

## Global Change Science

### *Analytics with R*

Spring 2023

39779 - BIOL 3323 – 001

39781 - BIOL 5323 – 001

**Instructor:** Dr. Mathew Helmus  
<https://www.iecolab.org/>

**Class Meetings:** MWF 11:00-11:50, Wed. Jan 18 to Mon. May 1, Final Exam Period is Fri. May 5 at 10:30-12:30  
Basement of Tuttleman Room 009

**Course Prerequisites:** Ecology 2227 or Instructor permission.

**Contact:** mrhelmus at temple or via Slack <https://globalchangescience.slack.com/>

**Office Hours:** MF 12:00-13:00 or by appointment

### **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).

**How This Course Will Be Taught:** We will meet synchronously for lecture class time (MWF 10:00-10:50pm) via Zoom. However, I understand that access to internet and devices across all students may not be synchronous. Therefore, I will record all Zoom lectures, make them available on Canvas, and post all class slides in our shared Google Drive.

**Course Approach:** Class time is split between lecture, working through assignments and projects, and in-class coding assessments. Lectures center on global problems, data science, and **R**. Computer-based assignments focus on learning **R** and in-class assessments focus on assessing student progress with learning the fundamentals of **R**. Students work in data-science teams. There is a midterm project and a final project. The mid-term is uniform for everyone. The final project is based on a topic of your choice. This final project 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 markdown** rendered document. You may analyze your own thesis data for your final project.

**Open-science Textbook:** Wickham, Hadley, and Garrett Golemund. *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-science (free) digital text is required, the hardcopy is not required and is not recommended to purchase for this class.

**Grades:** Grades are based on assignments, quizzes, the midterm project, and final project. Each of these will constitute approximately a quarter of your grade. No extra credit will be given to individual students.

**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 student projects will be presented in the final lecture.

**Graduate Credit:** Graduate students will lead assignment discussions and submit in-depth **R** assignments. Graduate student final projects should be focused on analyzing thesis data.

**Certificate in Sustainability:** This course counts toward Temple's [Certificate of Sustainability](#).

**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 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 or in-class assessment.

**Technology needs:** Because we will meet virtually and the textbook and assignments require the use of a computer that can run R, you will need: a device that allows you to watch videos, use Zoom, access the digital text, and run R and RStudio.

- Limited resources are available for students who do not have the technology they need for class. Students with educational technology needs, including no computer or camera or insufficient Wifi-access, should submit a request outlining their needs using the [Student Emergency Aid Fund](#). The University will endeavor to meet needs, such as with a long-term loan of a laptop or WIFI device, a refurbished computer, or subsidized internet access.
- All software required for the class is available for free download. Other specialty software such as Adobe and Microsoft Office products are also available free to Temple students and can be accessed through TUportal.
- [Temple Computer Labs](#) are open with computer that include R and RStudio installations.

**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) Advise 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. I am aware that COVID-19 may result in a need for new or additional accommodations.

**Student and Faculty Academic Rights and Responsibilities:** Freedom to teach and freedom to learn are inseparable facets of academic freedom. The University has a policy on Student and Faculty and Academic Rights and Responsibilities (Policy #03.70.02) which can be accessed [here](#).

**Do not share Class Recordings:** I will provide recordings of lectures delivered via Zoom (if any) for all students on Canvas. Class recordings should not be shared. Recordings will not include any breakout sessions. No student can record breakout sessions due to privacy concerns. Students are not permitted to copy, publish, or redistribute audio or video recordings of any portion of the class to any individual including students who are in this class, not in this class, and who are not students in the course without the express (emailed) permission of Dr. Helmus and of any students who are recorded. Distribution without permission is a violation of educational privacy law known as FERPA as well as certain copyright laws. Any recordings made by the instructor or university of this course are the property of Temple University and cannot be posted on any social media or other public outlet. Slides and other documents for this course are also not to be shared or distributed unless the express (emailed) permission of Dr. Helmus.

**Attendance Policy:** The primary reason for documenting attendance is to facilitate contact tracing if a student or instructor tests positive for COVID-19 and allow the university to provide resources for affected students and faculty. You will sign into *Qwickly* at the start of each class to indicate you are "present". *Qwickly* is integrated into *Canvas*.

**COVID-19:** Temple University's motto is Perseverance Conquers. We will meet the challenges of the COVID pandemic with flexibility and resilience. The university has plans for multiple eventualities. Working together as a community to deliver a meaningful learning experience is a responsibility that we all share. The following academic support services are available to support you:

- [Student Success Center](#)
- [University Libraries](#)
- [Undergraduate Research Support](#)
- [Career Center](#)
- [Tuttleman Counseling Services](#)
- [Disability Resources and Services](#)

If you are experiencing food insecurity or financial struggles, Temple provides resources and support. Notably, the Temple University [Cherry Pantry](#) and the Temple University [Emergency Student Aid Program](#) are in operation as well as a variety of resources from the Office of Student Affairs.

**Financial Services:** [Student Financial Services](#) provides many resources to Temple students to help with costs associated with going to college. Make sure to fill out a [FAFSA](#) every year starting on October 1. Priority deadline for Temple grant funding is February 1. Here is a [podcast](#) on the importance of talking to Financial Services and filling out a FAFSA each year.

## Schedule

Week	R Coding Topics	Global Problem	The Riff	Assignments
1	Intro to R, Team collaboration	Code History Algorithms and Race The Anthropocene	Online tools R intro	Intro to R, Chap 1 - 3
2	Visualization, R Markdown, Tidyverse basics	Planetary Boundaries Overpopulation Demographic Transition	Types of Error Visualization	Chap. 3 – 4
3	Data Transformation	Pollution and Mortality	Readable Code	Project Brainstorm, Chap. 5 - 6
4	Scripting	Power Inequality Health Outcomes	Getting Data	Chap. 7-8
5	Exploratory data analysis	Stress Hormones Great U.S. Migration Deforestation	EDA Mapping	Chap. 9 – 11 Mapping
6	Project management	Invasive Species Land-Use Change Packing and Splitting	Tidy Data, Variation	Chap. 12-16
7	Mapping data	NEON	Wrangle Data	Chap. 17-20
8	Spring Break	Spring Break	Spring Break	Spring Break
9	Joining, Relational data	Mid-term	Mid-term	Midterm Team Project
10	Functions	Pandemics Zoonotic Disease	Metrics Model output	Chap. 14-16 Chap. 17-19
11	Iteration	Tipping Points	Tidy Model Output	Chap. 20 – 21
12	Fitting models to data	Mutual causal interaction	Advanced Markdown	Chap. 27 – 28
13	Basic statistical models	Food Security Circular Economics Sustainability	OpenData	Project Proposal Chap. 29 – 30
14	Version control R package development	Climate Change	Coding Experience for Resumes	GitHub
15	Work week			
16	Final Project Final Presentation			