CPH930 Advanced Biostatistics Methods in Public Health

Instructor: Dr. Heather M Bush

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TA: Tim Crawford

Lectures: T 3:30 – 5:30 CPH 207
Labs: T 6:00 – 8:00 CPH 207
Text Book: *Fundamentals of Biostatistics*, Rosner
Prerequisite: STA580 or equivalent
DrPH Standing

Learning Objectives:

Upon successful completion of this course, a student will be able to identify appropriate statistical methods for his or her research and be prepared to critically review the statistical methods incorporated in public health literature. Specifically, the objectives of the course are as follows:

1. Learn basic principles of probability for binomial and Poisson distributions.
2. Utilize statistical methodologies such as multiple regression, logistic regression, Poisson regression, and the Cox proportional hazards model.
3. Learn basic principles for designing and analyzing epidemiologic studies, including confounding, standardization, and stratification.
4. Develop a familiarity with the design and analysis of studies routinely used in public health and medicine: crossover studies, equivalence studies, meta-analysis studies, and studies with clustered responses.

Method of Evaluation:

Examinations (35%):
Students will be asked to answer a series of questions pertaining to published articles that utilize the methods discussed in lecture and lab.

Statistical Methods Application (60%)
Students will be expected to complete four writing assignments in biostatistics applications. For each of these assignments, students will be expected to provide written reports which may include the analysis and interpretation of data.
(See handout for additional information).

In-Class Assignments (5%)
The primary purpose of in-class assignments is to facilitate the retention of main ideas covered in lecture and group discussion. These will be completed in-class, so late assignments or make-ups for unexcused absences will not be accepted. Only students with excused absences will be permitted to make-up or submit late assignments.

Grading Scale:
100 – 90 = A
89 – 75 = B
75 – 60 = C
60 – 0 = E

Policies:

Attendance Policy: The course is designed so that students should be successful with *active participation* and regular, punctual attendance. It is understandable that students may miss class; however, it is the student's responsibility to determine what assignments were missed and what material was covered. Students missing 5 or more class periods (excused or unexcused) will receive an E for the course.

Late Work: Only students with university excused absences or circumstances which the instructor finds a reasonable cause for non-attendance will be allowed to submit late work without penalty. Late work is defined as any work handed in after the scheduled due date and time. It is the student's responsibility to make arrangements for determining and handing in missed work, preferably in advance, but no later than one week after the absence. In all other cases, late work will be penalized 15% for each day late, and assignments will not be accepted more than one week late.

Academic Integrity: The Department of Biostatistics, the College of Public Health, and the University of Kentucky place a premium on academic honesty. Please refer to the University of Kentucky Student Rights and Responsibilities document.

Accommodations: If you have a documented disability that requires academic accommodations, please contact me as soon as possible. In order to receive accommodations in this course, you must provide a Letter of Accommodation from the Disability Resource Center.

Unforeseen Contingencies: In the unlikely event that an unforeseen contingency requires additional course policies, you will be promptly notified in an e-mail memorandum.

Course Description:
CPH 930 covers statistical methods used in public health studies. This includes receiver operator curves, multiple regression, logistic regression, confounding and stratification, the Mantel-Haenszel procedure, and the Cox proportional hazards model.

Tentative Schedule of Topics and Assignments:

Date	Topic	Readings	Due Dates
Jan 20	A Review of Descriptive Statistics and Statistical Tests Understanding the ANOVA Table	ROSNER: 2, 8, 10, 11.1-11.6, 12.1-12.5 SASHELP: SAS Basic SASHELP: Simple Procedures 1 SASHELP: Simple Procedures 2	
Jan 27	Multiple Linear Regression: Mechanisms	ROSNER: 11.9-11.11 SASHELP: Creating Tables SASHELP: Linear Regression	
Feb 3	Multiple Regression: Confounding and Variable Selection	ROSNER: 11.9-11.1, 13.4 SASHELP: Linear Regression	
Feb 10	Multiple Linear Regression: Diagnostic Tests and Residuals	ROSNER: 11.9-11.11 SASHELP: Linear Regression	Examination 1
Feb 17	Categorical Methods: Measures of Association	ROSNER: 13.1-13.6 SASHELP: Categorical Outcomes	Project 1Due
Feb 24	Logistic Regression: Mechanisms	ROSNER: 13.7 SASHELP: Logistic Regression	
Mar 3	Logistic Regression: Diagnostics	ROSNER: 13.7 SASHELP: Logistic Regression SASHELP: ROC Curves	
Mar 10	Logistic Regression Wrap-Up Meta-Analysis	ROSNER: 13.7-13.8 SASHELP: Logistic Regression	Examination 2
Mar 17	No Class Spring Break!		
Mar 24	Crossover Designs Equivalence Studies	ROSNER: 13.9-10	Project 2 Due
Mar 31	Incidence Rates Clustered Responses	ROSNER: 14.1-14.7	
Apr 7	Survival Analysis: Introduction and Mechanisms	ROSNER: 14.8-14.9 SASHELP: Time to Event Outcomes	
Apr 14	Survival Analysis: Log-Rank Test and Cox Regression	ROSNER: 14.10-11 SASHELP: Time to Event Outcomes SASHELP: Cox Regression	Examination 3
Apr 21	Cox Regression: Diagnostics and Variable Selection	ROSNER:14.11 SASHELP: Cox Regression	
Apr 28	Generalized Linear Models: Poisson Regression	SASHELP: Count Outcomes	Project 3 Due Examination 4
May 7	Exam Week		Project 4 Due

Competency attainment

Terminal Objectives in Biostatistics	**Competencies**	**Level of Attainment**
1. Explain basic principles of statistical estimation and inference.	a. Conceptualize sample measurements as realizations of random variables; b. Conceptualize estimates of population parameters as realizations of random variables; c. Construct confidence intervals for population parameters; d. Formulate statistical hypothesis tests concerning population parameters; e. Quantify the power of some basic hypothesis tests; f. Determine appropriate sample sizes for some basic hypothesis tests; g. Articulate the relationship between confidence intervals and hypothesis tests.	2 2 2 2 2 2 2
2. Identify and use standard experimental and sampling designs.	Be conversant in the use of the following: a. designing and analyzing a two way lay out with interaction; b. designing and analyzing experiments with repeated measures; c. designing and analyzing simple cross over experiments; d. adjusting for the effects of confounders and/or stratifying variables; e. explaining the biostatistical components of a clinical trial including large prevention trials in public health and community intervention studies; f. monitoring the progress of a disease over time using time series analysis or disease surveillance methods; g. applying spatial statistics to a problem in public health that has a geographic component.	 2 1 2 2
3. Understand elementary probability concepts used in Public Health.	a. Characterize conditional probability both mathematically and intuitively; b. Express the specificity of a diagnostic test as a conditional probability; c. Express the sensitivity of a diagnostic test as a conditional probability; d. Construct and interpret the receiver operator curve of a diagnostic test; e. Apply Bayes' Theorem to calculate the predictive positive value of a diagnostic test from the specificity, sensitivity, and disease prevalence; f. Describe the binomial probability model and the contexts in which it arises; g. Describe the Poisson probability model and the contexts in which it arises; h. Employ Markov chains to describe random phenomena with a special probabilistic structure.	2 2 2 2 2 2 2
4. Apply statistical methods commonly encountered in univariate data analysis.	a. Use descriptive statistics effectively; b. Perform paired and independent t-tests to compare means; c. Calculate chi squared statistics to compare proportions as well as construct confidence intervals for odds ratios and relative risk; d. Analyze data obtained from one way ANOVA designs (including multiple comparisons and contrast); e. Fit a simple linear regression model; f. Construct Kaplan Meier curves for right censored observations and compute the log rank statistic to compare these curves between two groups.	2 2 2 2 2 2

5. Apply statistical methods commonly encountered in multivariate data analysis.	a. Identify and apply appropriate multivariate statistical models including multiple linear regression, logistic regression, Poisson regression, proportional hazards regression, and mixed models; b. Critically interpret the outcomes of the multivariate analysis; c. Conduct graphical and analytical model diagnostics, and recommend remedies based on the diagnostics; d. Integrate the outcomes of multiple studies using meta analysis.	2 2 2 1
6. Gather, organize, and manage health survey data.	a. Design a health survey instrument; b. Assess instrument/item reliability and validity; c. Draw and analyze a simple random sample of measurements; d. Implement and analyze more complex survey designs including stratified samples, clustered samples, and multistage samples; e. Process incomplete data using imputation; f. Adopt an appropriate weighting scheme for observations in a health survey.	 1 1
7. Effectively use statistical software to collect, manage, and analyze Public Health data.	a. Master the use of SAS analyst, a click and point statistical software; b. Acquire the skills necessary to write code for SAS programs; c. Understand the principles of data acquisition, verification, and validation; d. Become skilled at editing, combining, and linking data sets; e. Learn the fundamentals of data manipulation and analysis; f. Efficiently create tables, graphs, and reports; g. Learn the fundamentals of the SAS macro facility; h. Learn to use nQuery Advisor, a sample size calculation software program.	1 1
8. Critically review biostatistical issues arising in Public Health literature.	a. Demonstrate they can select appropriate statistical methods for the problem; b. Resolve controversial issues associated with competing solutions in biostatistics for the same problem (discussing strengths and weaknesses).	2 1
9. Interpret and clearly express findings.	a. Interpret univariate statistical models; b. Interpret complex multivariate statistical models; c. Express their findings clearly both verbally and in writing.	2 2 1
10. Integrate principles of biostatistics in the practice of Public Health.	a. Use statistical methodology to analyze public health data; b. Recognize the potential for statistics to aid in the development of guidelines and policies, the implementation and management of programs, and the evaluation of programs.	2