



**EMORY**

**ROLLINS  
SCHOOL OF  
PUBLIC  
HEALTH**

**DEPARTMENT:** Biostatistics and Bioinformatics

**COURSE NUMBER:** BIOS 506 **SECTION NUMBER:** 2

**CREDIT HOURS:** 4 **SEMESTER:** Fall, 2020

**COURSE TITLE:** Foundations of Biostatistical Methods

**CLASS HOURS AND LOCATION:** 4 hours/week, CNR 1055

**INSTRUCTOR NAME:** Jeff Switchenko

**INSTRUCTOR CONTACT INFORMATION**

**EMAIL:** jswitch@emory.edu

**COURSE DESCRIPTION**

This course is a mathematically sophisticated introduction to the concepts and methods of biostatistical data analysis. The topics include descriptive statistics; probability; detailed development of the binomial, Poisson and normal distributions; sampling distributions; point and confidence interval estimation; hypothesis testing; a variety of one- and two-sample parametric and non-parametric methods for analyzing continuous or discrete data and simple linear regression. The course will also equip students with computer skills for implementing these statistical methods using standard software R. Prerequisites: College-level courses in linear algebra and calculus.

**MPH/MSPH FOUNDATIONAL COMPETENCIES:**

Analyze quantitative data using biostatistics, informatics, computer-based programming and software, as appropriate

**CONCENTRATION COMPETENCIES:**

MPH/MSPH Foundational Competency assessed	Representative Assignment
Analyze quantitative data using biostatistics, informatics, computer-based programming and software, as appropriate	<ol style="list-style-type: none"> <li>1. Homework Assignments</li> <li>2. Take-home midterm exams</li> </ol>
BIOS Concentration Competencies assessed	Representative Assignment

B <sub>M</sub> PH2: Collaborate with investigators in the design of clinical and observational studies, including sample size estimation.	Homework 3 and 4 Take-home midterm exams
B <sub>M</sub> PH5: Become familiar with fundamental concepts of probability and inference used in statistical methodology	Homework 1
B <sub>M</sub> PH6: Communicate the results of statistical analyses to a broad audience.	Take-home midterm exams
B <sub>M</sub> SPH1: Use concepts in probability and statistical theory to define performance and extend basic statistical analysis techniques.	Homework 2 and 3 Take-home midterm exams

## COURSE LEARNING OBJECTIVES:

### EVALUATION

**Homework (25%)** Five homework problem will be regularly assigned. The problem sets provide experience analyzing data using methods discussed in class, as well as additional methodological investigations. Students are encouraged to discuss homework problems and work with each other. The final write-ups must be independent work and are due at the start of class on the due date. Without prior approval, no late homework will be accepted after the solutions have been posted (usually within 2 days). 20% in grade will be deducted for late homework. Questions about graded homework should be addressed within 2 weeks of receiving the graded assignment. The homework assignments will also be graded for clarity and presentation.

**Midterms (40%)** There will be two take-home midterm exams. Weights for missed exams for approved emergencies/events will be assigned to the final exam.

**Final Exam (35%)** An in-class open-book/notes exam will be conducted during the final exam period.

### COURSE STRUCTURE

Course notes will be delivered during lectures with reading assignments from the textbook: Fundamentals of Biostatistics 8 th Ed by Bernard Rosner.

R will be used for statistical computing and data analysis. R is freely available and can also be accessed via RSPH Desktop. R can be downloaded from: <https://cran.rproject.org/>

Course materials (e.g. lecture handouts, homework and solutions, sample R code) will be posted on Canvas.

## RSPH POLICIES

### **Accessibility and Accommodations**

Accessibility Services works with students who have disabilities to provide reasonable accommodations. In order to receive consideration for reasonable accommodations, you must contact the Office of Accessibility Services (OAS). It is the responsibility of the student to register with OAS. Please note that accommodations are not retroactive and that disability accommodations are not provided until an accommodation letter has been processed.

Students who registered with OAS and have a letter outlining their academic accommodations are strongly encouraged to coordinate a meeting time with me to discuss a protocol to implement the accommodations as needed throughout the semester. This meeting should occur as early in the semester as possible.

Contact Accessibility Services for more information at (404) 727-9877 or [accessibility@emory.edu](mailto:accessibility@emory.edu). Additional information is available at the OAS website at <http://equityandinclusion.emory.edu/access/students/index.html>

### **Honor Code**

**You are bound by Emory University's Student Honor and Conduct Code.** RSPH requires that all material submitted by a student fulfilling his or her academic course of study must be the original work of the student. Violations of academic honor include any action by a student indicating dishonesty or a lack of integrity in academic ethics. *Academic dishonesty refers to cheating, plagiarizing, assisting other students without authorization, lying, tampering, or stealing in performing any academic work, and will not be tolerated under any circumstances.*

The RSPH Honor Code states: "Plagiarism is the act of presenting as one's own work the expression, words, or ideas of another person whether published or unpublished (including the work of another student). A writer's work should be regarded as his/her own property." ([http://www.sph.emory.edu/cms/current\\_students/enrollment\\_services/honor\\_code.html](http://www.sph.emory.edu/cms/current_students/enrollment_services/honor_code.html))

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## **COURSE CALENDAR**

### **Important Dates**

- 8/30 No class
- 10/09 No class (Fall break)
- 11/13 No class (APHA Conference)
- 11/22 No class (Thanksgiving break)

### **Tentative Timeline**

- A. Probability
  - 1. Definitions and axioms

2. Independence, conditional probability, Bayes' Theorem
3. Random variables
4. Discrete and continuous probability distributions
5. Mean and variance
6. Transformation of random variable

#### B. Inference for One Population

1. Inference for means and proportions
2. Inference for variance
3. Confidence intervals
4. Central limit theorem
5. Hypothesis testing, p-value, significance levels
6. Power and sample size

#### C. Issues in Statistical Analyses

1. Inference paradigms (Frequentists, Bayesian, likelihood)
2. Bootstrap
3. Bayesian inference
4. Multiple testing

#### D. Inference for Two Populations

1. Comparing two means
2. Paired samples comparison
3. Comparing two proportions
4. Permutation test

#### E. Contingency Tables

1. 2 x 2 tables, test, Fisher's exact test
2. r x c tables, goodness-of-fit test

#### F. Methods in Epidemiology

1. Prospective, case-control, cross-section designs
2. Relative risk, odds ratio
3. Simpson's paradox and Mantel-Haenszel test
4. Matching and McNemar's test

#### G. Nonparametric Methods

1. Signed rank test
2. Wilcoxon rank sum test
3. Kruskal Wallis test

#### H. Regression Modeling

1. Statistical model
2. Measures of correlation
3. Simple linear regression
4. Connections to one- and two-sample inference

## 5. Confounders, interactions, effect modification