SISBID 2017 Module 3: Reproducible Research

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This module is part of the [Summer Institute in Statistics for Big Data](https://www.biostat.washington.edu/suminst/sisbid)!

Taught by

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# Course Goals

* [pdf](RRcourse_goals.pdf)
* [html](RRcourse_goals.html)
* [MS Word](RRcourse_goals.docx)
* [Rmd Source](RRcourse_goals.Rmd)

# Homework

* [pdf](homework.pdf)
* [html](homework.html)
* [MS Word](homework.docx)
* [Rmd Source](homework.Rmd)

# Cheat Sheets

Karl's [Software Carpentry Course](https://kbroman.wordpress.com/2015/04/29/cheat-sheets-for-r-based-software-carpentry-course/)

These are from RStudio's [list](https://www.rstudio.com/resources/cheatsheets/)

* [Rmarkdown](http://www.rstudio.com/wp-content/uploads/2016/03/rmarkdown-cheatsheet-2.0.pdf); there's also a [reference guide](http://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf)
* [Package Development/Devtools](http://www.rstudio.com/wp-content/uploads/2015/06/devtools-cheatsheet.pdf)

There are many other sheets there (including some for user contributions and translations), so check it out!

These are from GitHub

* [Git/GitHub](https://services.github.com/on-demand/downloads/github-git-cheat-sheet.pdf)
* [Git](https://education.github.com/git-cheat-sheet-education.pdf)
* [Links to Translations](https://services.github.com/resources/cheatsheets/)
* [More Resources](https://help.github.com/articles/git-and-github-learning-resources/)

# Course Syllabus and Lecture Materials

## Day 1, Jul 17, 2017

### Session 1, 8:30-10

**Lecture 0, Basic Intro, Keith, 5-10 min** [pdf](2017_SISBID_3_00_basic_intro.pdf), [printable pdf](2017_SISBID_3_00_basic_intro_printable.pdf) Introduction to the course, administration, course goals Definitions - reproduction vs replication

**Lecture 1, Intro and Common Problems, Karl, 40 min** [pdf](2017_SISBID_3_01_introduction_slides.pdf), [printable pdf](2017_SISBID_3_01_introduction_printable.pdf) An introduction to reproducible research by way of commonly encountered problems, plus discussion of the organization of project files

**Lecture 2, A Train Wreck, Keith, 40 min** [pdf](2017_SISBID_3_02_train_wreck.pdf), [printable pdf](2017_SISBID_3_02_train_wreck_printable.pdf) A case study describing just how bad things can get, with clinical implications

### Session 2, 10:30-12

**Lecture 3, R Markdown and Literate Programming, Karl, 45 min** [RMarkdown notes](2017_SISBID_3_03_Rmarkdown.md), [Rmd example](2017_SISBID_3_03_example.Rmd) An introduction to R markdown, RStudio, and Literate Programming, with examples illustrating how to produce reproducible reports

**Homework part 1, participants, 45 min** Set up the analysis folder, write the preprocessing script in R markdown, compile to html / pdf / word

### Session 3, 1:30-3

**Lecture 4, R Packages, Keith, 45-60 min (much live demo)** [pdf](2017_SISBID_3_04_r_packages.pdf), [printable pdf](2017_SISBID_3_04_r_packages_printable.pdf) How to write R packages quickly and easily with devtools, roxygen2, rmarkdown, and knitr - overhead, code, data, vignettes, clean code, and templates

**Homework part 2, participants, 30 min** writing a basic package

### Session 4, 3:30-5

**Lecture 5, EDA, Big Jobs, and Automation, Karl, 75 min (includes some short activities)** [pdf](2017_SISBID_3_05_bigjobs_slides.pdf), [printable pdf](2017_SISBID_3_05_bigjobs_printable.pdf), [activity 1 spin example](2017_SISBID_3_05_bigjobs_activity1_spin.R), [activity 2 caching example](2017_SISBID_3_05_bigjobs_activity2_cache.Rmd) Capturing exploratory data analysis, handling the challenges arising when data or jobs are big enough to make rerunning unpleasant or infeasible, and a brief introduction to automation with [GNU Make](https://www.gnu.org/software/make/)

**Lecture 6, Vitamin D, Keith, 10-15 min** [pdf](2017_SISBID_3_06_vitamin_d.pdf), [printable pdf](2017_SISBID_3_06_vitamin_d_printable.pdf) Discussion of how recommendations are set, and reconstruction of analyses obscured by lack of code and misapplied terminology. Linked to course homeworks.

[R package sisbid3, with a vignette on adding data to R packages](sisbid3_0.1.0.tar.gz) [just the vignette](loadingData.html) [report fitting logistic regression to Priemel et al](estimatesFromPriemel.pdf)

## Day 2, Jul 18, 2017

### Session 5, 8:30-10

**Lecture 7, Problems with Replication, Keith, 40 min** [pdf](2017_SISBID_3_07_problems_w_replication.pdf), [printable pdf](2017_SISBID_3_07_problems_w_replication_printable.pdf) A review of several factors which can make results harder to replicate (be seen again with new samples) vs hard to reproduce (starting from the same raw data)

**Lecture 8, Git on your Computer, Keith, 50 min, mostly live** [pdf](2017_SISBID_3_08_git_1_solo.pdf), [printable pdf](2017_SISBID_3_08_git_1_solo_printable.pdf) Using git to track files and versions; init, status, add, commit, branch, checkout, merge

### Session 6, 10:30-12

**Lecture 9, Git with GitHub, Keith, 45 min** [pdf](2017_SISBID_3_09_git_2_github.pdf), [printable pdf](2017_SISBID_3_09_git_2_github_printable.pdf) Introducing GitHub, perhaps the "killer app" for git; working with remote repositories, bare repos, cloning, pull, push

**Homework, participants, 45 min** Establishing a repo at GitHub Post your package to GitHub

This session will be a mixture of lecture and live demo.

### Session 7, 1:30-3

**Lecture 10, Collaborating with Git, Keith, 45 min** [pdf](2017_SISBID_3_10_git_3_collab.pdf), [printable pdf](2017_SISBID_3_10_git_3_collab_printable.pdf) Working with others, making comments, providing feedback, fixing errors

**Homework, participants, 45 min** Working with your neighbor's repos

### Session 8, 3:30-5

**Homework, participants, 45 min** Add comments and vignettes to your package on GitHub

**Lecture 11, Implementing RR at MDACC, Keith, 45 min** [pdf](2017_SISBID_3_11_mdacc_start.pdf), [printable pdf](2017_SISBID_3_11_mdacc_start_printable.pdf) A review of ongoing efforts within the biostat department at MD Anderson to produce reproducible reports, and how we took a report written a few years ago using a mix of R and Stata and revamped it in R/rmarkdown to emulate not just the results but also the "look and feel" of the initial MS word output. Hits on tables and figures in rmarkdown, references, reformatting headers.

## Day 3, Jul 19, 2017

### Session 9, 8:30-10

**Lecture 12, Writing Good Reports, Keith, 45 min** [pdf](2017_SISBID_3_12_good_reports.pdf), [printable pdf](2017_SISBID_3_12_good_reports_printable.pdf) The "non-codeable" parts of reproducibility - trying to increase the odds your collaborators will understand what it is you're trying to do.

**Homework, participants, 45 min** Automating common tasks with templates - report structures, directory structures, and look and feel

### Session 10, 10:30-12

**Lecture 13, Summary and Wrapup, Karl, 45 min** [pdf](2017_SISBID_3_13_summary_slides.pdf), [printable pdf](2017_SISBID_3_13_summary_printable.pdf) Maintaining the Mindset, summary of the course, sharing your work, some links to resources, and brief discussions of topics that we didn't cover

**Final Class Discussion**

**Evals, participants, 5 min**

# Recommended Reading/Browsing

## General

* [Christopher Gandrud, Reproducible Research with R and Rstudio, 2e (2015)](http://www.amazon.com/Reproducible-Research-Studio-Second-Chapman-ebook/dp/B010ACWGBI/ref=tmm_kin_title_0?_encoding=UTF8&sr=&qid=)
* [Hadley Wickham, R Packages (2015)](http://www.amazon.com/R-Packages-Hadley-Wickham-ebook/dp/B00VAYCHL0/ref=pd_sim_351_6?ie=UTF8&refRID=1E8HS30WBHRCW45SEWXM)
* [Yihui Xie, Dynamic Documents with R and knitr, 2e (2015)](http://www.amazon.com/Dynamic-Documents-knitr-Second-Chapman-ebook/dp/B00ZBYPJEW/ref=tmm_kin_title_0?_encoding=UTF8&sr=&qid=)

[Karl Broman's Tools for RR Course](http://kbroman.org/Tools4RR/)