# Software Design, Development, and Distribution in R

## MinneAnalytics Women in Analytics and Data Science

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2020-10-30

https://github.com/knudson1/WiADS2020/blob/master/doc/WiADS_Slides.pdf

# Dr. Dietz's Disclaimer

The views expressed in this presentation are strictly my own. They do not necessarily represent the position of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

# About Us

- Friends since meeting in our Statistics PhD program in 2011
- Co-organizers of R Ladies-Twin Cities and the noRth conference
- Both cyclists & coffee lovers

# Objectives of this talk

```
library(MyFirstPackage)

# Design your R package
design_package()

# Build your R package
build_package()

# Distribute your R package
distribute_package()

#Profit!
```

# Our Assumptions

- You have some experience programming in R
- You have some experience on Git (i.e. we won't show you how to set it up)
- You have some custom R functions on your computer that get used repeatedly
- You have an audience (including yourself) for your code

# Best practices for R package design

# What is a design document?

- A blueprint or recipe for your project with plenty of details
- Doc written with the understanding that future-you will forget these details otherwise

# Why use a design document? (1 of 5)

# Why use a design document? (2 of 5)

- Separates thinking and coding

Imagine creating enchiladas without a recipe!

# Why use a design document? (3 of 5)

- Forces you to explain everything in detail
- Helps you predict problems and tricky points

# Why use a design document? (4 of 5)

- Helps you divide the work into reasonable modules so you can split it between days or people and make sure it it will come together seamlessly

No need to ladle and stir at the same time

# Why use a design document? (5 of 5)

- Helps future you/developers understand what you had done so that you can create improvements or additions
- Helps you remember everything you'll inevitably forget

# What to include in your design document

- Goal of each function
- Inputs and outputs of each
- Flow chart between functions
- Calculations/equations
- Any tricky points
- Numerical stability considerations
- How you will approach each function (and some pseudo code)
- Tests you will implement (again goals, details)
- Helpful sketches
- Major updates
- Things you want to add/change in the future

# Examples of Design Docs

- `glmm`
- `stableGR`

# Building An R Package

- You have the building blocks
  - Repeatable processes
  - Custom functions
  - Design document

How it started

How it's going

# Create the Package

- Building R packages used to take expert knowledge. Not anymore!
- Several R packages and RStudio built-ins exist to help you
- Option #1 - Use the RStudio interface: File -> New Project -> New Directory -> R Package
- Option #2 - Use the aptly named `usethis` package

```
#install.packages('usethis')
library(usethis)

usethis::create_package("~/MyFirstPackage")
```

# Add files for your functions

- Option #1 - Create .R files with your function and move them into the package's R folder
- Option #2 - `usethis` package

```
usethis::use_r('target_psrf')
usethis::use_r('minESS')
```

If R functions are new to you, check out **this resource**

# Create (or copy/paste) functions

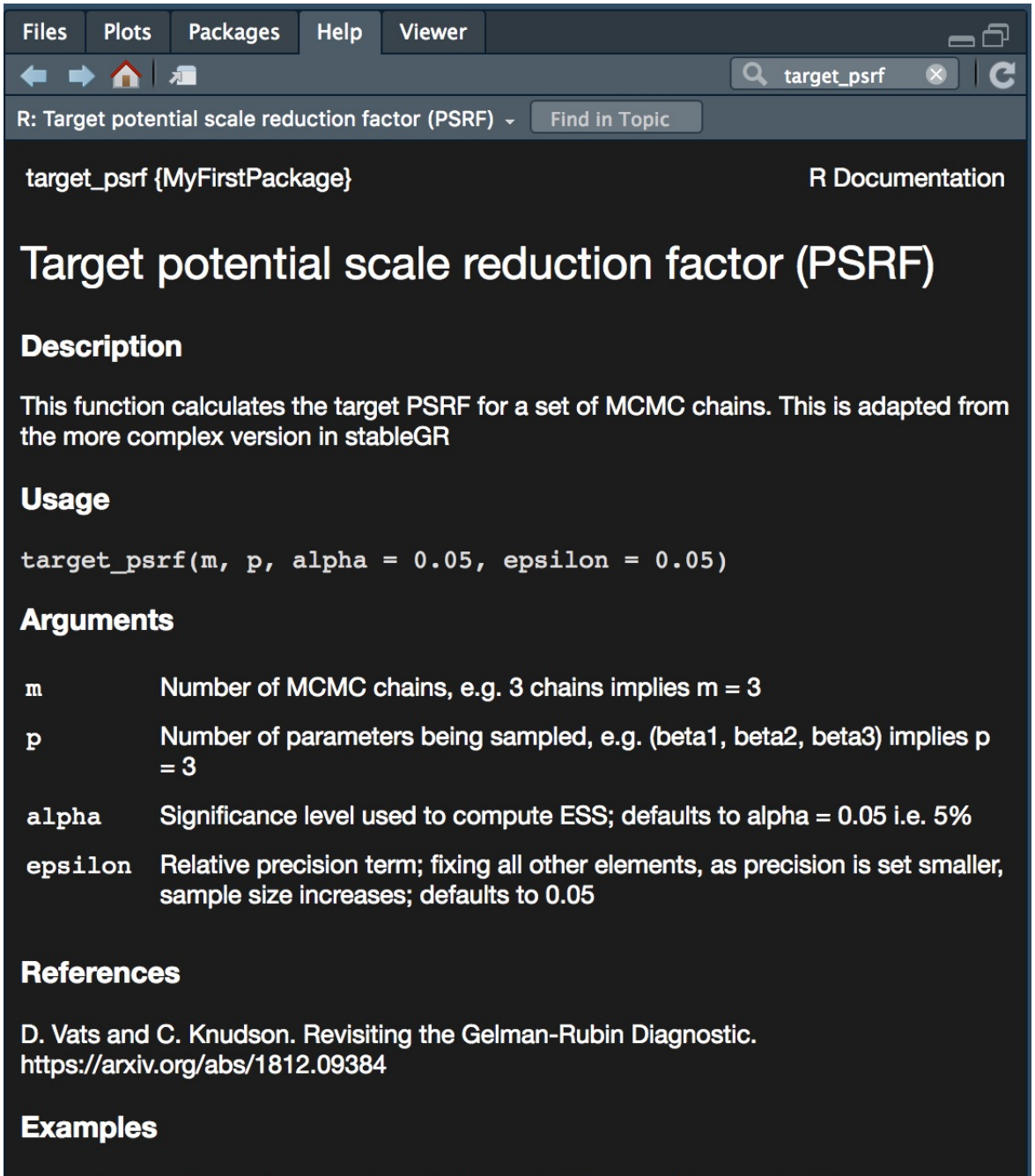
```r
target_psrf <- function(m, p, alpha = 0.05, epsilon = 0.05) {

  # Calculate the minimum effective sample size for the given input parameters
  Tee <- as.numeric(minESS(p = p, alpha = alpha, epsilon = epsilon))

  # Calculate PSRF
  psrf <- sqrt(1 + m / Tee)

  return(list(psrf = psrf, epsilon = epsilon))
}
```

# Add help documentation for functions

- In an R package, help documentation is mandatory; good documentation is optional (but not really!)
- While you can create documents manually (in the man folder), the `roxygen2` package makes it easy to create the documentation with your code

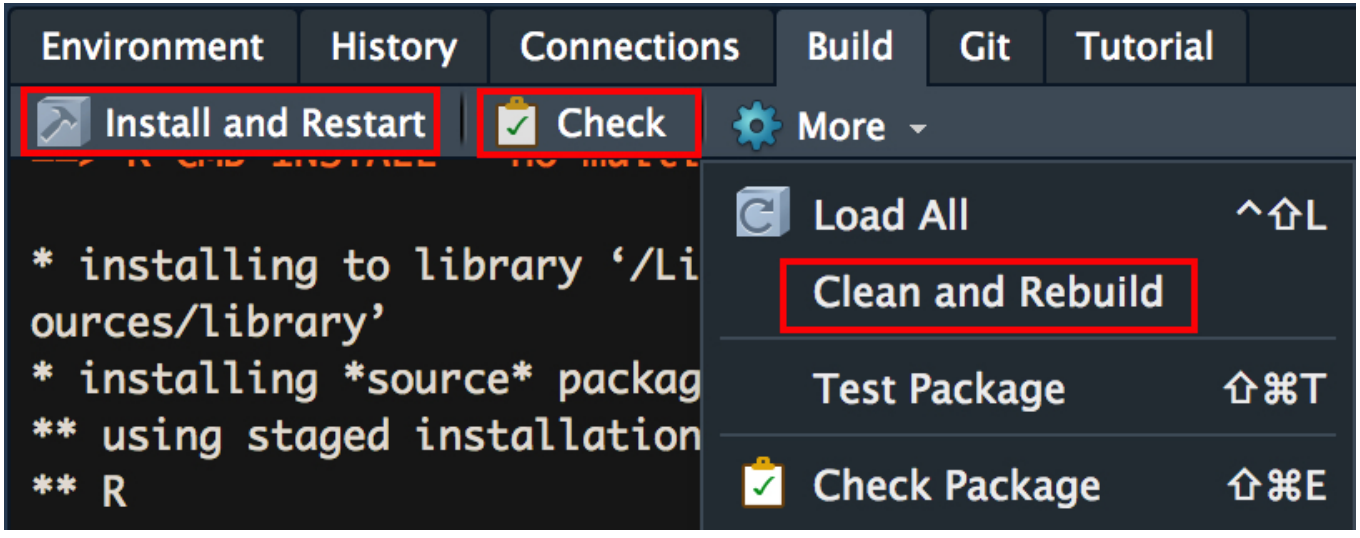
```r
#' @title Target potential scale reduction factor (PSRF)
#' @description This function calculates the target PSRF for a set of MCMC chains.
#' This is adapted from the more complex version in stableGR
#' @param m Number of MCMC chains, e.g. 3 chains implies m = 3
#' @param p Number of parameters being sampled, e.g. (beta1, beta2, beta3) implies p = 3
#' @param alpha Significance level used to compute ESS; defaults to alpha = 0.05 i.e. 5%
#' @param epsilon Relative precision term; fixing all other elements,
#'                as precision is set smaller, sample size increases; defaults to 0.05
#' @examples
#' target_psrf(m = 2, p = 2, alpha = 0.05, epsilon = 0.05)
#' target_psrf(m = 5, p = 2, alpha = 0.10, epsilon = 0.05)
#' @export target_psrf
#' @references D. Vats and C. Knudson. Revisiting the Gelman-Rubin Diagnostic.
#'             https://arxiv.org/abs/1812.09384

target_psrf <- function(m, p, alpha = 0.05, epsilon = 0.05) {

  # Calculate the minimum effective sample size for the given input parameters
  Tee <- as.numeric(minESS(p = p, alpha = alpha, epsilon = epsilon))

  # Calculate PSRF
```

# Help documentation generated by roxygen2



# Check, build, and install your package

Option #1 Use the tools in RStudio




Option #2 Use the `devtools` package (can be useful when things get more complicated)

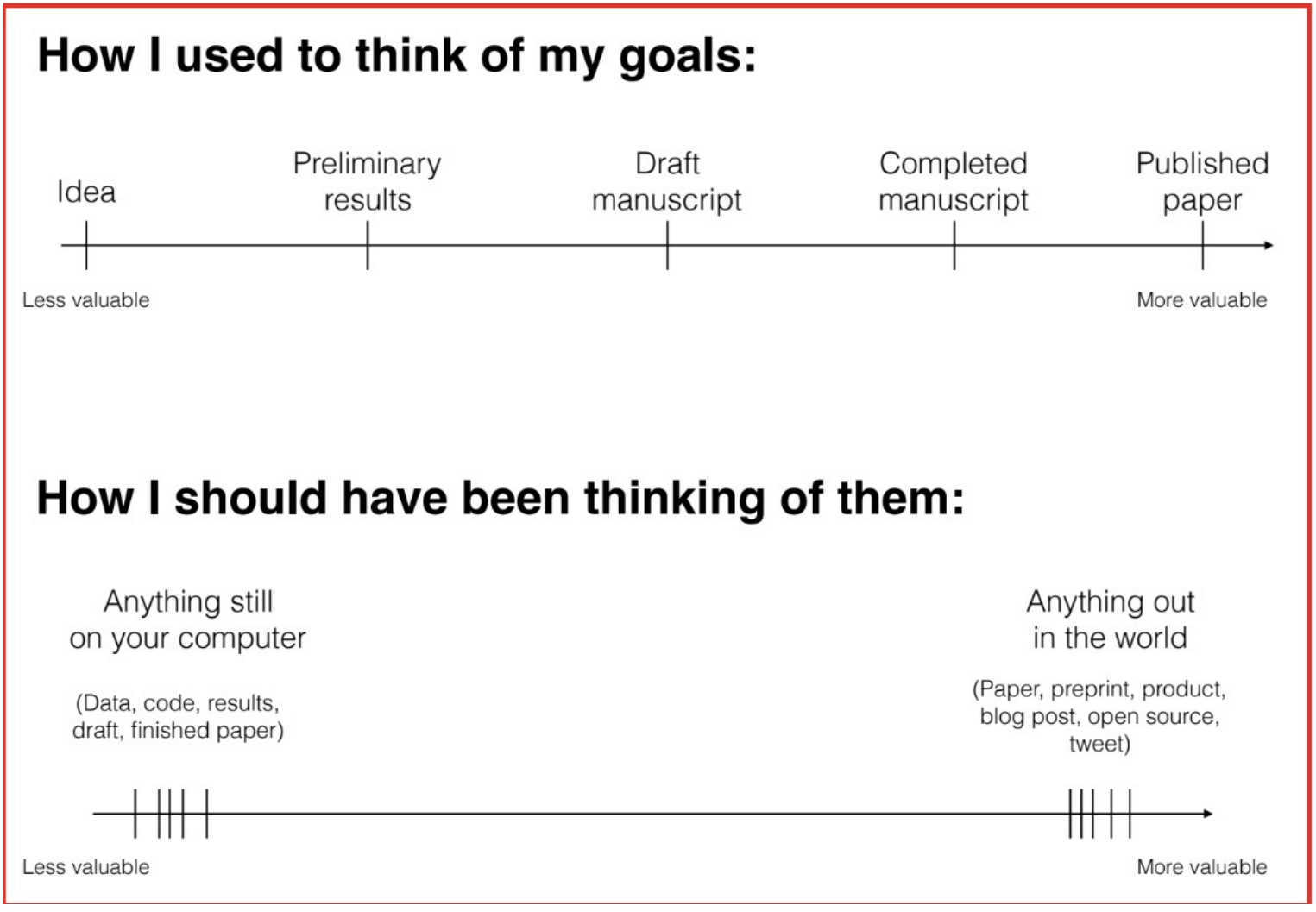
```
devtools::check()
devtools::build()
devtools::install()
```

# Customize

- Add tests, package dependencies, vignettes!
- Check out this **comprehensive R package building resource**

# Distribution of Your R Package

# Why Distribute Your R Package?




From David Robinson's **excellent talk at rstudio::conf(2019)**

# Why Distribute Your R Package?

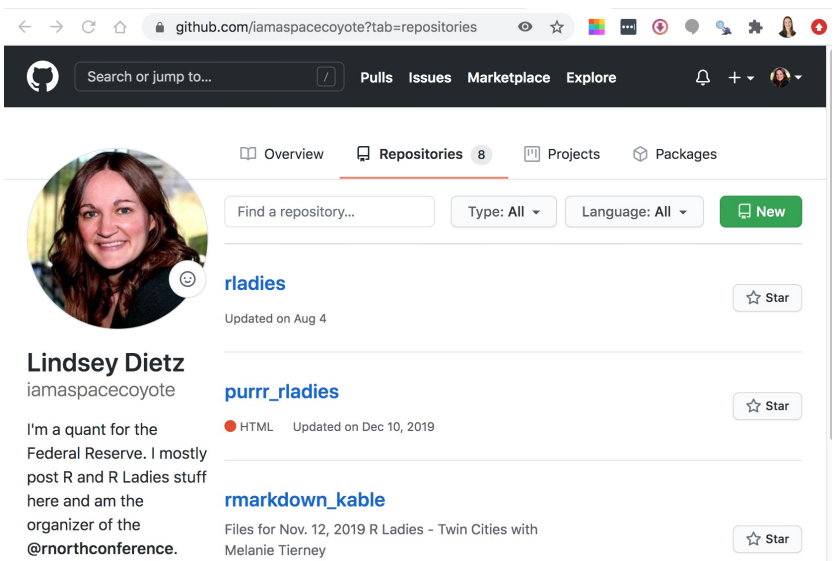
- Gains in usership/citations for those in the public domain (academics, nonprofits)
- Gains in productivity for those in private industries
- Saving "future you" time with third parties such as audit
- You control the narrative of your code

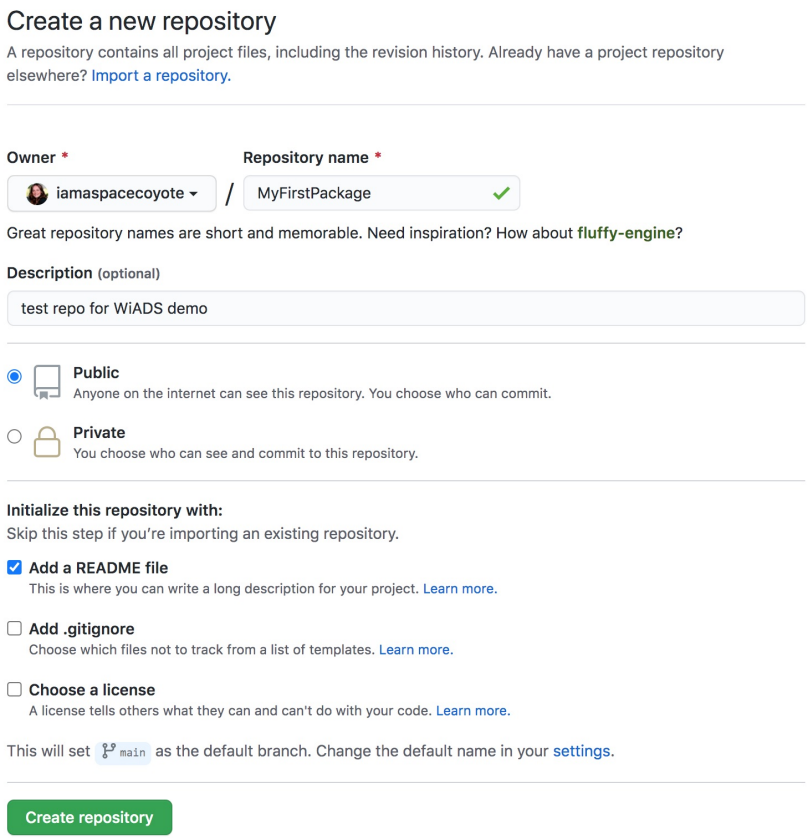
# Distibution in Git

- Git has become a dominant version control technique
- Git makes it easy to (1) track changes over time (2) plan future changes (3) work with teams
- Git is well integrated into RStudio

# (Some) Startup in Github

- An amazing and free resource for R users is **Jenny Brian's book**
- Create an account
- **Create an SSH key**
- Create a new repository



# Git going

- Clone
- Commit & Push

# Git Jargon

- **Git has A LOT of jargon**. Don't let it stop you!
- Some start-up words:
  - repository (repo) - a remote folder for your things on your Git site of choice (Github, GitLab, etc.)
  - clone - make a copy of your remote repository on your computer
  - pull - incorporate changes from a remote repository into your local clone
  - commit - record changes to your local clone
  - push - update remote repository with changes from your commits

# The Beginning

- We hope we've planted the seeds for you to build R packages to showcase your work going forward
- Thanks for being here and to the WiADS organizers for making a great conference happen