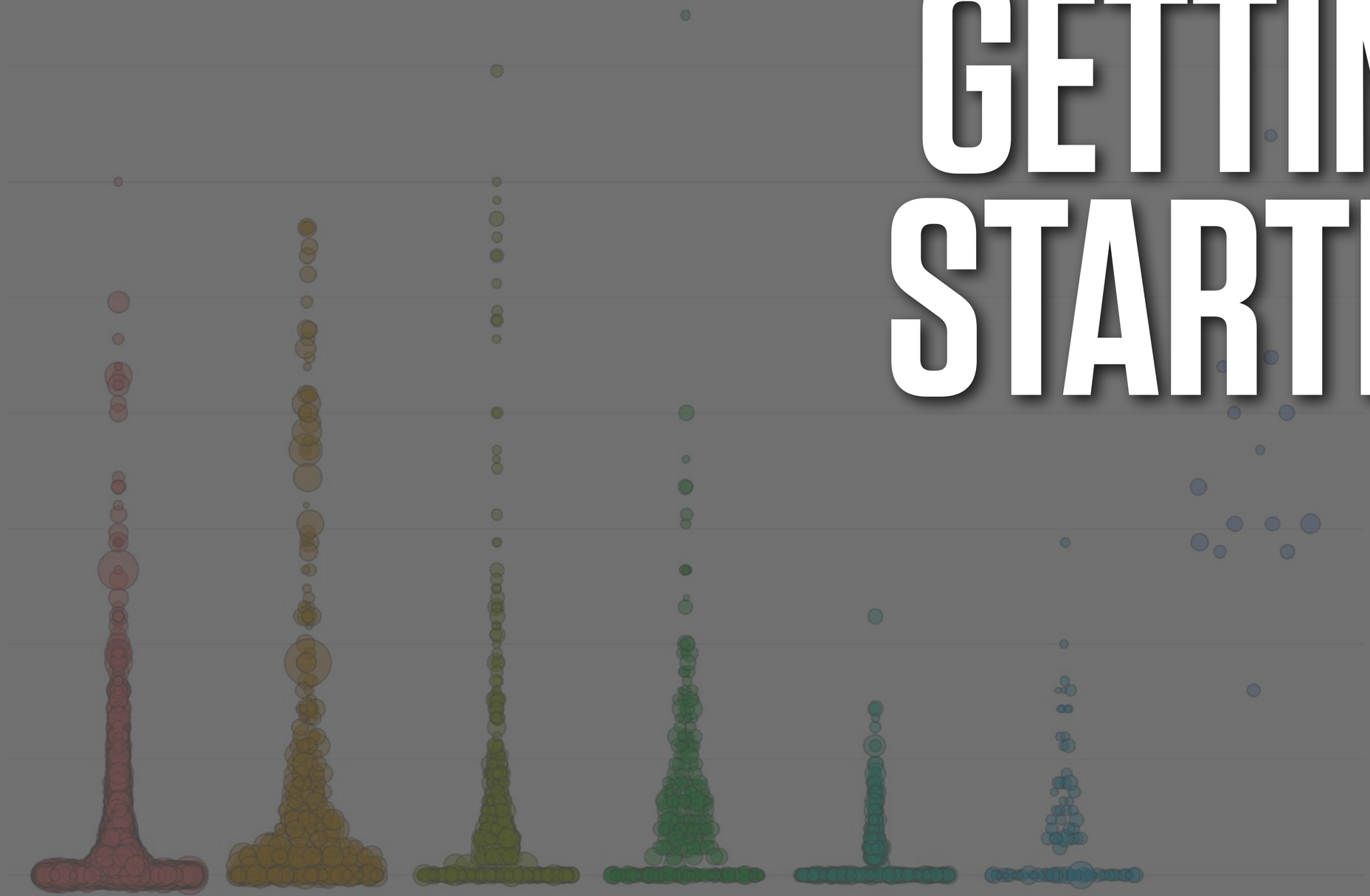
GETTING STARTED



WE WANT TO DRAW GOOD DATA GRAPHICS REPRODUCIBLY

Abstraction in Software

Less → More

Easy things are awkward

Hard things are straightforward

Really hard things are doable

Easy things are trivial

Hard things are really awkward

Really hard things are impossible

D3

Grid

ggplot

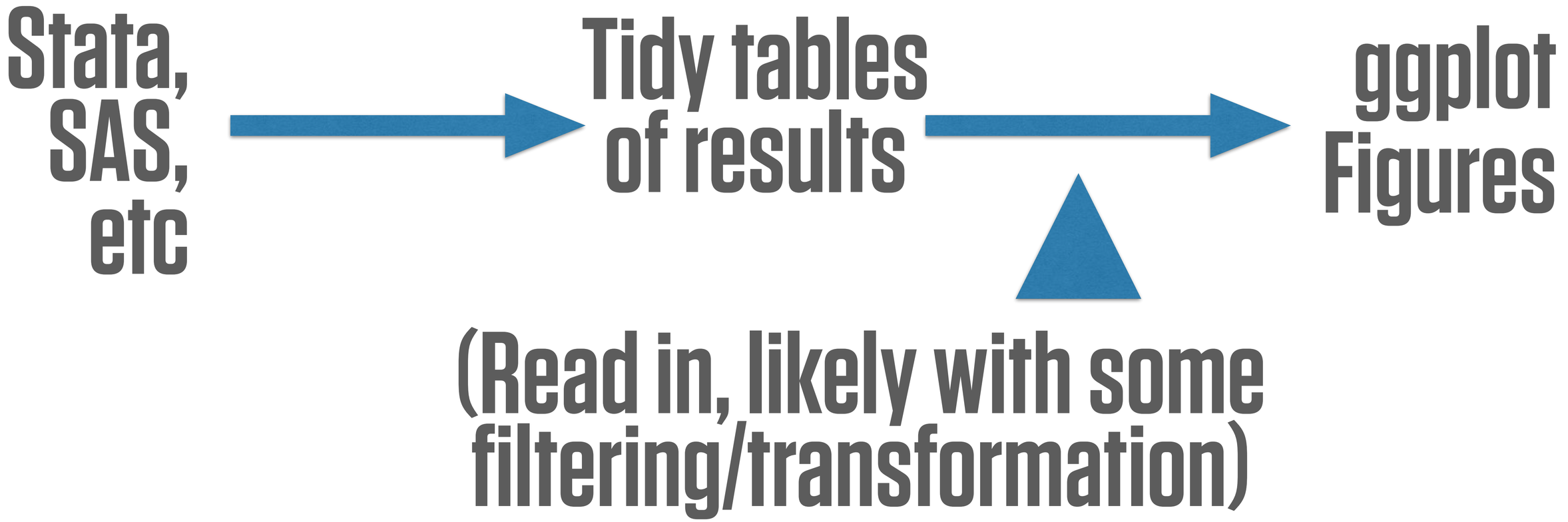
Stata

Excel

Two ways to use R and ggplot

1. Do Everything in R

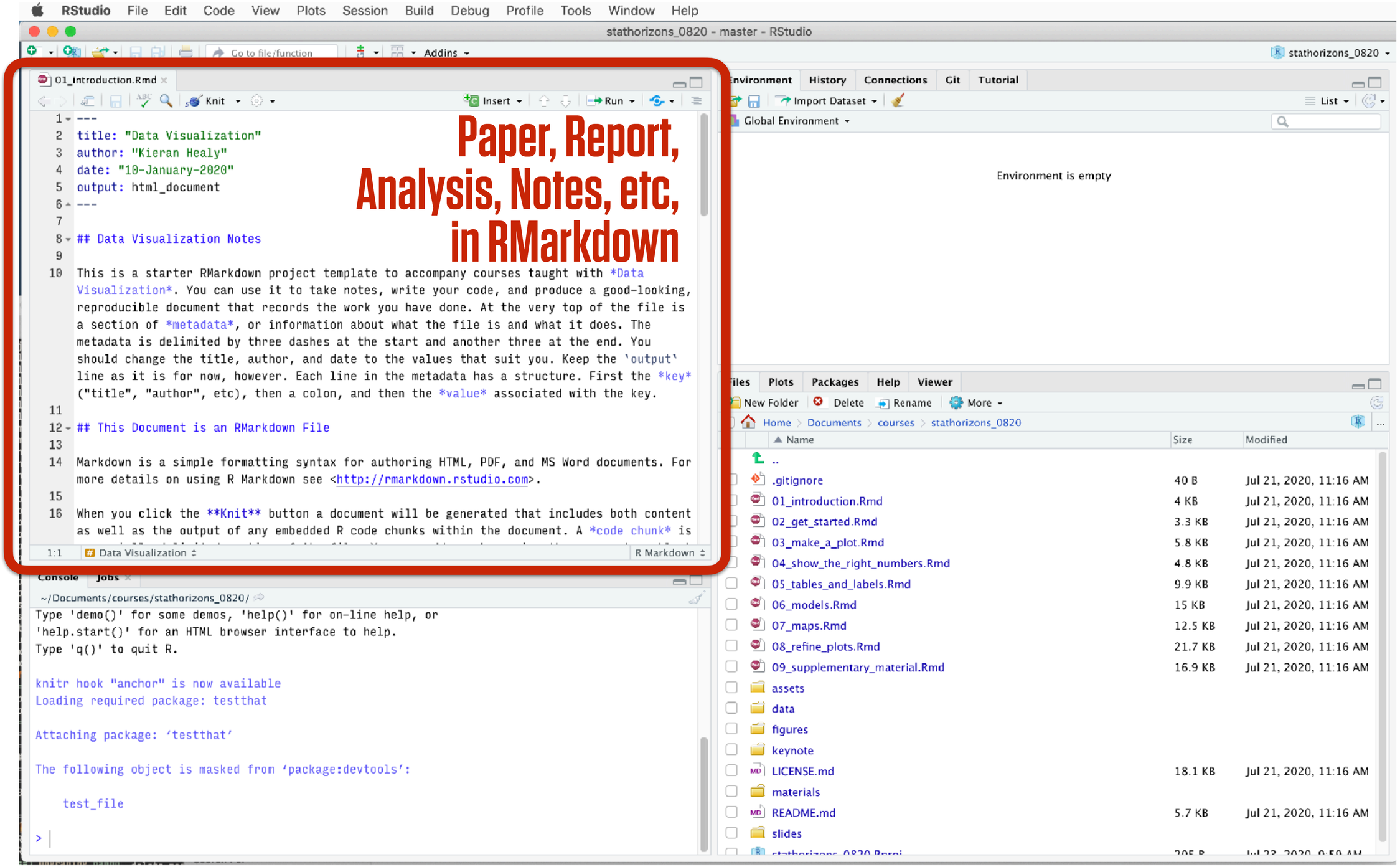
2. Just use ggplot



THE RIGHT FRAME OF MIND

TYPE OUT YOUR CODE BY HAND

RSTUDIO


RStudio File Edit Code View Plots Session Build Debug Profile Tools Window Help
stathorizons_0820 - master - RStudio
Go to file/function
Addins
stathorizons_0820
01_introduction.Rmd
Knit
Insert
Run
Paper, Report, Analysis, Notes, etc, in RMarkdown
1 ---
2 title: "Data Visualization"
3 author: "Kieran Healy"
4 date: "10-January-2020"
5 output: html_document
6 ---
8 ## Data Visualization Notes
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R Markdown
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Console Jobs
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Type 'demo()' for some demos, 'help()' for on-line help, or
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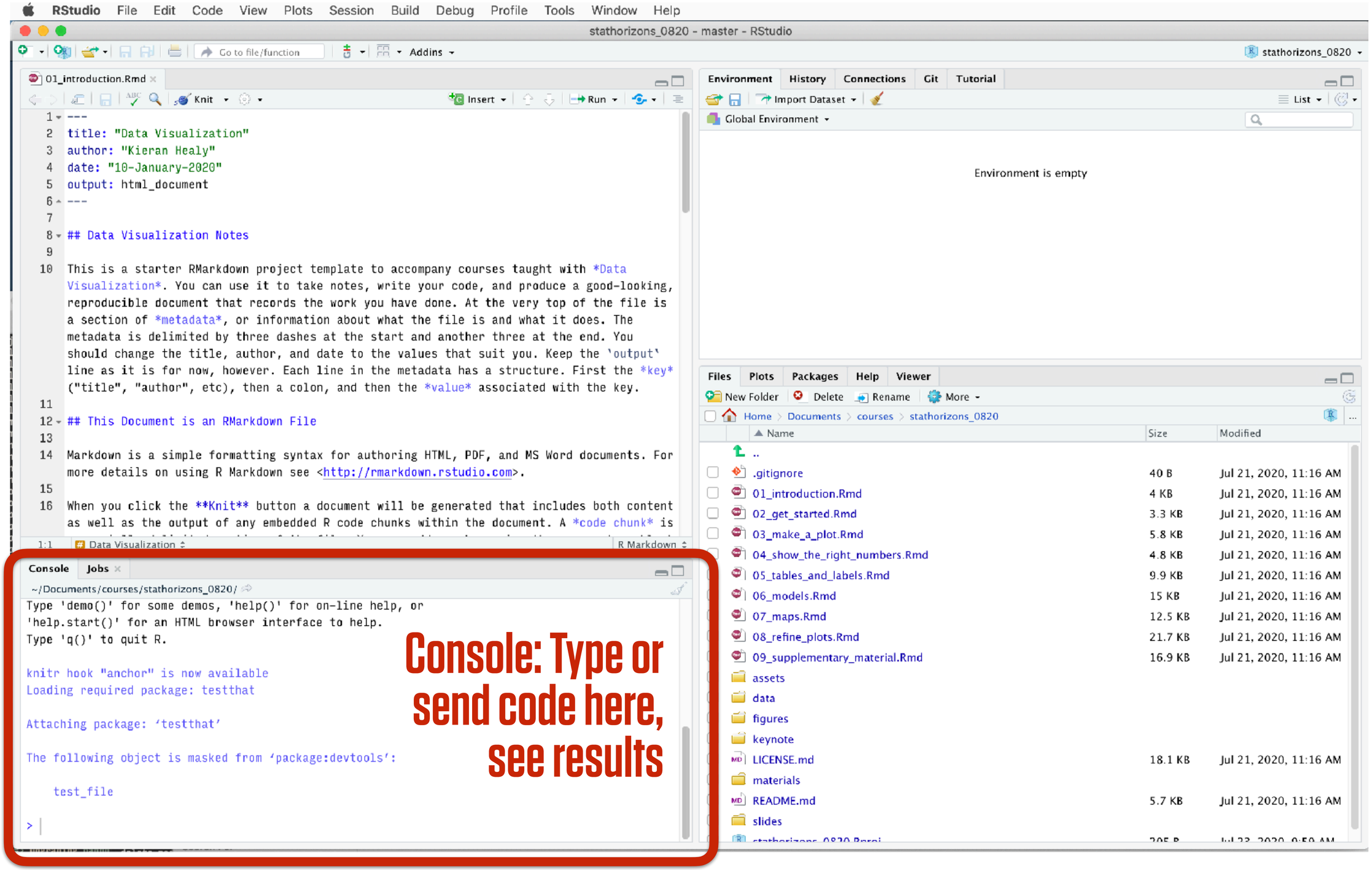
RStudio File Edit Code View Plots Session Build Debug Profile Tools Window Help
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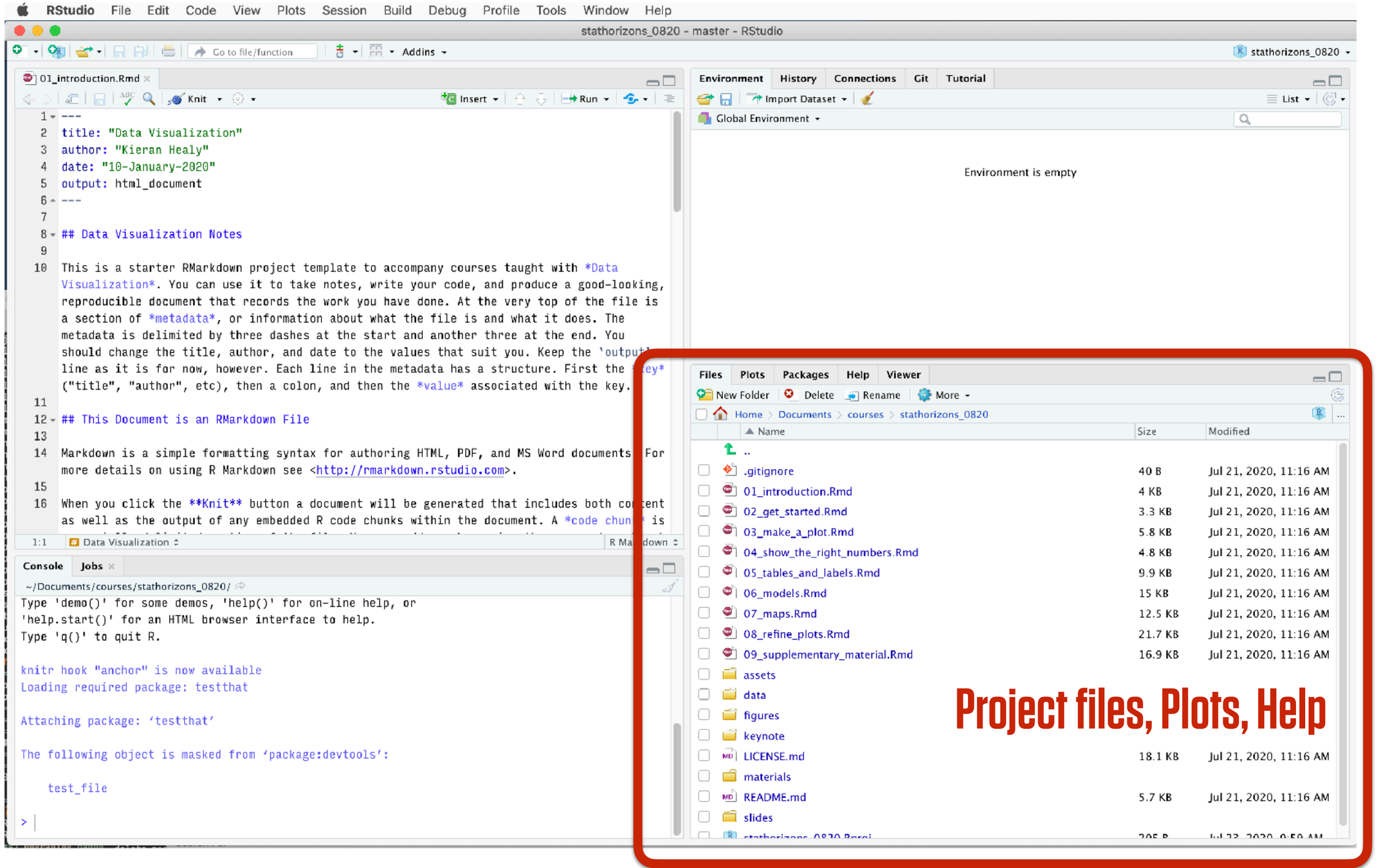
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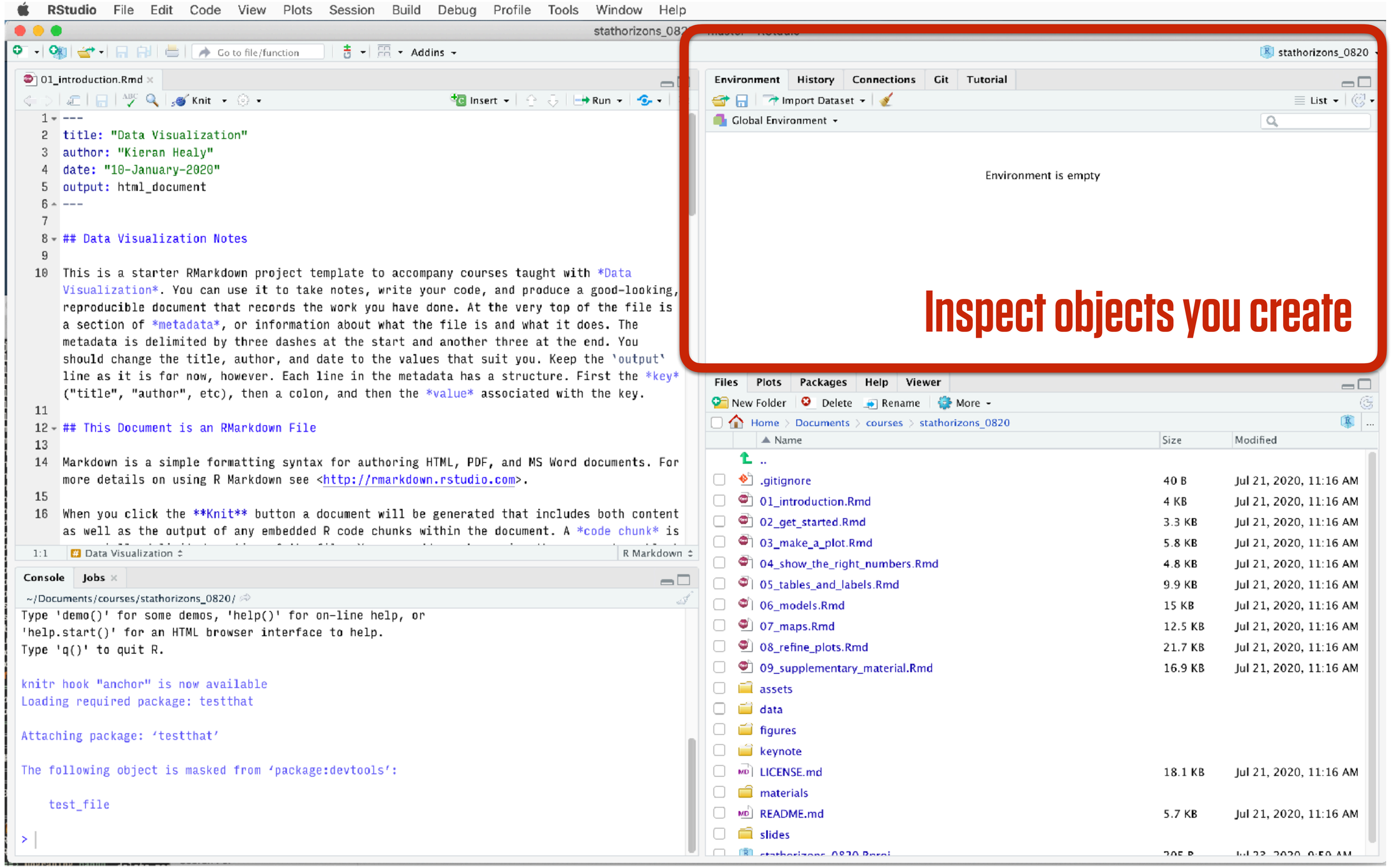
Project files, Plots, Help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Files
Plots
Packages
Help
Viewer
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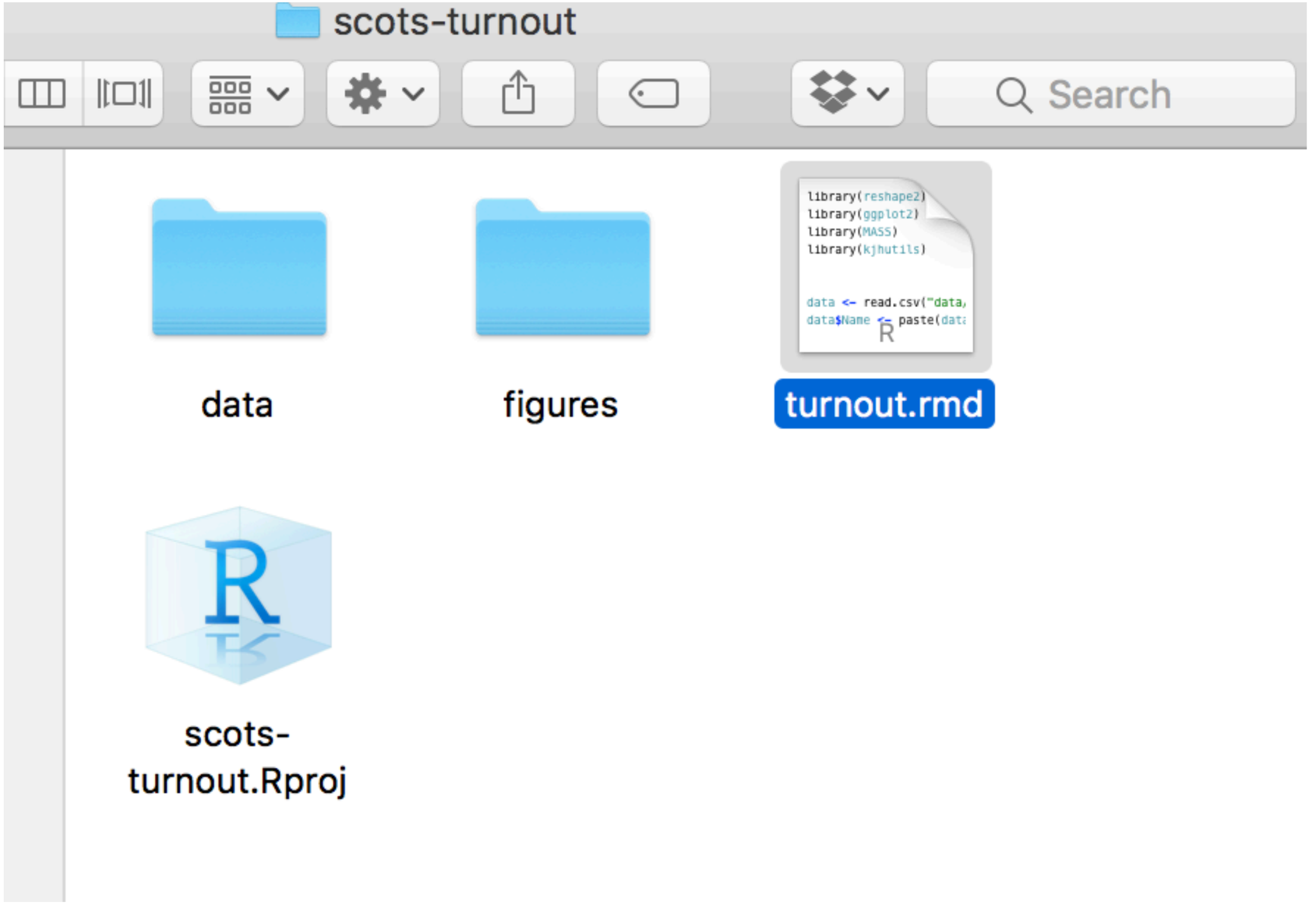
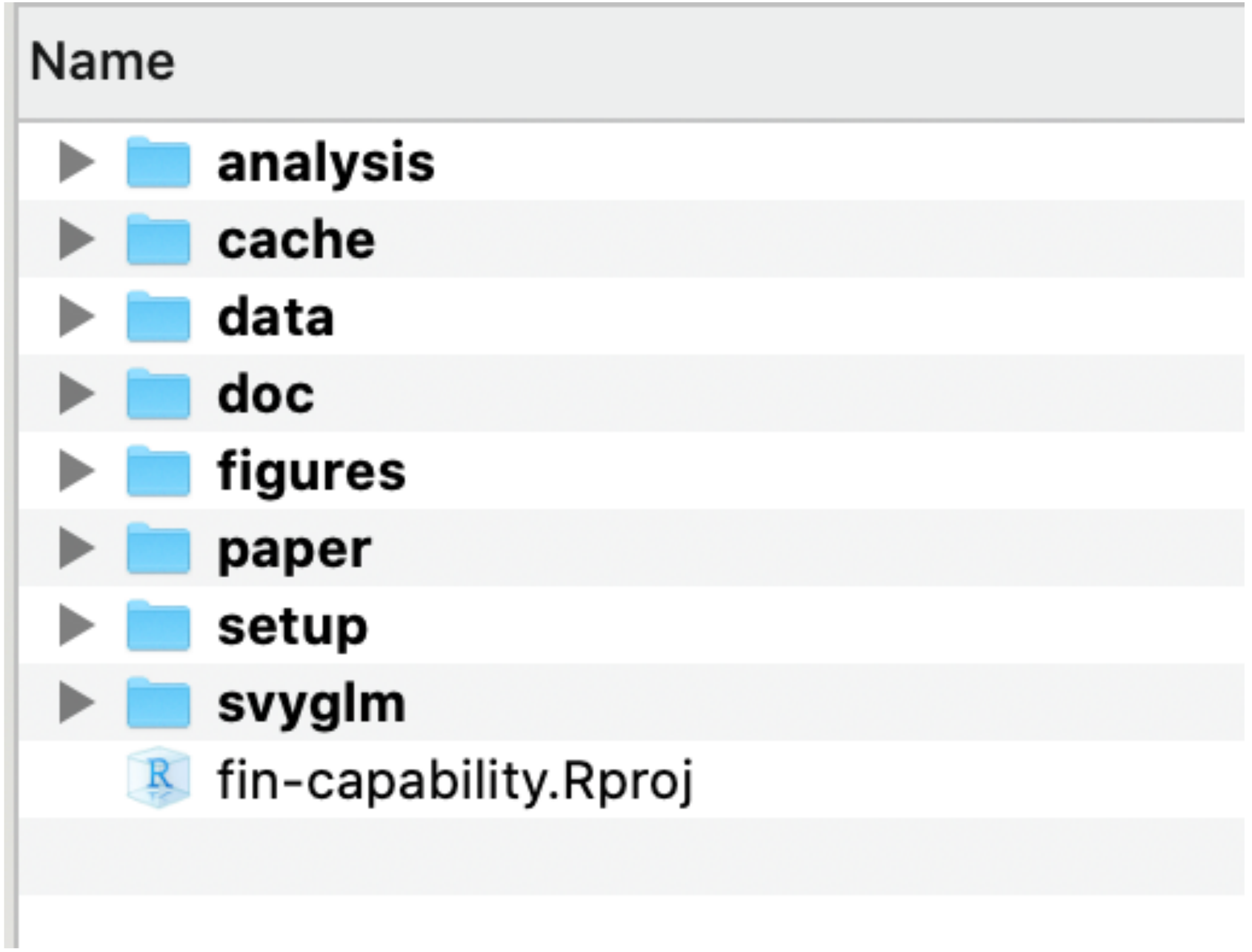

scots-turnout
Search
library(reshape2)
library(ggplot2)
library(MASS)
library(kjhutils)
data <- read.csv("data,
data$Name <- paste(dat
data
figures
turnout.rmd
scots-
turnout.Rproj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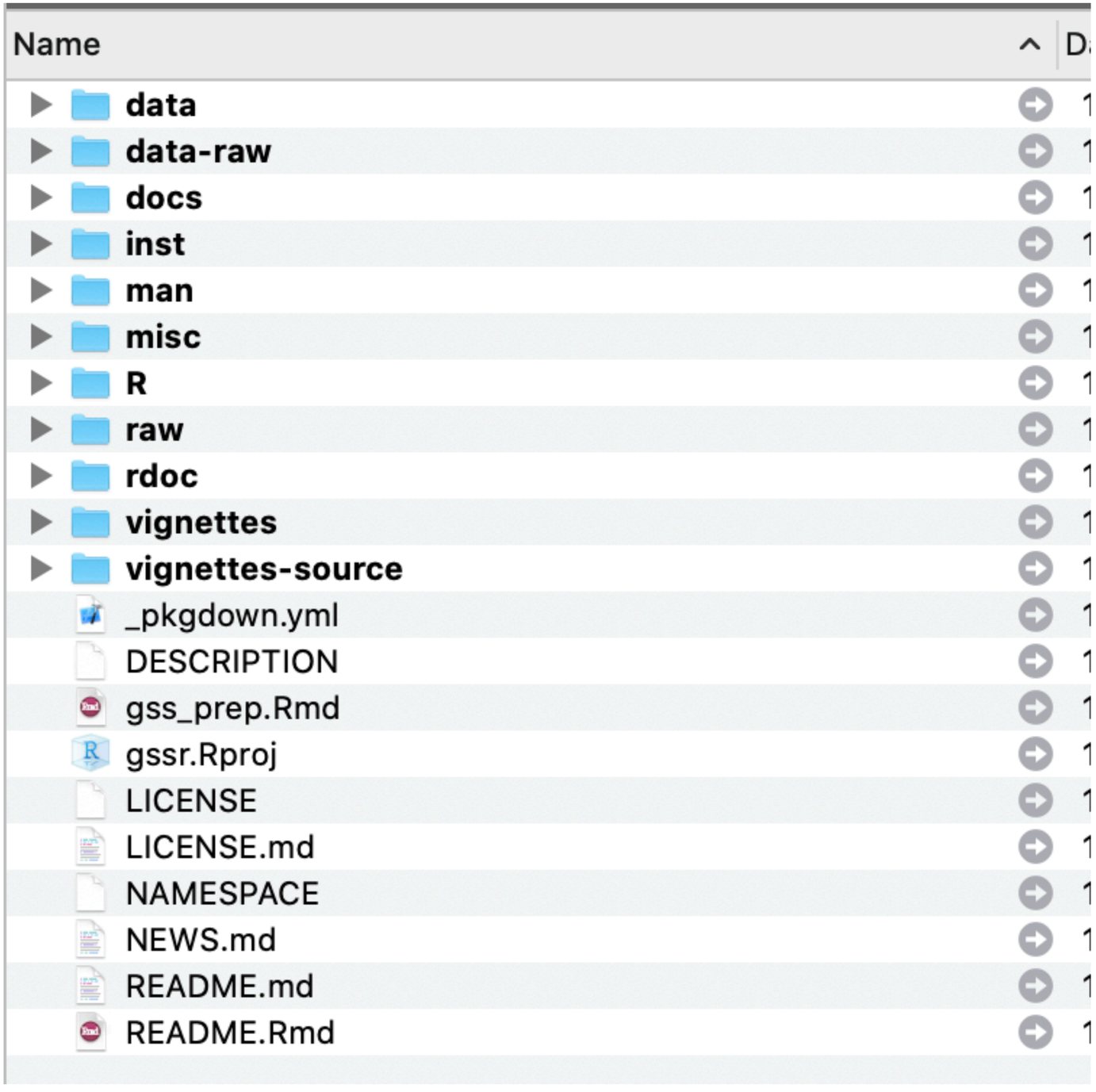
Name
data
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misc
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raw
rdoc
vignettes
vignettes-source
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DESCRIPTION
gss_prep.Rmd
gssr.Rproj
LICENSE
LICENSE.md
NAMESPACE
NEWS.md
README.md
README.Rmd

Use RMarkdown

TO REPRODUCE YOUR OWN WORK

1. Lorem Ipsum

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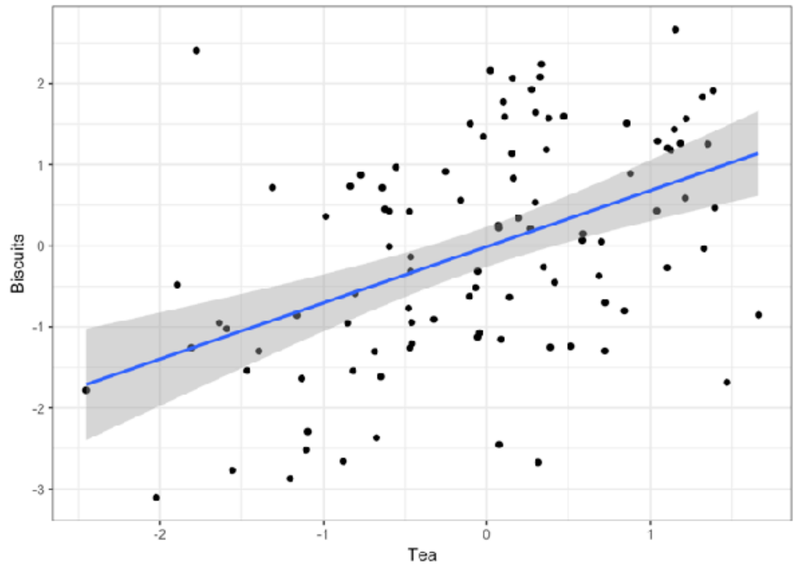

This is what we want to end up with: nicely formatted text, plots, and tables.

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Lorem Ipsum

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```
library(ggplot2)
tea <- rnorm(100)
biscuits <- tea + rnorm(100, 0, 1.3)
data <- data.frame(tea, biscuits)
p <- ggplot(data, aes(x = tea, y = biscuits)) +
    geom_point() +
    geom_smooth(method = "lm") +
    labs(x = "Tea", y = "Biscuits") + theme_bw()
print(p)
```

In a **Literate Programming** approach to documents, chunks of code are processed and replaced with their output

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1. Lorem Ipsum

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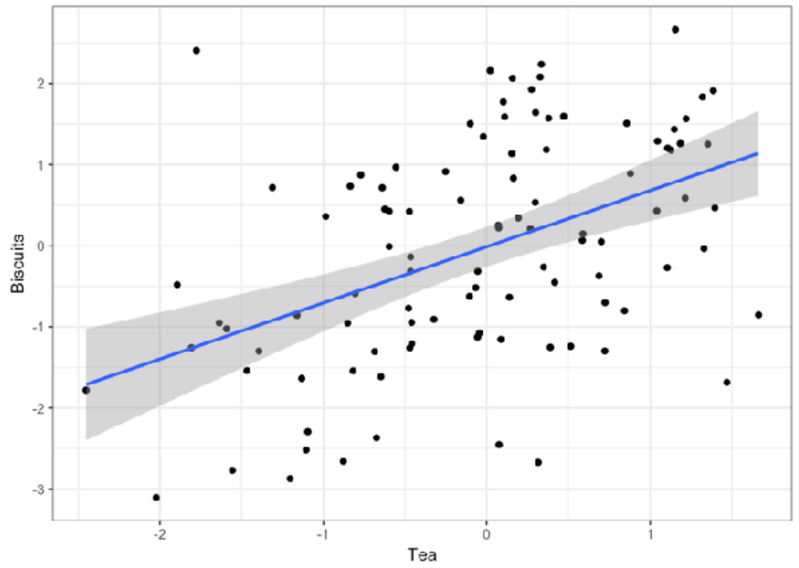

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notes.Rmd

```
# Report
We can see this *relationship*
in a scatterplot.

```{r my-code}
  p <- ggplot(data, mapping)
  p + geom_point()
```

As you can see, this plot
looks pretty nice.
```

knit in R

notes.pdf

Report

We can see this *relationship*
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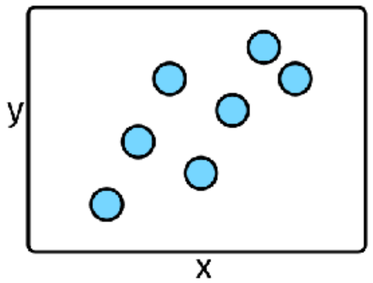

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An Rmd document lets you keep your code and notes together in plain text

And produce good-looking output in a range of formats

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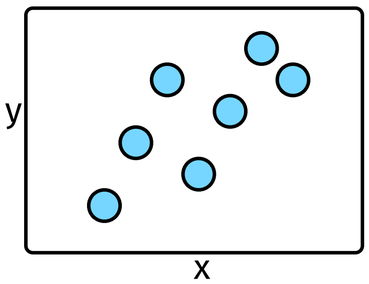

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notes.docx

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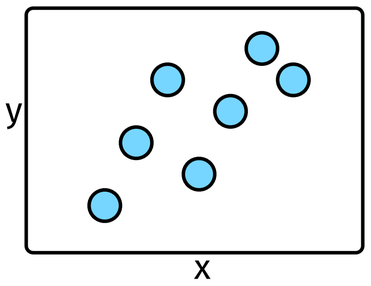

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Markdown	Output
`# Header`	**Header**
`## Subhead`	**Subhead**
`Plain text`	Plain text
`*italics*`	*italics*
`**bold**`	**bold**
`` `verbatim` ``	`verbatim`
`1. List`	1. List
`2. List`	2. List
`- Bullet 1`	° Bullet 1
`- Bullet 2`	° Bullet 2
`Footnote.[^1]`	Footnote.[1]
`[^1]: The footnote.`	[1]The footnote.

A **Markdown Processor** turns the marked-up plain text into actually formatted output in HTML, PDF, DOCX or other file types.

Markdown puts formatting instructions in plain-text documents

```
---
title: "My Notes"
author: "Kieran healy"
date: "12/7/2016"
output: html_document
---
```

Header section provides metadata and sets options

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

Code chunk

```
## R Markdown

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```

Text with Markdown formatting

```
```{r cars}
summary(cars)
```
```

In RStudio, code chunks can be "played" one at a time

```
## Including Plots

You can also embed plots, for example:
```

```
```{r pressure, echo=FALSE}
plot(pressure)
```
```

Code chunks can have their own names and options

```
Note that the `echo = FALSE` parameter was added to the code chunk to prevent
printing of the R code that generated the plot.
```

Chunks are replaced by their output when the document is made

1. Lorem Ipsum

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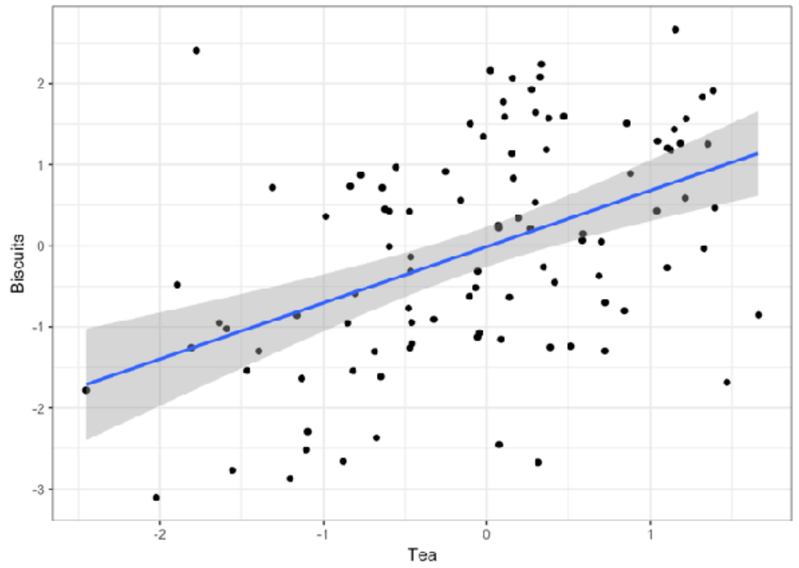

RStudio will do all the work for you when it comes to processing your document—i.e., getting it from plain-text Rmd to HTML, Word, or PDF.

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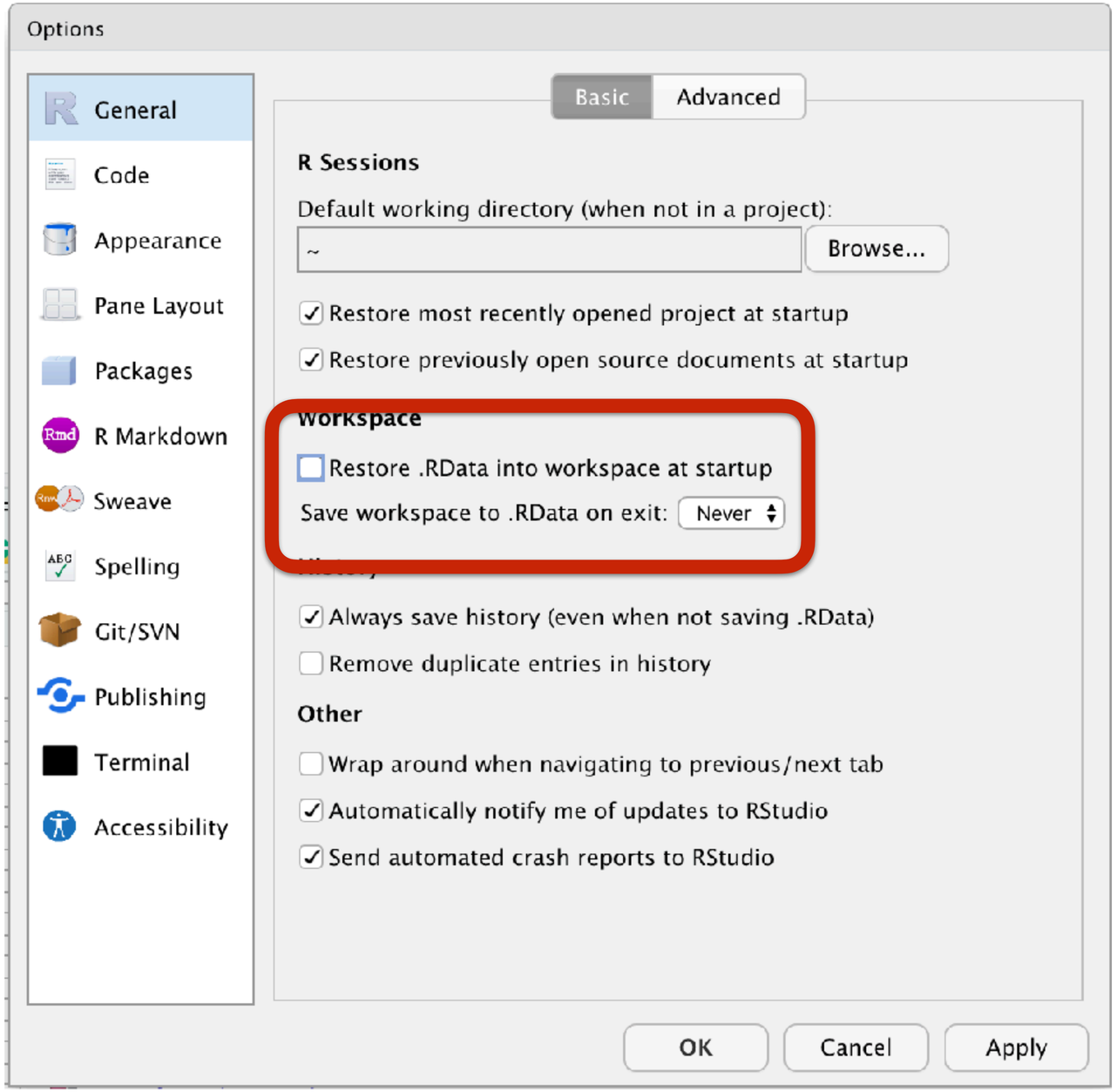
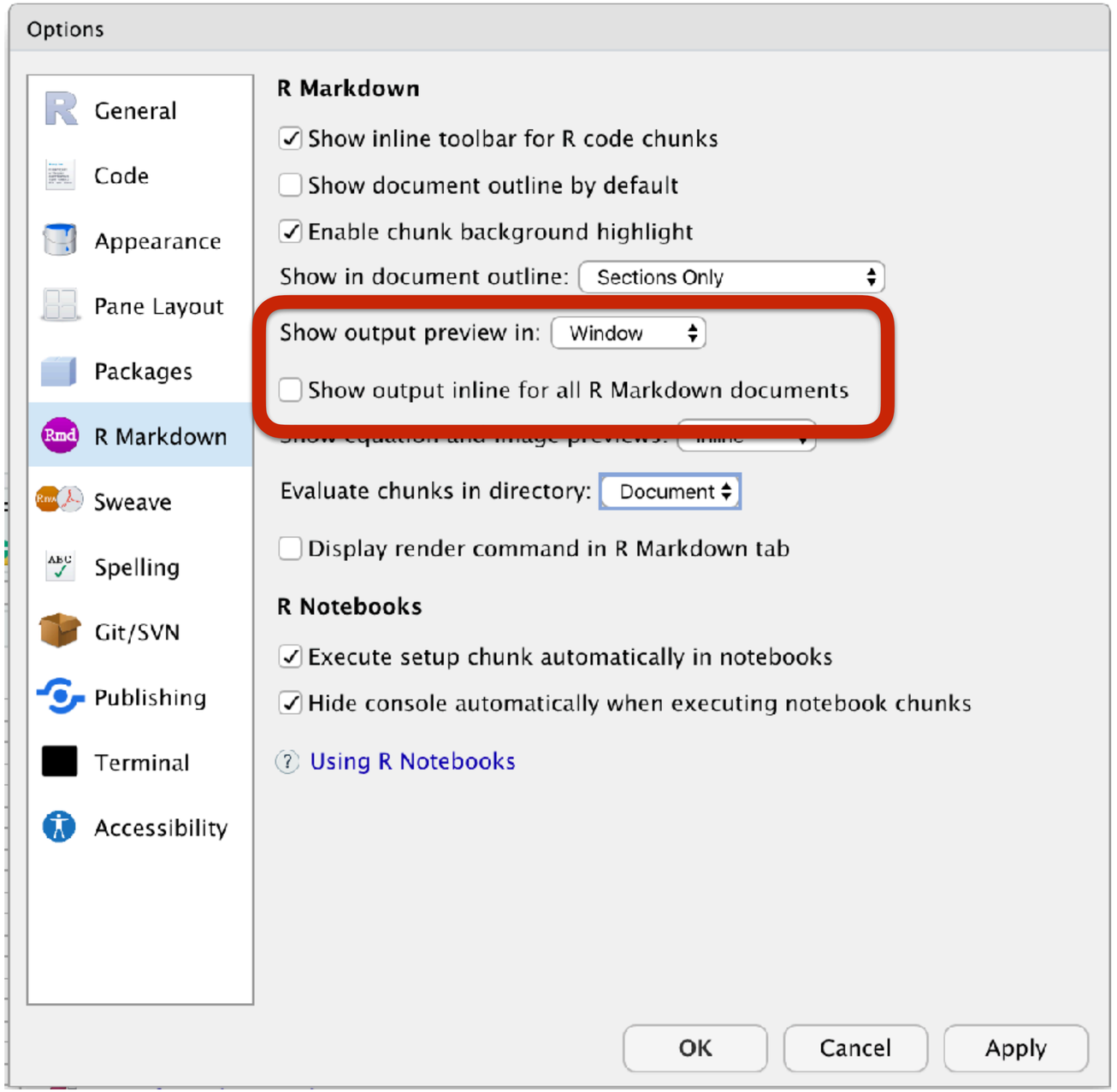


In general, your code is what's "real" in your project, not the objects you create.



Consider not showing your output inline

GETTING ORIENTED

The Tidyverse

```
library(tidyverse)
```

```
Loading tidyverse: ggplot2
Loading tidyverse: tibble
Loading tidyverse: tidyr
Loading tidyverse: readr
Loading tidyverse: purrr
Loading tidyverse: dplyr
```

- Draw graphs
- Nicer data tables
- Tidy your data
- Get data into R
- Cool functional programming stuff
- Action verbs for manipulating data

Course-Specific Library

```
library(socviz)
```

CODE YOU CAN TYPE AND RUN

```
## Inside chunks of code, lines beginning with
## the hash character are comments
my_numbers <- c(1, 1, 4, 1, 1, 4, 1)
```

OUTPUT

```
my_numbers
```

```
## [1] 1 1 4 1 1 4 1
```

What R Looks Like

FOUR THINGS TO KNOW ABOUT R

1: Everything has a Name

```
my_numbers
data
p
```

Some names are forbidden

```
FALSE   TRUE   Inf

for   if    break

function
```

2. Everything is an Object

```
> letters
##  [1] "a" "b" "c" "d" "e" "f" "g" "h" "i" "j" "k" "l" "m" "n" "o" "p" "q" "r" "s"
[20] "t" "u" "v" "w" "x" "y" "z"
```

You create objects by assigning a thing to a name


```
my_numbers <- c(1, 2, 3, 1, 3, 5, 25)
```

You create objects by assigning a thing to a name

```
my_numbers <- c(1, 2, 3, 1, 3, 5, 25)
```

The assignment operator performs the action of creating objects. Use a keyboard shortcut to type it:

`option -` Mac `alt -` Windows

3. You do things with named objects using functions and operators

named thing

"gets"

this stuff

```
my_numbers <- c(1, 2, 3, 1, 3, 5, 25)
```

c() is a function that takes comma-separated numbers or strings and joins them together into a vector

Functions

take arguments,
perform actions,
produce outputs

Functions have parentheses
at the end of their name.
This is where the inputs,
or **arguments** go.

```
mean()
```

"Take this object ..."

```
mean(x = my_numbers)
```

Named argument. "Calculate the mean of what, please?"
These names are internal to functions.

Functions

take arguments,
perform actions,
produce outputs

```
mean(my_numbers)
```

If you just write the name of the input,
R assigns it to the function's arguments
in order. Look at the function's help page
to see the order it expects its arguments.

You can assign a function's output to a named object

```
my_summary <- summary(my_numbers)
```

```
my_sd <- sd(my_numbers)
```

```
my_summary
```

```
my_sd
```

Objects you create exist until you overwrite or delete them

```
rm(my_numbers)
```

```
my_numbers
```

```
my_numbers <- c(1, 2, 3, 1, 3, 5, 25)
```

Objects are of different classes

```
class(my_numbers)
```

Vectors

`numeric`

`character`

`factor`

Arrays

`matrix`

`data.frame`

`tibble`

Models

`lm`

`glm`

Things to try on Objects

```r
class(my_numbers)
table(my_numbers)
```

Notice that these are functions

```r
x <- c(my_numbers, 5)
y <- c(my_numbers, "hello")
```

How do x and y differ?

```r
mean(c(my_numbers, my_numbers))
```

Functions can be nested, and will be evaluated from the inside out.

Some operators

`<-` or `=` Assignment ("gets")

`+, -, *, /, ^` Arithmetic

`<, >, <=, >=, ==, !=` Relational

`&, &&, |, ||, !` Logical

`%*%, %in%, %>%` Special

The pipe operator %>% "and then"

```r
mean(my_numbers)
```

```r
my_numbers %>% mean()
```

```r
round(mean(my_numbers))
```

```r
my_numbers %>% mean() %>% round()
```

This will be very convenient later on

4. R will be Frustrating

We're going to be joining a lot of objects and functions together

```
ggplot(data = mpg,
       mapping = aes(x = displ, y = hwy)) +
    geom_point()
```

◀ "+" goes here

```
ggplot(data = mpg, mapping = aes(x = displ, y = hwy))
+ geom_point()
```

▲ not here

```
39  p <- ggplot(data = gapminder
40              mapping = aes(x = gdpPercap,
41                            y = lifeExp))
```

4. R will be Frustrating

RStudio tries its best to help.
Learn to attend to what it's trying to tell you

```
38 ```{r 03-make-a-plot-4}
39 p <- ggplot(data = gapminder
40             mapping = aes(x = gdpPercap,
41                           y = lifeExp))
42
```

```
39 p <- ggplot(data = gapminder
   expected ',' after expression
41                           y = lifeExp))
42
```

```
39 p <- ggplot(data = gapminder,
40             mapping = aes(x = gdpPercap,
41                           y = lifeExp))
```

```
39 p <- ggplot(data = gapminder,
40             mapping = aes(x = gdpPercap,
41                           y = lifeExp)))
42
```

```
39 p <- ggplot(data = gapminder,
40             mapping = aes(x = gdpPercap,
41                           y = lifeExp)))
   unexpected token ')'
43 ```
```

LET'S GO

```r
library(gapminder)
gapminder
```

```
# A tibble: 1,704 x 6
       country continent  year lifeExp      pop gdpPercap
        <fctr>    <fctr> <int>   <dbl>    <int>     <dbl>
 1 Afghanistan      Asia  1952  28.801  8425333  779.4453
 2 Afghanistan      Asia  1957  30.332  9240934  820.8530
 3 Afghanistan      Asia  1962  31.997 10267083  853.1007
 4 Afghanistan      Asia  1967  34.020 11537966  836.1971
 5 Afghanistan      Asia  1972  36.088 13079460  739.9811
 6 Afghanistan      Asia  1977  38.438 14880372  786.1134
 7 Afghanistan      Asia  1982  39.854 12881816  978.0114
 8 Afghanistan      Asia  1987  40.822 13867957  852.3959
 9 Afghanistan      Asia  1992  41.674 16317921  649.3414
10 Afghanistan      Asia  1997  41.763 22227415  635.3414
# ... with 1,694 more rows
```

Named thing gets ...

... using these arguments

```
p <- ggplot(data = gapminder,
            mapping = aes(x = gdpPercap,
                          y = lifeExp))
```

... the output of this function ...

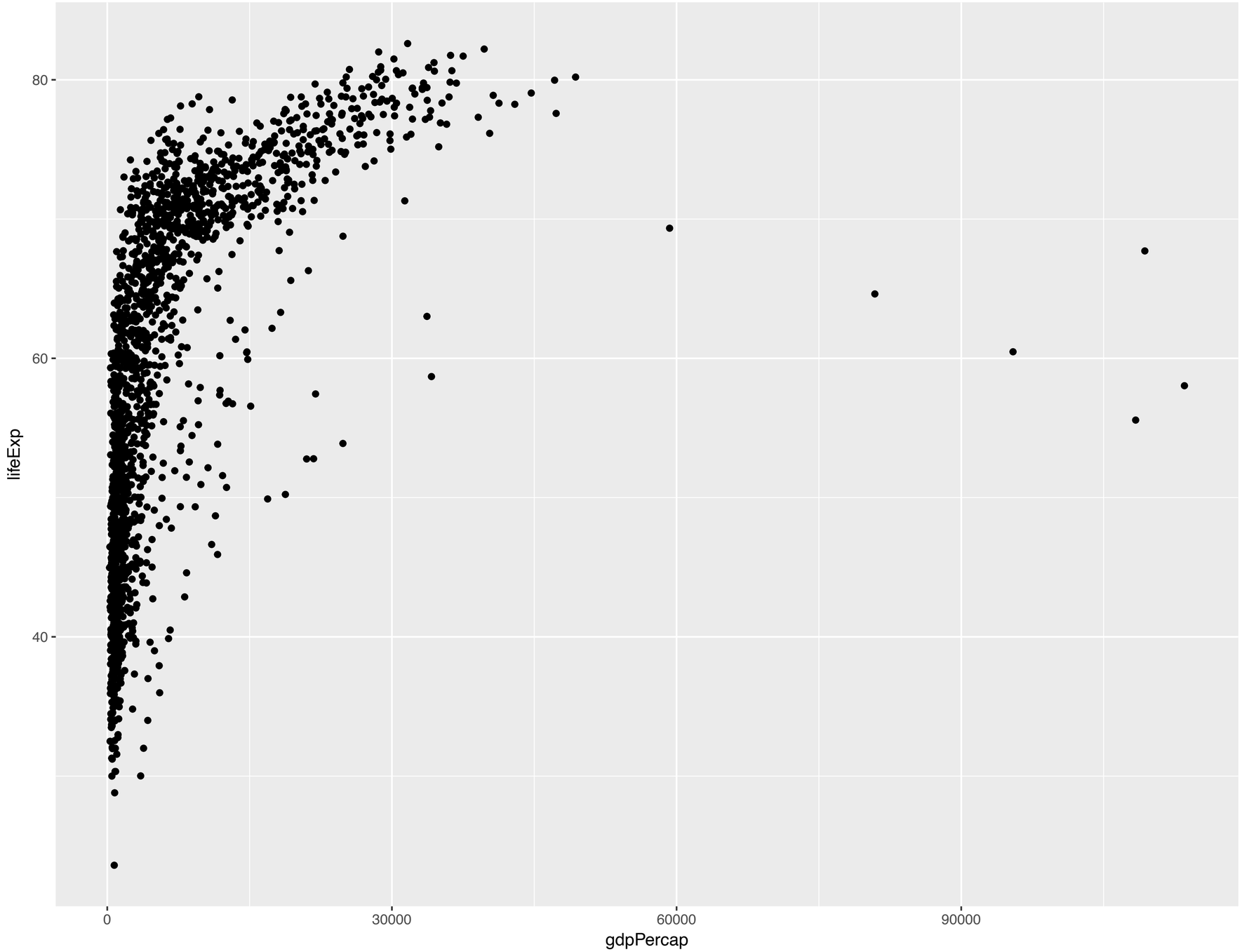
```
p
```

```
p + geom_point()
```

Objects created by ggplot() are unusual in that you can "add" things to them, and they will work as though you wrote all the code at once.

```r
p <- ggplot(data = gapminder,
            mapping = aes(x = gdpPercap,
                          y = lifeExp))
```

```r
p + geom_point()
```


80
60
40
lifeExp
0
30000
60000
90000
gdpPercap