R Notebook Tutorial

Tufts BUGS workshop

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Contents

1 What is an R Notebook?

- A file format (.rmd) that can be opened by R Studio
- Allow you to mix prose, code, and code output
- Uses a simple system called Markdown for formatting prose
- Markdown headings allow easy navigation in R Studio
- Notebooks can be "knit" to produce beautiful reports as html, pdf, or Word documents
- Allows configuration of what to show in these outputs (e.g. code, output, warnings)

2 Why Notebooks?

- It's a good practice to annotate your code anyway, and .rmd lets you do this in a richer, easier to read way
- As an analysis notebook. Organizing your code into "chunks" interspersed with prose helps you think through problems better and keep track of your thought process.
- Portability/collaboration. No need to use `setwd()`
- Beautiful, easy to navigate reports. You can hide or show code depending on who the report is for (e.g. does this person know R?)
- Creating examples, tutorials, assignments, etc. using R
- Plain text (despite richly formatted output), so very compatible with Git and other version control.

3 Workshop Outline

3.1 Make a Notebook!

- Make a new notebook, run the chunks, preview the output

- avoid spaces in filename

3.2 Reports

- "knit" button calls functions from `knitr` package
- pdf generation requires LaTeX installation
- difference between "Preview" and "knit..." is preview does not run all chunks explicitly. Knit fails if code doesn't run.

3.3 Basics of Markdown

3.3.1 Basic Formatting

- **bold**
- *itallics*
- subscript^{x}
- superscript$_{y}$
- formatting as `code` with backticks
- lists (must have space between list header and first list item)

3.3.2 Headings and subheadings

- using different nubmers of "#"
- integration with RStudio interface

3.3.3 Equations

- Inline with "$". E.g. n $= 5$ vs. $n = 5$.
- Display equation with "$$"

$$n = 5$$

- More complicated equations can be made using LaTeX:

$$s = \sqrt{\frac{\sum y_i^2 - \frac{(\sum y_i)^2}{n}}{n-1}}$$

- A cheat-sheet for making equations like this can be found here

3.3.4 When Markdown doesn't work

- R Markdown is "portable". It works for html, pdf, Word.
- However, if your output is html, you can use html.
- If your output is pdf, you can use LaTeX
- If your output is Word, just edit it in Word
- R Markdown is limited, but you probably won't need super advanced formatting
- Getting help:
  - *Help > Markdown Quick Reference*
  - *Help > Cheatsheets > R Markdown Cheatsheet*
  - *Help > Cheatsheets > R Markdown Reference Guide*

- Google

3.4 Code chunks

3.4.1 Inserting and naming code chunks

- Insert with menu, keyboard shortcut, or just typing
- naming code chunks and integration with R Studio (**Duplicate names not allowed**)
- Inline code with ‘ r #code ‘

3.4.2 Running code in code chunks

- “play” button
- one line at a time with *cmd + enter*
- run all previous with down button.
- “Run” button. Use *Restart R and Runn All Chunks* to test self-containedness.
- Self-containedness of R Notebooks
  - don’t use `setwd()`
  - use absolute paths. Also package `here()` might be helpful to make things more self-contained
  - shareable (in html output there is even a download code button)
  -
- If your code chunk produces multiple outputs, they will show up in separate “tabs.”

```
plot(cars)
plot(trees)
cor(trees)
```

- in pdf or word, output appears after code that generated it.

3.4.3 Code chunk options

- gear icon to access.
- specify what shows up in output. (useful for sharing results with non-R-literate)
- don’t show errors or warnings (useful for package loading chunks)
- don’t run code (useful for keeping broken code visible. Remember, won’t knit if code throws errors.)
- figure size specification (**Note**: Base R plots have way larger margins than ggplot. Be careful when mixing.)

```
#base R plot resized to 2" x 2"
plot(cars)

#ggplot resized to 2" x 2"
library(ggplot2)
ggplot(cars) +
  geom_point(aes(x = speed, y = dist))
```

3.4.4 Using code chunks for non-code-like output

- must explicitly load `library("knitr")`
- Use `kable()` to produce pretty tables in pdf and Word output.
- `kable()` tables are less pretty in html output (including in-line output and Preview output)
- show example notebook
- Use `include_graphics()` to add already existing pictures. **NOTE:** figure sizes don't affect these. You have to use the `out.width` chunk option which can accept quoted values like `"2in"` or `"50%"`. Unfortunately, `out.width` doesn't affect in-line output or Preview output, only knit output.

3.5 YAML header

- Defaults
- Many other options including, but not limited to:
  - subitle
  - author
  - date
  - many output-specific options

3.6 Advanced options for reports

- In gear icon, output options...
- Code-folding
- themes and highlighting
- Floating TOC with html. Tutorial here