



Intro to Programming with R for Political Scientists

Session 1: RStudio and Version Control

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Intro

Welcome Young Padawans

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.

Welcome Young Padawans

Who am I?

- Soon™ PhD student. Likes stats and pol sci. Also likes cooking and (board) gaming.
- Web: 

Who are you?

I hate online introductory rounds.

Let's do a break-out session instead so you get to know a few people.

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**

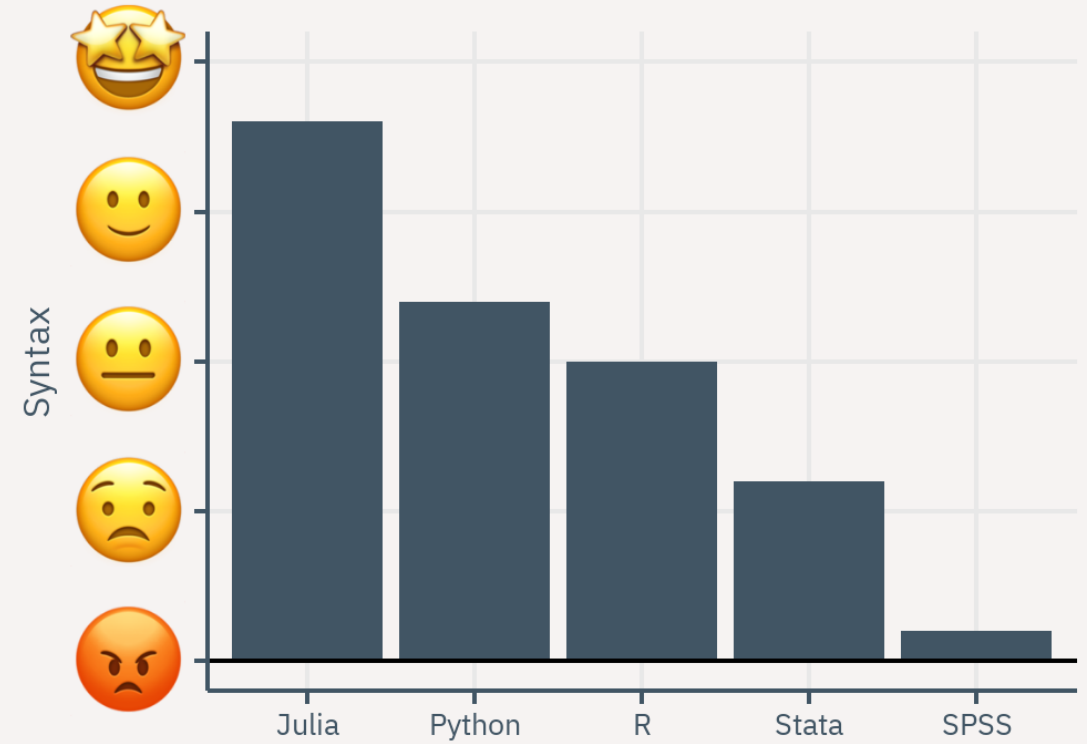
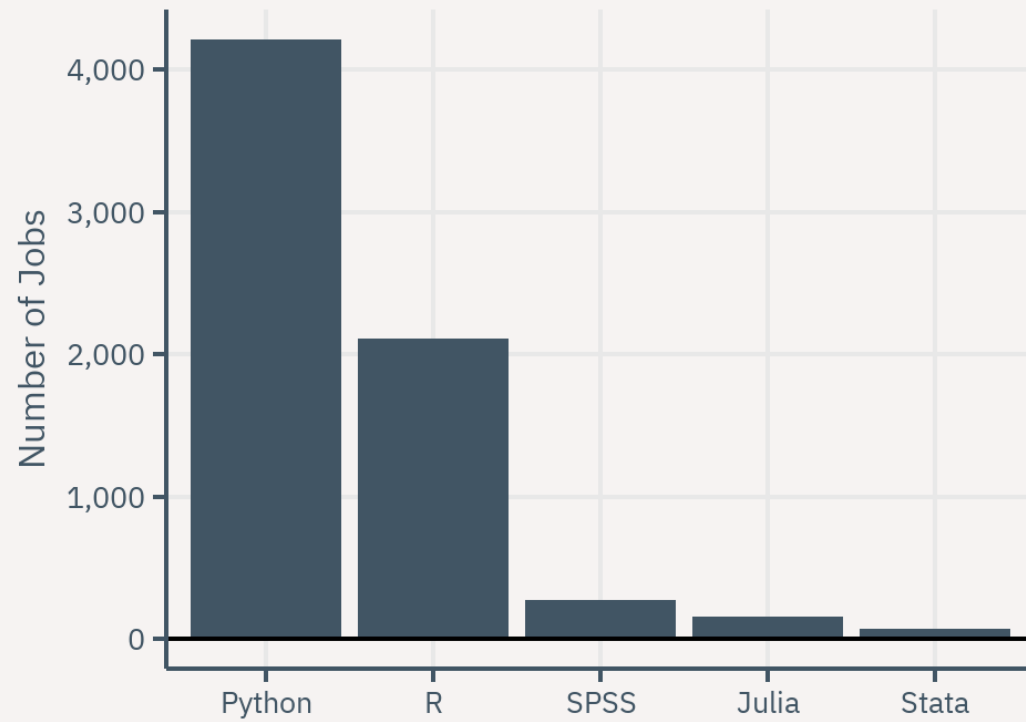
Why R?

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?

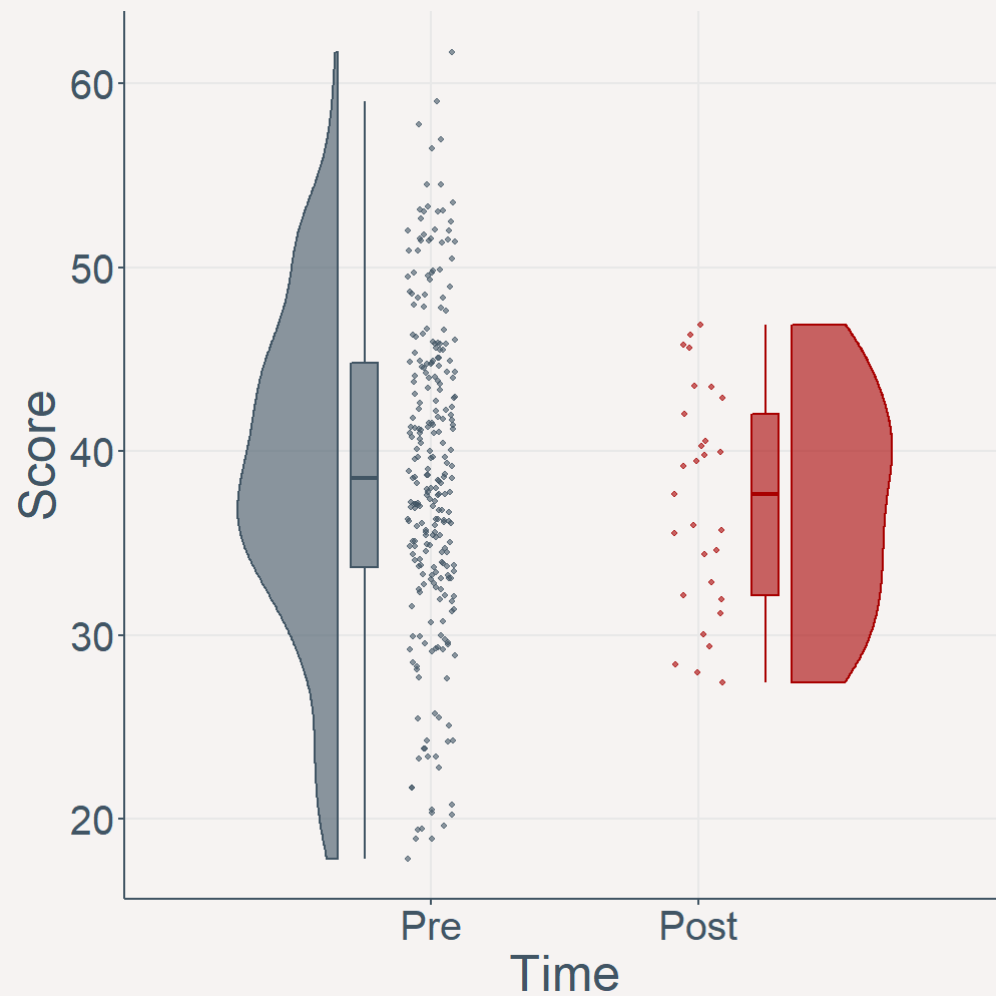
DS Jobs on Indeed.com, 01/05/2021



R versus other langs/software

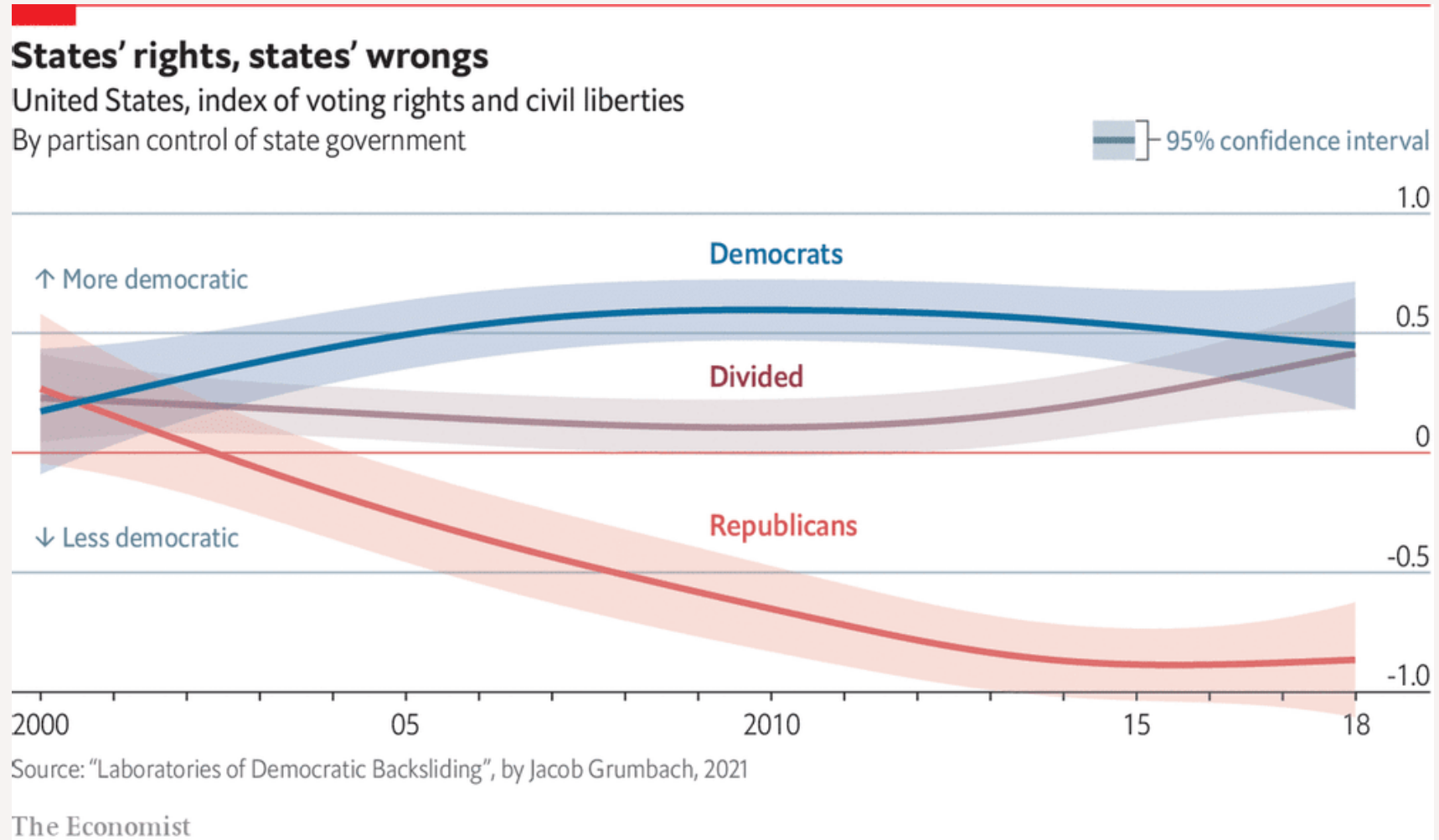
Showcase

U can make pretty graphs...



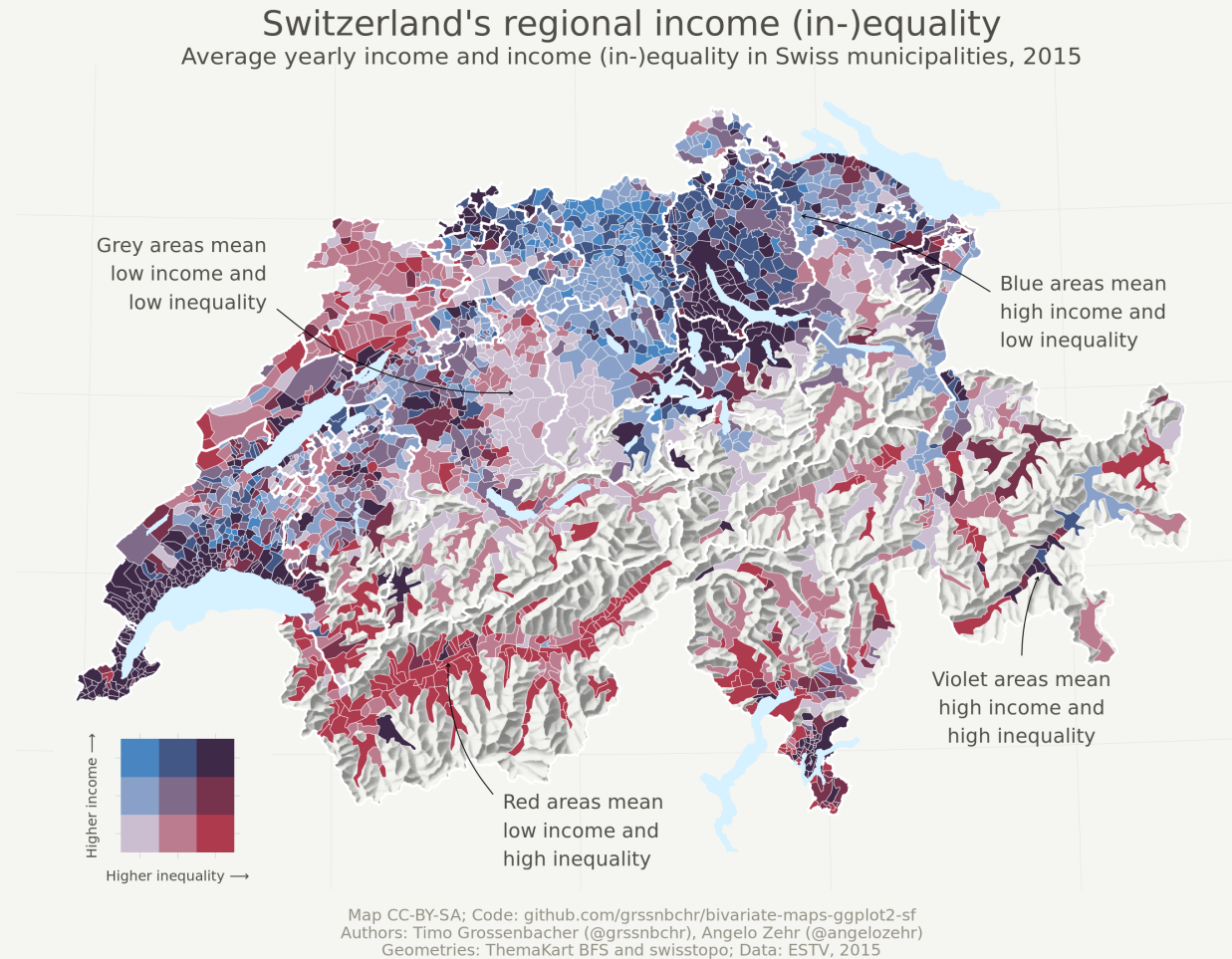
Showcase

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



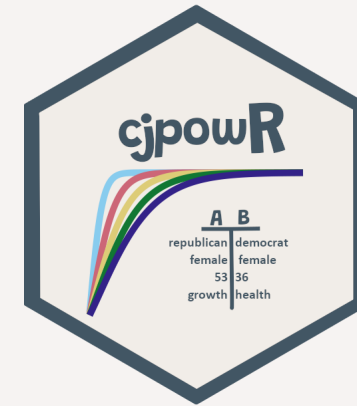
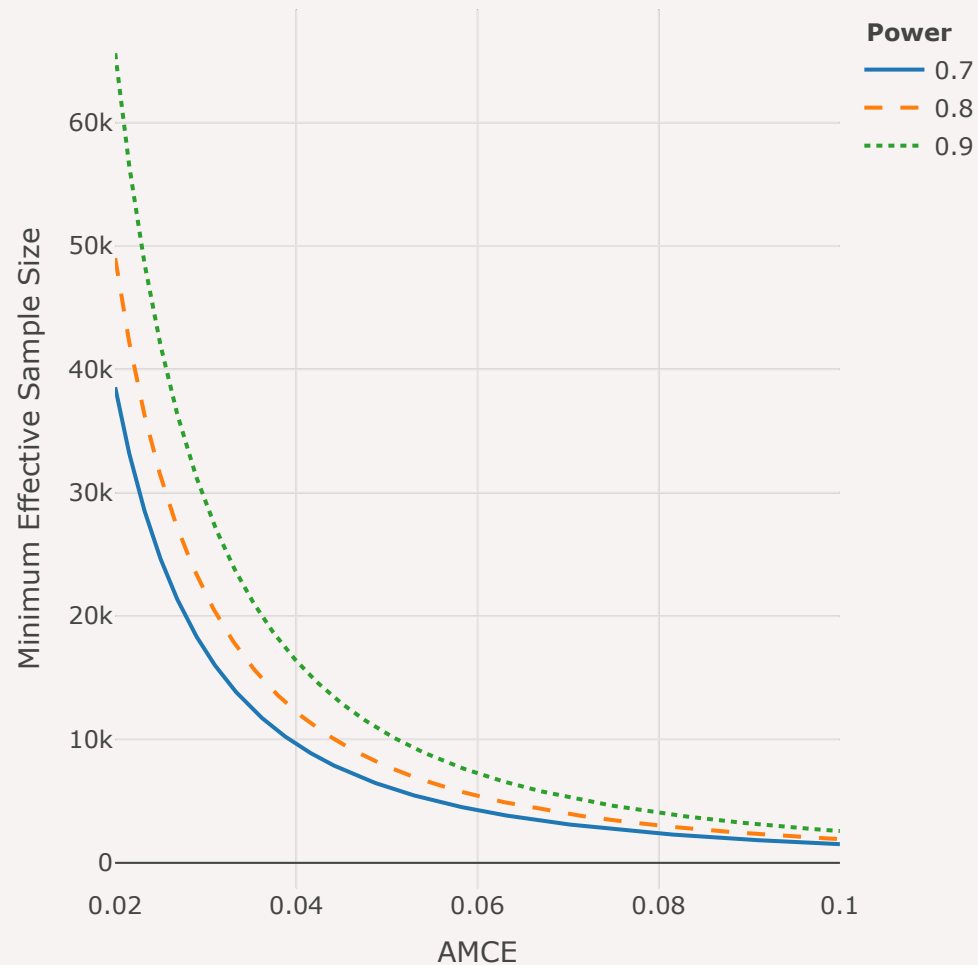
Showcase

Or maps...



Showcase

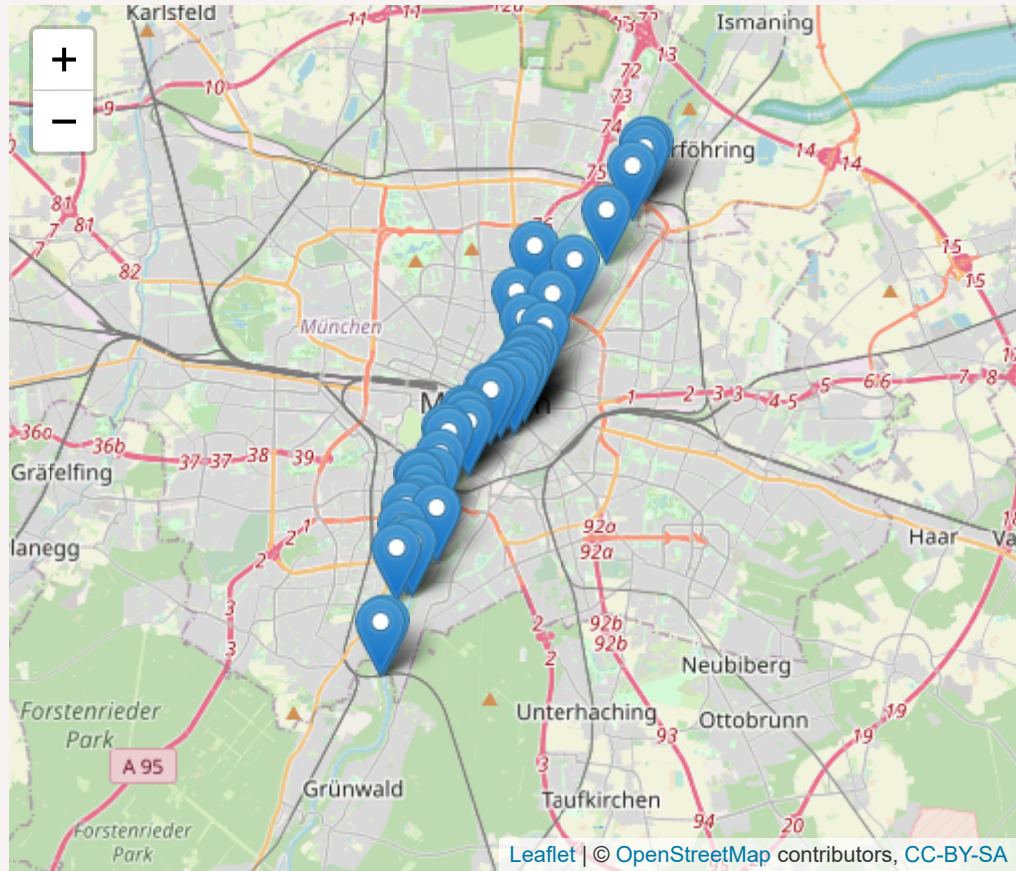
Or interactive graphs...



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

Showcase

Or or interactive maps...



Showcase

- 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:

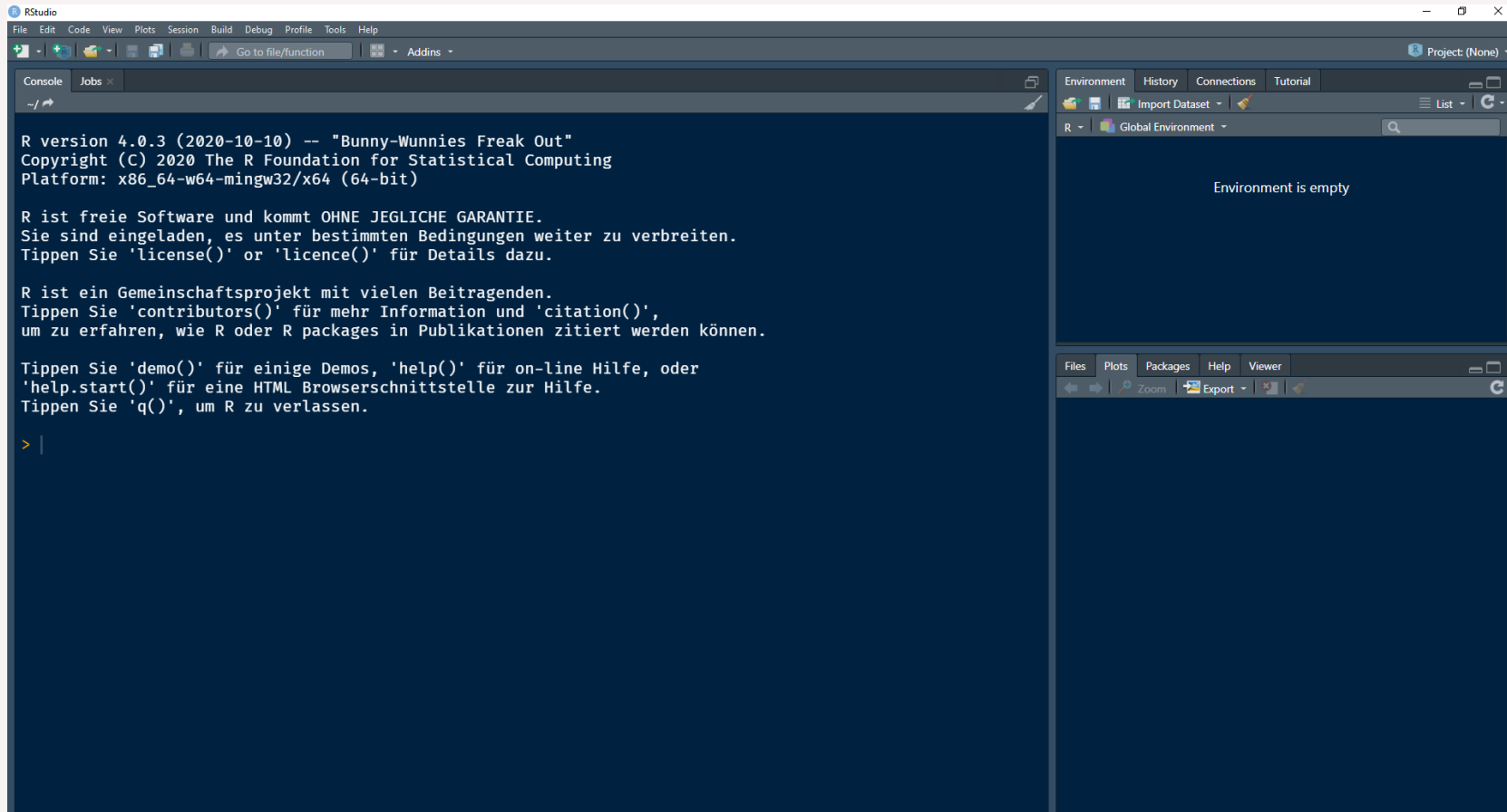
- comes with a console, code editor, tools for plotting, history, debugging and workspace
- open source
- pretty accessible/easy to use

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.):

```
```\r\n---\r\ntitle: "Untitled"\r\nauthor: Markus\r\noutput: html_document\r\n---\r\n```\r\n
```

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

# 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")`.

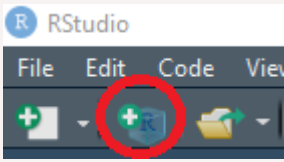
Just don't use `setwd()`. Ever.<sup>1</sup>

Why? Reproducibility.

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

# R projects

## Ok

Clicking , creating a local "R-Project".

This creates a folder with an `.Rproj` 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. `Figures/somepicture.png`).

## 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.
  - 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 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.**

--> 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 readme.
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)

- "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:



	COMMENT	DATE
○	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
○	ENABLED CONFIG FILE PARSING	9 HOURS AGO
○	MISC BUGFIXES	5 HOURS AGO
○	CODE ADDITIONS/EDITS	4 HOURS AGO
○	MORE CODE	4 HOURS AGO
○	HERE HAVE CODE	4 HOURS AGO
○	AAAAAAA	3 HOURS AGO
○	ADKFJSLKDFJSDKLFJ	3 HOURS AGO
○	MY HANDS ARE TYPING WORDS	2 HOURS AGO
○	HAAAAAAAANDS	2 HOURS AGO

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:



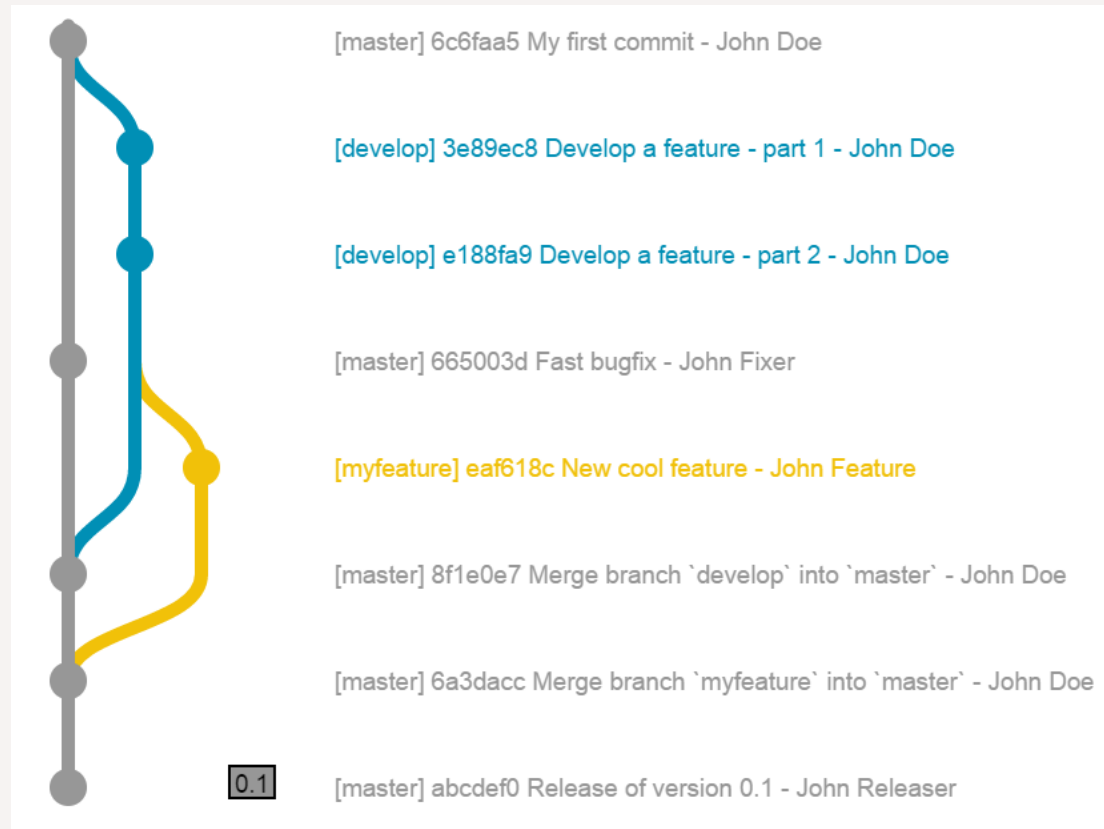
# When Things Go Sideways: Merge Conflicts

What do you do now?

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



# Branches

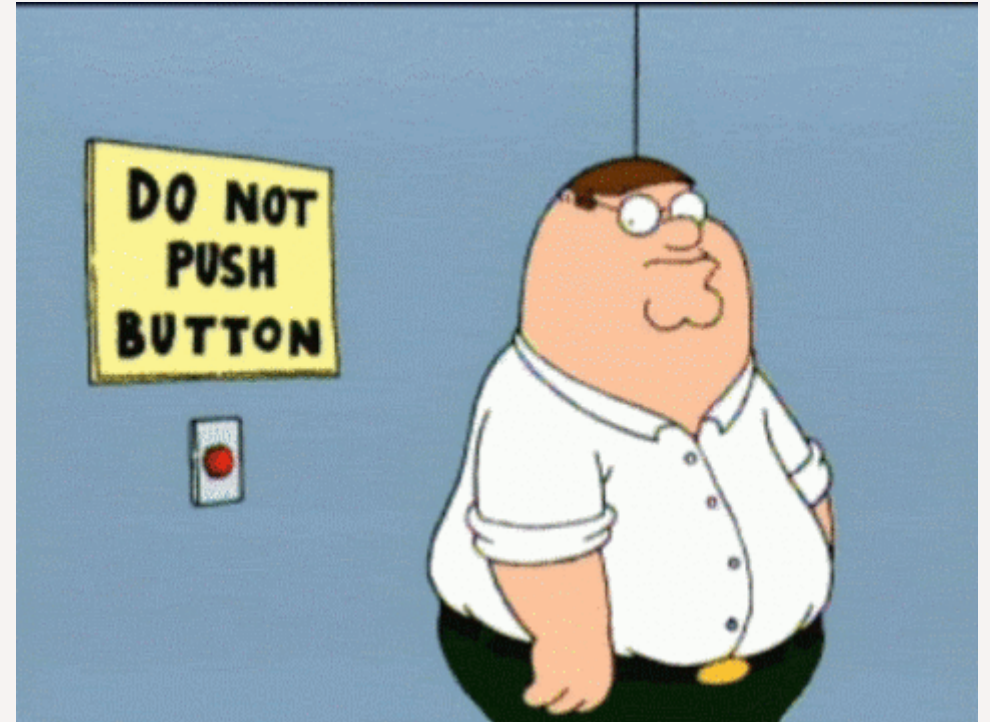


# Branches

- 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 committing 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**