EMORY
ROLLINS SCHOOL OF PUBLIC HEALTH

DEPARTMENT: BIOS

COURSE NUMBER: 511 **SECTION NUMBER:**

CREDIT HOURS: 4 **SEMESTER:** Spring 2020

COURSE TITLE: Introduction to Statistical Inference

CLASS HOURS AND LOCATION: TBD

INSTRUCTOR NAME: David Benkeser

INSTRUCTOR CONTACT INFORMATION

EMAIL: benkeser@emory.edu

PHONE: (404)712-9975

SCHOOL ADDRESS OR MAILBOX LOCATION: 1518-002-3AA

OFFICE HOURS

Teaching Assistant(s): TBD

COURSE DESCRIPTION

This course provides an introduction to statistical inference. The course is required for Biostatistics MPH students and taken in the second semester of the first year. Fundamental concepts in statistical inference will be covered including: statistical models, sampling distributions, standard errors, asymptotic normality, confidence intervals, hypothesis tests, power analysis. Common frameworks for inference will be discussed including: parametric/likelihood-based inference, the delta method, bootstrap, permutation tests, Bayesian inference.

MPH/MSPH FOUNDATIONAL COMPETENCIES:

- Analyze quantitative data using biostatistics, informatics, computer-based programming and software, as appropriate
- Interpret results of data analysis for public health research, policy or practice
- Select communication strategies for different audiences and sectors

CONCENTRATION COMPETENCIES:

- Design clinical and observational studies, including sample size estimation, in collaborative research teams.
- Use statistical software for data management and exploratory data analysis.
- Explain fundamental concepts of probability and inference used in statistical methodology.
- Communicate the results of statistical analyses to a broad audience.

EVALUATION

Homework (weekly): 40%

Students are expected to complete weekly homework assignments. Each assignment will evaluate the students' understanding in three areas: statistical theory, application, and computation. Multiple questions for each area will be included in each assignment. Students will have the ability to choose which problems to answer but must complete at least one problem in each category. An example of a theory question is to derive a maximum likelihood estimator. An example of an application question is to analyze a data set, interpret, and write about the results. An example computation question is to execute a simulation study to compute the coverage of a confidence interval.

Midterm (take home): 30%

A take home midterm exam will be given. Students will have one week to finish the exam and are expected to work independently. As with homework, the exam will be a mix of theory, application, and computation, and students will have the option of completing different "types" of questions.

Final (take home): 30%

Similar to the midterm.

Grade scale:

- A = 93 -- 100%
- A- = 90 -- 93%
- B+ = 87 – 90%
- B = 83 – 85%
- B- = 80 – 83%
- C = 65 – 80%
- F = <65%

COURSE STRUCTURE

The course will be organized into weekly lectures consisting of a combination of electronic slides, whiteboard problem solving, and computational demonstrations. Students are expected to ask and answer questions in class.

MPH/MSPH Foundational Competency assessed	Representative Assignment
Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate	Homework assignments and exams will involve analysis of real data sets
Interpret results of data analysis for public health research, policy or practice	Homework assignments and exams will involve interpretation of confidence intervals and hypothesis tests.
Select communication strategies for different audiences and sectors	Lectures will emphasize common barriers to communication of statistical ideas. Homework questions will be assigned that require students to interpret statistical techniques in a way that is appropriate to statistical audiences, but also in a way that is appropriate to applied researchers with no statistics background.
BIOS Concentration Competencies assessed	**Representative Assignment**
Design clinical and observational studies, including sample size estimation, in collaborative research teams.	Homework assignments in the sections on power will require simulation-based power calculations.
Use statistical software for data management and exploratory data analysis.	Homework assignments and exams will require programming in R or a similar language.
Explain fundamental concepts of probability and inference used in statistical methodology.	Homework assignments will require interpreting results of a statistical analysis, including interpreting confidence intervals, p-values, Bayesian inference, etc.
Communicate the results of statistical analyses to a broad audience.	Homeworks and exams will require interpreting the same results, but in a way that is appropriate for different audiences.

COURSE POLICIES

Students are expected to attend lectures and ask questions during class. For computational assignments, students are encouraged, but not required, to bring a laptop to class to follow along with code demonstrations. An encouraged textbook companion to the course is “All of Statistics” by Larry Wasserman.

As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Equity and Inclusion, 404-727-9877.

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. 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)

COURSE CALENDAR AND OUTLINE

Topics and dates are subject to change as the semester progresses.

Date	Topics	Evaluations

M - 1/14	Review: super populations, distributions, pdfs, cdfs, parameters, expectation	
W - 1/16	Review: central limit theorem, delta method, models (parametric vs. nonparametric)	HW 1 given
M - 1/21	MLK HOLIDAY	
W - 1/23	Concepts in estimation: bias, consistency, mean squared error	HW 1 due, HW 2 given
M - 1/28	Concepts in inference: sampling distributions, standard error	
W – 1/30	Concepts in inference: confidence intervals and hypothesis tests	HW 2 due, HW 3 given
M – 2/4	Empirical CDF, estimating statistical functionals	
W – 2/6	Simulation studies	HW 3 due, HW 4 given
M – 2/11	Bootstrap confidence intervals	
W – 2/13	Method of moments, introduction to likelihood-based estimation and inference	HW 4 due, HW 5 given
M – 2/18	Maximum likelihood estimation and inference	
W – 2/20	Maximum likelihood estimation and inference	HW 5 due, HW 6 given
M – 2/25	Masimum likelihood estimation and inference	
W – 2/27	Confidence intervals for MLE, delta method revisited, parametric bootstrap	HW 6 due, Midterm given
M – 3/4	Simulation studies for confidence intervals	
W – 3/6	Multi-parameter MLEs and delta method	Midterm due
M – 3/11	SPRING BREAK	
W – 3/13	SPRING BREAK	
M – 3/18	Introduction to testing: null and alternative hypotheses, one-sided, two-sided tests	
W – 3/20	Wald, score, and likelihood ratio tests	HW 7 given
M – 3/25	Wald, score, and likelihood ratio tests	
W – 3/27	Permutation tests	HW 7 due, HW 8 given
M – 4/1	Simulations for testing	
W – 4/3	Power calculations	HW 8 due, HW 9 given
M – 4/8	Modern issues in testing	
W – 4/10	Introduction to Bayesian inference	HW 9 due, HW 10 given
M – 4/15	Methods for Bayesian inference	
W – 4/17	Methods for Bayesian inference	HW 10 due
M – 4/22	Introduction to causal inference	Final exam given
W – 4/24	TBD	
M – 4/29	EXAM TIME – NO CLASS	
W – 5/1	EXAM TIME – NO CLASS	Final exam due