Syllabus Page

Course Information

ENVH 556 Quantitative Exposure Analysis

Winter 2021 -- 3 credits

Meeting times: Wednesdays 2:30-4:20; Fridays 2:30-3:20. (2021 schedule: Changed from TTh starting at 1:30)

Zoom link: https://washington.zoom.us/j/96646010491 (https://washington.zoom.us/j/96646010491)

Instructor:

Lianne Sheppard, Professor
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Office Hours: Mondays 5:00-6:00 p.m. or TBA

Co-Instructor:

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GitHub: cmzuidema
Office Hours: Mondays 5:00-6:00 p.m. or TBA

Office hour zoom link: https://washington.zoom.us/j/99603329033 (https://washington.zoom.us/j/99603329033)

About the Course

Course Goals and Overview

This course will introduce students to quantitative aspects of occupational/environmental exposure data analysis with the goal of better understanding the nature of exposures and their interpretation for human health. Issues in the analysis and interpretation of exposure data will be explored through reading and discussions of the primary literature on exposure assessment methods. Practice exposure data analyses will be conducted using real exposure datasets and statistical analysis software.

Specific topics will include:

1. Purposes and use of exposure data
2. Exposure distributions and their description
3. Sampling strategies
4. Modeling of exposure
5. Exposure measurement error
6. Special topics

Student Learning Goals

The overall objective of this course is to give students a deep and broad understanding of quantitative exposure assessment for environmental health. A secondary goal is to train students to analyze exposure data and develop the confidence and skills needed to conduct an analysis of exposure data and write it up with the goal of publication in mind. By the conclusion of this class, students should be able to:

1. Describe the primary purposes of exposure assessment
2. Calculate and describe the meaning of measures of central tendency and distributional properties of normal and lognormal data
3. Describe and understand the importance of design of major exposure assessment strategies, citing the logistical and statistical strengths and weaknesses of each
4. Develop, validate, interpret, and use multivariable linear models from existing exposure datasets to describe and predict exposures
5. Effectively use random, fixed and mixed models for exposure determinants
6. Identify importance of time-related factors in exposure distributions
7. Describe sources and effects of different types of exposure measurement error in epidemiology
8. Discern general lessons from and implications of primary research papers on exposure assessment methods, and use these lessons to design effective assessment strategies for future studies
9. Use reproducible research tools to conduct exposure analyses
10. Create a complete exposure analysis and write-up that covers its purpose, methods, results, and interpretation.

Required Texts

Readings will be drawn primarily from the primary research literature. Typically you will be asked to read two papers from the primary literature each week. We will also recommend additional supplementary papers. These and the additional supplementary papers are posted on the class website. We also provide a list of recommended supplemental texts and textbooks on this **Canvas page (https://canvas.uw.edu/courses/1434471/pages/supplemental-text-and-textbooks)** .

Prerequisites

This course assumes

- You have a working knowledge of biostatistics at the level covered in BIOST 511 and 512 (or 517 and 518). Students should have completed BIOST 512/518 or a comparable course that covers multiple linear regression. While much more challenging, students are allowed take BIOST 512 or 518 concurrently with ENVH 556.
- You understand basic concepts in public and environmental health, as well as epidemiology.
- You have basic R skills. We will provide some review of R in early labs and provide an introduction to R Markdown.

Class Sessions and Learning Remotely

Class session zoom link: **https://washington.zoom.us/j/96646010491 (https://washington.zoom.us/j/96646010491)**

The basic structure of this course is 1 hour 50 minutes of lecture and discussion on Tuesdays and a 50 minutes for a lab exercise on Thursdays. This course will have both synchronous and asynchronous options. You are invited to determine on a week-to-week basis which option you prefer. The instructors will also hold regular office hours to support your learning.

Synchronous option:

- Tuesday's class will be a combination of lecture and discussion. Turn in the post-class reflection after class and no later than Thursday before class.
- Thursday's class will be a lab structured as an introductory lecture of approximately 25 minutes followed by in-class practice. Turn in your lab write-up the following Wednesday.
- The lectures will be recorded and materials will be posted online in advance. The discussions and in-class practice will not be recorded.

Asynchronous option:

- Please watch the recorded lectures prior to the next scheduled class time and with sufficient time to complete the assignments.
- After watching the Tuesday lecture, draft a short summary of your perspective on the discussion questions covered in class. Turn this reflection in no later than Thursday before class.

- While watching the recorded part of the Thursday lab should be helpful, the lab assignments should stand alone. Turn in your lab write-up the following Wednesday.

Additional resources to support both synchronous and asynchronous learning: These include class discussion boards on Canvas, office hours, and emailing the instructors. Your instructors are committed to supporting the best learning experience possible. Please let your instructors know if you need additional resources to support your success in this course and we will do our best to help you with additional support or accommodations.

Software and Computing

This course assumes a basic working knowledge of R which would have been gained through various Biostatistics courses at UW (e.g. BIOST 511 and 512, BIOST 509). We will teach R Markdown and use RStudio. While you are welcome to do your work locally on your laptop, but we will not be able to provide support for local installations. For more information, see the **GettingStarted (https://canvas.uw.edu/courses/1434471/files/71777137/preview)** document.

All labs and other R Markdown files for this course will be maintained on a GitHub template repository: **https://github.com/liannesheppard/ENVH556_2021course (https://github.com/liannesheppard/ENVH556_2021course)**. The most up-to-date versions of all R Markdown files will be in this GitHub repository. We will ensure that the latest version is posted to Canvas before each lab (or as announced if additional updates are necessary). While we encourage students to sign up for and learn **GitHub (https://github.com)**, this is not required. (For guidance on using GitHub with RStudio, see **https://resources.github.com/whitepapers/github-and-rstudio/ (https://resources.github.com/whitepapers/github-and-rstudio/)**.)

Course Requirements and Grading

- Class preparation and participation: 25%

  Read and be prepared to discuss weekly readings in class. In order to support an asynchronous environment, written reflections of these discussions will be required. Complete the readings prior to Tuesday's class and turn in the written reflections before Thursday's class.

- Homework assignments: 50%

  Complete weekly labs. These are data analysis assignments, presented as lab reports that include summarized results and interpretation. Due Wednesdays.

- Final paper: 25%

  Analyze a dataset to answer a set of specific questions and provide a written report including rationale, methods, results and discussion. Due finals week.

Course Communication

- **Course updates** will be posted on Canvas. We will send Canvas announcements for all time-sensitive updates. Please make sure your Announcements setting on Canvas is "Notify Immediately".
- **Discussion board**: This is an excellent mechanism for students to get their technical questions answered and for all students to be able to support each other in this process. It is very likely that other students will have the same question as you, and sharing your questions this way will benefit everyone in the course. We also encourage you to post responses to peer questions.
- **Office hours:** There is currently one office hour scheduled per week. We will add more or change the time as needed. Please make use of this time to get additional assistance and feedback.
- **Email the instructors**: Instructor contact information is at the top of this page. You are encouraged to contact one or both of us with your questions. We will strive to respond as soon as possible and within 48 hours on weekdays.
- **Anonymous feedback**: Click on this link to submit feedback anonymously: **https://www.get3sixty.com/:0uh7se (https://www.get3sixty.com/:0uh7se)**

Course Schedule

WEEK 1

Tuesday 5-Jan Introduction and Basic Concepts

- Class structure, class norms, syllabus review
- Introduction to datasets: DEMS, Snapshot, Welding School Exposures
- General introduction to term project
- Purposes of exposure assessment and quantitative exposure modeling
- Descriptive statistics
- Variability and uncertainty (including formulas for bias, precision and uncertainty)

Thursday 7-Jan Lab: R, R Markdown, RStudio, GitHub, Data, and Distributions

- Introduction to R, and R Markdown
- Familiarity with syntax, and reporting results
- Exploring data, basic data analysis using the DEMS data
- Principles of reproducible research, computing best practices

WEEK 2

Tuesday 12-Jan Exposure Assessment Strategies

- Lognormal distribution and its parameters

- Exceedance probabilities
- Survey design
- Stationary and personal Sampling
- Sample size
- Exposure metrics
- Individual, task and group assessment
- Concept of HEGs/SEGs/JEMs
- Variance components concepts

Thursday 14-Jan Lab: Presentation and precision of distribution parameters

- Exceedance fractions, impact of sample size and compliance exercise using the DEMS data
- Includes assessing distributions,calculation of lognormal (LN) parameters, exceedance
- Data presentation principles

WEEK 3

Tuesday 19-Jan Regression Models and Regression for Association

- Linear regression introduction
- Estimation vs. prediction goals
- Dummy Variables, co-factors, confounding, interaction
- Mean and variance models concepts
- Model selection for association models

Thursday 21-Jan Lab: Fitting and Interpreting Regression Models

- Regression model practice using the Snapshot data

WEEK 4

Tuesday 26-Jan Prediction Modeling and Validation

- Regression for prediction
- Model selection forprediction
- Validating regression models: In-sample vs. out-of-sample validation, cross validation
- Bias-variance tradeoff

Thursday 28-Jan Lab: Prediction and Cross-Validation

- Bias-variance tradeoff and cross-validation exercise using the Snapshot data

WEEK 5

Tuesday 2-Feb Variance Components and Mixed Models

- Variance components estimation
- Integration of variance components and regression: Mixed models

Thursday 4-Feb Lab: Variance Components from Mixed Models

- Fit mixed models with the adjusting variable included in random and fixed terms; provide contrasting interpretations
- Describe fixed and random effects in the Welding School data

WEEK 6

Tuesday 9-Feb Review and DEMS papers discussion

- Discussion on papers and material read up to this point
- Introduction of Term Paper Assignment and Discussion of Approach

Thursday 11-Feb Begin Term Project

- Explore and select models for prediction using personal REC data
- Explore and describe CO historical data and covariates

WEEK 7

Tuesday 16-Feb Exposure Measurement Error in Epidemiology

- Misclassification
- Regression measurement error
- Classical and Berkson error models
- Consequences and exceptions

Thursday 17-Feb Lab: Exposure Measurement Error Exercise

- Exposure measurement error exercise using simulation

WEEK 8

Tuesday 23-Feb Geostatistics and Air Pollutant Exposure Modeling

- Spatial and spatio-temporal prediction models
- Variograms
- MESA Air example
- NO2 national model example with random vs. spatially clustered cross-validation

Thursday 25-Feb. Lab: Geostatistics and Universal Kriging

- Geostatistics: Kriging and variograms using the Snapshot data
- Plotting predictions on maps

WEEK 9

Tuesday 2-Mar Time-varying Exposures and Mobile Monitoring

- Time series data
- Autocorrelation
- Temporal smoothing

Thursday 4-Mar Lab: Time-varying exposures and temporal aggregation

- Time-averaging
- Autocorrelation
- Smoothing

WEEK 10

Tuesday 9-Mar Pesticide exposure assessment

- Review of methods to assess pesticide exposures
- Environmental vs. occupational exposure assessment

Thursday 11-Mar Lab: Problem-solving for term project

- Review and problem-solving for the term project

Syllabus Resources and Course Norms

Learning Environment and Classroom Climate

Your success in learning is important to your instructors. In addition to providing materials and assignments to support your success, we will do our best to provide a welcoming and supportive classroom environment. Our learning space is our collective mutual responsibility; as such, we all have a responsibility to engage in dialogue in a way that supports learning for all of us. To support a healthy learning environment for everyone we will discuss and revise these ground rules together during the first week of class. The ground rules are:

Norms for everyone to follow:

- Be respectful and supportive of our diverse knowledge, experiences and backgrounds
- Affirm and encourage, and respect multiple pathways to learning
- If comfortable, share your questions and your strategies with the whole class

Additional norms for the instructors:

- Teach and help inclusively; adapt to students' different learning styles
- Be flexible and understanding of students' diverse and challenging situations
- Be responsive: check in regularly to confirm students are following the materials; answer questions in the chat; post common questions and their answers on Canvas

In addition to these norms, if you have any comments or suggestions regarding the classroom climate please get in touch with your instructors using the mechanisms described in the *Course Communication* section above. It is our highest priority to address your comments as satisfactorily as possible. However, if you are not satisfied with our response, you may reach out to others at the Department, School, and/or University level. If you wish to follow up with others, we encourage you

to first contact Trina Sterry, Manager of Student and Academic Services (tsterry@uw.edu; 206 616-4177) in the Department of Environmental and Occupational Health Sciences. See also the **School of Public Health Student Concern Policy (https://sph.washington.edu/students/student-concern-policy)**. If your concerns are still not satisfactorily resolved using the above mechanisms, you may also contact the Graduate School at G1 Communications Building by phone at (206) 543-5139 or by email at **raan@uw.edu. (mailto:raan@uw.edu)**

Diversity

Diverse backgrounds, embodiments and experiences are essential to the critical thinking endeavor at the heart of University education. In SPH, students are expected:

1. To respect individual differences, which may include, but are not limited to, age, cultural background, disability, ethnicity, family status, gender, immigration status, national origin, race, religion, sex, sexual orientation, socioeconomic status and veteran
2. To engage respectfully in the discussion of diverse worldviews and ideologies embedded in course readings, presentations and artifacts, including those course materials that are at odds with personal beliefs and values.

Bias Concerns

As noted above, the School of Public Health has a **student concern policy (https://sph.washington.edu/students/student-concern-policy)**, a faculty concern policy and standard HR procedures for staff concerns. Our 2018 climate survey states that most people in SPH do not report bias incidents because they do not know where to go. Students are encouraged to report any incidents of bias to someone they feel comfortable with, including instructors, advisers or department staff. They can email **dcinfo@uw.edu (mailto:dcinfo@uw.edu)** for immediate follow up. Bias concerns can be anonymously and confidentially reported at this link **https://sph.washington.edu/about/diversity/bias-concerns. (https://sph.washington.edu/about/diversity/bias-concerns)** Data are collected by the Assistant Dean for Equity Diversity and Inclusion and the Director of Program Operations for Student and Academic Services and tracked for resolution and areas are identified for further training.

Privacy/FERPA Statement

This course has a synchronous learning option that will run at the scheduled class time via Zoom. These Zoom class sessions will be recorded. The recording will capture the presenter's audio, video and computer screen. Student audio and video will be recorded if they share their computer audio and video during the recorded session. The recordings will only be accessible to students enrolled in the course to review materials. These recordings will not be shared with or accessible to the public.

The University and Zoom have FERPA-compliant agreements in place to protect the security and privacy of UW Zoom accounts. Students who do not wish to be recorded should:

- Change their Zoom screen name to hide any personal identifying information such as their name or UW Net ID, and
- Not share their computer audio or video during their Zoom sessions.

If you have any questions or concerns about being recorded during lecture please let your instructors know and we will do our best to answer your questions and address your concerns.

Academic Integrity

Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity. The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the **University of Washington Student Conduct Code (WAC 478-121). (http://www.washington.edu/cssc/for-students/student-code-of-conduct/)** We expect you to know and follow the university's policies on cheating and plagiarism, and the **SPH Academic Integrity Policy. (http://sph.washington.edu/students/academicintegrity/)** Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the **University of Washington Community Standards and Student Conduct website. (http://www.washington.edu/cssc/)**

Specific expectations that apply to ENVH 556:

- You are welcome and encouraged to discuss your lab assignments with your peers, but you should not copy each other's work. You must turn in your own individual lab write-ups and analyses
- If you wish to share code chunks with your peers, please post these in an accessible location such as on the class discussion board so that all students in the class may benefit.

Access and Accommodations

Your experience in this class is important to me. **Disability Resources for Students (DRS) (https://depts.washington.edu/uwdrs/)** offers resources and coordinates reasonable accommodations for students. If you have already established accommodations with DRS, please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or **uwdrs@uw.edu (mailto:uwdrs@uw.edu)** or **disability.uw.edu. (http://depts.washington.edu/uwdrs/)** DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and

DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at **Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/)**. Accommodations must be requested within the first two weeks of this course using the **Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/)**.

Safety

Call SafeCampus at 206-685-7233 anytime – no matter where you work or study – to anonymously discuss safety and well-being concerns for yourself or others. SafeCampus's team of caring professionals will provide individualized support, while discussing short- and long-term solutions and connecting you with additional resources when requested.

Writing Resources

If a student feels that they could benefit from additional opportunities to improve their writing skills, a list of resources at the UW and others accessible online can be found on the SPH website (**https://sph.washington.edu/sites/default/files/inline-files/Writing-Resources-4.3.19.pdf (https://sph.washington.edu/sites/default/files/inline-files/Writing-Resources-4.3.19.pdf)**).

The University of Washington acknowledges the Coast Salish people of this land, the land which touches the shared waters of all tribes and bands within the Duwamish, Suquamish, Tulalip and Muckleshoot nations.