Introduction to $\mathcal{R}$

Session 01: The Very Basics

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Outline

General Information

Who am I?

- **Background**: Political Scientist
- **Position**: Research Fellow, Chair of Comparative Politics, UP
- **Fields**: Autocracy, Contentious Politics, and Applied Methods
- **Secret weakness**: Zero intuition for maths & statistics

Introductory Round

So, who are you? Mind to fill us in on your secret weakness?

Goals of this workshop

1. Provide a grand tour of elementary $\mathcal{R}$
   - Basic (probabilistic) programming
   - Elementary data management
   - Introduction to ggplot2
   - Applied regression & working with regression results
2. Introduce self-help strategies
   - Diagnose error messages
   - Find *relevant* resources
   - Ask a good question
3. Promote interest, because $\mathcal{R} \approx$ Fun

Workshop logistics

- **Place**: Campus Griebnitzsee, House 7, Room 144
- **Coffee break**: 10:45 - 11:00
- **Lunch break**: 12:30 - 13:30
- **Materials**: Go to https://github.com/dagtann/pcqr/

Day	Start	End	Official Topic
1	09:15	10:45	The Very Basics
	11:00	12:30	Data Management
	13:30	15:00	Basic Program Flow
2	09:15	10:45	Graphics
	11:00	12:30	Basic Statistics
	13:30	15:00	GLMs

Toward $\mathcal{R}$

Anyways, what is $\mathcal{R}$?

- open-source programming language
- purpose: statistical computing and graphics
- written by Robert Gentleman & Ross Ihaka (Auckland, NZ)
- cross-plattform (UNIX, Linux, FreeBSD, Windows, MacOS)
- one of the most popular programming languages

Why bother with $\mathcal{R}$?

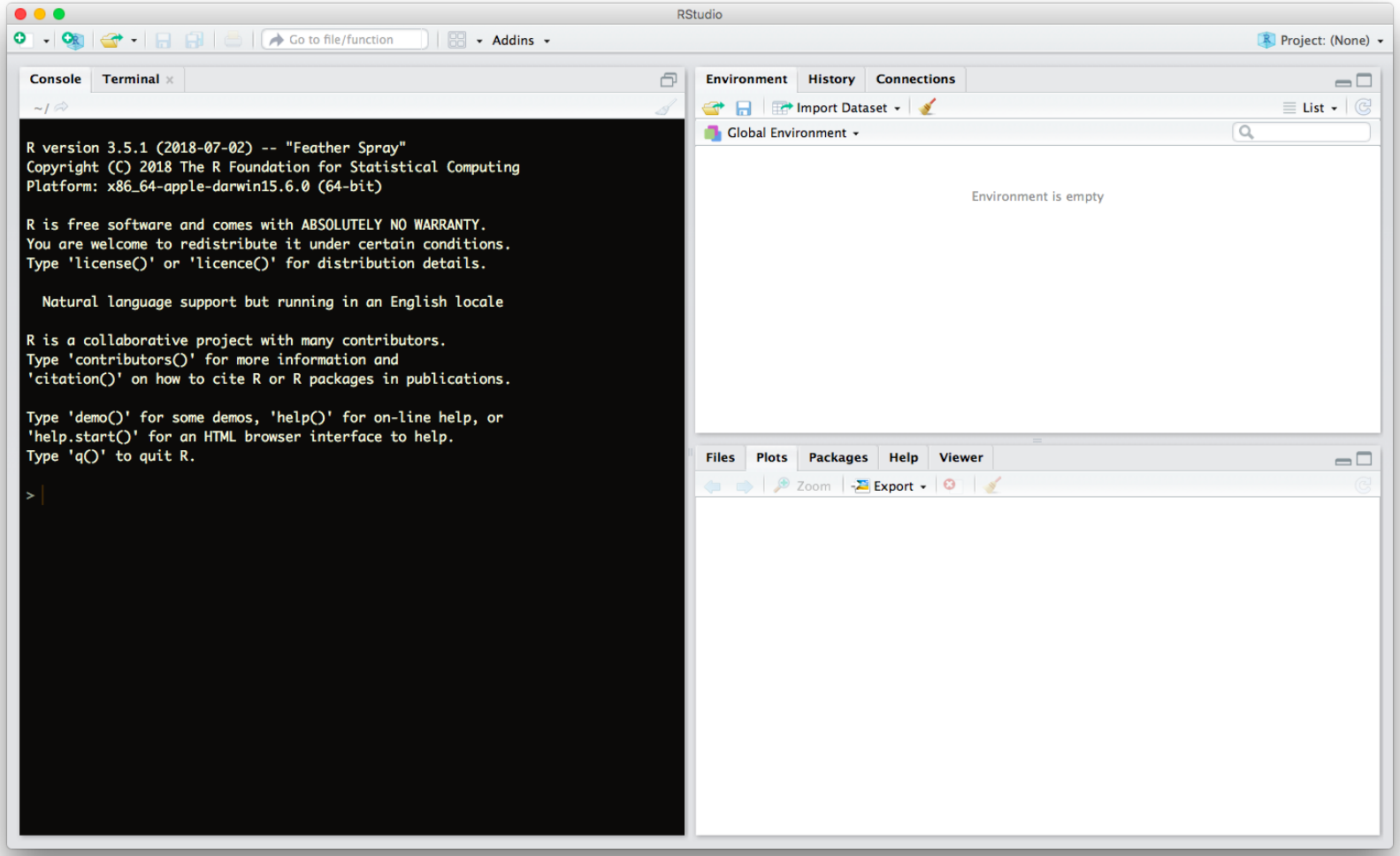
- **Popular**
  - Large community to turn to for help
  - New statistical routines often first implemented in R
- **Data wrangling**
  - powerful tools for handling, cleaning and exploring data
- **Data vizualization**
  - powerful, flexible, and easy plotting (unlike S. . . .)
- **Open source**
  - free for teachers, students, and everyone else
  - huge & active community of developers
  - tons and tons and tons of free material
  - free multi-core support (unlike S. . . .)

Install & Open R

- If you brought your own computer
  - Download R from https://cran.r-project.org/ & install
  - Download RStudio from https://www.rstudio.com/ & install
- Open RStudio.

Making Landfall

A first glance at RStudio



Let's take $\mathcal{R}$ for a ride.

See if you can solve the following problems.

1. $2 + 2$
2. $-3 \cdot 9$
3. $\sqrt[3]{8}$ (Hint: $\sqrt[3]{8} = 8^{\frac{1}{3}}$)
4. $(2 + 3) \cdot 8$
5. $\mathcal{R}$ ships with an extensive online documentation. For instance, it includes a manual named "An Introduction to R".[2] Use the RStudio help pane to locate this manual.

[2] Note, the title doesn't say "gentle".

What did we just learn?

1. You can interact with $\mathcal{R}$ from the console.
   - $>$: $\mathcal{R}$ is waiting for input.
   - $+$: Your command is incomplete.
   - Error: Something went wrong.
2. $\mathcal{R}$ is a super-charged calculator which supports almost everything you can imagine.
3. An elementary way to get help on $\mathcal{R}$ is to ask $\mathcal{R}$.[3]
   a. ?"+" - Opens the help page on arithmetic operators.
   b. help("+") - Same here.
   c. ??Regression - Conducts a keyword search for "Regression".

[3] Quotation marks are mandatory for operators (e.g., $+$) and control statements (e.g., if).

Objects

What is an object?

- $\mathcal{R}$ stores data in objects.
- When encountering an object, $\mathcal{R}$ returns the data saved inside.
- Demonstration:

```
a <- 1 # Assign value "1" to object "a".
a # Retrieve the value of "a".
```

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

```
a + 2 # Retrieve the value of "a" and add "2" to it.
```

```
## [1] 3
```

```
a <- 999; a # On reassignment R overwrites an object.
```

```
## [1] 999
```

The Rules of Assignment

- Valid assignment patterns:

```
a <- 3 # Object <- Value
3 -> a # Value -> Object
```

- Naming rules:
  - Rule 1: An object name cannot start with a number.
  - Rule 2: An object name cannot use certain special symbols, e.g., ^, !, $, @, +, -, /, [.
  - Rule 3: Capitalization matters, i.e. A $\neq$ a.

What names will work?

!d0	FOO	1_day	day_1
_day1	.day1	day.1	day^1

How does are operate on objects?

Execute these commands and describe the result.

```
die <- 1:6
die * die
die + 1:3
die %*% die
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- If $\mathcal{R}$ operates on vectors of unequal length, it will repeat the shorter vector until it meets the longer one.[4]

[4] This is called "recycling".

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- If $\mathcal{R}$ operates on vectors of unequal length, it will repeat the shorter vector until it meets the longer one.[4]
- $\mathcal{R}$ won't do linear algebra unless explicitly asked to.

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Functions

What is a function?

- $\mathcal{R}$ uses functions to operate on data.
- The data passed to a function is called its argument.
- Syntax: FctName(arg.1 = value.1, . . . , arg.n - value.n)

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die <- 1:6; mean(die)
round(mean(die))
round(mean(die), digits = 2); round(mean(die), 2)
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- **Lessons learned**:
- Arguments can be raw data or results of another function.
- Functions have optional arguments with default values.
- Using argument names is optional.

How do you get more functions?

- Install & load new packages.[5]

```
install.packages("ggplot2")
library("ggplot2") # Load a package 2 access its fcts.
```

- Write your own function.

```
FctName <- function(x, y, z = 1){ # Assign function
  ## x, y ... mandatory arguments
  ## z ... optional argument
  # Function body
  A <- x + y
  A + z ## FctName will return the last line of code
}
```

[5] Only load packages that you need!

How do I get help on a function?

- Access the function's help page.
- Sections of a help page:
  1. *Description* Summary of the function
  2. *Usage* Example of how you would type the function
  3. *Arguments* Explanation of the function's arguments
  4. *Details* In-depth description of the function
  5. *Value* What does the function return?
  6. *See Also* List of related functions in $\mathcal{R}$
  7. *Examples* Code that demonstrates the function.

Let's do that together. What does the function **sample** do?

Summary

What have we learned so far?

- $\mathcal{R}$ is an open-source programming language for statistical computing and graphics.
- $\mathcal{R}$ has two main components.
  1. Objects store data. They are the nouns of the $\mathcal{R}$ language. To assign objects we write: object <- data.
  2. Functions operate on data. They are the verbs of the $\mathcal{R}$ language. To call a function we write: FctName(arg.1 = val.1, arg.2 = val.2, ...).
- $\mathcal{R}$ ships with an extensive, easily accessible documentation.
- Users can extend $\mathcal{R}$'s functionality by installing new packages or by writing their own functions.