PPHA 312: Mathematical Statistics for Public Policy I
Fall 2017

Instructor: Jesse Naidoo (**jnaidoo@uchicago.edu**)
Office Hours: Tuesday 9.30 - 10.20 AM, Harris Cafe, or by appointment.

Teaching Assistants:
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Office Hours: Wednesdays 4.00 - 5.00 PM, Harris Cafe, or by appointment.

This is an introductory course in mathematical statistics. I will assume you know calculus. Linear algebra is helpful but not required.

Lectures are Tuesdays and Thursdays, 10.30 AM - 11.50 AM, in Harris 289A.
TA sessions are Thursdays, 3.00 PM - 4.20 PM, in Harris 140C.

Problem sets will be due at the beginning of TA sessions (i.e. Thursday afternoons). I will post new problem sets on Thursdays. There will be six problem sets, due on October 5, 12, 19, and 26, and on November 10 and 17.

You are free to work with your classmates on problem sets, but you must hand in your own set of answers to the assigned problems.

Grades will be determined by a weighted average of your scores on the final exam, the midterm, and on the problem sets. The respective weights will be either 50%, 25%, and 25% OR 60%, 20%, and 20%, whichever is in your favor.

Important Dates

Midterm: Thursday, November 2^{nd} 10.30 AM - 11.50 AM (in class).

Final Exam: Thursday, December 7^{th}, 11.00 AM - 11.00 AM.

Textbooks

Mathematical Statistics with Applications (7th edition), by Wackerly, Mendenhall, and Sheaffer.

In previous years, we used *Mathematical Statistics and Data Analysis* (3rd edition), by John Rice. Both books cover the same material. However, some of the assigned exercises will come from the Wackerly et al book, so if you have to choose, it is better for you to buy (or rent) it rather than Rice. On the other hand, there are likely to be many secondhand copies of Rice for sale around Harris.

I will partly base my lectures on the text, but I may present the content in a slightly different way in class. Study several different sources (the internet may be useful here) and - most importantly! - do the problems to make sure you understand.

Syllabus

Univariate Distributions [4 lectures]

Basic probability theory: axioms for counting, conditional probability, independence. Some examples of distributions on the real line: binomial, Normal, Poisson, geometric. Moments. Chebyshev's inequality.

References: Rice Ch. 1 - 2; Wackerly et al., Ch. 2 - 4.

Multivariate Distributions [2 lectures]

Joint distributions and joint densities. Some examples. Conditional distributions and densities. Covariance and correlation; finding moments of linear combinations of random variables. Finding the distribution of functions of random variables; order statistics. An aside on "identification".

References: Rice Ch. 3 - 4; Wackerly et al, Ch. 5 - 6.

Large-Sample Approximations [3 lectures]

The classical (frequentist) paradigm. Weak law of large numbers. Central limit theorem. Simple random sampling and the standard error of the mean. Clustered and stratified random sampling. Correcting for nonresponse.

References: Rice Ch. 5 , 7; Wackerly et al, Ch. 7, 9.3.

Frequentist Estimation and Inference [4 lectures]

Hypothesis testing. Type I and Type II errors; test size and power. Desirable properties of estimators: lack of bias, efficiency, consistency. Maximum likelihood: principles and some examples. Confidence intervals.

References: Rice Ch. 8 - 9; Wackerly et al, Ch. 8 - 10.

Linear Regression [4 lectures]

Linear regression as an approximation. OLS estimates with one regressor. Large-sample properties of OLS estimators. Multiple linear regression.

References: Rice Ch. 14; Wackerly et al, Ch. 11.

One class will be taken up by the midterm, one by a pre-midterm review session, and one by a pre-exam review session.

This version: September 25, 2017