

EDS 212: Essential Math in Environmental Data Science

Quarter: Summer 2023

Units: 2

Grading: Pass / No Pass

Prerequisites: None

Instructors, meeting times, & requirements

Instructor: Allison Horst

Email: ahorst@ucsb.edu

Course assistant: Mae Rennick

Class meets: 10am - 5pm PST, M-F (August 7th - 11th), NCEAS MEDS classroom

Course website: https://allisonhorst.github.io/EDS_212_essential-math/

Required textbook(s) / reader(s): None

Additional course requirements: Students are expected to bring their own laptop / device that meets MEDS requirements. If you are having trouble with installations or need support, please reach out before the class starts so that we can help you. All students should bring their laptop and charger to class every day, as interactive sessions will include problems done by-hand and in R and RStudio. Students should also bring a notebook and pens/pencils to each session.

Conduct, inclusion and accommodations

Course conduct: We are committed to actively creating, modeling, and maintaining an inclusive climate and supportive learning environment for all course participants (including instructors, guests, and students). We expect everyone to treat every member of our learning community with respect. Harassment of any kind will not be tolerated. Everyone is expected to read and adhere to the Bren School Code of Conduct, and the UCSB Code of Conduct.

Access & accommodations: It is never too late to apply for DSP accommodations. If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive you may be eligible to use formal accessibility services on campus. To arrange class-related accommodations, [please contact DSP](#). DSP will initiate communication about accommodations with faculty. By making a plan through DSP, appropriate accommodations can be implemented without disclosing your specific condition or diagnosis to course instructors.

Name and pronouns: Everyone has the right to be addressed and referred to by name and pronouns in accordance with their identity. By default, the UCSB Registrar roster only includes students' legal names, but your profile can be updated with pronouns - which I encourage you to do.

Course information

Course description: Quantitative skills and understanding are critical when working with, understanding, analyzing and gleaning insights from environmental data. In the intensive EDS 212 course, students will refresh fundamental skills in basic math (algebra, uni- and multivariate functions, units and unit conversions), derivative and integral calculus, differential equations, linear algebra, basic probability and summary statistics, and reading, writing and evaluating logical operations.

Learning objectives: The goal of EDS 212 (Essential Math in Environmental Data Science) is to prepare incoming MEDS students with quantitative methods, skills, notation and language commonly used in environmental data science and required for their data science courses and projects in the program. By the end of the course, students should be able to:

- **Perform the following by hand and in R:** convert units, basic algebra and working with logs and exponentials; write, interpret and evaluate univariate and multivariate functions; basic derivatives and integrals with univariate and multivariate functions; solve simple differential equations; basic operations with scalars, vectors and matrices; writing and evaluating logicals
- **Find and visualize** basic summary statistics, uncertainty, and distributions, and understand the limitations of aggregated information about data with R in RStudio
- **Explain and share examples** for how all topics in EDS 212 are useful and used in applied environmental data science
- **Interpret** examples of applied math & models from environmental science case studies
- **Work with peers** to solve group tasks, then **communicate** the process of problem solving to the rest of the class

Course details

Course components:

- **Lectures:** Lectures will focus on reviewing (or learning) math skills and concepts relevant for environmental data science, and exploring their applications through case studies and examples from the environmental workplace
- **Interactive sessions:** Interactive sessions will combine guided problem-solving and coding, practice tasks (individually and in small groups), group challenge problems and presentations, and discussion about applications of math in environmental data science.
- **Flex time:** Flex time will vary widely, but may include: Guest visits from working environmental data scientists, professional development activities, community building, and communication skill-building exercises.

Getting extra help: During this intensive 1-week course, it is really important that you reach out for help *right away* if you feel you missed something or have started to fall behind. We have a wonderful Course Assistant, Mae Rennick, who is available specifically to help you get caught up. I also encourage asking questions during all sessions (lectures, interactive sessions, flex time) so that we can all learn together in EDS 212.

Assignments: Given the course intensity, all aspects of EDS 212 coursework should be completed within the scheduled course times (10:00am to ~ 5:00pm M-F). Students will complete problem sets, tasks, and group work during three interactive sessions scheduled daily to practice essential math skills, work with peers to solve a problem, and communicate findings or solutions to the group. **Students will not be assigned additional take-home work.** Students will be assessed based on activities and tasks assigned during interactive sessions, sometimes by peer- and self-review.

Grading: EDS 212 final grades will be **Pass/No Pass**. Grades will be based on three components:

1. Participation (50%): Students are expected to attend and actively participate in all course components (lectures, interactive sessions, and flex time activities).
2. Interactive session tasks & problems (20%): Students are expected to complete all assigned activities and problem sets. Grading for this component will be based on self- and peer-review.
3. Daily tasks & group challenges (30%): Students will work individually and in small groups to complete daily activities

Tentative topics:

Day #	Lecture #	Interactive session
1	<p>1: Course introduction & motivation. Basic math refresher: algebra, units, conversions, prefixes, univariate functions.</p> <p>2: Exponents & logs, plotting simple functions, multivariate functions</p>	<p>Analog:</p> <ul style="list-style-type: none"> ● Algebra review problems ● Units and unit conversions ● Logs & exponents ● Evaluating functions <p>Computational:</p> <ul style="list-style-type: none"> ● Meet R & RStudio ● R as a calculator ● Making graphs in ggplot2 ● Simple functions in R

2	<p>3: Definition of the derivative, basic derivative rules, and interpretation</p> <p>4: Higher order derivatives, partials: notation, interpretation</p>	<p>Analog:</p> <ul style="list-style-type: none"> • Find, evaluate, interpret derivatives • Applied derivatives <p>Computational:</p> <ul style="list-style-type: none"> • Our first R script • Basic derivatives and eval in R • ggplot2 continued
3	<p>5: Differential equations: notation and interpretation in environmental data science</p> <p>6: Introduction to linear algebra</p>	<p>Analog:</p> <ul style="list-style-type: none"> • Reading and thinking about simple differential equations • Interpreting simple differential equations <p>Computational:</p> <ul style="list-style-type: none"> • deSolve • Vectors, matrices, scalars
4	<p>7: Linear algebra essentials: working with scalars, vectors and matrices, transformation</p> <p>8: Summary statistics</p>	<p>Analog:</p> <ul style="list-style-type: none"> • Basic linear algebra with scalars, vectors and matrices • Drawing vector addition and scalar multiplication <p>Computational:</p> <ul style="list-style-type: none"> • R Markdown intro • Definite integrals in R • Reproducible reporting • Summary statistics
5	<p>9: Basic probability theory</p> <p>10: Boolean logic & algebra</p>	<p>Analog:</p> <ul style="list-style-type: none"> • Boolean algebra and logic <p>Computational:</p> <ul style="list-style-type: none"> • Boolean operators, logic, expressions

Additional student resources

Graduate school is exciting, challenging, and rewarding - and can also be very stressful. Your health and wellness is my top priority. I encourage you to reach out if you need support (or if you aren't sure if you need support). Below are some of the many UCSB resources available to you while you're here at the Bren School with us.

The text below is provided by the UCSB Disabled Students Program.

Counseling and Psychological Services (CAPS). As a student you may experience a

range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily activities. CAPS is available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus. They can be reached by phone at 805.893.4411, or online at <http://caps.sa.ucsb.edu>. The CAPS building is the pink building next to the Humanities and Social Science building (HSSB)

Food insecurity: <http://food.ucsb.edu/> includes the Cal Fresh Program <http://food.ucsb.edu/calfresh> and the Associated Students food bank <https://foodbank.as.ucsb.edu>

Resource Center for Sexual and Gender Diversity (RCSGD) in the SRB, offers a host of services for LGBTQI+ students including a library and many events throughout the year. <http://rcsgd.sa.ucsb.edu/>

Dream Scholars/Undocumented Student Services Program offers workshops, helps students find scholarships and financial support as well as providing community for our undocumented students. <http://www.sa.ucsb.edu/dreamscholars/home>

Campus Learning Assistance Services (CLAS) helps students grow academically by offering workshops, walk-in and pre-scheduled tutoring, and writing help both for native and non-native (ESL) English as a second language speakers. Over 50% of students will stop by CLAS at one time or another. <http://clas.sa.ucsb.edu>

Student Resource Building (SRB) houses many campus resources offices, including the African Diasporic Cultural resource Center, the American Indian Resource Center, the Asian Resource Center, the Middle Eastern Resource Center, the Non-Traditional and Re-Entry Student Resource Center.

<http://www.sa.ucsb.edu/student-resource-building/home>

Multicultural Center (MCC), located in UCEN, hosts a wide variety of cultural events and educational programming throughout the year, including film showings, lectures, musical performances, and more: <http://mcc.sa.ucsb.edu/>

Campus Advocacy, Resources, & Education (CARE) offers 24/7 confidential support and advocacy in situations of sexual assault, dating and domestic violence, and

stalking. Located in the SRB, they can be reached at 805.893.4613 or <http://wgse.sa.ucsb.edu/care/home>

Financial Crisis Response Team: If you are experiencing issues of housing insecurity contact the Financial Crisis Response Team at financialcrisis@sa.ucsb.edu to begin application for assistance.

Health and Wellness: Student well-being is integral to academic success, student development, and life satisfaction. On this website, students will find links to a range of services related to well-being such as: assistance with basic needs (food, housing, finances); counseling and physical health resources, daily wellness centers and programs; social connection, and personal safety. <https://wellbeing.ucsb.edu/>