Introduction to R

Week 1: The basics

Louisa Smith

July 13 - July 17

Let's start with...

The basics

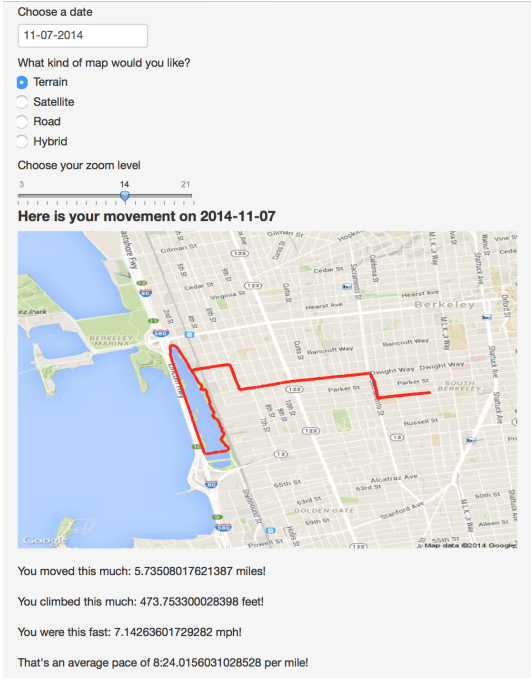
About this class

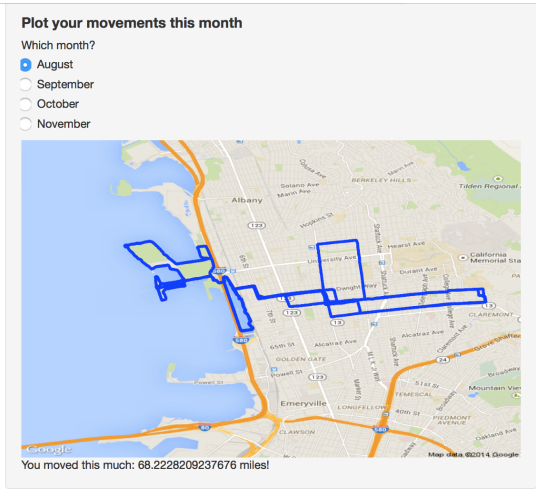
- Non-credit
- 6 weeks
- Watch the videos and do the exercises on your own (or with friends/classmates), come together for lab
- Practice by yourself in between classes
- Everything you need is at http://intro-to-r-2020.louisahsmith.com

> You are not going to break anything!

About me

- Rising 5th-year PhD candidate in Epidemiology
- Started using R during my master's (so 6 years of experience); learned mostly by doing
- Problem sets, manuscripts, slides, website all in R
- Almost 100 R projects on my computer, over 1000 R scripts





> I have to Google things literally every time I use R!

Plan

Week 1: The basics

Week 2: Figures

Week 3: Selecting, filtering, and mutating

Week 4: Grouping and tables

Week 5: Functions

Week 6: Analyze your data

An IDE for R

An *integrated development environment* is software that makes coding easier

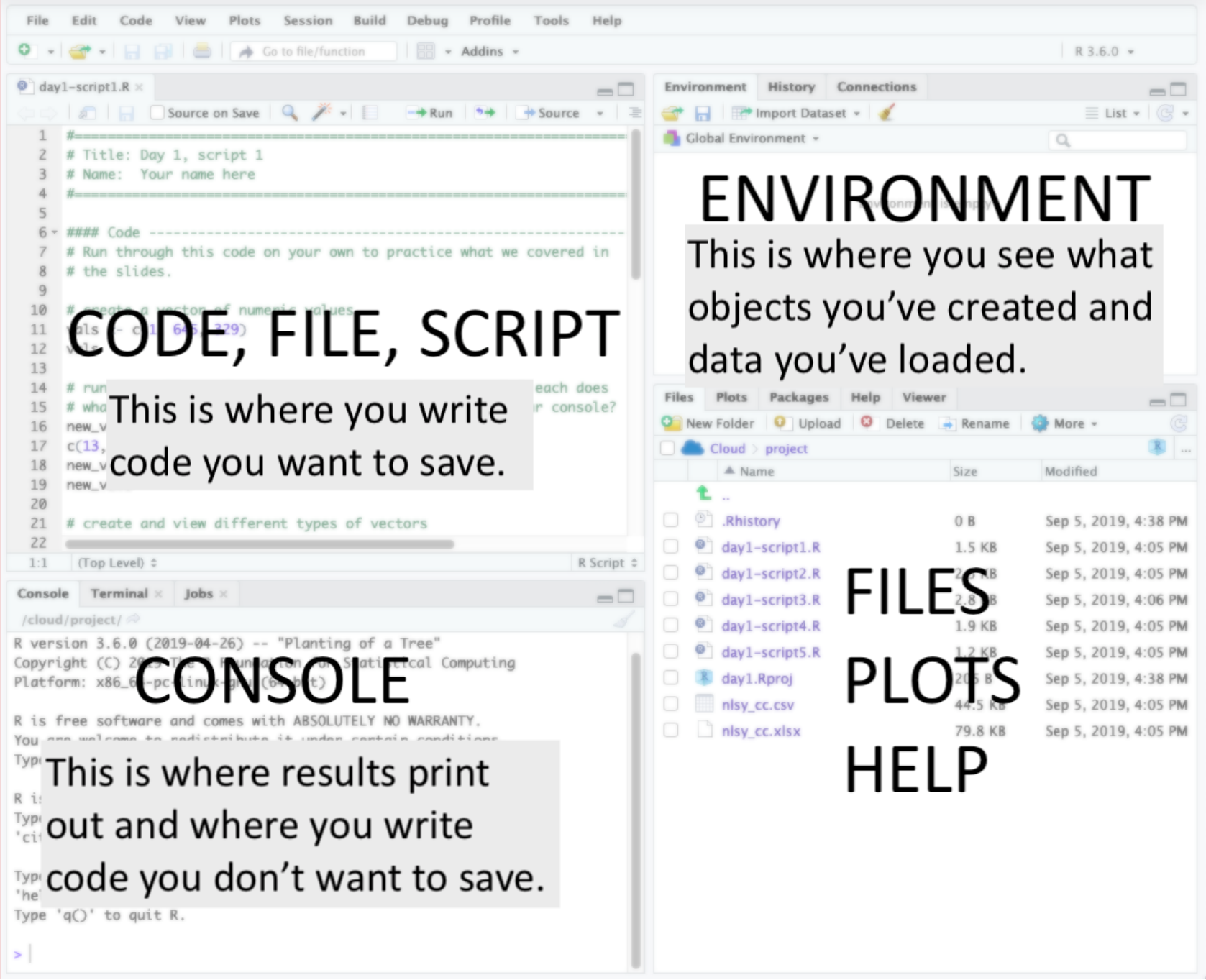
- see objects you've imported and created
- autocomplete
- syntax highlighting
- run part or all of your code

SETUP...

Your turn...

1

- Install R
- Install R Studio


File Edit Code View Plots Session Build Debug Profile Tools Help
Addins
R 3.6.0
day1-script1.R
Source on Save
Run
Source
Title: Day 1, script 1
Name: Your name here
Code
Run through this code on your own to practice what we covered in
the slides.
create and view different types of vectors
CODE, FILE, SCRIPT
This is where you write code you want to save.
Environment
History
Connections
Import Dataset
List
Global Environment
ENVIRONMENT
This is where you see what objects you've created and data you've loaded.
Files
Plots
Packages
Help
Viewer
New Folder
Upload
Delete
Rename
More
Cloud
project
Name
Size
Modified
.Rhistory 0 B Sep 5, 2019, 4:38 PM
day1-script1.R 1.5 KB Sep 5, 2019, 4:05 PM
day1-script2.R Sep 5, 2019, 4:05 PM
day1-script3.R Sep 5, 2019, 4:06 PM
day1-script4.R 1.9 KB Sep 5, 2019, 4:05 PM
day1-script5.R Sep 5, 2019, 4:05 PM
day1.Rproj Sep 5, 2019, 4:38 PM
nlsy_cc.csv Sep 5, 2019, 4:05 PM
nlsy_cc.xlsx 79.8 KB Sep 5, 2019, 4:05 PM
FILES
PLOTS
HELP
Console
Terminal
Jobs
/cloud/project/
R version 3.6.0 (2019-04-26) -- "Planting of a Tree"
R is free software and comes with ABSOLUTELY NO WARRANTY.
Type 'q()' to quit R.
CONSOLE
This is where results print out and where you write code you don't want to save.

Packages

- Some functions are built into R
  - `mean()`, `lm()`, `table()`, etc.
- They actually come from built-in packages
  - `base`, `stats`, `graphics`, etc.
- Anyone (yes, *anyone*) build their own package to add to the functionality of R
  - `ggplot2`, `dplyr`, `data.table`, `survival`, etc.

Image from Zhi Yang

Packages

- You have to **install** a package once*

```
install.packages("survival")
```

- You then have to **load** the package every time you want to use it

```
library(survival)
```

*Actually, with every new major R release, but we won't worry about that.

Packages

"You only have to buy the book once, but you have to go get it out of the bookshelf every time you want to read it."

```
install.packages("survival")
library(survival)
survfit(...)
```

Several days later...

```
library(survival)
coxph(...)
```

Demonstration...

Package details

- When you use `install.packages`, packages are downloaded from CRAN (The Comprehensive R Archive Network)
  - This is also where you downloaded R
- Packages can be hosted lots of other places, such as Bioconductor (for bioinformatics), and Github (for personal projects or while still developing)
- The folks at CRAN check to make things "work" in some sense, but don't check on the statistical methods...
  - But because R is open-source, you can always read the code yourself
- Two functions from different packages can have the same name... if you load them both, you may have some trouble

tidyverse

- The same people who make RStudio also are responsible for a set of packages called the `tidyverse`

Journal of Statistical Software

August 2014, Volume 59, Issue 10. *http://www.jstatsoft.org/*

Tidy Data

tidyverse

- Running `install.packages(tidyverse)` actually downloads more than a dozen packages*
- Running `library(tidyverse)` loads:

  `ggplot2`, `dplyr`, `tidyr`, `readr`, `purrr`, `tibble`, `stringr`, `forcats`
- This is by no means the only way to manage your data, but I find that a lot of the time, it's the easiest and simplest way to get things done.

*See which ones at https://tidyverse.tidyverse.org

Your turn...

2

- Install the `tidyverse` "package"
- Load *one* of the `tidyverse` packages

R projects

```
my-project/
├── my-project.Rproj
├── README
├── data/
│   ├── raw/
│   └── processed/
├── code/
├── results/
│   ├── tables/
│   ├── figures/
│   └── output/
└── docs/
```

- An `.Rproj` file is mostly just a placeholder. It remembers various options, and makes it easy to open a new RStudio session that starts up in the correct working directory. You never need to edit it directly.
- A README file can just be a text file that includes notes for yourself or future users.
- I like to have a folder for raw data -- which I never touch -- and a folder(s) for datasets that I create along the way.

This course

```
R-course/
├── 01-week/
│   ├── 01-week.Rproj
│   ├── 01-exercises.R
│   ├── 01-lab.Rmd
│   ├── 01-slides.pdf
│   └── data/
│       └── nlsy.csv
├── 02-week/
│   ├── 02-week.Rproj
│   ├── 02-exercises.R
│   ├── 02-lab.Rmd
│   ├── 02-slides.pdf
│   └── data/
│       └── nhanes.xlsx
└── 03-week/
```

- Each week you'll download a zip file of some or all of the things you need for the week
  - You may be adding more later!
- Open the week's work by opening the `.Rproj` file
  - This will ensure you're in the right working directory to easily access the data, etc.

DEMONSTRATION...

3

Your turn...

- Download the `01-week.zip` file here
- Open up the `01-week.Rproj` file

R uses `<-` for assignment

Create an object `vals` that contains and sequence of numbers:

```
# create values
vals <- c(1, 645, 329)
```

Put your cursor at the end of the line and hit ctrl/cmd + enter.

Now `vals` holds those values.

We can see them again by running just the name (put your cursor after the name and press ctrl/cmd + enter again).

```
vals
```

```
## [1]   1 645 329
```

> No assignment arrow means that the object will be printed to the console.

Types of data (*classes*)

We could also create a character *vector*:

```
chars <- c("dog", "cat", "rhino")
chars
```

```
## [1] "dog"   "cat"   "rhino"
```

Or a *logical* vector:

```
logs <- c(TRUE, FALSE, FALSE)
logs
```

```
## [1]  TRUE FALSE FALSE
```

> We'll see more options as we go along!

Types of objects

We created *vectors* with the `c()` function (`c` stands for concatenate)

We could also create a *matrix* of values with the `matrix()` function:

```
# turn the vector of numbers into a 2-row matrix
mat <- matrix(c(234, 7456, 12, 654, 183, 753), nrow = 2)
mat
```

```
##      [,1] [,2] [,3]
## [1,]  234   12  183
## [2,] 7456  654  753
```

The numbers in square brackets are *indices*, which we can use to pull out values:

```
# extract second row
mat[2, ]
```

```
## [1] 7456  654  753
```

Dataframes

We usually do analysis in R with dataframes (or some variant).

Dataframes are basically like spreadsheets: columns are variables, and rows are observations.

```
gss_cat
```

```
## # A tibble: 21,483 x 9
##     year marital         age race  rincome      partyid        relig         denom
##    <int> <fct>         <int> <fct> <fct>        <fct>          <fct>         <fct>
##  1  2000 Never marr…    26 White $8000 to 99… Ind,near rep   Protestant    Southern
##  2  2000 Divorced       48 White $8000 to 99… Not str repu… Protestant    Baptist-
##  3  2000 Widowed        67 White Not applica… Independent    Protestant    No denom
##  4  2000 Never marr…    39 White Not applica… Ind,near rep   Orthodox-ch… Not appl
##  5  2000 Divorced       25 White Not applica… Not str demo… None          Not appl
##  6  2000 Married        25 White $20000 - 24… Strong democ… Protestant    Southern
##  7  2000 Never marr…    36 White $25000 or m… Not str repu… Christian     Not appl
##  8  2000 Divorced       44 White $7000 to 79… Ind,near dem   Protestant    Lutheran
```

tibble???

tibbles are basically just pretty dataframes

```
as_tibble(gss_cat)[, 1:4]
```

```
# A tibble: 21,483 x 4
    year marital         age race
   <int> <fct>         <int> <fct>
 1  2000 Never married    26 White
 2  2000 Divorced         48 White
 3  2000 Widowed          67 White
 4  2000 Never married    39 White
 5  2000 Divorced         25 White
 6  2000 Married          25 White
 7  2000 Never married    36 White
 8  2000 Divorced         44 White
 9  2000 Married          44 White
10  2000 Married          47 White
# … with 21,473 more rows
```

```
as.data.frame(gss_cat)[, 1:4]
```

```
   year       marital age  race
1  2000 Never married  26 White
2  2000      Divorced  48 White
3  2000       Widowed  67 White
4  2000 Never married  39 White
5  2000      Divorced  25 White
6  2000       Married  25 White
7  2000 Never married  36 White
8  2000      Divorced  44 White
9  2000       Married  44 White
10 2000       Married  47 White
11 2000       Married  53 White
12 2000       Married  52 White
13 2000       Married  52 White
14 2000       Married  51 White
```

and tibbles are the quickest and most intuitive way to make and read a dataset

```
dat1 <- tibble(
  age = c(24, 76, 38),
  height_in = c(70, 64, 68),
  height_cm = height_in * 2.54
)
dat1
```

```
## # A tibble: 3 x 3
##     age height_in height_cm
##   <dbl>     <dbl>     <dbl>
## 1    24        70      178.
## 2    76        64      163.
## 3    38        68      173.
```

```
dat2 <- tribble(
  ~n, ~food, ~animal,
  39, "banana", "monkey",
  21, "milk", "cat",
  18, "bone", "dog"
)
dat2
```

```
## # A tibble: 3 x 3
##       n food   animal
##   <dbl> <chr>  <chr>
## 1    39 banana monkey
## 2    21 milk   cat
## 3    18 bone   dog
```

Your turn...

4

- Work through the code in `01-week/01-todo.R`