ENVH 556 Syllabus
QUANTITATIVE EXPOSURE ANALYSIS
Winter Quarter, 2019
3 Credits

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Meetings:  Class: Tuesday, 8:30 - 10:20  HSB T 530
           Laboratory: Thursday, 8:30-9:20  HSB T359 (bring laptop to lab sessions)
(extended labs as needed)

Class Website: https://canvas.uw.edu/courses/1099265

Office Hours:  By arrangement

Course Goals: 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 analysis 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. Statistical and biological basis of exposure metrics
6. Measurement error
7. Special topics

Learning Objectives: 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 design 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 in predicting risk, including short-term peak exposures and the effects of biological dampening of variability.
7. Describe sources and effects of different types of measurement error.
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.
Disability Resources for Students (DRS) offers resources and coordinates reasonable accommodations for students with disabilities. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. If you have not yet established services through DRS, but have a temporary or permanent disability that requires accommodations (this can 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 or disability.uw.edu

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 478-120). We expect you to know and follow the university’s policies on cheating and plagiarism, and the SPH Academic Integrity Policy. 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.

Course Requirements
1. Read and be prepared to discuss weekly readings in class. (It is possible that written reflections of these assignments will be required. Regardless, be prepared with comments.) Due Tuesdays in class. Bring your own laptop to Thursday laboratory sessions.
2. Complete weekly data analysis assignments, presented as summarized results and interpretation. (This means data analyses are in the form of a presentation (e.g., tables/figures) of results accompanied by a brief written description and interpretation.) Due Wednesdays at 5pm.
3. Analyze a dataset to answer a set of specific questions and provide a written report including rationale, methods, results and discussion. Due finals week.

Grading
1. Class preparation/participation: 25%
2. Homework Assignments: 50%
3. Final paper: 25%

Software: Students are encouraged to use R. Materials will be provided in R. Previous offerings of this class used Stata so those materials are available to students if necessary. Students may need to develop their own command code to complete assignments.

Texts: Readings will be drawn primarily from the primary research literature. These and additional supplementary papers are posted on the class website.

The additional recommended texts listed below:
ENVH 556: Weekly Class Schedule

WEEK 1
8-Jan 2 Hours  Introduction and Basic Concepts (NS)
Class structure, general introduction to term project
Introduction to datasets: DEMS, snapshot, Welding School Exposures
Exposure assessment for epidemiology, risk assessment, compliance
Descriptive statistics
Variability and uncertainty (including formulas for bias, precision and uncertainty)


10-Jan 1 Hour  Lab: Stata, Data, and Distributions (LS)
Read “Getting Started” and review Lab 1 Document in advance.
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.

WEEK 2
15-Jan 2 Hours  Exposure Assessment Strategies (NS)
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


Lab Due:  Data exploration

17-Jan 1 Hour  Lab: Presentation and precision of distribution parameters
Exceedance fractions, sample size and compliance exercise using the DEMS data. Includes assessing distributions, calculation of lognormal (LN) parameters, exceedance. Data presentation principles.
### WEEK 3

**22-Jan**  
2 Hours  
**Regression Models and Regression for Association (LS)**

- Linear regression introduction Estimation vs. prediction goals
- Dummy Variables Co-factors, Confounding, Interaction
- Mean and variance models concepts
- Model selection for association models

**Readings Due:**  
DEMS IV – Vermeulen et al 2012  
Friesen MC, Davies HK, Teschke K, Marion S, Demers PA. Predicting historical dust and wood dust exposure in sawmills: Model development and validation. *JOEH*, 2005, 2:650-8

**Optional reading:**  

**For Lab:** also skim Mercer, 2011. Comparing universal kriging and land-use regression for predicting concentrations of gaseous oxides of nitrogen (NOx) for the Multi-Ethnic Study of Atherosclerosis and Air Pollution (MESA Air). *Atmospheric Environment* 45 (2011) 4412-4420.

**Lab Due:**  
Distributions

**24-Jan**  
1 Hour  
**Lab: Fitting and Interpreting Regression Models (LS)**

Regression model practice using the Snapshot data

### WEEK 4

**29-Jan**  
2 Hours  
**Prediction Modeling and Validation (LS)**

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

**Readings Due:**  

**Lab Due:**  
Regression models

**31-Jan**  
1 Hours  
**Lab: Prediction Modeling and Validation (LS)**

Bias-variance tradeoff and cross-validation exercise using the Snapshot data
WEEK 5

5-Feb  2 Hours  NO CLASS: SNOW DAY
Lab Due:  Regression for Prediction and Cross-validation
7-Feb  1 Hour  Review and Term Project Lab Introduction

WEEK 6

12-Feb  2 Hours  Variance Components and Mixed Models (LS)
Variance components estimation
Integration of variance components and regression: Mixed models

Readings Due:

Optional reading:

14-Feb  1 Hour  Lab: Variance Components from Mixed Models (LS)
Fit a mixed model, adjusting variable included in random and fixed terms and provide contrasting interpretations. Describe fixed and random effects in Welding School data.

WEEK 7

19-Feb  2 Hours  Measurement Error in Epidemiology (LS)
Misclassification
Regression measurement error
Classical and Berkson error models
Consequences and exceptions

Readings Due:

Lab Due:  Variance Components Analysis

21-Feb  1 Hours  Lab: Measurement Error Exercise (LS)
Measurement error exercise using simulation
WEEK 8
26 Feb  2 Hours  Meta-analysis, DEMS Risk Assessment (NS/LS)


Supplemental readings: Berman DW. Case BW. Overreliance on a single study: There is no real evidence that applying quality criteria to exposure in asbestos epidemiology affects the estimated risk. Ann Occup Hyg. 56: 869-878 (2012).
DEMS III – Vermeulen et al 2010
Revisit DEMS II – Coble
Revisit DEMS V – Stewart et al 2012
More optional: Read: Borak 2011 Comment and Stewart’s reply ,

28-Feb  1 Hours  Lab: Meta-analysis Lab
Explore and select models for prediction using personal REC data
Explore and describe CO historical data and covariates
Systematically evaluate quality of exposure assessments for Diesel and Lung CA Studies.
WEEK 9
5-Mar  2 Hours  Air Pollutant Exposure Modeling (LS)
Land Use Regression (LUR) with extension to geostatistical smoothing. Kriging and variograms.


7-Mar  1 Hour  Lab: Geostatistics and Universal Kriging (LS)
Geostatistics: Kriging and Variograms using the Snapshot data

WEEK 10
12-Mar  2 Hours  Biomonitoring and the Exposome (NS)
Comparison of biomonitoring and external exposure monitoring
Physiologic Dampening
Exposome concepts and realities


Lab Due: Geostatistics and Variograms

14-Mar  1 Hours  Lab: Problem-solving for term project (NS)
Review and problem-solving for term project
EXAM WEEK

19-Mar
Term project due