

ESM 566/CE 566 Environmental Data Analysis

CRN: 11208/10492

M 10:15 am-12:15 (In-person discussion, SRTC B1-82)

W 10:15 am-12:15 (Zoom discussion for remote learners)

Instructor: Yangdong Pan (email: pany@pdx.edu)

Teaching assistant: Shersten Finley (email: sfinley@pdx.edu, office hours: T: 11:00-12:00)

Office hours: Wednesday 3:00-4:00 pm < <https://pdx.zoom.us/j/87599069283>> or a Zoom meeting upon request

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Classroom Requirements for All Students Due to Covid-19

The University has established rules and policies to make the return to the classroom as safe as possible. It is required for everyone to follow all the Return to Campus rules and policies. To participate in this class, PSU requires students to comply with the following.

Masks Required at all Times in Classroom

- [Wear a mask or face covering indoors](#) at all times. Your mask or face covering must be properly worn (fully covering nose and mouth and tight fitting). Mesh masks, face shields, or face covering that incorporates a valve designed to facilitate easy exhalation are not acceptable. **Because a mask must be worn in the classroom, there should be no eating or drinking in the classroom.** If you have a medical condition or a disability that prevents you from wearing a mask or cloth face covering, you must obtain an accommodation from the [Disability Resource Center \(DRC\)](#) to be exempt from this requirement.
- CDC, State, and County guidance does not limit class size for in-person instruction or require physical distancing.

Vaccination

- Be vaccinated against COVID-19 and complete the [COVID-19 vaccination attestation](#) form. Those students with medical or nonmedical exemptions or who will not be on campus at all must complete the process described on “COVID-19 Vaccine Exemption Request Form” to establish those exemptions.

Health Check, Illness, Exposure or Positive Test for COVID-19

- Complete the [required self-check for COVID-19 symptoms before coming to campus each day.](#)
- If you are feeling sick or have been exposed to COVID-19, do not come to campus. Call SHAC to discuss your symptoms and situation

(503.725.2800). They will advise you on testing, quarantine, and when you can return to campus.

- If you test positive for COVID-19, [report your result to SHAC](#) and do not come to campus. SHAC will advise you on quarantine, notification of close contacts and when you can return to campus.
- Please notify me, (i.e. your instructor), should you need to miss a class period for any of these reasons so that we can discuss strategies to support your learning during this time.
- If I become ill or need to quarantine during the term, either I or the department chair will notify you via PSU email about my absence and how course instruction will continue.

Failure to Comply with Any of these Rules

As the instructor of this course, the University has given me the authority to require your compliance with these policies. If you do not comply with these requirements, I may ask you to leave the classroom or I may need to cancel the class session entirely.

In addition, failure to comply with these requirements may result in a referral to the Office of the Dean of Student Life to consider charges under PSU's Code of Conduct. A student found to have violated a university rule (or rules) through the due process of student conduct might face disciplinary and educational sanctions (or consequences). For a complete list of sanctions, see Section 14 of the [Student Code of Conduct & Responsibility](#)

Guidance May Change

Please note that the University rules, policies, and guidance may change at any time at the direction of the CDC, State, or County requirements. Please review the University's main [COVID-19 Response](#) webpage and look for emails from the University on these topics.

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Course learning goals and objectives:

The main purpose of this course is to help students *think statistically* and use statistics effectively in *framing, conducting, and reporting* their researches. At the end of the term, students are expected to understand and be able to use statistical analyses within an overall environmental research framework (i.e., conceptual model, problem formulation, sampling/study design, model parameter estimates, hypothesis testing, statistical inference, and environmental conclusions). Specifically, students are expected to

- Design statistically sound field studies and lab experiments
- Graphically and numerically summarize the data
- Select appropriate statistical methods, and be able to assess the assumptions and find possible remedies if the assumptions are violated

- Draw statistical conclusions and understand the uncertainty associated with each statistical decision (e.g., Type I and II error)
- Communicate scientific results effectively
- Critically interpret statistical analyses in the environmental research literature
- Use statistical computing programs, specifically, R, effectively to analyze environmental data

Textbook:

Gotelli, N. J. and A. M. Ellison. 2013. *A Primer of Ecological Statistics*. Sinauer Associates, Inc. Publishers, Sunderland, MA. (2nd edition) (required)

Software/APP:

- *R* (free downloadable from <<https://cran.r-project.org/>>. Please install the software to your computer.
- *RStudio*: a text editor for R and others (free downloadable from <<http://rstudio.org/download/desktop>>). Please install the software to your computer.
- We will primarily use RStudio in the course. Please watch this [short video](#) on how to get start.
- For the basic R tutorial to get a start with R, please go to <<http://www.cyclismo.org/tutorial/R/>>. For more helpful documents and webinars on RStudio, please go to <<http://rstudio.org/docs/>> and <[RStudio Webinars - RStudio](#)>.
- *D2L*: an on-line learning system (<https://d2l.pdx.edu/>). You need to use your ODIN user name and password to log in. Class materials such as syllabus, homework assignments, lecture PowerPoint presentations, grades, and extra readings will be posted in “D2L”. Students are encouraged to use “D2L” to post questions, comments, and suggestions.
- *Zoom*: a video conferencing tool which we will use for remote teaching, learning, and interactions (freely available from <https://www.pdx.edu/oit/zoom-meetings>)

Useful R Resources:

- [The Comprehensive R Archive Network](#) for free R reference manuals/books and other information <<http://cran.cnr.berkeley.edu/>>
- [UCLA’s IDRE Institute for Digital Research and Education](#): Rich resources for helping you learn and use R
- [Stack overflow](#): many R-related questions and answers.
- [R-Bloggers](#): R news and tutorials contributed by >500 R bloggers
- [The R Journal](#): an open access, refereed journal of the R project for statistical computing

Approach:

1. All lecture contents will be delivered online. PowerPoint slides with recorded audio explanations and exercise worksheets will be posted weekly in D2L.

2. If you are comfortable with **in-person learning**, we will meet in-person every **Monday between 10:15 and 12:15 in SRTC B1-82**. We will use this two-hour in-person time period for discussions on all questions that you may have after you go through the lecture slides and the worksheets. We can also use the time as a workshop in which you can continue to work on the worksheet individually or as a group and interact with both instructor and TA.
3. If you prefer **the remote choice**, we will meet every **Wednesday between 10:15 and 12:15 via Zoom** (a Zoom link will be posted in D2L). We will discuss any issues that you may have with group discussion, screen-sharing, etc. You can also continue your work on the worksheet individually or as a group during the time period.
4. Since the COVID-19 situation is fluid, the separation between the two learning modes is not strict. In other words, as the time goes on or your circumstance may change or the pandemic may be under control or may get worse during the term, anyone can switch from one to the other.

1. Virtual classroom facetime via Zoom video conference

We will use Zoom for virtual meetings and recordings in this course. Your use of Zoom is governed by [the Acceptable Use Policy](#) and [PSU's Student Code of Conduct](#). A record of all meetings and recordings is kept and stored by PSU, in accordance with the Acceptable Use Policy and FERPA. Individual use and distribution of recording is limited to academic purposes.

How to join a Zoom meeting in D2L

Note: Zoom meetings run best via the Zoom App or Google Chrome. If you have not already downloaded the app, you will be prompted to do so upon joining the meeting. It will take a few minutes and thus it is highly recommended that you join the first zoom meeting several minutes before class starts.

1. Login to D2L at d2l.pdx.edu
2. Navigate to the course in which the Zoom meeting is scheduled.
3. Click **People**, then **Zoom Meetings**.
4. Find your meeting from the list of upcoming meetings and click Start or Join.
5. Confirm the browser dialogue to launch Zoom.
6. Select your audio conference options. In most cases, you should choose "Join With Computer Audio," which may be your only option.

For more details, please check this webpage < <https://oaiplus.pdx.edu/blog/2019/09/20/getting-started-with-zoom-via-d2l/> >

2. Student-led and group-based learning

Interaction with your group members frequently becomes much more important under today's environment with social distancing. You can find more information on the research projects at the end of the syllabus.

Student guide to learning remotely and remote learning kit

PSU has a variety of tools to help you connect, share information, and complete coursework without meeting physically. For more information, please check these webpages

< <https://portlandstate.atlassian.net/servicedesk/customer/portal/2/article/877265100>>
<<https://pdx.pressbooks.pub/remoteteachingkit/front-matter/introduction/>>

The term will be divided into three phases:

1. The first part of the term (6 weeks) will focus on introduction of commonly used multivariate methods. This part will include lectures, in-class exercises, and homework.
2. The 2nd part of the term (3 weeks) will emphasize on student-led research projects. The lecture will be condensed with no more homework. Each research group will have plenty time during the class to discuss their research ideas, analyze the data, and interpret the results.
3. The 3rd part of the term (1 week) will be largely on applications of some multivariate methods in environmental sciences. Each class period will be organized in the same way as a professional conference. Each group will present their group research projects followed by questions and discussion.

Research Project: Each group is required to identify a dataset which is suitable for the multivariate data analysis covered by this course. It is preferred that the students use their own research datasets. Each group will then formulate research questions/objectives, construct a conceptual model, select appropriate multivariate data analyses, and perform the analyses on the datasets. The evaluation of the project is based on (1) professional conference-style PowerPoint presentation (2) professionally written journal-style report.

Grading:

- Homework (3-4 homework exercises: 60%): Late homework will be accepted but will suffer a 5% per day grade reduction.
- Project (35%): You are required to formulate a study question and a conceptual model, collect/"borrow" data, analyze the data and interpret the results with relation to the study question, and write a professional research paper.
- Class participation (5%): Class participation includes class discussion, class presentations, and on-line discussion

Grading Scale (percent scores and grade break points for letter grades):

A: "excellent", comprehensive knowledge and understanding of subject matter;

B: "good", moderately broad knowledge and understanding of subject matter;

C: "satisfactory", reasonable knowledge and understanding of subject matter;

D: "inferior", minimum knowledge and understanding of subject matter

A: 94–100; A⁻: 90–93; B⁺: 87–89; B: 84–86; B⁻: 80–83; C⁺: 77–79; C: 74–76; C⁻: 70–73

Pass: C⁻ or above

Incomplete: Departmental and university policies dictate that incompletes can be given only for verified medical reasons (through the Office of the Dean of Student Life).

Peer-evaluations:

1. The class emphasizes tremendously on team-work and student-based learning. To be fair with every member of the team, each member will have a chance to evaluate their peers’ performance at the end of the term. The outcome of the peer evaluation will affect a student’s final grade.
2. Each student will have a chance to evaluate each group’s oral presentation during the week 10 using Google Form and all peer comments will be available so that the presenters can incorporate the peer comments/suggestions in their final written papers.

Statement on Academic Honesty

Plagiarism of any form will not be tolerated in this class and will result in failing grades for the assignment and course participation, and a referral to the Office of the Dean of Student Life. For more information, please see the Portland State University's Bulletin and how to [avoid plagiarism](#).

Tentative Course Outline

Both lecture and workshop topics and their orders will be subject to changes depending on students’ interests and their data sets.

Week	Topics	Reading
1	Research framework; Population vs. sample Parameter estimates;	Chapter 3 (p.58)
2	Exploratory data analysis: Display data graphically using ggplot and lattice Summarize data numerically using dplyr	Ch. 8 (p.212-236)
3	Hypothesis testing Analysis of Variance (ANOVA) Experimental design, Statistical power;	Ch. 4 (p.79) Ch. 10 (p.288-300) Ch. 10 (p.300-308)
4	Simple ordinary least-square linear models: Estimation and inference Residual analysis and diagnostic checks (Due: “Conceptual model/Study question”)	Chapter 9 (p239-264)
5	Multiple linear models: Variance inflation factor and multicollinearity Step-wise regression hypothesis-testing (Due: Dataset descriptions)	Chapter 9 (p275) Chapter 9 (p282)

6	Generalized Least Squares (GLS) models for Dependent data Heterogeneity	Zuur et al. (2009)
7	Generalized linear models (GLM): Logistic regression models	Guisan et al. (2002) <i>Ecol. Modeling 157</i>
8	Multi-level regression models for nested data Random intercept models Random slope models Random intercept and slope models (Due: Draft)	Zuur et al. (2009)
9	Tree-based models: Regress tree models; Classification tree models; Random Forests and Boosted models (Due: Peer review)	De'ath & Fabricius (2000) <i>Ecology 81</i>
10	Time-series: Autoregression (AR) Moving-averaging (MA) ARIMA models (Revision)	
11	Final paper due (Tuesday by Midnight)	

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PSU Student Resources

- [Title IX reporting](#)
- [PSU Prohibited Discrimination & Harassment Policy](#)
- [Disability accommodations](#) and the [Disability Resource Center](#)
- [Dean of student life](#)
- [Religious accommodations policy](#)
- [Library](#)
- [Writing Center](#)
- [Food assistance](#)
- [General PSU Policies](#) (e.g., Student Conduct and Responsibility Policy)
- [Student Resources and Centers](#) (e.g., campus public safety, veterans resource center, etc.)

- [Sanctuary campus information and resources](#)
- [DACA](#) resources