

ESM 206: Introduction to Statistics and Data Analysis in Environmental Science and Management (Fall 2022)
Bren School of Environmental Science & Management

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Overview: In ESM 206, you will build conceptual, technical, and communication skills to investigate and answer environmental questions using data. Topics include data manipulation, exploratory data analysis, descriptive statistics, regression, hypothesis testing, uncertainty, and data visualization. Skills for data exploration, analysis, and project management will be developed through analysis of real-world datasets using R and RStudio while building tools for and understanding of computational reproducibility and collaboration.

COURSE COMPONENTS:

All course materials will be posted to GauchoSpace. Enrolled students should refer to GauchoSpace as the primary course resource. Lectures will be in person and not recorded.

Weekly learning is through:

- Lectures: 2 weekly 75-minute lectures (M W 8 am in Bren 1414)
- Computer labs: 1 weekly 2-hour lab (M T 12:30pm - 2:20pm in Bren 1414)
- Assignments and readings: ~5 total assignments
- All lecture slides, lab materials, and keys will be posted on GauchoSpace the day before instruction

How to succeed in this course:

1. Attend lectures
2. Keep current in coding and assignments
3. Work collaboratively and actively with your classmates

4. Reach out to me or the TAs if you have any concerns
5. Use the slack channel to communicate with your peers on this course material:
https://join.slack.com/t/esm206fall2022/shared_invite/zt-1ggsz16et-9Us_0PaUNuKvmxmuASvQEA

Before the first class, you must download and install R, RStudio, and the tidyverse package. These programs are free.

Step-by-step instructions [Here](#) (also found on GauchoSpace)

R: <https://cran.r-project.org>

RStudio: <https://www.rstudio.com/products/rstudio/>

Calendar of activities: This is a tentative schedule of topics and activities. We will adjust as the quarter progresses. Lecture slides and discussion notes will be posted on GauchoSpace at least the day before.

Date	Topic(s)
9/26/2022	Introduction, Expectations, and Motivation; What is data science?
9/28/2022	Computational reproducibility & reproducible workflows; introduction to R, tidy data structure
Discussion	Meet R/RStudio; project management in R projects; creating organized, well-annotated and reproducible scripts; reading in CSVs; basic data management with {dplyr}; {ggplot2} intro
10/3/2022	Exploring data; “Good enough practices” in data science;
10/5/2022	Engaging and responsible data visualization
Discussion	R Markdown intro; initial cleaning for messy(ish) data; data management with {dplyr} and {tidyr} continued; exploratory data analysis; dataviz with {ggplot2} continued (ASSIGNMENT)
10/10/2022	Version control with Git & GitHub, metadata
10/12/2022	Population, sampling, bias, basic summary statistics (central tendency & data spread)
Discussion	Basics of working between GitHub and RStudio; wrangling and data viz continued; {lubridate} for dealing with dates and times (ASSIGNMENT)
10/17/2022	Exploring differences between populations (effect size, actual differences, difference in context, intro to null hypothesis statistical testing)
10/19/2022	Continued (QUIZ)
Discussion	Frequency tables with {count}, {tally} and {n}; summary statistics; exploring normality; t-tests; project management with GitHub and R projects (ASSIGNMENT)
10/24/2022	Hypothesis testing pros & cons, t-tests, ANOVA, pitfalls of null hypothesis statistical testing
10/26/2022	Errors, risk & bias, communicating outcomes of hypothesis tests (and why the p-value should be the least interesting thing you present)
Discussion	GitHub continued; t-tests; ANOVA; responsibly visualizing differences between groups; reading in data from different sources/file types (URLs, .xlsx, etc.)
10/31/2022	Ordinary least squares, correlation, thinking critically about relationships
11/2/2022	Continued

Discussion	Linear regression (ASSIGNMENT)
11/7/2022	Types of bias; chi-square;
11/9/2022	Multiple linear regression
Discussion	Chi-square; advanced data management and cleaning; dataviz customization; exporting graphs and tables; GitHub collaboration intro; multiple linear regression intro & assumptions
11/14/2022	Multiple linear regression continued; interpreting coefficients; interaction terms
11/16/2022	Communicating regression outcomes (QUIZ)
Discussion	Tidy model outputs; diagnostics; assessing fit; reporting results; {broom} and {stargazer};
11/21/2022	Logistic regression
11/23/2022	Rank-based tests
Discussion	Binary logistic regression, ordinal logistic regression intro; Mann-Whitney U; Wilcoxon Signed-Rank (ASSIGNMENT)
11/28/2022	Intro to spatial data viz in R; thinking beyond R;
11/30/2022	Course review & "Oh, the places you'll go!"
Discussion	Spatial data viz and exploration with {sf}, {tmap}
Final Exam	Take home final explained (on par with assignments, but more comprehensive)

GRADE BREAKDOWN:

Assignments (50%) are created to help you practice conceptual, computational, and critical thinking skills needed for environmental data science. You will submit your assignments via GauchoSpace. Expect five assignments during the quarter. Submit by midnight of the due date.

Quizzes (20%) two in-class quizzes will be conducted in discussion sessions. They will be announced the week before.

The final exam (30%) will be an individual take-home exam (this is an assignment that aggregates everything you've learned during the quarter). Submit by midnight of the due date.

Policies (Taken and slightly modified from UCSB suggested policies):

Schedule changes: The schedule is subject to change depending on the progress of the course.

Due dates: Late assignments will not be accepted. However, if a verifiable emergency arises, I will work with you. Yet, we will not grant extensions after the due date has come and gone. ALL TAKE-HOME ASSIGNMENTS AND THE FINAL EXAM/ASSIGNMENT ARE DUE BY MIDNIGHT OF THE DUE DATE.

Exam makeup policy: Any foreseeable reason for missing the exam must be reported to the instructor as soon as possible. In the case that you must miss the exam (or critical

due date) for a legitimate and documented reason, I must be notified *at least a week in advance* and a make-up exam will be provided or accommodation for other evaluated deliverables.

Class participation: In this course, we will work and learn *together*. That means that you need to be here, in class, for the learning to happen. I understand that you may encounter situations where you can't attend class. Work with your classmates or me to get copies of notes and the information presented. Some lectures may be recorded.

Plagiarism and academic integrity: All students are expected to understand and comply with university policies regarding plagiarism and the originality of work. **Plagiarism** occurs when a writer deliberately passes off another's words or ideas without acknowledging their source. For example, turning another's work as your own is plagiarism. Plagiarized assignments will receive a grade of 0 and may result in additional disciplinary action. You can view the university's policy on student conduct at http://www.sa.ucsb.edu/Regulations/student_conduct.aspx.

Plagiarism is different from **misuse of sources**, occasions when a writer does not properly cite a source, misuses quotations, includes too much of an original source in a paraphrase or summary, or commits similar *unintentional* violations of academic protocol. If you misuse sources, we will work together on appropriately incorporating and/or citing the sources. Note that some audiences/instructors will consider misuse of sources to be plagiarism; for this reason, it is *extremely* important for you to identify the conventions associated with source use and citations in any class.

Grade appeals If you have a dispute with a grade you have received, you have the right to request a review by the instructor. Please keep in mind that an appeal will invoke a review of the full assignment and could result in a lower grade.

Intellectual property and course materials: All course materials (class lectures and discussions, handouts, examinations, web materials) and the intellectual content of the course itself are protected by United States Federal Copyright Law and the California Civil Code. UC Policy 102.23 expressly prohibits students (and all other persons) from recording lectures or discussions and from distributing or selling course materials without the prior written permission of the instructor (See <http://policy.ucop.edu/doc/2710530/PACAOS-100>). Students are permitted to make notes solely for their own private educational use. Exceptions to accommodate students with disabilities may be granted with appropriate documentation.

Students with disabilities: If you are a student with a documented disability (registered with the DSP program: 893-2668, www.sa.ucsb.edu/dsp) and would like to arrange accommodations, please contact me after class and I will be happy to discuss alternative arrangements.

General academic support: Campus Learning Assistance Services (CLAS) offers instructional groups, drop-in tutoring, writing and ESL services, skills workshops and one-on-one consultations. CLAS is located on the third floor of the Student Resource Building.

Mandatory Reporting As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I want to ensure that students feel they can speak to me, but I also want students to be informed that I have a mandatory reporting responsibility related to my role as a professor. I am **required** to share information regarding sexual misconduct or information about a crime that may have occurred on UCSB's campus or in the community. A result of my mandated report will be that students will receive outreach and resources from the campus Title IX office. Students may speak to someone confidentially by contacting CARE, Campus Advocacy, Resources & Education at the 24/7 advocacy line at (805) 893-4613 or visit them in person at the Student Resource Building.