Course Syllabus for
SPPH 500 – Analytical Methods in Epidemiological Research
Section 007, January, 2020

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Calendar Description

Basic epidemiological designs as a framework for commonly used biostatistical techniques such as the Mantel-Haenszel, chi-squared, linear and logistic regression, and survival analysis. Computer packages will be available for computation of assignments.

Learning Objectives

This course is intended to provide a solid understanding of the concepts, principles, and interpretation of multivariable regression modeling. These key principles will be covered using a combination of examples, review of journal articles and relevant case studies. Students will be required to effectively communicate statistical concepts, interpret statistical models, critically evaluate the application of these models, and present findings. On completion of this course the student should be able to:

1. Distinguish between different objectives of a regression analysis;
2. Understand the principles of model development for each objective;
3. Relate regression models (linear, logistic, Poisson, survival) to appropriate types of health outcome data;
4. Interpret parameters of each regression model and summarize results for scientific journals;
5. Critically evaluate the analytic methods sections in health care literature;
6. Communicate effectively with statistical practitioners on regression methods.

Pre-requisites

SPPH 400 (or SPPH 567), SPPH 502, or permission of the Instructor

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Course Format

In-class seminars Mondays 1:00pm – 4:00pm from January 6, 2020 to March 31, 2020 excluding February 17, 2020.

Statistical software will be used in-class to support illustration of the modeling process; students are encouraged to use statistical software to facilitate learning but assignments will not require its use.

Reference Texts

Vittinghoff E, Glidden D, Shiboski S and McCulloch C. *Regression Methods in Biostatistics, 2nd ed.* Springer 2011. *(primary course text; available online through the UBC library)*

Rothman, KJ, Greenland S and Lash TL. *Modern Epidemiology, 3rd ed*. Wolters Kluwer 2008.

Gelman A, and Hill J. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge 2007.

Assessment, Evaluation and Grading

In-class participation (20%): Students are expected to have read the designated literature prior to class and be prepared to contribute actively to the discussion.

Class summaries (50%)**:** Following each class, students will prepare a summary (no more than 1000 words, say) of the most important 3 to 5 "take-home points" from the class. Each point should be accompanied by a short explanation of the underlying rationale. For example, the point "Do not choose adjustment variables for a causal model based on p-values" should be accompanied by an explanation such as "The p-value does not tell you whether bias is introduced by including/excluding the variable." **These summaries are due 11:59pm on the Thursday following the class (the aim is to of have the summaries marked and returned prior to the next class). Late assignments are not accepted. Please submit in a Microsoft Word compatible format to enable addition of comments.** Assessment of these summaries will be based on accuracy of points made and clarity of exposition.

Final project (30%): The final project will be a critique of a published journal article (individually chosen by each student; approved by the instructor) that involved a substantial amount of regression modeling. **It is comprised of a presentation in the last class and a write-up due one week after the last class.**

Course Topics and Required Readings

Lecture 1: (Jan 6)

- Introduction: Course outline, policies
- Review of basic concepts and definitions in statistics (population, sample, parameter, statistic/estimator, etc)
- Key objectives of statistical modeling (data summarization, prediction, causal effect estimation)
- General approach and principles in data analysis, role of design and sampling

Lecture 2: (Jan 13)

- Simple and multiple linear regression, basics
  Ref: Vittinghoff 4.1 – 4.2
- Analysis of variance and analysis of covariance
  Ref: Vittinghoff 4.3

Lecture 3: (Jan 20)

- Modeling variable interactions/effect modification
  Ref: Vittinghoff 4.6

- Data transformations; guidelines and impact on model interpretation
  Ref: Vittinghoff 4.7

Lecture 4: (Jan 27)

- Principles of variable selection for estimating causal effects: confounding bias, causal graphs, adjusted effect, multicollinearity considerations, direct vs indirect effects
  Ref: Vittinghoff 10.2 – 10.6, Rothman 12
- Principles of variable selection for prediction: prediction errors, over-fitting and bias-variance trade-offs, AIC, cross-validation, practical considerations
  Ref: Vittinghoff 10.1, 10.2 – 10.6
- Interpreting and reporting linear regression models

Lecture 5: (Feb 3)

- Logistic regression, basics
  Ref: Vittinghoff 5.1 – 5.4, 5.8
- Regression coefficients; relationship to contingency tables
- Assumptions and categorical variables
  Ref: Vittinghoff 5.1

Lecture 6: (Feb 10)

- Logistic regression case study – estimating a causal effect, omitted variable bias
- Logistic regression case study – developing a predictive model, sensitivity, specificity, ROC curves
  Ref: Vittinghoff 5.2.5 – 5.2.6

Lecture 7: (Feb 24)

- Matched case-control studies; conditional logistic regression
  Ref: Vittinghoff 5.3
- Poisson regression
  Ref: Vittinghoff 8.1 – 8.3

Lecture 8: (Mar 3)

- Time to event data, censoring, hazard rates & ratios, Kaplan-Meier method
  Ref: Vittinghoff 3.5
- Cox proportional hazards model
  Vittinghoff 6.1, 6.2, 6.4

Lecture 9: (Mar 10)

- Survival models continued, time-dependent exposures, more on censoring
  Vittinghoff 6.3, 6.6 – 6.9
- Accounting for non-simple random sampling
  Ref: Vittinghoff 12.1 – 12.6

Lecture 10: (Mar 17)

- Modeling hierarchical/clustered/longitudinal data, basics
  Ref: Vittinghoff 7.1 – 7.12

Lecture 11: (Mar 24)

- Approaches to missing data
  Ref: Vittinghoff 11.1 – 11.9

- Causal modeling (by guest lecturer)

Lecture 12: (Mar 31)

- Student presentations

UBC's values and policies

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