ESM 322 Environmental Risk Assessment

CRN 61103, TR 10:00-11:50 am, in-person, VSC B1-17

Instructor: Yangdong Pan (SRTC 238F, email: pany@pdx.edu)

Student hours (aka Office hours): 1:30 pm-2:30 pm Friday or by appointment

E-student hours: anytime, please put "ESM 322" in your email subject line or request for a Zoom meeting

Content

Overall objectives

Policy-makers, managers, and stakeholders rely on accurate evaluations of environmental risks of stressors to understand their impacts on both individuals and ecosystems. The realm of environmental risk assessment is continuously evolving to address this need. This course aims to familiarize students with the fundamental structure, principles, and techniques of environmental risk assessment, with a specific focus on the ecological ramifications within freshwater ecosystems. Covering a spectrum of topics including laboratory ecotoxicology, field-based bioassessment, and probabilistic risk characterization, the curriculum will adhere to the Ecological Risk Assessment Framework established by the US Environmental Protection Agency (EPA). Students will be tasked with applying this framework through the completion of an environmental risk assessment project.

Approach

This class emphasizes tremendously student-led and group-based learning. This approach places more responsibility on the student to guide one's own learning and intellectual development. Therefore, the learning you achieve in this class is largely a product of your participation in all aspects of the course. During lab (ESM 325), the class will be divided into project groups of 3 members, which will work together on a common research question and write a scientific paper using US EPA's Ecological Risk Assessment Framework. The same group will be working on assignments during class time periods in ESM 322. Each group can discuss each assignment, share the workload, and submit a group-based written product and when there are any questions or concerns, each group can request for meetings with the instructor.

Prerequisites

ESM 320/323
ESM 321/324

Recommended reading materials

No textbook is required for the course. Recommended reading materials will be posted as pdfs in "Canvas".

Grading

Exams: two exams	**50%**
Group-based assignments	**20%**
Group-based project (written paper)	**25%**
Group participation	**5%**

If you will miss an exam, please notify the instructor ***prior to*** the exam date

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

A (A: 94 – 100; A-: 90 – 93)	"excellent", comprehensive knowledge and understanding of subject matter
B (B+: 87 – 89; B: 83 – 86; B-: 80 – 82)	"good", moderately broad knowledge and understanding of subject matter
C* (C+: 77 – 79; C: 73 – 76; C-: 70 – 72)	"satisfactory", reasonable knowledge and understanding of subject matter
D	"inferior", minimum knowledge and understanding of subject matter

*A minimum of C- is required for the major to pass this course

Incompletes: Please check PSU's policy for receiving an incomplete grade
https://www.pdx.edu/registration/incomplete-grades

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.

Access and Inclusion for Students with Disabilities

PSU values diversity and inclusion and is fully committed to fostering mutual respect and full participation for all students. If you encounter barriers to your inclusion in the class due to aspects of instruction or course design, which impedes your learning, please let me know. If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is located in 116 Smith Memorial Student Union, 503-725-4150. If you already have accommodations, you are encouraged to contact me to make sure how your DRC accommodations can be met. Students who need accommodations for tests should schedule your tests with the test center at your earliest convenience and are expected to schedule your tests to overlap with the time the class is taking the test.

PSU Student Resources

- **PSU's latest COVID-19 virus responses** <https://www.pdx.edu/coronavirus-response>
- **Student resources during COVID-19** < https://www.pdx.edu/clas/covid-19-resources-for-students>

- Title IX reporting
- 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

Tentative Course Outline

Week	Topic

Module One. Ecological Risk Assessment (ERA) Framework and Lab-based Aquatic Ecotoxicity Testing

April 1 (T)	Course introduction: Ecosystem as a complex system; adaptative management; and US EPA Ecological Risk Assessment Framework
April 3 (Th)	Assessing ecological effects: experimental design; ecotoxicity tests; and test endpoint I (NOEC, LOEC) ***Assignment 1. Find NOEC and LOEC: ANOVA and Tukey's HSD test***
April 8 (T)	Assessing ecological effects: statistical decisions; Type I and II errors; and statistical power
April 10 (Th)	Assessing ecological effects: What is a P-value? ***Assignment 2. Can we trust P-value?***
April 15 (T)	Assessing ecological effects: simple linear regression; logistic regression; and test endpoint II (LC_{50}, EC_{50})
April 17 (Th)	Characterizing ecological effects and exposures; distribution: relative and cumulative frequency; species sensitivity distribution model (SSD); hazardous concentration (HC_x) ***Assignment 3. Assessing ecological effects: Cumulative frequency distribution and species sensitivity distribution model***
April 22 (T)	Risk characterization; Case study: Ecological risk assessment of atrazine I
April 24 (Th)	Case study: Ecological risk assessment of atrazine II ***Assignment 4. Ecological risk assessment***

Exam I (April 29, Tuesday)

Module Two. Ecological Risk Assessment at an Ecosystem Level: Causal Effects

May 1 (Th)	Conceptual model; Introduction of Bayesian network model ***Assignment 5 Causal link: Bayesian Network model using Netica (part 1)***
May 6 (T)	Bayesian learning and Bayesian network model using Netica (part I)
May 8 (Th)	Stream/river as a complex ecosystem; Stream assessment: reference conditions as 'control'. ***Assignment 6 Causal link: Superius correlation***
May 13 (T)	Stream assessment: How to minimize confounding factors (study design)? How to minimize confounding factors using Propensity scores?
May 15 (Th)	Stream assessment: How to minimize confounding factors using Quantile regression? ***Assignment 7 Causal link: Propensity score***
May 20 (T)	Stream assessment: How to analyze and interpret data using Multimetric indices and RIVPAC models?
May 22 (Th)	Stream assessment: How to fit into the EPA's Ecological risk assessment framework? ***Assignment 8 Causal link: Bayesian Network model using Netica (part 2)***
May 27 (T)	Stream assessment: How to learn a complex system using Bayesian network models? Adaptive management revisited

Exam II (May 29, Thursday)

Module Three. Applications for Ecological Risk Assessment

June 3 (T)	Class presentation I and discussion
June 5 (Th)	Class presentation II and discussion

Written group projects due June 9 (Monday)

Group-based research project:

1. Project:
2. The format of the paper and grading guidelines on the ESM 322 Final Group Project Paper (25 pts total):

Title and author's names

Abstract (1 pt): an abstract is a concise summary of the study which should include

- Purpose of the study (one or two sentences)
- Study objective or hypothesis (one or two sentences)
- Brief method description (one or two sentences)
- Key findings (two or three sentences)
- Conclusion (one sentence)

Introduction (5pts):

- Opening with a big picture: a large problem and its societal importance. Is the purpose of the study clear in the introduction (i.e., why is this risk assessment or study necessary?)
- An extension of opening with background information that readers need to know to understand your work. Do the authors provide enough background information on the stressor and its ecological effects? What we know and what we don't know? Is the conceptual framework explicit and justified (supported by cited references)?
- Challenge with a specific hypothesis/question of the current study. Is the risk hypothesis clearly formulated, unambiguous, and complete?

Methods (4 pts): Keep in mind that others should be able to replicate the work based on the description in this section. It is often very helpful if a flowchart or other illustration is used to help the readers to understand the study design and provide the rationale for each decision made during the study.

- Do the authors clearly explain the study design with relation to the study objective?
- Do the authors provide the source of the data and some necessary information on the original study?
- What is the stressor, the ecosystem that was assessed, and the endpoint (variable of interest)?
- What statistical methods are used to test the risk hypothesis? Are the statistical methods suitable for the hypothesis-testing?

Results (6 pts): This section is to summarize general trends/patterns in the data without comment or interpretation. Please focus on the findings that are relevant to the study objective/question.

- Do the authors adequately characterize the data using summary statistics or plots which are relevant to the study objective/risk hypothesis?

- Do the authors present relevant statistical testing results which are relevant to the study objective/risk hypothesis?

Discussion (8 pts): This section is to analyze the data and relate them to other studies. To "analyze" means to evaluate the meaning of the key results in terms of the original question or hypothesis with mechanistic explanations and point out their scientific significance.

- Do the authors discuss the major findings which are relevant to the study objective/risk hypothesis? In other words, do the authors provide scientific explanations for what they find? Are the major findings compared with relevant literature?
- If the outcome is not what the authors expect (negative results), do the authors adequately discuss why the results are negative and provide suggestions for the future studies?
- Is the conclusion fully supported by the results?
- Do the authors discuss the uncertainty of their risk assessment?

Presentation (1 pt):
Is the text well written and easy to follow? Is the vocabulary appropriate? Is the content complete and fully congruent?
Is the manuscript well organized? Are tables and figures used effectively and well formatted with complete captions? Are reference citations consistent in format? Are all references cited in the text included in the reference section?

Others:
No page limit and minimal page requirement; 12 font size; double space; Please save the work as a **word** document with the team name and every author's last names separated by underscore as the file name (e.g., TeamAlpha_smith_johnson_oliver.docx) and submit the document in Canvas by **June 9, 2025** (before mid-night). I will email you the graded papers with my comments after I finish grading.

An example showing a paragraph structure in scientific writing

INTRODUCTION

Understanding and explaining the structure and dynamics of biotic communities in response to environmental gradients is a central goal in ecology. As planktonic organisms in aquatic systems have short generation times (Collins, Rost, & Rynearson, 2014), are very dynamic interactions, they are well suited to study the reaction of communities to environmental changes……..

The first sentence in red: A topic sentence highlights the main point for this paragraph
The following sentence: Elaboration of the topic sentence with more explanations and literature