Getting Started with



Proseminar for GSID

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Why R we here?

- R is a (computing) language and an interpreter that turns commands into...
 - data manipulation, statistical analysis, graphics, & programming
 - a useful tool for getting started: R Studio IDE (Integrated Development Environment)
- Large Community of Users
 - free software (in both senses)
 - R packages on **C**omprehensive **R** **A**rchive **Network** (CRAN)
 - Google / Stack overflow / Jason
- Make Your Research Reproducible (and Accessible)
 - Dynamic Documents
 - Shiny Apps

Agenda

- Sept 1st
 - R markdown (and dynamic documents)
 - motivation, basic syntax, installation, & simple example
 - Basic R syntax and data structures
 - R script with useful commands for getting started
 - understanding R objects
- Sept 9th
 - cleaning & preparing data
 - regression
 - making tables & figures
- GitHub: https://github.com/jarathomas/sociol8802

Motivation: Dynamic Documents

- Use a single file to weave data output and substantive text
 - reduce the number of steps to create the final document (e.g., academic article) and efficiently reproduce those steps
 - if we want publication-quality product, we need a simple language to add structure and formatting... enter *markdown* pause

"A Markdown-formatted document should be publishable as-is, as plain text, without looking like it's been marked up with tags or formatting instructions."

— John Gruber

Motivation: Dynamic Documents (cont.)

- Weave in results/data/tables/figures using code chunks sections that include R code for processing data & creating output
- There are several tools for creating dynamic documents that are available in different stats packages
 - R Markdown (powered by knitr and pandoc) is a popular R package (and rightfully so)
 - output options include: pdf (paper and slides); MS Office (Word & PowerPoint)

Markdown

Syntax for adding styling to your documents (we'll see this again)

- **this is bold** and * this is italicized *
- lists with asterisks, dashes, plus sign (nested lists with indentation)
- section headers (add more # for subsections)
 - # Section 1
 - ## Section 2
- Web links: [link name] (link url):
 - e.g. [R markdown] (https://rmarkdown.rstudio.com/)
 - R markdown

Installing R Markdown (& dependencies)

We need to install a few programs & packages to get up and running (all of the default options are fine)

- (good idea to go with RStudio for this)
- Mac users should install X Quartz program from https://www.xquartz.org/, which
 is used by Mac to show plots
- LATEX is needed to create PDFs (can do this through R packages as we will now see)

R Packages for R Markdown

Open R Studio, then copy and paste the following command into the **Console** pane.

- Note 1: this assumes you do not have LATEXinstalled on your computer (which is needed to create PDF files with R Markdown.)
- Note 2: knitr is an important package that will do the weaving (and gets installed as a dependency of rmarkdown)

R Packages (cont.)

 Install a small version of LATEX (using the tinytex package) with the following command (in the R Studio console)

```
tinytex::install_tinytex()
```

(this will take a few minutes)

- Windows users may see a warning about needing to install the Rtools program, and
 warnings complaining about missing files associated with luatex.dll
 - but these can all be ignored.

R Packages (cont.) Warning Messages

 Here are 3 screenshots of the informational and (2) warning messages that Windows users can safely ignore.

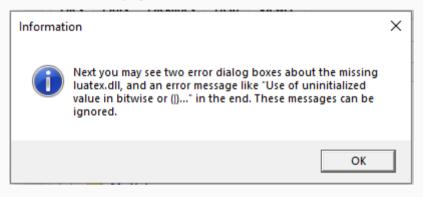


Figure 1: informational message

R Packages (cont.) Warning Messages 1

(can safely ignore)

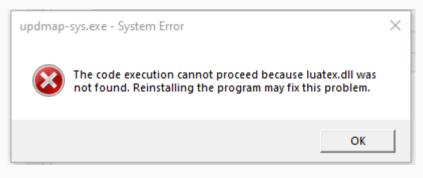


Figure 2: 1st warning message

R Packages (cont.) Warning Messages 2

(can safely ignore)

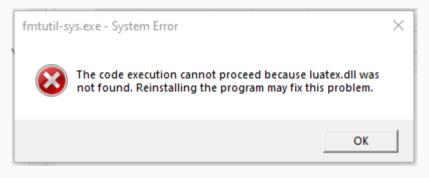


Figure 3: 2nd warning message

R Packages (cont.)

 If you would like to test your tinytex installation, close R Studio, then re-open it and run the following command

```
tinytex:::is_tinytex() ## should return TRUE
```

Note the 3 colons after tinytex. If the above command returns a value of TRUE, then you are all set.

Dynamic Document: intro

Let's get some practice making a dynamic document (and using markdown)...

- In the R Studio menu bar: File... New File... R Markdown
 - Choose **Document** (any format is fine)
- This will provide us with a basic template for a dynamic document
 - YAML block section at the top (surrounded by 3 dashes) where we can add title info and set options (e.g., output format is PDF or Word doc)
 - code chunks blocks where we include R commands (that will be evaluated with the results included in the dynamic doc)
- Before we dive in a quick markdown review and more on code chunks

Dynamic Document: markdown syntax

Quick recap of markdown formatting

- **this is bold** and * this is italicized *
- lists with asterisks, dashes, plus sign (nested lists with indentation)
- section headers (add more # for subsections)
 - # Section 1
 - ## Section 2
- Web links: [link name] (link url)
 - e.g. [R markdown] (https://rmarkdown.rstudio.com/)
 - R markdown
- Links to References
 - cheat sheet (pdf)
 - an html ref

Dynamic Document: code chunks

A **code chunk** is a *fenced* section that includes R code/commands that can get processed (think R code sandwich)

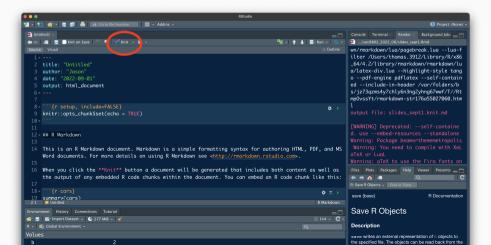
bread: 3 backticks, followed by an {r}, then code, and closed with another 3 backticks:

```
% {r, echo = TRUE}
3 + 6
plot(cars)
```

- Useful options:
 - echo = FALSE don't show the code, but do show the results in the dynamic doc
 - include = FALSE exclude code and results from appearing in the dynamic doc
 - eval = FALSE don't run the code in the code chunk
- link to description of all options

Dynamic Document: producing output

click on the knitting needles icon in the toolbar to produce the output (don't forget to save your file)



Intro to R Syntax & Data Structures

We'll now shift gears a bit and introduce. . .

- 1. a few basic R commands for getting started,
- 2. some logic for understanding types of objects created by R
- (i.e., different ways we can hold data)
- probably best to open up the script r_script_sept1.R (from GitHub repo)

Basic Syntax: useful commands

- date() useful when running scripts in BATCH mode
- getwd() & setwd() print and set the working directory
- dir() or dir("../") print the files and folders in the given directory
- 1s() print the name of all objects currently loaded in R's memory
- rm(object1) remove the object called object1 from R's memory
- Comments are lines that begin with pound/hash/#
- ?date will show the help file for the date command
- help.search("weighted mean") search the help files for the term "weighted mean"

Basic Syntax: saving & loading data

- save.image("file_name.RData") save everything in memory to a file called file_name.RData
- save(object1, object2, file = "file_name.RData") save objects called object1 and object2 to a file called file_name.RData
- load("file_name.RData") load the data file called "file_name.RData"
- data <- read.csv("file_name.csv") load the contents of a CSV file</pre>

Basic Syntax: R Packages

- library() list the installed packages
- library(package name) load the package called "package name"
- install.packages("package name") install a package (only need to do this one time)
 - e.g. install.packages("haven")
 - install multiple packages with install.packages(c("dplyr", "ggplott2"))
- update.packages()
- remove.packages("package name")

Data Structures

- Now we'll learn the basic logic for understanding some of the different types of objects that R uses
- R has different structures for holding data, which can be organized by...
 - how many dimensions does it have?
 - do the types of data need to be the same?

Data Structures

Vectors

- 1. 1 dimension
- 2. same data type
- special case: factor (predefined categories)

Matrices

- 1. rows and columns
- 2. same data type

Arrays

- 1. any number of dimensions
- 2. same data type

Data Structures

Data Frames

- 1. rows and columns
- 2. different data types

Lists

- 1. 1 dimension
- 2. different data types (and structures)