SCHOOL OF
PUBLIC HEALTH
UNIVERSITY OF MINNESOTA

PUBH 8412, SECTION 001

Advanced Statistical Inference
Spring 2019

COURSE & CONTACT INFORMATION
Credits: 3
Meeting Time: Tuesday and Thursday 1p - 2:15p
Meeting Place: Malcolm Moos Health Science Tower 1-435

Instructor: Thomas Murray
Email: murra484@umn.edu
Office Phone: 612-626-6697
Office Hours: Wednesday 1p - 2p and Thursday 2:30p - 3:30p, or by appointment
Office Location: Mayo A459

Teaching Assistant: Souvik Seal
Email: sealx017@umn.edu
Office Hours: Tuesday and Thursday 11a - 12p in Mayo A446

COURSE DESCRIPTION
The course provides an overview of inferential methods critical to biostatistical research and will not rely overtly on measure-theoretic concepts. The course emphasizes classical likelihood inference, asymptotic distribution theory, robust inferential methods (M-estimation), bootstrap and jackknife.

COURSE PREREQUISITES
Stat 8101-8102 or equivalent. Students should be comfortable with the multivariate normal distribution and have some introduction to convergence concepts.

COURSE GOALS & OBJECTIVES
Upon completion of this course students will:
- Understand how to construct likelihoods
- Understand large-sample results for likelihood-based methods
- Understand likelihood-based tests and confidence regions
- Be familiar with several techniques to prove large sample convergence for a variety of estimators
- Understand how likelihood methods can be made more robust through the use of estimating functions
- Understand how to implement parametric and non-parametric bootstrap

METHODS OF INSTRUCTION AND WORK EXPECTATIONS
Course Workload Expectations
PubH 8412 is a 3 credit course. The University expects that for each credit, you will spend a **minimum** of three hours per week attending class or comparable online activity, reading, studying, completing assignments, etc. over the course of a 15-week term. Thus, this course requires approximately 135 hours of effort spread over the course of the term in order to earn an average grade.

Students are expected to attend class, participate in class discussions and complete the assigned homework and exams. Working together on homework is permitted but each student is expected to independently write-up homework assignments using their own computing and in their own words. Students are highly encouraged to work through the assignments throughout the week (rather than waiting until near the due date) in order to receive feedback from the instructor and the TA.

In this course, students are expected to engage with each other in respectful and thoughtful ways.

All student to student communication is covered by the Student Conduct Code (https://z.umn.edu/studentconduct).

COURSE TEXT

Boos, DD and Stefanski, LA (2013) Essential Statistical Inference: Theory and Methods. Springer ISBN-101461448174, ISBN-13 978-1461448174

The textbook is available online, free of charge, through the UMN libraries here. A link to the textbook is available on the course website as well.

COURSE OUTLINE/WEEKLY SCHEDULE

Week	Topic	Readings	Activities/Assignments
Week 1 01/21-01/25	• Introduction + Likelihood Construction	• 2.1-2.2.4	• 1.1, 1.2, 2.9
Week 2 01/27-02/01	• Likelihood Construction Cont.	• 2.2.5-2.4	• 2.10, 2.16, *
Week 3 02/04-02/08	• Maximum Likelihood Estimator	• 2.5 & 2.7	• 2.37, 2.44, 2.58, 2.60
Week 4 02/11-02/15	• Methods for finding the MLE	• 2.6	• 2.45, 2.46, *
Week 5 02/18-02/22	• Convergence Concepts	• 5.1-5.4	• *
Week 6 02/25-03/01	• Large Sample Tools	• 5.5	• 5.12, 5.13, 5.17, 5.20, 5.21
Week 7 03/04-03/08	• Large Sample Tools Cont.	• 5.5	• *, 5.27a, 5.33
Week 8 03/11-0315	• Review + Midterm	• None	• None
Spring Break (03/18-03/22)			
Week 9 03/25-03/29 (ENAR)	• Large Sample Results for MLE	• 6.1-6.5	• 6.1, 6.2, 6.6, 3.1
Week 10 04/01-04/05	• Likelihood-Based Tests and Confidence Regions	• 3.1-3.3, 6.6	• *
Week 11 04/08-04/12	• M-Estimation (Estimating Equations)	• 7.1, 7.2, 7.4, 8.2, 8.3.1	• 7.1, 7.2, 7.9, 8.10
Week 12 04/15-14/19	• Approximation by Averages + Jackknife	• 5.5.8, 10.1-10.3	• 5.42, 5.44, 8.5, 10.5, 10.9
Week 13 04/22-04/26	• Jackknife Cont. + Bootstrap	• 10.1-10.3, 11.1-11.6	• 11.1-11.6
Week 14 04/29-05/03	• Bootstrap Cont. + Review	• 11.1-11.6	• None
Final Exam (Tuesday 05/14 from 10:30a - 12:30p in Moos 1-435)			

* indicates additional problems available on the course website

SPH AND UNIVERSITY POLICIES & RESOURCES

The School of Public Health maintains up-to-date information about resources available to students, as well as formal course policies, on our website at www.sph.umn.edu/student-policies/. Students are expected to read and understand all policy information available at this link and are encouraged to make use of the resources available.

The University of Minnesota has official policies, including but not limited to the following:
- Grade definitions
- Scholastic dishonesty
- Makeup work for legitimate absences
- Student conduct code
- Sexual harassment, sexual assault, stalking and relationship violence
- Equity, diversity, equal employment opportunity, and affirmative action
- Disability services
- Academic freedom and responsibility

Resources available for students include:
- Confidential mental health services
- Disability accommodations
- Housing and financial instability resources
- Technology help
- Academic support

EVALUATION & GRADING

Homework Assignments
Homework assignments will be graded on a ternary scale with one point awarded for attempting all assigned problems and another for getting the correct solution to one of the assigned problems chosen by the instructor or teaching assistant. Working together on homework is permitted but each student is expected to independently write-up homework assignments using their own computing and in their own words. Students are highly encouraged to work through the assignments throughout the week (rather than waiting until near the due date) in order to receive feedback from the instructor and the TA.

Midterm and Final Exam
There will be an in-class midterm exam and an in-class final exam. These will be graded by the instructor.

Grading Scale
Your grade will be determined by a weighted average of your performance on the homework assignments (25%), midterm exam (35%) and final exam (40%).

The University uses plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following, and you can expect the grade lines to be drawn as follows:

% In Class	Grade	GPA
93 - 100%	A	4.000
90 - 92%	A-	3.667
87 - 89%	B+	3.333
83 - 86%	B	3.000
80 - 82%	B-	2.667
77 - 79%	C+	2.333
73 - 76%	C	2.000
70 - 72%	C-	1.667
67 - 69%	D+	1.333
63 - 66%	D	1.000
< 62%	F	

- A = achievement that is outstanding relative to the level necessary to meet course requirements.
- B = achievement that is significantly above the level necessary to meet course requirements.
- C = achievement that meets the course requirements in every respect.
- D = achievement that is worthy of credit even though it fails to meet fully the course requirements.
- F = failure because work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (Incomplete).
- S = achievement that is satisfactory, which is equivalent to a C- or better
- N = achievement that is not satisfactory and signifies that the work was either 1) completed but at a level that is not worthy of credit, or 2) not completed and there was no agreement between the instructor and student that the student would receive an I (Incomplete).

Evaluation/Grading Policy	Evaluation/Grading Policy Description
Scholastic Dishonesty, Plagiarism, Cheating, etc.	You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis (As defined in the Student Conduct Code). For additional information, please see https://z.umn.edu/dishonesty

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://z.umn.edu/integrity.

If you have additional questions, please clarify with your instructor. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism). |
Late Assignments	Contact the instructor prior to the due date to request an extension.
Attendance Requirements	Students are required to attend lectures.
Extra Credit	N/A