This course will introduce you to methods used in environmental studies, including environmental study designs, data analysis and data interpretations. Students will be able to formulate and identify research questions and conceptual framework for environmental research. They will analyze study and experiment design, manage and summarize data, test hypotheses, analyze data, interpret results and communicate their findings.

Course objectives:

- Identify and critically evaluate the structure of mensurative and manipulative environmental science studies.
- Summarize, analyze and interpret data with descriptive and basic univariate statistics.

Expectations

- *Give this class enough time!* Although not an in-person class, this is not an “at your own pace” sort of course. You should
expect to dedicate between 8-12 hours to this course per week, schedule it in now!

- **Ask Questions:** if something is unclear, please ask and we will try to clarify. Ask your classmates, ask the TA or ask the instructor.

- **Be respectful:** This course has several discussion sections. Please be respectful of the shared space and of other people as you interact with them online. Being respectful means not only approaching discussions and interactions in a responsible and thoughtful manner, but it also refers to being respectful of everyone’s time by turning in assignments and participating in discussions in a timely manner.

Adhere to the code of conduct: http://www.pdx.edu/dos/codeofconduct; e.g., no academic dishonesty or negligence; no harassment. You are expected to engage with members of this University in a respectful and honest manner.

**Texts & readings:**


**Schedule (SUBJECT TO CHANGE)**

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| 1/10  | 1 | Course introduction: Science and the Scientific method                                           | How to describe nature: Mensurative and Manipulative studies.  
Identify in 3 published studies whether they are mensurative or manipulative, explain how you know. |
<p>| 1/7   | 2 | Asking questions based on observation: Establishing a conceptual framework                        | Heath ch(1,2)                                                                                    |
| 1/24  | 3 | Considerations in survey design                                                                  | BLM chs 2&amp;7                                                                                     |
| 1/31  | 4 | Experimental Design                                                                               | Heath ch (3,12)                                                                                  |
|       |   | Find one manipulative study in the literature and identify key features                           |                                                                                                 |
|       |   | Nature of the experimental unit and pseudoreplication                                            | Hurlburt 1984                                                                                    |
| 2/7   | 5 | Summarize and explain (raw) data.                                                                 | Heath chs 4, 7(p.155-172)                                                                        |
|       |   | Summarize data from one published data set (create at least one graph)                           |                                                                                                 |
|       |   | Data management strategies, summary statistics, graphical displays                               |                                                                                                 |
| 2/14  | 6 | Why, how and when to use statistics?:                                                              | Heath chs. 5,12(p.310-314)                                                                       |
|       |   | Distributions, transformations, statistical powers, errors, decisions and interpreting the p-values |                                                                                                 |
|       |   | MIDTERM                                                                                          | Use tools to identify what appropriate statistical test to use, support your decision.           |</p>
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<td>Detecting differences in averages: t-test ANOVA</td>
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<td>Looking for associations between 2 variables</td>
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<td>Communication with others: how to explain your research and findings in the context of your conceptual framework:</td>
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*The topics and schedule of discussions listed in this syllabus may change, changes will be announced in class.*

**Class Policies:**

- Assignments must be in **on time**. I will not accept unexcused late homework.
- **Type** your homework assignments.
- **Quality** is important and is factored into the grade of each assignment.
- Although much of the work will be conducted as a class or in small groups, your homework must be your **own work**. I encourage you to discuss the concepts and interpretations of the data with your classmates, however, you must generate your own reports, graphs, etc... Do not turn in identical or strikingly similar assignments as your classmates (current or anyone who has taken this class previously). You will not receive a score and you risk further academic prosecution for plagiarism.
- Be considerate of your classmates. Because this class will involve group activities, please come prepared and ready to participate in group and class activities.
o Familiarize yourself with the academic code in the University catalog.

o There are many forms of plagiarism, including:
  o o Copying word for word without quotation marks and proper citation
  o o Closely paraphrasing without proper citation
  o o Be especially careful of information obtained from the Internet. In general, for your lab reports do not cite work from the web. Follow the information to its source and cite the primary, peer reviewed literature.
  o o

Student evaluation & policies

Participation (10 modules) 20%

Homework (5% ea) 35%

  Manipulative or mensurative?
  Conceptual framework
  Mensurative design analysis
  Manipulative design analysis
  Chi-squared
  ANOVA / t-test
  Associations

Project: 25%

  Summarize data (5%)
  Identify statistical test (2%)
  Apply statistical test (3%)
  Final paper & presentation (15%)
Exams: 20%

Total 100%

A= 100 to 94%; A-= 93 to 90%; B+= 89 to 87%; B= 86 to 84%; B-= 83 to 80%; C+= 79 to 77%; C= 76 to 74%; C-= 73 to 70%; D= 69 to 60%; F= 59% and below.

Participation & Attendance:

For each module, you will be awarded points for your participation. This will be determined by the completion, on time, of the online portion and completion of the online quizzes and discussions and activities. Each week contributes 2% to your grade.

Homework:

Homework assignments are due Sunday by midnight. Assignments must be typed and on-time. We will not accept late homework assignments. Discussion activities must be completed by Wednesday afternoon (5pm)

Project:

The purpose of the project is to evaluate a paper, be able to identify the conceptual framework, and the design of the study, and to be able to take their raw data and evaluate the data in the paper. You will determine whether the study was done appropriately and came to the correct conclusions based on your analysis.

Exams:
You will have two: Midterm and Final. You should be able to identify and analyze key features of a mensurative and of a manipulative study. You should also be able to determine what sort of statistical test is appropriate and whether it was applied correctly in a paper.

*PREFERRED FORMAT FOR CITATION OF RESEARCH PAPERS:*

Last name, first initial of all authors. (Year) Title of article. Journal title. Volume(issue): pgs.


*Please notice what is NOT included in this reference... eliminate any extraneous information including the date accessed, publisher, which website you used, the doi (unless extremely relevant).*

**RUBRICS**

*Each homework assignment (HW) contributes equally to your grade (5% each assignment)*

**HW1: Is it manipulative or mensurative?** (12 pts each paper, 36 pts total)

Find 3 primary research papers in a field of environmental science and identify whether the study conducted is a manipulative or a mensurative study. For each bullet point for each paper you will receive (3- Professionally...
executed, no errors, clearly explained, 2- sufficiently completed, explained without details, may be missing a small aspect 1-Not complete or not explained clearly, 0- missing)

- Complete reference (Format given above*) (3, 2, 1, 0)
- One sentence summary of the concept of the paper
- State whether the study was manipulative or mensurative.
- Explain how you know

**HW2: Create a conceptual framework for one primary research paper** (36 pts total)

Your job is to find a scientific research paper that is in an environmental sciences topic.

Read through the introduction and create a flow-chart or an outline that diagrams the conceptual framework of the paper. Then in 1-2 sentences, describe whether this conceptual model is compelling and places that need more work.

- Complete reference* (3, 2, 1, 0)

Identify the following:

- What is the main observation? (3, 2, 1, 0)
- Who are the players (biotic features)? (3, 2, 1, 0)
- What is the scale? (Temporal, Spatial, Taxonomic) (3, 2, 1, 0)
- What are the abiotic components of the interaction? (3, 2, 1, 0)
- Describe the interactions (biotic-biotic, biotic-abiotic) (3, 2, 1, 0)
- Current theories that are applied (3, 2, 1, 0)
- What does previous literature show (brief overview) (3, 2, 1, 0)
- What is well understood? (3, 2, 1, 0)
- What is not well known? (3, 2, 1, 0)
- What does the author predict will happen? (3, 2, 1, 0)
- Explain why you think this conceptual model is compelling, be specific (3, 2, 1, 0)
- Which areas do you think need some more explanation or work (3, 2, 1, 0)
HW3: Key features of a mensurative study (36 pts):

- Complete reference* (3, 2, 1, 0)
- State the objective of the study. (3, 2, 1, 0)

Identify the following (3- clearly explained, 2- sufficiently explained, but missing some information, 1- missing information, not clearly stated, 0- missing)

- target population of interest. (3, 2, 1, 0)
- sample population. (3, 2, 1, 0)
- sampling unit. (3, 2, 1, 0)
- What is sampling unit size/shape. (3, 2, 1, 0)
- How are the sampling units be positioned (randomly, stratified, haphazard, explain)? (3, 2, 1, 0)
- Are sampling units be temporary or permanent? (3, 2, 1, 0)
- How many sampling units are taken? (3, 2, 1, 0)
- Will the sampling design appropriately address the objective of the study? Explain clearly with examples (6, 4, 2, 0)
- Diagram / draw the sampling plan (3,2,1,0)

HW4: Key features of manipulative study: (36 pts)

- Complete reference* (3, 2, 1, 0)
- State the objective of the study and identify main research question (3, 2, 1, 0)

Identify the following (3- clearly explained, 2- sufficiently explained, but missing some information, 1- missing information, not clearly stated, 0- missing)

- Experimental Unit (3,2,1,0)
- Treatment Structure (3,2,1,0)
- Control (3,2,1,0)
- Design Structure (3,2,1,0)
- Replication (3,2,1,0)
- Randomization (3,2,1,0)
- Response Structure (3,2,1,0)
- Does the experimental design appropriately address the research question as stated? (6,4,2,0)
Diagram the experiment identifying the above features (3,2,1,0)

HW5,6,7: Problem sets (chi-square, ANOVA, associations) (12 pts each)

- Summarized the data (graph) (3,2,1,0)
- Showed work (3,2,1,0)
- Correct output (3,2,1,0)
- Correct interpretation of the findings (1-4 sentences includes discussion of p-values and df where appropriate). (3,2,1,0)

PROJECT: Although you will be working on the same datasets as others in the class, you will be required to complete, submit and support your work individually. You will notice that this is a cumulative project, you will be including the key outcomes of previous assignments in subsequent assignments.

Project: Summarize the data (5%) (21 pts total)

- Complete reference* (3,2,1,0)
- Objective of the project (3,2,1,0)
- Graph that includes the following:
  - Clear depiction and summary of the raw data. (3,2,1,0)
  - Labeled axes and legend where appropriate (3,2,1,0)
  - Appropriate summary information (average, associated variables etc., error bars where appropriate) (3,2,1,0)
  - A figure caption that includes all of the information needed to understand the graph (3,2,1,0)
  - 1-2 sentences explaining the pattern illustrated by the graph with specific reference to direction and magnitude of any patterns (3,2,1,0)
Project: **Identify statistical test (2%)** (18 pts)

- Complete reference* (3,2,1,0)
- Objective of the project and summary graph (plus caption) (3,2,1,0)
- Identify the appropriate statistical test that should be used to analyze the data (3,2,1,0)
- Explain clearly why this is the appropriate test to use. (3,2,1,0)
- Which assumptions does the data meet? Which does it not meet? (3,2,1,0)
- Does the data need to be transformed, how? (3,2,1,0)

Project: **Apply statistical test (3%)** (18 pts)

- Complete reference* Objective of the project and summary graph (plus caption) (3,2,1,0)
- Identify the appropriate statistical test that should be used to analyze the data (3,2,1,0)
- Appropriate Statistics applied (3,2,1,0)
- Work Shown (3,2,1,0)
- Appropriate interpretation of the findings including a 1-2 sentence description of the summary information (3,2,1,0)
- Appropriate interpretation of the findings including a 1-2 sentence description of the statistical support for the findings. (3,2,1,0)

Project: **Final paper individually written (10%) and presentation as a group (5%)** (30 pts)

- Complete reference* (3,2,1,0)
- Objective of the project (3,2,1,0)
- Identification of key features of the design (see HW 3&4) (6,4,2,0)
- Appropriate summary graph, including labels and figure caption (3,2,1,0)
- 1-2 sentences explaining the patterns of the data (3,2,1,0)
- Identify statistical test and support your decision (3,2,1,0)
- Excellent execution of statistical test (3,2,1,0)
Appropriate interpretation of statistical findings (3,2,1,0)
Does your interpretation of the statistics match the findings in the paper. Make direct comparisons with examples (discuss p-values, and df where appropriate). (3,2,1,0)