DATA 399: Environmental Data Science

Spring Semester 2026

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Course Overview

Description

This course applies data science methods and ecological knowledge to develop solutions to environmental problems. Students will become broadly familiar with methods used by ecologists and environmental scientists, including univariate and multivariate statistics, dynamical modeling, machine learning, spatial statistics, and time series analysis. Case studies include climate change, species conservation, biodiversity monitoring, natural resource management, and ecological restoration. Following team science practices, students will manage projects on GitHub, analyze big environmental data in RStudio, and write white papers to propose science-based policy recommendations.

Learning Outcomes

Upon completion of this course, students will be able to:

- Design and conduct a research project involving the analysis of big environmental data
- Apply standard workflows in data cleaning, wrangling, analysis, and visualization
- Read and write code using `tidyverse` and several R packages specific to environmental science, including `heatwaveR`, `popbio`, `treeClim`, `dplR`, and `vegan`
- Implement best practices in scientific programming to promote reproducible research
- Manage complex research projects using a version control system (GitHub)
- Synthesize research findings in a broader environmental or scientific context
- Communicate scientific findings via written reports and oral presentations
- Advocate for science-based policy positions

Prerequisites

DATA 151 or BIOL 245W or ENVS 151 with R programming experience

Course Materials

You will need to use a computer for nearly all assessments in this course. No textbooks need to be purchased. However, we will be reading numerous journal articles, which will be provided. I will make all lecture and coding materials available on GitHub (linked through Canvas) at the beginning of each week. Students are responsible for downloading materials before class.

Class Times & Structure

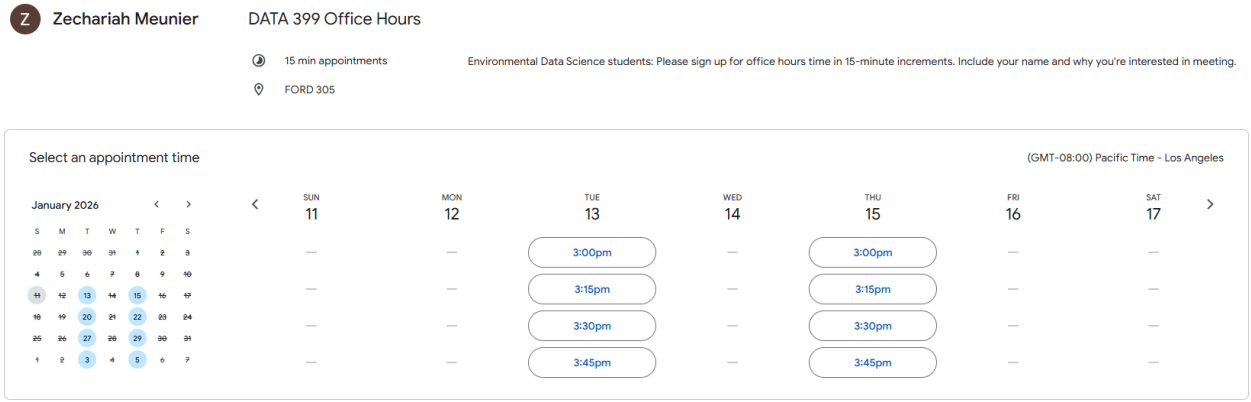
We will meet from **1:10 – 2:40 pm on Tuesdays and Thursdays in Ford 302**. We will employ multiple pedagogical approaches to engage with the material. Classes will be composed of interactive lectures, discussions, activities, and programming labs. Please come to class ready to actively engage. I wish to promote a vibrant classroom community so that we may all learn from and teach each other.

Credit Hours

As a 4-credit course in the undergraduate college, the expectation is a combined 150 clock hours of instruction and student work. I will provide 50 clock hours of in-class instruction and supervised project meetings, which leaves 100 clock hours of out-of-class student work, **or an average of 6.7 hours per week outside of class spent on lab summaries, course readings, and project tasks.**

Office Hours

Office hours will be held in-person in my office or virtually via Google Meet upon request to increase equitable access. My office hour booking page includes 15-minute time slots between 3 and 4 pm on Tuesdays and Thursdays (immediately after class). You can reserve more than 15 minutes by signing up for multiple sessions, but remember that there may be high demand. If you cannot make an appointment, cancel it so that other students can sign up. If none of these times work for you, send me an email to schedule either a virtual or in-person appointment. I am happy to find a time that works for both of us.



In addition to individual office hours, project check-in meetings are required to be scheduled via my calendar during weeks 7 or 8 with all group members attending. These meetings should be scheduled for 30 minutes to allow for adequate discussion of project scope and analyses.

Research Project

The objective of the collaborative, term-long research project is to engage students in a detailed exploration of environmental data, emphasizing data acquisition, analysis, and the formulation of actionable recommendations for stakeholders. Groups of 3–4 students will identify publicly available datasets related to chosen environmental topics, conduct mathematical and statistical analyses, and present their findings in an oral presentation during **Willamette's Student Scholarship Recognition Day (SSRD)** on April 15. Group members will collaborate to write a white paper as a persuasive, authoritative, in-depth report that presents a problem and provides a solution. Students will also write thorough peer reviews and revise their work based on reviews.

Course Calendar (subject to change)

Graded assignments are in bold, ungraded assignments are unbolded. Lab summary (LS) and project task (PT) assignments are due Wednesdays at 11:59 PM, except where noted. Green shading indicates when we will have paper discussions, so read the papers in advance.

Tuesday	Thursday	Assignments (Due Date)
1A: Jan. 13 Syllabus & expectations, global change biology	1B: Jan. 15 Data sourcing & validation	PT1: GitHub onboarding (1/21)
2A: Jan. 20 Reading, writing, & the literature	2B: Jan. 22 Amaya et al. 2023, Smith et al. 2024, Farchadi et al. 2025	PT2: Partner survey (1/28)
3A: Jan. 27 Marine heatwaves lecture & lab	3B: Jan 29 Group formation & project management	**PT3: GitHub README (2/4), LS1: Marine heatwaves (2/11)**
4A: Feb. 3 Coding & visualization best practices	4B: Feb. 5 Dynamic equation modeling	**PT4: Project proposal presentations (Thur. 2/19)**
5A: Feb. 10 Thogmartin et al. 2017, Crone et al. 2019, Agrawal 2019	5B: Feb. 12 Monarch populations lecture & lab	**LS2: Monarch populations (2/25)**
6A: Feb. 17 Modeling environmental systems	6B: Feb. 19 Project proposal presentations	PT5: Project check-in meetings & SSRD abstract (Thur. 3/5)
7A: Feb. 24 Spatial statistics	7B: Feb. 26 Time series analysis	PT6: Annotated bibliography (3/11)
8A: Mar. 3 DeSoto et al. 2020, Hammond et al. 2022, Andrus et al. 2024	8B: Mar. 5 Andrus guest lecture, Dendroclimatology lab	**LS3: Dendroclimatology (3/18)**
9A: Mar. 10 Multivariate statistics I	9B: Mar. 12 Multivariate statistics II	**PT7: Draft poster (4/1)**
10A: Mar. 17 Rosenberg et al. 2019, Kim et al. 2022, Johnston et al. 2025	10B: Mar. 19 Avian biodiversity lecture & lab	**LS4: Avian biodiversity (4/8)**
Spring Break (March 23 – 27)		
11A: Mar. 31 Machine learning I	11B: Apr. 2 Roberts et al. 2017, Pichler & Hartig 2023, Gasper & Cahalan 2025	**PT8: Poster presentation (Tues. 4/14)**

12A: Apr. 7 NO CLASS – ADVISING DAY	12B: Apr. 9 Groundfish fisheries lecture & lab	**LS5: Groundfish fisheries (4/22)**
13A: Apr. 14 Poster presentations	13B: Apr. 16 Machine learning II	**PT9: Draft white paper (4/22)**
14A: Apr. 21 Ratajczak et al. 2022, Wesselkamp et al. 2024, Kaspari & Welti 2025	14B: Apr. 23 Prairie restoration lecture & lab	**PT10: Peer reviews (4/29), LS6: Prairie restoration (5/6)**
15A: Apr. 28 In-class project work day	15B: Apr. 30 NO CLASS – STUDY DAY	**PT11: Final white paper, PT12: GitHub repository (Thur. 5/7)**

Grading Policies

Weighting

Assessment	Count	Individual Weight	Total Weight
Lab summaries	6 (drop lowest)	8%	40%
Paper discussions	6 (one absence)	2%	10%
PT3: GitHub README	1	5%	5%
PT4: Proposal presentation	1	5%	5%
PT7: Draft project poster	1	5%	5%
PT8: Poster presentation	1	10%	10%
PT9: Draft white paper	1	5%	5%
PT10: Peer reviews	2	2.5%	5%
PT11: Final white paper	1	10%	10%
PT12: GitHub repository	1	5%	5%

Letter Grade Determination

Percentages will be rounded to the nearest whole number before letter grades are assigned.

Grade	Percentage Range	GPA Equivalent
A	100% – 93%	4.0
A-	92% – 90%	3.7
B+	89% – 87%	3.3
B	86% – 83%	3.0
B-	82% – 80%	2.7
C+	79% – 77%	2.3
C	76% – 73%	2.0
C-	72% – 70%	1.7
D+	69% – 67%	1.3
D	66% – 60%	1.0
F	59% – 0%	0

Late Work

Assignments submitted late will be penalized by 10% per day and will not be accepted more than 10 days after the due date. That is, your grade will be determined as follows:

$$Score = Original\ score \times (1 - Number\ of\ days\ late \times 0.1)$$

If you need an extension for difficult circumstances, it is your responsibility to request an extension in advance of the due date. Extensions will not be granted for being too busy.

Turnaround Time

My goal is to complete grading for assignments within 10 days of submission. For example, if an assignment is due on February 4, I will aim to complete grading by February 14.

Academic Integrity

Students of Willamette University are members of a community that values excellence and integrity in every aspect of life. As such, we expect all community members to live up to the highest standards of personal, ethical, and moral conduct. Students are expected not to engage in any type of academic or intellectually dishonest practice and encouraged to display honesty, trust, fairness, respect, and responsibility in all they do. Plagiarism and cheating, **including unauthorized large language model use**, are especially offensive to the integrity of courses in

which they occur and against the SCIS community as a whole. These acts involve intellectual dishonesty, deception, and fraud, which inhibit the honest exchange of ideas. Plagiarism and cheating may be grounds for failure in the course and/or dismissal from the SCIS.

Inclusive Policies

Trans Inclusive Classroom Space

I will gladly honor your request to address you by your affirmed name or gender pronoun. Please advise me of this at any point in the semester so that I may make appropriate changes to my records.

Diversity and Disability Statement

Willamette University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. My goal is to create a learning environment that is functional, equitable, inclusive, and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify me as soon as possible. Students with disabilities are also encouraged to contact the Accessible Education Services office in Smullin 155 at 503-370-6737 or accessible-info@willamette.edu to discuss a range of options to removing barriers in the course, including accommodations.

Land Acknowledgement

We are gathered on the land of the Kalapuya, who today are represented by the Confederated Tribes of the Grand Ronde and the Confederated Tribes of the Siletz Indians, whose relationship with this land continues to this day. We offer gratitude for the land itself, for those who have stewarded it for generations, and for the opportunity to study, learn, work, and be in community on this land. We acknowledge that our University's history, like many others, is fundamentally tied to the first colonial developments in the Willamette Valley. Finally, we respectfully acknowledge and honor past, present, and future Indigenous students of Willamette.

Religious Practice

Willamette University recognizes the value of religious practice and strives to accommodate students' commitment to their religious traditions whenever possible. Please let me know within the first two weeks of the semester if a conflict between holy days or other religious practice and full participation in the course is anticipated. I will do my best to work with you to determine a reasonable accommodation.