PM 522b Introduction to the Theory of Statistics (Part II)

Keck School of Medicine of USC

Units:	3
Term:	Spring 2019
Time:	W 10am-1pm
Location:	USC HSC, Soto Building Room 106
Instructor:	Meredith Franklin (Associate Professor)
Office:	SSB 202A
Office Hours:	W 1-2pm
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Course Description

PM522b follows PM522a with a rigorous introduction to statistical inference. The sequence PM522a-b is required for all the Biostatistics Ph.D. and M.S students, and is suggested for quantitatively oriented students in Epidemiology and other population-based sciences. Topics covered in 522b include the theoretical approaches to point estimation, evaluation of estimators, likelihood methods, numerical solutions to likelihood, hypothesis testing, asymptotics, and theoretical basis behind ANOVA and regression (if time permits).

Learning Objectives

Through this course, students will become familiar with commonly used inferential techniques. We will cover:

- the basic theoretical foundations of point estimation including method of moments and maximum likelihood
- properties of estimators
- the theory of hypothesis testing
- the theory of interval estimation
- asymptotic theory
- theoretical aspects of analysis of variance and linear regression

Prerequisite(s): PM522a
Recommended Preparation: courses in linear algebra and calculus

Course Notes

Lecture notes presented in class will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required

There will be some computation using R (downloaded from http://cran.r-project.org)

Required Readings and Supplementary Materials

Required text:

1) George Casella and Roger L. Berger *Statistical Inference, 2nd edition* (2002), Brooks/Cole.

Description and Assessment of Assignments

Assignments: There will be 10-11 assignments given throughout the semester, approximately every weeks. Students may discuss the problems with one another, however, individual solutions must be submitted and copying will not be tolerated. Late assignments will be penalized by 20% for each day past the due date.

Exams: There will be two in-class exams (midterm 2hrs, final 3hrs). A one-page "cheat sheet" will be allowed in both exams.

Participation: We will work through several examples in class, and students are expected to participate through discussion and problem solving.

Grading Breakdown

Assignment	**% of Grade**
In-class participation	5%
Homework (10-11)	30%
Midterm Exam	30%
Final Exam	35%
TOTAL	100%

Assignment Submission Policy

Assignments shall be submitted on Blackboard. Late homework assignments will not be accepted without penalty, except when verifiable extenuating circumstances can be demonstrated.

Course Schedule: A Weekly Breakdown

	Topics/Weekly Activities	Due Dates
Week 1 January 9	Intro to statistical inference, review of random variables, random samples, order statistics	
Week 2 January 16	Principles of data reduction: statistics, sufficiency principle, likelihood principle	
Week 3 January 23	Principles of data reduction con't: minimum sufficient statistics, exponential family	**HW1 Due**
Week 4 January 30	Methods for finding point estimators: maximum likelihood estimation	**HW2 Due**
Week 5 February 6	Methods for finding point estimators: numerical solutions to maximum likelihood estimation, EM algorithm	**HW3 Due**
Week 6 February 13	Methods for finding point estimators: moment generating functions, method of moments	**HW4 Due**
Week 7 February 20	Evaluating estimators: bias, mean squared error, best unbiased estimators (MVUE), the Cramer-Rao lower bound	**HW5 Due**
Week 8 February 27	Evaluating estimators: Cramer-Rao (con't) the Rao-Blackwell & Lehmann-Scheffe Theorems	**HW6 Due**
Week 9 March 6	Midterm Exam (2 hours)	**Midterm Exam**
Spring Break March 13	No Class	
Week 10 March 20	Hypothesis testing: simple and composite hypotheses, type I & type II error, p-values	
Week 11 March 27	Hypothesis testing: likelihood ratio test, Neyman-Pearson lemma	**HW7 Due**
Week 12 April 3	Interval estimation: confidence intervals, upper and lower bounds, coverage probabilities	**HW8 Due**
Week 13 April 10	Asymptotics: point estimators, rates of convergence, consistency, efficiency, asymptotic normality	**HW9 Due**
Week 14 April 17	Asymptotics: bootstrap, EM algorithm, robustness	**HW10 Due**
Week 15 April 24	Theoretical concepts behind ANOVA and linear regression Matrix representation of linear regression	**HW11 Due**
FINAL May 8	**In class final exam (3 hours)**	**Final Exam**

Statement on Academic Conduct and Support Systems

Academic Conduct:
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:
Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime
Provides overall safety to USC community. http://dps.usc.edu