DEPARTMENT: BIOS

COURSE NUMBER: 513 **SECTION NUMBER:** 1

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

COURSE TITLE: Statistical Inference I

CLASS HOURS AND LOCATION:
Monday and Wednesday, 1:00-2:50pm
CNR 1034

INSTRUCTOR NAME: John Hanfelt, PhD

INSTRUCTOR CONTACT INFORMATION

EMAIL: jhanfel@emory.edu

PHONE: (404) 727-2876

SCHOOL ADDRESS OR MAILBOX LOCATION: GCR 330

OFFICE HOURS: Fridays 11-12 am or make an appointment

Teaching Assistant(s): Gavin Tian

COURSE DESCRIPTION

Introduces the theory of parameter estimation, interval estimation, and tests of hypotheses. In this course, we emphasize the classical "frequentist" (i.e., Neyman-Pearson-Wald) approach to inference. As time permits, we briefly explore alternative paradigms of inference such as neo-Fisherian, Bayesian, and statistical decision theory. This course is required for Biostatistics MSPH students and typically is taken in the second semester of the first year. An encouraged textbook companion to the course is Casella & Berger (2002). *Statistical Inference, 2nd ed.* Duxbury.

Prerequisite: BIOS 512 or permission of instructor

MPH/MSPH FOUNDATIONAL COMPETENCIES:

- Interpret results of data analysis for public health research, policy or practice

CONCENTRATION COMPETENCIES:

- $B_{MSPH}1$: Apply concepts in probability and statistical theory to define performance and extend basic statistical analysis techniques.
- $B_{MSPH}4$: Assess technical accuracy and performance of advanced analytic methods.

EVALUATION

Homework (8 assignments): 30%

Students are expected to complete all homework assignments and turn in the assignments at the assigned deadlines. Certain assignments will require students to generate plots using statistical software of the students' choosing. Students may work together in teams to discuss the homework questions, but each student must independently provide his or her own answers to the questions. Copying another person's solutions is not allowed. If a student discusses homework questions as part of a team, then, in order to cultivate professional ethics, the student should acknowledge the contributions of others by writing down the names of team members on the assignment.

Midterm Exam: 35%

An in-class midterm exam will be given. No books, notes, or electronic devices are allowed.

Final Exam: 35%

An in-class final exam will be given that covers the second half of the class only (i.e., the final exam is not comprehensive). No books, notes, or electronic devices are allowed.

Grade scale:

- A = 95 -- 100%
- A- = 90 -- 94%
- B+ = 85 – 89%
- B = 80 – 84%
- B- = 75 – 79%
- C+ = 70 – 74%
- C = 65 – 69%
- F = <65%

COURSE STRUCTURE

The course is organized into lectures primarily using the whiteboard. Students are expected to ask questions in class and participate in class discussions.

MPH/MSPH Foundational Competency assessed	Representative Assignment
Interpret results of data analysis for public health research, policy or practice	Homework assignments will include interpretation of confidence intervals and hypothesis tests.
BIOS Concentration Competencies assessed	**Representative Assignment**
$B_{MSPH}1$: Apply concepts in probability and statistical theory to define performance and extend basic statistical analysis techniques.	Homework assignments and exams will require the use of probability and statistical theory to examine the performance of the following: point estimators, with regard to bias, mean square error, consistency and asymptotic efficiency; confidence intervals, with regard to coverage probability and expected length; and hypothesis tests, with regard to size and power.
$B_{MSPH}4$: Assess technical accuracy and performance of advanced analytic methods.	Homework assignments and exams will require finding optimal analytic methods, including the best-supported point estimator, the minimum variance unbiased estimator, the asymptotically efficient point estimator, and the uniformly most powerful test.

COURSE POLICIES

Students are expected to attend lectures and ask questions during class.

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 - 1/13	Law of Likelihood; Likelihood Function	
W - 1/15	Likelihood for interval-censored data; Sufficient Statistics; Minimal Sufficient Statistics	HW 1 given
M - 1/20	MLK HOLIDAY	
W - 1/22	Maximum Likelihood Estimator (MLE)	HW 1 due, HW 2 given
M - 1/27	Method of Moments Estimator (MME); Criteria for evaluating point estimators: bias, mean square error, consistency	
W – 1/29	Assessing consistency: Mann-Wald Theorem, Weak Law of Large Numbers	HW 2 due, HW 3 given
M – 2/3	Minimum Variance Unbiased Estimator (MVUE): uniqueness, Rao-Blackwell Theorem	
W – 2/5	MVUE: implications of Rao-Blackwell Theorem	HW 3 due
M – 2/10	MVUE: completeness, Lehmann-Scheffe Theorem	
W – 2/12	MVUE in regular exponential family, examples & counter-examples	HW 4 given

M – 2/17	Cramer-Rao Lower Bound	
W – 2/19	Asymptotic normality & asymptotic efficiency of MLE	HW 4 due, HW 5 given
M – 2/24	Asymptotic normality (using Central Limit Theorem and Delta Theorem) & asymptotic inefficiency of MME	
W – 2/26	Sketch proofs: consistency and asymptotic normality of MLE	HW 5 due
M – 3/2	Review session for midterm exam	
W – 3/4	Midterm exam	Midterm due
M – 3/9	SPRING BREAK	
W – 3/11	SPRING BREAK	
M – 3/16	Interval estimation: Likelihood Interval, Confidence Interval, Pivotal Quantity	
W – 3/18	Confidence interval based on two independent normal samples; Welch-Satterthwaite approximation	
M – 3/23	Large-sample confidence intervals based on MLE or MME; Plug-in Principle; Improvements in medium-sized samples; Limitations of confidence interval	HW 6 given
W – 3/25	Hypothesis tests: Neyman-Pearson Lemma	
M – 3/30	Randomized Most Powerful Tests	
W – 4/1	Uniformly Most Powerful Test	HW 6 due
M – 4/6	Wald Test, Score Test, Likelihood Ratio Test	HW 7 given
W – 4/8	Fisher's Test of Significance	
M – 4/13	Modern concerns with testing	
W – 4/15	Bayesian inference: prior distribution, posterior distribution, Bayes estimator	HW 7 due; HW 8 given
M – 4/20	Empirical Bayesian inference	
W – 4/22	Statistical decision theory	
M – 4/27	Review session for final exam	HW 8 due
W – 4/29	FINALS PERIOD – NO CLASS	
M – 5/4	Final exam	Final exam due