Global Change Science
Analytics with R
Spring 2019

Instructor: Dr. Mathew Helmus

Class Meetings: Tuttleman 007, MWH 10:00-10:50

Course Prerequisites: Instructor permission.

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Office Hour: Mondays 13:00-14:00 or by appointment – SERC 538

Course Description:
Learn how researchers use data to tackle global problems such as climate change, mass extinction, pandemics, and poverty. Explore interdisciplinary data, from economics to public health, and learn a marketable skill: **R**, an intuitive statistical computer language. The course is project based, no prior coding experience is necessary, and no tests are given. Instead, student assessment is on project progress and communication of a global change problem of their choice. The most successful students leave class with the quantitative skills to go out and solve our most pressing problems.

Learning Objectives:
1. Understand what biological data science is and how it applies to global change.
2. Become fluent in data manipulation, modeling and communication in **R**.
3. Identify fundamental global problems and the methods to solve them.
4. Be able to interpret conclusions from big data studies.
5. Communicate findings to both a scientific and general audience.
6. Learn the tools for team collaboration (R Studio, R markdown, Slack, GitHub, Google Drive).

Course Approach: Classes meet in a computer lab. Class time is split between lecture and working through assignments and projects. Lectures center on global problems, data science, and **R**. Computer-based assignments focus on learning **R**. Students work in data science teams. There is a team-based midterm project and an individual final project. The mid-term is a uniform project for all groups. The final project is based on a topic of your choice. It includes a written proposal, peer-review of team member proposals, comprehensive coding, presenting the project orally to class and submitting the project as a digital **R** rendered document. You may analyze your own thesis data for your final project.

Primary Open-source Readings: Wickham, Hadley, and Garrett Grolemund. *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. 1 edition. O'Reilly Media, 2017. http://r4ds.had.co.nz/index.html. Only the open-source digital text is required, the hardcopy is not.

Grades: Grades are based on assignments and course projects.

Final Projects: Components of projects include: 1) a written proposal formatted as a brief scientific synopsis; 2) proposal peer-review; 3) tidy code; 4) database archive; 5) scientific presentation; 6) digital product.

No Final Exam: Final projects are presented during the final exam scheduled time.

Graduate Credit: Graduate students will lead research teams, submit team projects, and submit in-depth R assignments. Graduate student final projects should be focused on analyzing thesis data.

Code of Conduct (COC): Violations of the COC include, but not limited to: academic dishonesty, impropriety, plagiarism, cheating, and interfering with or disrupting the conduct of classes or any other normal activities of the University.

Using Technology in Class: Class work will be performed on lab computers. While in class, you may not use technology for personal activities. If found violating these rules you will be asked to leave the classroom and will receive a zero for that day's assignment.

Disability Disclosure: I am happy to make accommodations and I strive for an instructional design that is universal to all learning styles. Temple University is committed to the inclusion of students with disabilities and provides accessible instruction, including accessible technology and instructional materials. The process for requesting access and accommodations for this course is: (1) Advice the current instructor of the need for access or accommodations; (2) Contact Disability Resources and Services to request accommodations; (3) DRS will consult with instructors as needed about essential components of the program; (4) Present instructors with a DRS accommodation letter.

Schedule

Week	R Coding Topics	Global Problem	The Riff	Assignments
1	Intro to R, Team collaboration	The Anthropocene, Planetary Boundaries	Online tools, why R?	Intro to R, Chap 1 - 2 Collaborative tools tutorial
2	Visualization, R Markdown, Tidyverse basics	Overpopulation, Demographic transition	Types of error, Bitcoin visualization	R markdown tutorial, Chap. 27.1 – 27.4 Chap. 3 - 4
3	Data Transformation	Pollution, Mortality, Circular economies	Readable code	Project Brainstorm, Chap. 5 - 6
4	Scripting	Power, Inequality and health	Getting data,	Chap. 7-8
5	Exploratory data analysis	Stress and health, Great U.S. migration	Data wrangling, EDA mapping	Chap. 9 – 11 Mapping
6	Project management	Invasive species, Packing and splitting	Tidy data, Variation	Chap. 12-16
7	Mapping data	Habitat restoration, Extinction	Programmatic coding	Chap. 17-20
8	Joining, Relational data,	**Spring Break**	**Spring Break**	
9	Data types	Global trade impacts	for loops	Midterm Team Project, Chap. 21
10	Functions	Epidemics, Zoonotic disease	Metrics and statistics, Model output	Chap. 22-24
11	Iteration	Tipping points	Tidy model output	Chap. 25 - 26
12	Fitting models to data	Mutual causal interaction	Advanced markdown	Chap. 27 – 28
13	Basic statistical models	Food security	OpenData	Project Proposal Chap. 29 - 30
14	Version control R package development	The future of evolution	GitHub	Team GitHub Project
15	Work week			
16	Final Project Final Presentation			