

Syllabus

(Wed Aug 19, 2015 08:00 AM - Tue Dec 15, 2015 12:00 AM)

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BIOS 550: Basic Elements of Probability and Statistical Inference I

Fall 2017

Instructor: Young Truong, Professor of Biostatistics

Lectures: Monday, Wednesday 09:05-10:20, MG1304

Lab: Wednesday 3:35PM - 4:35PM, RO 0228

Course Objectives

To provide an introduction to the mathematical foundations of statistical inference and to set out the principles of hypothesis testing and confidence intervals.

Course Description

This course covers an introduction to set theory and basic probability, population, sample, random variables, discrete distributions, continuous distributions, moments, bivariate and multivariate distributions, independence, covariance, distributions of functions of random variables. Will cover the essential features of one sample and two sample inference for discrete and continuous response data, with an emphasis on parametric methods.

Prerequisites

Multivariate (especially two-variable) differential and integral calculus.

Required textbooks

Wackerly, Mendenhall and Scheaffer (2008). *Mathematical Statistics with Applications*. Duxbury Press. 7e.

Topics to be covered

- **Introduction to probability** -- Review of set theory, Venn diagrams, permutations and counting. Probabilities of events, conditional probability, additive, multiplicative laws, law of total probability, Bayes rule.
- **Discrete and continuous random variables** -- Discrete random variables, probability distributions, expectation and variance. Discrete distributions: binomial, geometric, negative binomial, Poisson, hypergeometric. Probability generating functions. Continuous distributions, distribution and density functions. Uniform, normal, exponential, gamma, beta distributions. Moments and moment generating functions. Some probability inequalities.
- **Bivariate and multivariate distributions** -- Bivariate distributions, joint, marginal and conditional distributions. Expectation of functions of random variables. Independence, covariance. Linear functions of random variables. Bivariate normal distribution. Multinomial distribution.

- **Functions of random variables and sampling distributions** -- Distribution of functions of random variables. Transformations and MGF-based methods for deriving sampling distributions. Random sample, statistic and its sampling distribution. Sampling distributions related to the normal: t, chi-square, F distribution. Central limit theorem. Order statistics.
- **Estimation** -- Point estimation, unbiasedness, MSE. Confidence intervals, large sample CI. Relative efficiency, consistency, sufficiency, Rao-Blackwell theorem, MVUE.
- **Methods of estimation and hypothesis testing** -- Method of moments. Likelihood and MLE. CIs for MLES. Likelihood ratios, hypothesis testing, P-values, goodness of fit-tests.
- **Special topics (if time permits)** -- Simple linear regression, categorical data, nonparametric tests, Markov chains, Bayesian statistics.

Course requirements/Assessment

- Midterm exams: 30%
- Final exam: 30%
- Class Participation: 10%
- Weekly homework assignmentst: 30%

Grading scale

A: 95-100, A-: 90-94, B+: 85-89, B: 80-84, B-: 76-79, C: 66-75, F: below 65.

H: 95-100, P: 66-94, F: below 65.

Attendance Policy

The course is designed so that students should be successful with active participation and regular, punctual attendance. It is understandable that students may miss class; however, it is the student's responsibility to determine what assignments were missed and what material was covered. Students missing 5 or more class periods (excused or unexcused) will receive an I for the course.

Late Work

Only students with university excused absences or circumstances which the instructor finds a reasonable cause for non-attendance will be allowed to submit late work without penalty. Late work is defined as any work handed in after the scheduled due date and time. It is the student's responsibility to make arrangements for determining and handing in missed work, preferably in advance, but no later than one week after the absence. In all other cases, late work will be penalized 15% for each day late, and assignments will not be accepted more than one week late.

Office hours

My office is MC3105A, phone is 6-7270. Office hours: MW 1400-1500. Questions by e-mail are most welcome.

TA:

Grader:

