Lessons Learned Registering Simulation Studies

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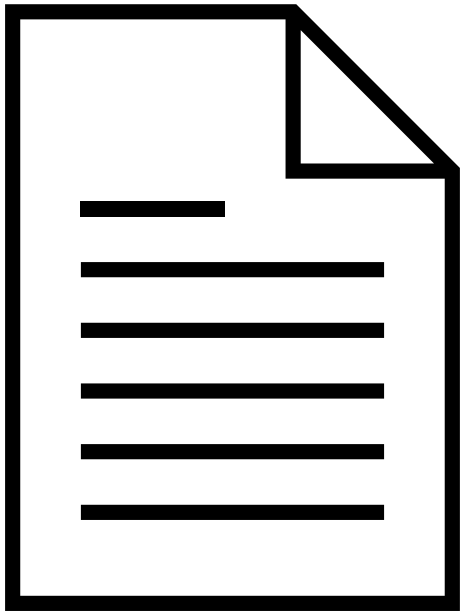
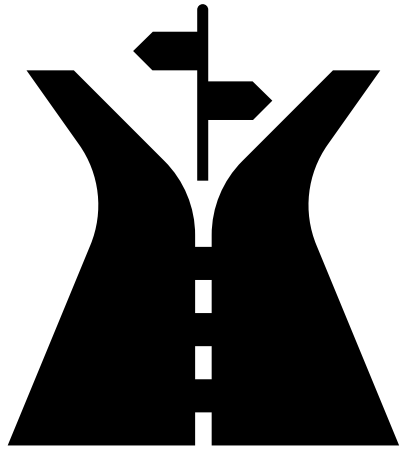


Study Planning and Justification

- RR vs traditional simulation:
  - Stage 1 reviews!
  - Can’t make choices based on results
  - Injects rigour
- Justify your study conditions
- Describe your expected results

Justify Study Conditions



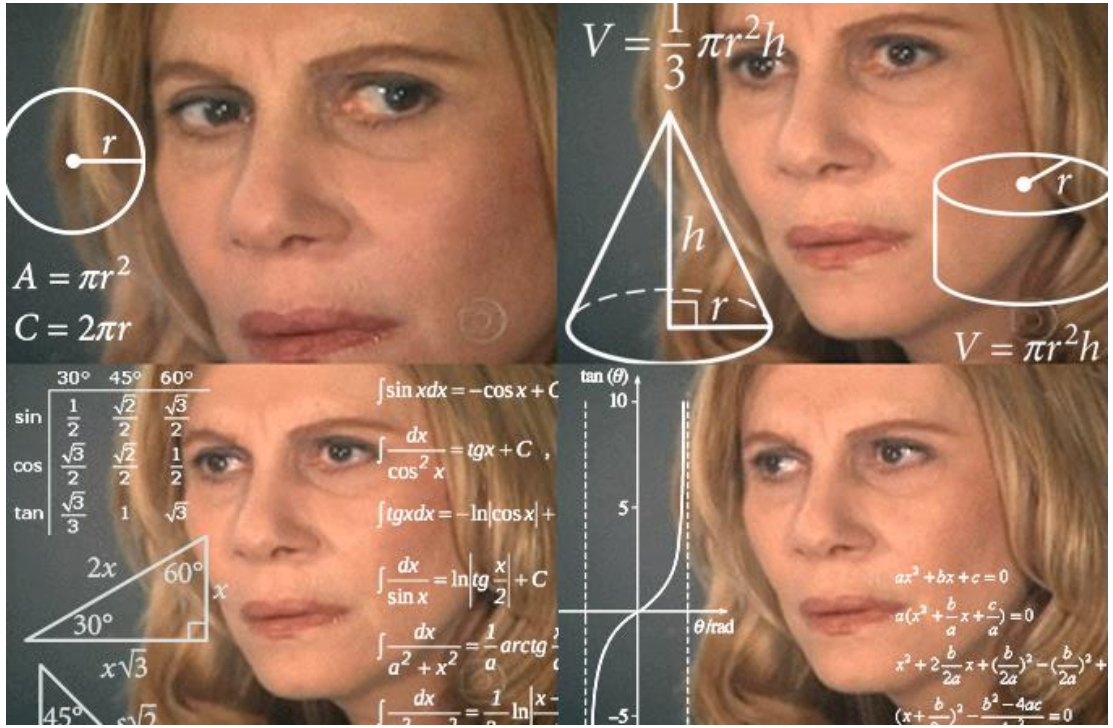
- What's different?
  - Can't use results
  - Locked in (mostly)
  - Reviewers can request changes at Stage 1, but not Stage 2!
- Justify using:
  - Your research questions
  - A previous simulation
  - A review of:
    - Common practice
    - Simulations

Describe Expected Results

Research Question	Hypotheses	Analysis Plan	Interpretations
How does sample size affect type 1 error rates?	Lower type 1 error rates with increasing sample size	ANOVA comparing Type 1 Error rates between sample size conditions	If we find support... If we don't...

Describe Expected Results

- More results than you know what to do with!
- Which results will you present?
  - Consider decision rules in advance
- How will you organize results?
  - Example tables and plots



Reproducibility

- Is it reproducible?
- Is it easy to check reproducibility?

Stage 1 Simulation Code

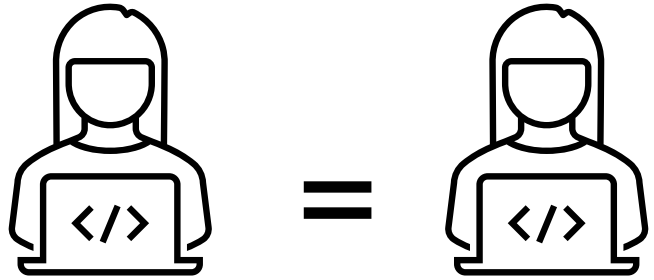
- In a simulation study, you're simulating your data, but don't want to know actual results
- Option 1: small number of fake datasets
  - Saves computing time and keeps results unstable

```
c_options <- c(10, 10, 10)
n_options <- c(10, 10, 10)
effect_size_options <- c("null", "small", "medium")
ndat_options <- 5
# ndat_options <- 1000
```

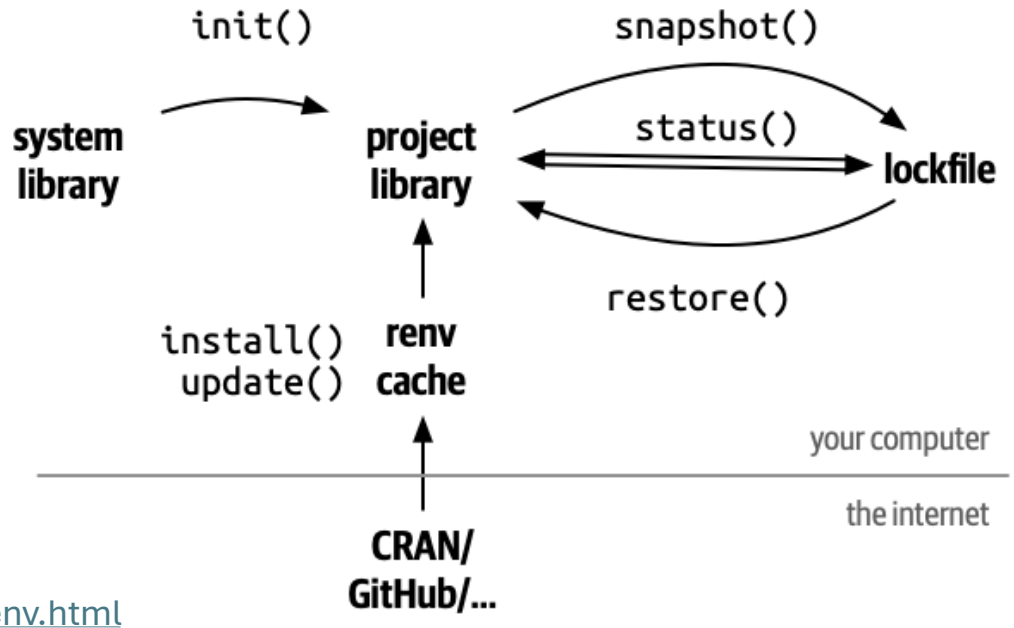
- Option 2: simulate data that has the structure you want, but fake starting values

```
# TEST EFFECTS
if (effect_size == "null") {
  effect <- 0.1
} else if (effect_size == "small") {
  effect <- 0.1
} else if (effect_size == "medium") {
  effect <- 0.1
} else {
  stop("Error in effect size condition")
}
```

Reproducibility: Package and Software

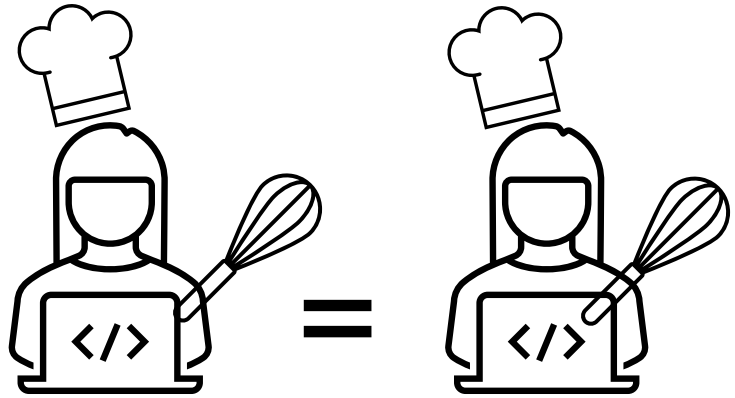


- List software and package versions in your paper
- renv automatically tracks your package versions and installs them on a reproducer's machine with the call renv::restore()

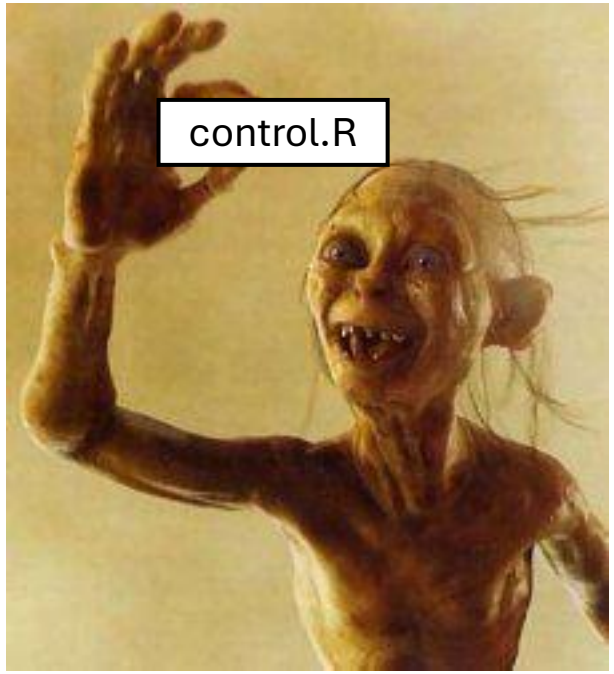


https://rstudio.github.io/renv/articles/renv.html

Reproducibility: Control File

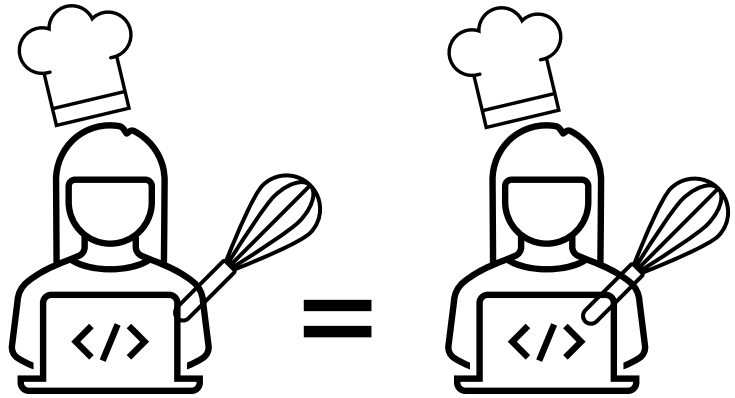


- Many manual changes = recipe for disaster
- Implementing some kind of “control file” can help manage files: one file that manages all conditions and runs the entire simulation, calling separate function-specific files
- More effort up front, way easier in the long run

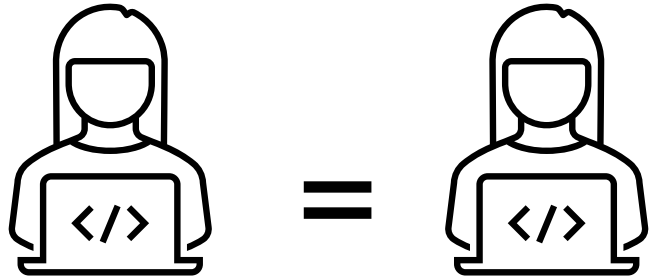


Control File Structure (for latest project)

```r
# control.R

# Load dependencies
library(lme4)

# Load functions written in other files
source("R/generate_data.R")
source("R/run_models.R")
source("R/calculate_results.R")

# Specify variables you manipulate
c_options <- c(10, 20, 30)
n_options <- c(10, 20, 30)
effect_size_options <- c("null", "small", "medium")
ndat_options <- 1000

# Create population data
datasets <- generate_data(c_options, n_options, effect_size_options, ndat_options)

# Run models of interest
raw_values <- run_models(datasets)

# Calculate final results
results <- calculate_results(raw_values)
```

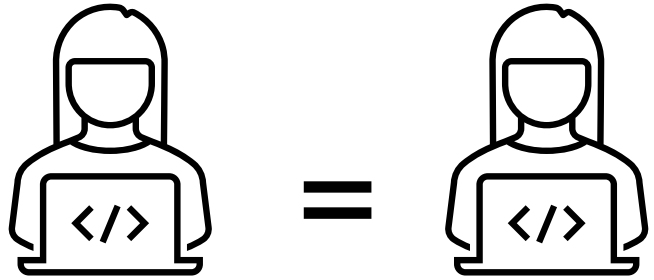


Reproducibility: Make Reproducers' Lives Easier



- Implement ways for reviewers to check that they're on the right track without running the entire simulation
- We're often simulating hundreds or thousands of datasets; manually exporting some allows reviewers to check theirs match ours early on
- If something doesn't reproduce, can help narrow down why

Reproducibility: Make Reproducers' Lives Easier



CODE

```
# create datasets
datasets <- simulate_data(ndat = 1000)

# save out two datasets
write.csv(datasets[[1]], "tests/df1.csv")

write.csv(datasets[[2]], "tests/df2.csv")
```

GITHUB README

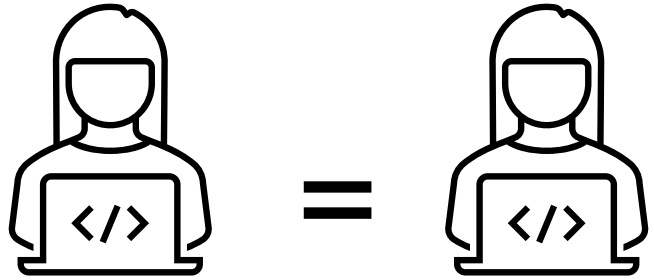
Step 1.1. Check the generated "df1" dataset for reproducibility. The first five rows of data should be:

```
  X_id         y           x1        z1
1    1 13.085108  0.005631125 0.6302638
2    1  6.031263 -0.638537285 0.6302638
3    1 18.820961  0.263297987 0.6302638
4    1 16.852893 -1.448011439 0.6302638
5    1 10.133860  0.230134755 0.6302638
```

Step 1.2. Check the second generated "df2" dataset. The first five rows of data should be:

```
  X_id         y         x1         z1
1    1  9.956949  1.2972483 0.09844718
2    1 12.188077  1.3861479 0.09844718
3    1  9.065660 -0.9633913 0.09844718
4    1 12.261863 -1.3337259 0.09844718
5    1  9.805620 -0.5786500 0.09844718
```

Reproducibility: Make Reproducers' Lives Easier

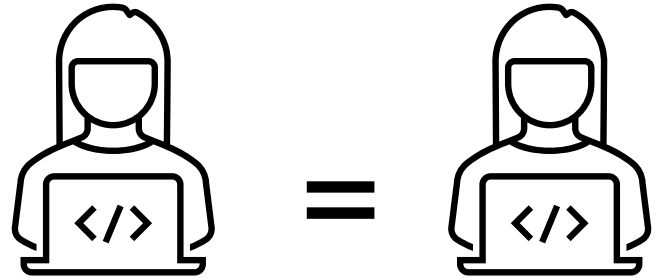


Reference your code in your paper

- Clearly labelled files
- Create numbered sections or use line numbers
  - "Simulated data were generated from a standard normal distribution (data_generation.R, 2.2)"

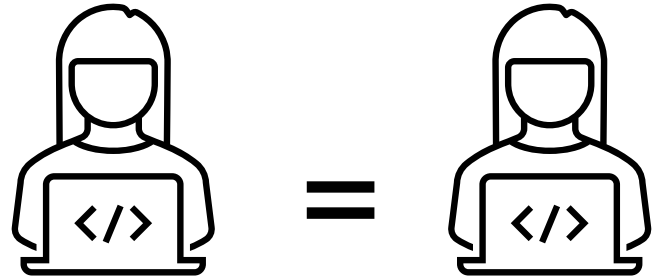
```
68 ### 1.2 Demographics
69
70 ```{r 1.2.1}
71 # descriptives by sample group
72
```

Reproducibility: Odds and Ends



- Set seed
- Store your code publicly
  - OSF, GitHub
  - If you're worried about releasing the code before running the study, you can make a read-only option
  - GitHub read-only mirror of repository: https://gitfront.io

Reproducibility: Odds and Ends



GITHUB

READ-ONLY MIRROR

multimlm Private

Unwatch 1

master · 1 Branch · 0 Tags · Go to file t · Add file · Code

mkshaw Add coding sheet for review of papers. 6e2ac50 · 2 weeks ago · 31 Commits

R	Updates PLCI with explicit instruction, updates data files f...	last month
renv	Adds renv for session and package info, closes #13.	3 months ago
review of papers	Add coding sheet for review of papers.	2 weeks ago
tests	Updates PLCI with explicit instruction, updates data files f...	last month
.Rprofile	Adds renv for session and package info, closes #13.	3 months ago
README.md	Updates PLCI with explicit instruction, updates data files f...	last month
final_results.csv	Updates estimator to Nelder-Mead. Close #1.	2 months ago
multimlm.Rproj	Starts reproducibility readme, #19, #20.	3 months ago
renv.lock	Centers generated datasets and updates renv with appro...	3 months ago

README

Multilevel Modelling Multiverse Simulation

multimlm

multimlm · Clone

- R
- renv
- review of papers
- tests
- .Rprofile
- README.md
- final_results.csv
- multimlm.Rproj
- renv.lock

README.md

Multilevel Modelling Multiverse Simulation

Closing Thoughts

- A lot of these things apply generally as good practices. Preregistration just makes it unavoidable
- Reviewers are with you along the way, which can help catch your oversights
- Preregistration frontloads the work – you do more reading and planning up front, and once results are in you have identified contingent paths
- Future you is the one following the map, so make it as detailed as possible