

Using RStudio's R-Notebooks for Creating Interactive Content for Statistics Courses

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Introduction

About Me

- Dr. Bekah Selby
- Assistant Professor of Economics at Emporia State University
- Data Nerd by trade (applied econometrician)
- Teach classes ranging from basic statistics to graduate level applied econometrics

My Problems

- Data can be daunting
- Students feel disenfranchised in mathematics courses
- AKA they dread them
- How to make statistics “come to life”
- How to emphasize transparency
- How to reduce my own workload

One Solution

- Use technology that combines interactivity with transparency
- Rstudio has a feature called “R-Notebooks”
 - Scripting + Word Processing
 - Includes code with visuals and other output
 - Emphasizes process and description
 - Great place for students to do homework if R is incorporated as part of the curriculum
- Also good for the teacher:
 - Create complementary slides and handouts very easily
 - Homework is output to a .html file which renders on LMS
 - Teachers can download .Rmd source file from submissions

Today

- Introduce some features of notebooks that I frequently use
- Show you the basic structure of R-Notebooks so you can get started right away
- Discuss creation of interactive content and how it can be incorporated in LMS

Introduction to R-Studio's R-Notebook

The YAML Header

- The first thing you see in a notebook is a YAML header.
 - title: “An Exceptional Title”
 - author: “Dr. Such and Such”
 - output: html_notebook
 - date: “October 4, 2019”
- This renders in the output as a title.

- You can choose lots of formats for the output, here we choose `html_notebook` to use the R-notebook capabilities

Purpose of a Notebook

- The R-notebook is a way to include all components of an analysis:
 - Code
 - Output
 - Discussion
- It also has the capability of using interactives because it is rendered in html
- In classroom assignments, this creates an emphasis on transparency of research and analysis (nothing is done “behind the scenes”)

Markdown:

Uses markdown syntax to create formatted headers (see above), paragraphs, bulleted lists (this is one!), *font emphasis*, hyperlinks, block quotes, images, and more

Renders math-equations using LaTeX. Example:

```
## [1] "The equation  $Y_t = X_t + \varepsilon_t$  renders to"
```

$$Y_t = X_t + \varepsilon_t$$

- This is commonly used to write up discussion about the analysis!

R-Chunks

R-chunks are pieces of code that are included in the place where the output is wanted.

- Included Chunk

```
x<-c("Hello","World")
x
```

```
## [1] "Hello" "World"
```

- Excluded Chunk

```
## [1] "Hello" "World"
```

- Excluded Output

Inline R Code

- You can also write up code using inline syntax
- If we want to calculate the average of `cars$speed`, we might write

```
mean(cars$speed)
```

```
## [1] 15.4
```

or write “The average is 15.4”

Creating an Interactive Notebook

Let’s Pretend

- Suppose we want to create an interactive lesson:

- Calculating means and standard deviations
- Creating histograms
- We also want to test their ability to successfully use R code

Creating Basic Plots and Tables in R

First things first, using R to create visuals.

We are going to use data already preinstalled in R called `cars`

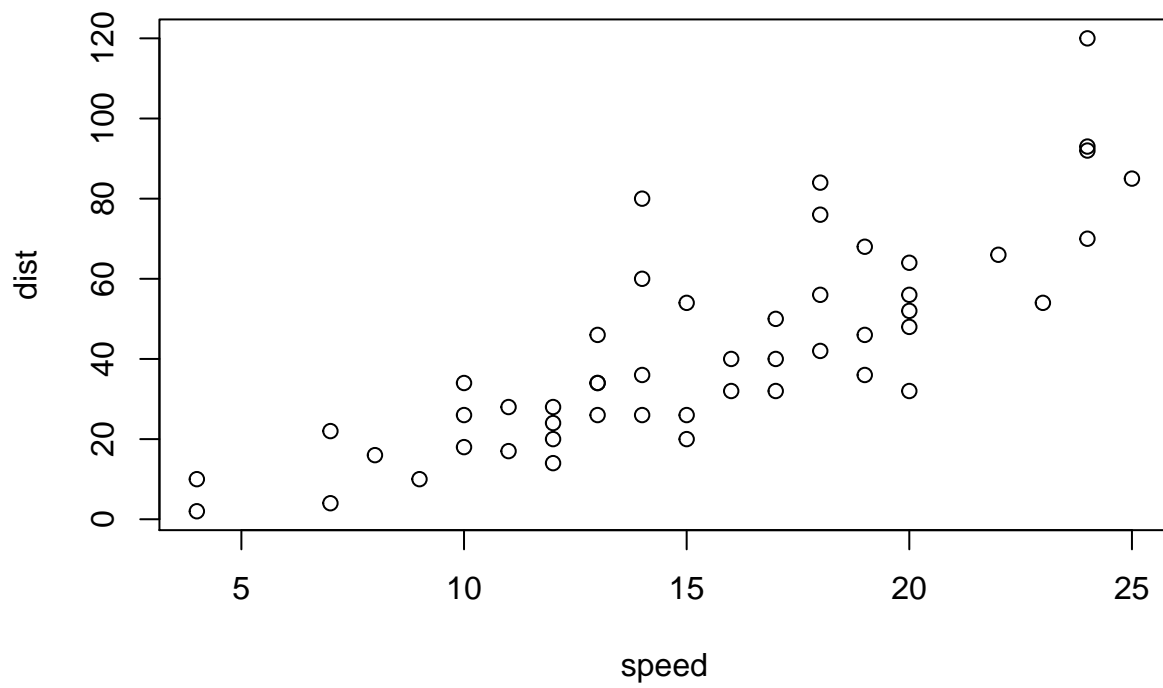
1. Create a table containing the first 10 observations from the data set `cars`:

```
head(cars,10)
```

```
##      speed dist
## 1         4    2
## 2         4   10
## 3         7    4
## 4         7   22
## 5         8   16
## 6         9   10
## 7        10   18
## 8        10   26
## 9        10   34
## 10       11   17
```

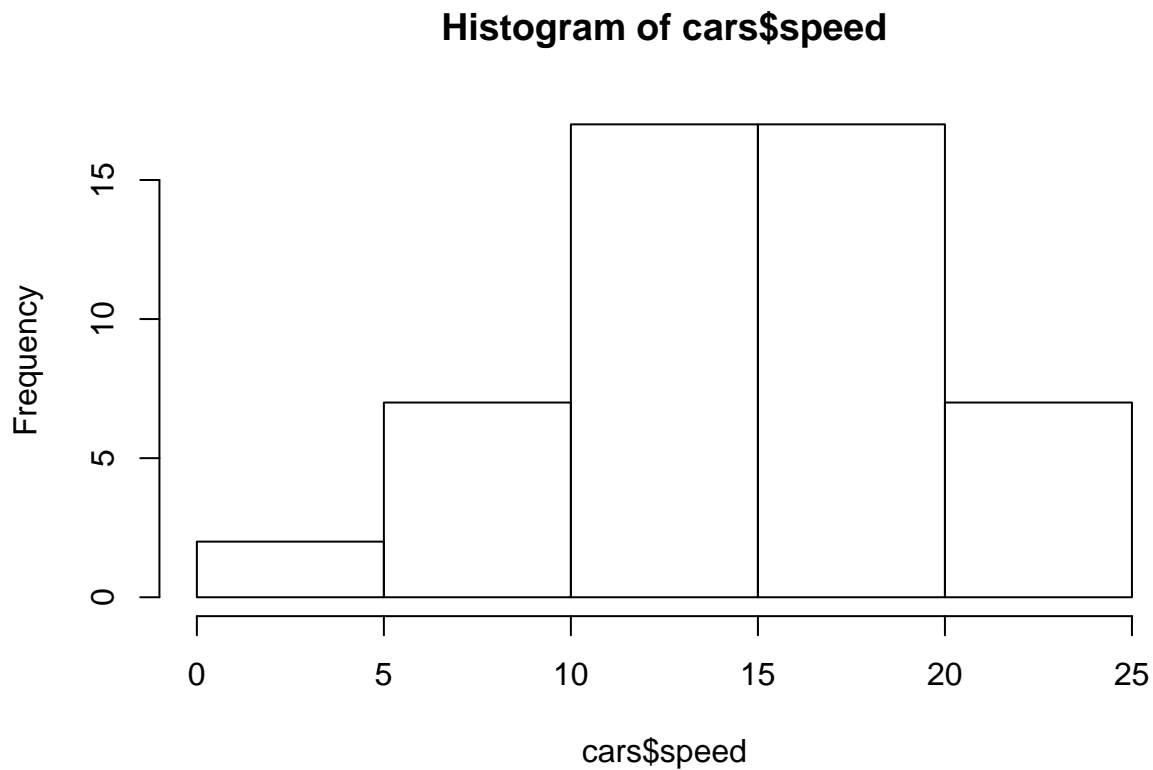
2. Create a scatter plot of the speed and distance in the data set `cars`

```
plot(cars)
```



3. Create a histogram for the speed of cars in the data set `cars`.

```
hist(cars$speed)
```



Tutorials and Quizzes

Suppose we want to create an interactive tutorial where students can test their knowledge of R commands.

```
#install.packages("tutorial")
library(tutorial)
go_interactive(greedy = FALSE)
```

eyJsYW5ndWFnZSI6InliLCJzYW1wbGUiOiIjIENhbGN1bGF0ZSB0aGUgYXZlcmFnZSBzcGVlZCBvZiBjYXJzLiBTYXZlIGF

Interactives using Shiny

- Using runtime: shiny in the YAML, you can create interactive apps
- I have a problem when making this presentation however...
- The Shiny runtime does not work with the tutorial package!
- My workaround, for this presentation: a separate file

Interactive Graphs Using Plotly

```
p <- plot_ly(cars, x = ~speed, y = ~dist)
p
```

```
plot_ly(x = cars$speed, type = "histogram")
```

```
plot_ly(x = cars$speed, type = "box")
```

2D Histograms

```
p <- plot_ly(x=cars$speed,y=cars$dist)
pp <- subplot(
  p %>% add_markers(alpha = 0.2),
  p %>% add_histogram2d()
)
pp
```