

### Intro to Programming with R for Political Scientists

Session 1: RStudio and Version Control

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# Intro

### Hi!

#### Why this course?

- Intro to R with a focus on programming (<-> standard pol sci quant training).
- Set some good programming/workflow habits to make your life easier later on.

"I want to give a short (crash) course that provides you with some basic practical skills necessary to get serious about (political) sciencing."

- There are tons of awesome & free materials from the best R Gurus of the world out there.
- Take this course as a humble starting point to see through the thickit.

Note: Text will be highlighted in yellow or turquise. Links will appear purple.

### Hi!

#### Who am I?

- Research Fellow (pre-doc). Likes stats and pol sci. Also likes cooking and (board) gaming.
- Web: **(**

#### Who are you?

Let's do a break-out icebreaker session.

This will also be your team for the problem sets.

## What are we going to cover?

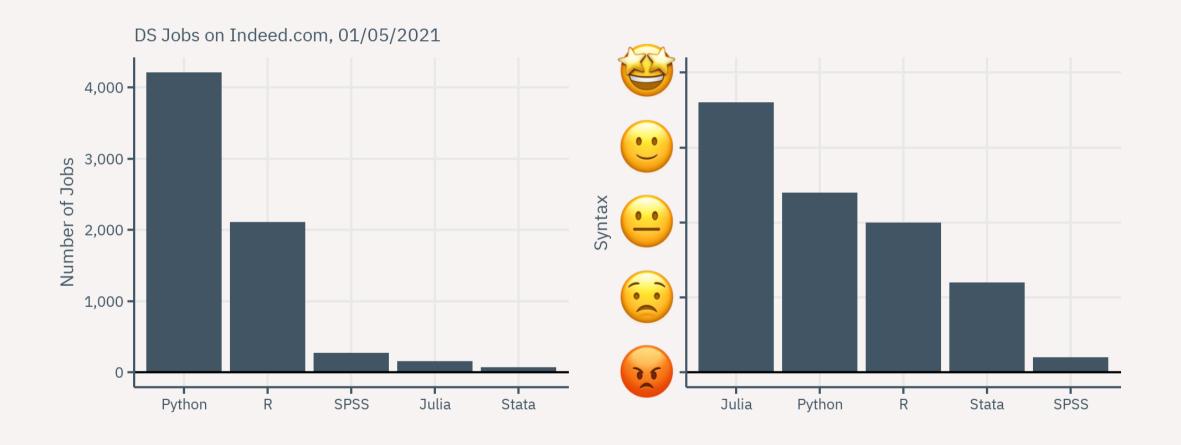
- 1. Intro
- 2. R-Studio and Git(Hub)
- 3. Base R & Tidyverse Basics
- 4. Data Wrangling I
- 5. Data Wrangling II
- 6. Data Viz
- 7. Writing Functions
- 8. A complete scientific workflow with R

## Why R?

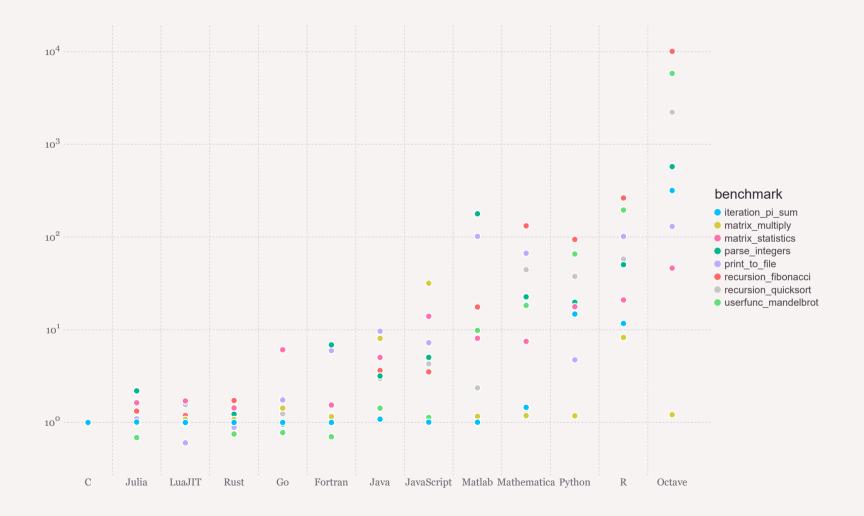
At the present day (and surely years to come), R is arguably the best programming language for academics:

- R is from statisticians for statisticians.
- Most active (academic) development community for **statistical** computing/programming.
- Nice IDEs; Good integration of other languages and workflow components.
- Best for data viz.

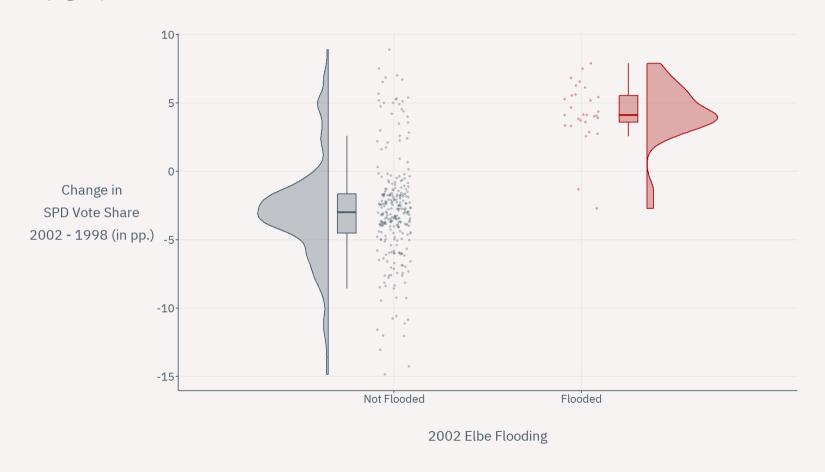
# Why R?



# R versus other langs/software

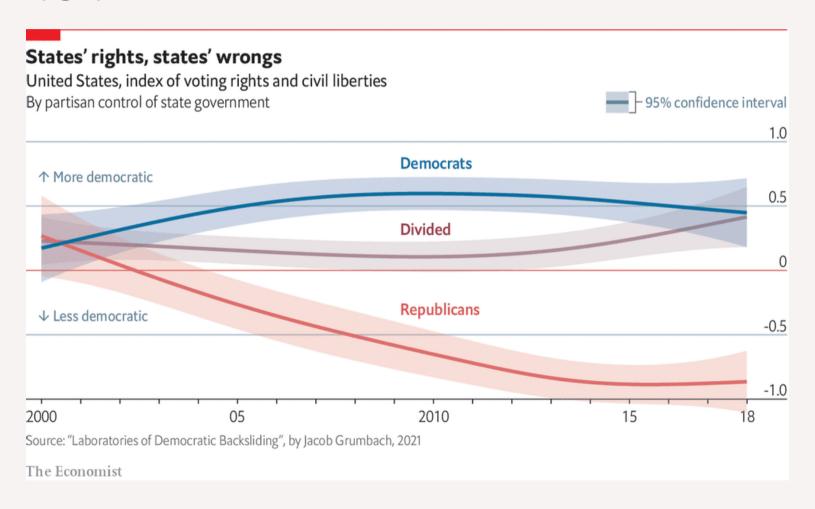


U can make pretty graphs...

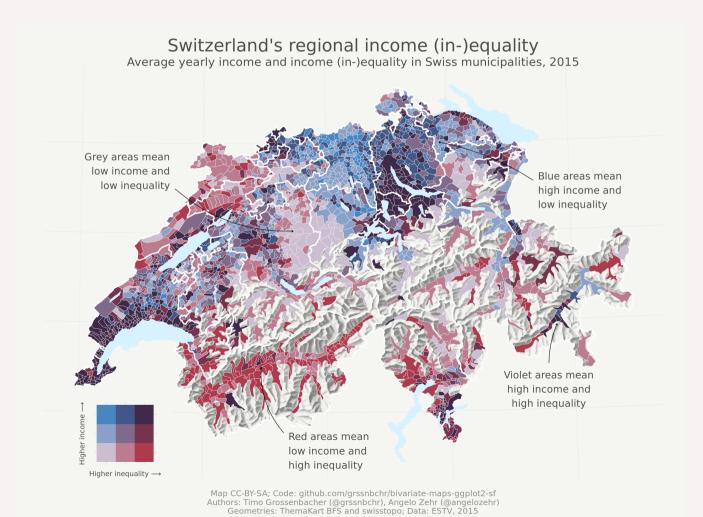


Data from Haimueller/Bechtel 2011.

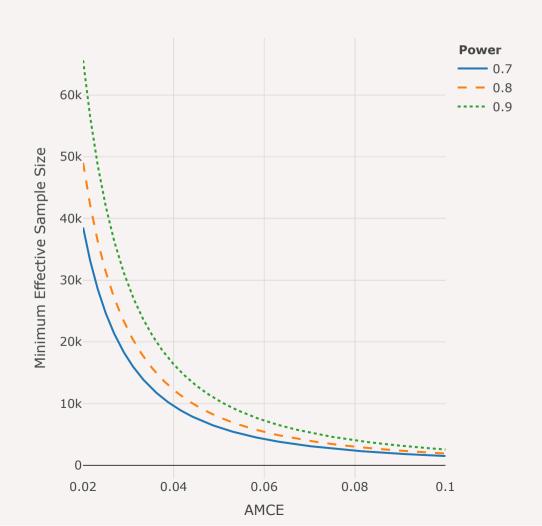
U can make pretty **graphs**...



#### Or maps...



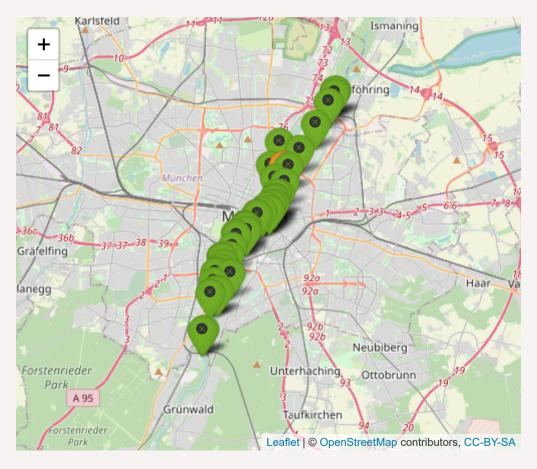
Or interactive graphs...





If you are interested in **power for** (conjoint/factorial) survey experiments...

Or or interactive maps...



Map shows **points of interest** at the southern part of the Isar in Munich (GSI in orange). Let summer come!

- U can easily combine R code and text in so called Rmarkdown files to produce reproducible documents in various output formats (html, pdf, etc.).
- This presentation is a (hopefully good) example. You can check out the source code **here**. Feel free to take and adapt.
- We will learn a little more about this in just a few slides and much more tomorrow!

# R-Studio & Git(Hub)

### **Installation**

Steps you should have done already:

- 1. Install R.
- 2. Install **R-Studio**.
- 3. Create a **GitHub** account. Take some care with the user-name if you want to keep this account throughout your career. You can't change it afterwards.
- 4. Install and set up **Git** (and optionally a desktop client).

### **R-Studio**

R-Studio is an IDE (integrated development environment) for the R language:

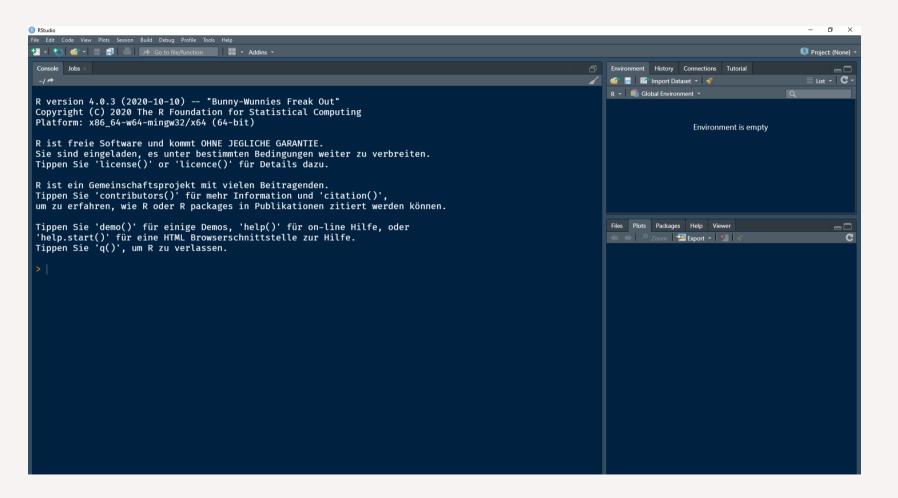
- comes with a console, code editor, tools for plotting, history, debugging and workspace
- open source
- pretty accessible/easy to use

#### Alternatives:

- Visual Studio Code (nice, if you work with multiple langs; my fav IDE)
- Alternatives are worse for package development, shiny platforms and some other R-specific stuff
- If your main language is R, RStudio is best

### **R-Studio**

Lets take a tour...



## A Small Detour: Two Types of "Scripts"

In this course, we will use two types of scripts to write our code:

- 1. Classic R-Scripts (.R): simple text file; comments are usually done like so: # A comment.
- 2. **Rmarkdown** files ( . rmd ): combines code and free text (+ figures and formulae)
  - Can be "knitted" to, e.g., .pdf, .html and Word
  - Makes your documents (e.g. a paper or a thesis) fully reproducible (more on this tomorrow!)
  - Nice for problem sets (hence, we will use it for this right from the beginning)

### Rmarkdown

An Rmarkdown file consists of mainly three things:

1. **YAML header** (Yet Another Markdown Language). Specifies meta info (e.g. author, date, document format, etc.):

```
title: "Untitled"
author: Markus
output: html_document
---
```

- 2. **Code chunks** sorrounded by ``` . You can execute each chunk individually.
- 3. Plain text formatted via Markdown, a markup language with very easy syntax.

Problem sets will come as pre-formatted . rmd files such that you can start working on excercises directly.

## R projects

• To keep our sanity when coding (and to produce something reproducible in the end), we want to keep all our data, analysis scripts, outputs (e.g. figures) etc. together.

#### **Three approaches:**

#### **Bad**

Creating a folder in the explorer and dropping all files into it. Setting the working directory in the R script manually using, e.g., setwd("C:/Users/XYZ/New Folder").

Just don't use setwd(). Ever. 1

Why? Reproducibility.

[1] Yes, I am looking at you, Stata user, who loves to set working directories via cd.

### R projects

#### Ok



This creates a folder with an <code>.Rproj</code> file. Whenever you open an R-project, a fresh instance of R starts and **the current working directory is set to the project directory.** You can then work with file paths relative to the project directory: E.g. <code>Figures/somepicture.png"</code>).

#### Good

Creating a project and using version control.

This is where Git(Hub) comes in...

## Why Git(Hub)?

Having multiple scripts inside your project called, e.g., thesis\_analysis\_final\_01\_revised\_2.R is a nightmare.

- Using Git(Hub) improves your workflow:
  - helps with keeping track of the changes you do.
  - o makes (code) collaboration with other researchers easy.
  - helps to make your research/code projects accessible/reproducible/open source.

# Why Git(Hub)?

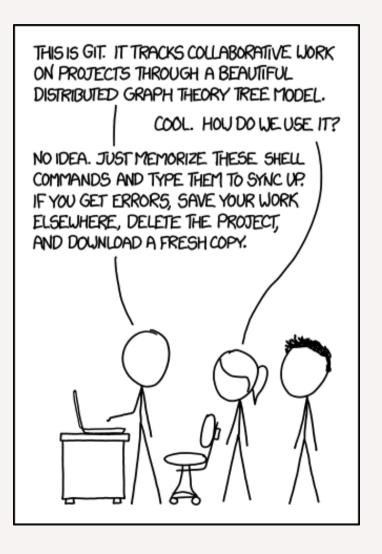
What's that thing called "Git"?

• It's a version control system:

Git  $\approx$  MsOffice track changes and restore features + dropbox/google drive version history

- But it's better, especially for any kind of projects that involve code
- You have to "commit" (i.e. save) actively, but that's a good thing (you could still have some sort of auto-save on you local machine)!

## Why Git(Hub)?



### **GitHub**

#### GitHub to the rescue:

- Built on top of Git
- A kind of online cloud service that makes working with Git easier
- again, no automated sync (but that's good!)
- Instead of some folder, your project lives in a remote **repository**

#### The remote repository is your upstream storage.

- $\rightarrow$  You can **clone** it from GitHub to create a local copy.
- → You can **fork** some repo (including those of other users); i.e. create a copy of the repo under "your repositories". You can then **clone** this forked repo to get a local copy.

## Your first repo

- 1. Click **here** and create a new Git(Hub) repo. Call it "test", set it to **private** and initialize with a readme file.
- 2. In R-Studio, navigate to File > New Project > Version Control > Git.
- 3. Paste the Repository URL, chose a name and project path and clone the thing.
- 4. You will be asked to provide a personal access token. Generate it **here** using some name and check the "repo box".
- 5. In the files tab, open README.md. Also click on the Git tab.

Do this **now**!

### 4 Operations You Need to Know

#### 1. Stage ("add")

Tells Git which files u want to make changes (edits, deletes, etc.) to in the repo
 (simplification); in R-Studio this boils down to "selecting" files/changes to files by checking
 them.

#### 2. Commit

Git's way to "save" the changes you staged.

#### 3. Pull

"downloads" all new changes/new commits from GitHub

#### 4. Push (to origin)

o "uploads" all commits to GitHub; to the origin, i.e. your upstream remote repo.

### Commit

Make some changes to the README.md file, stage, commit and push.

To establish best practice, give your commit a meaningful name:



AS A PROJECT DRAGS ON, MY GIT COMMIT MESSAGES GET LESS AND LESS INFORMATIVE.

- In general, commit whenever you think you made a meaningful change
- Push a bit less often than you commit

## **Collaborate with Git(Hub)**

- Using version control really comes to shine when collaborating.
- BUT: you are always collaborating. With your future self. Therefore, always use version control.
- To invite someone to a repo on GitHub, go to the repo settings > manage access.
- Your collaborator can then clone the repo and contribute commits, push them etc.

# When Things Go Sideways: Merge Conflicts

- 1. Go to your new repo. Edit the README.md manually in line 3.
- 2. Commit some changes in the **same** line locally in R-Studio. Commit.
- 3. Pull (don't push).
- 4. Git:



## When Things Go Sideways: Merge Conflicts

What do you do now?

- Well, you (maybe in exchange with your collaborator) decide!
- Solve the conflict manually, add, commit, push.

### Branches

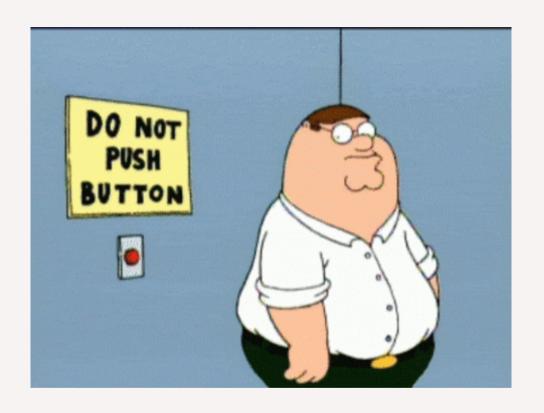


### **Branches**

- Branches allow you to develop/test some idea without touching the main version of your code.
- Useful for larger projects. You get a full copy of the repo and you can commit/pull/push all you want.
- If your idea turned out not to work. Just delete the branch.
- In R-Studio, they can be created via the little purple branch icon in the Git tab.
- If you want to integrate the feature/idea into the main branch, issue a **pull request** (easiest way is via GitHub).

# When Things Go Really, Really Wrong

- DON'T PUSH.
- If you did not, just clone a fresh instance of the repo.
- If you did, you can revert to an older version (but that's more work).



## **Workflow Summary**

- 1. Create a repo or fork some existing repo
- 2. Invite collaborators
- 3. Clone it & create an R project
- 4. Edit code or make other changes
- 5. Stage, commit (with message), pull (esp. if u work with others/to avoid conflicts right away), push
- 6. Rinse and repeat steps 4-5.

## **Workflow Summary**

Yes, the order really is stage, commit, pull, push.

Well, we got an intuition for it when we created a merge conflict. See this concise **stackoverflow** answer for a summary:

It's better to commit first. Pulling without commiting may make your work overwritten. With a local commit, conflicts will be shown and prompted for manual merging when pulling, giving you a better control over your work.

## **Further Steps**

- Fork the course repo and clone it via R-Studio (that's perhaps a bit hacky but easy and does the job).
- You will need this to conveniently access the course materials/problem sets.
- As the fork is your own copy of the repo, feel free to commit and push all you want.
- You could also use the shell to clone the repo or, alternatively, GitHub Desktop
- For beginners, using a Git GUI (like GitHub Desktop) and R-Studio will cover well over 90% of the use cases imo

See, e.g., here for further reading.

# Next Up: Base R & the Tidyverse