rate_maine)) +  
  labs(title = "Relationship between Margarine Consumption and  
             Divorce Rates in Maine",  
        subtitle = "2000-2009",  
        x = "Margarine Consumption per Capita",  
        y = "Divorce Rate")`
```

5. Knit and save a PDF/HTML copy of the file to the "output" folder