Economics 770
Introduction to Econometric Theory

Prof. Jonathan B. Hill

Lecture Time and Place   **Office and Office Hours**
Tues, Thurs. ####   GA 200F : Mon, Wed. 11:30-12:30
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Recitation Time and Place: ####

T.A. (email, office, hours): ####

Objectives
This course provides the statistical and probability theoretic foundations of econometrics, and will have practical value to Economics, Finance and Statistics Ph.D. students, in particular Economics students within any of the trilogy subfields: micro, macro or econometrics. The long run goal is to build a foundation for manipulating stochastic objects, including point estimation and inference, incorporating probability, mathematical statistics and large sample theory for point estimators, and minimum discrepancy estimators including least squares, maximum likelihood, empirical likelihood and generalized method of moments (many of the latter topics are treated in subsequent Ph.D. Econometrics courses here). The short-run goals include the following topics: probability theory, mathematical expectation, conditional expectation, modes of convergence, limit theorems, inequalities, and the asymptotics of maximum likelihood.

Evaluation
There will be one midterm exam (30%) that will take place in the evening (2 hours), a final exam (40%) in class (3 hours), and an assortment of assignments based on theory and some computer applications that involve programming simulations (30%). While students may consult with each other, each must turn in his or her own work.

Statistics Software
Students are expected to incorporate any major statistics software as they see fit, including possibly Matlab, Fortran, Stata, R, Ox, and so on. Matlab, Stata and Fortran are highly popular in Economics and Finance, while R is popular in statistics. Students can obtain Matlab inexpensively from UNC; R is shareware and therefore free online; Fortran is fairly expensive, but fast, with a massive support community. Students will be required to program simulations, so a point-and-click software will not satisfy our needs (e.g. Eviews, SPSS), and SAS does not have the sophistication to handle the type of code you need to write. See UNC's ITS software links[1] for students for free/cheap software (e.g. Matlab, STATA).

Reading and Textbooks

Required Reading
Hansen, B. E. (2020). *Probability and Statistics* (freely available, and stored in the course Sakai resources).
Casella, G. and R. L. Berger (2002), *Statistical Inference*, 2nd edition (pdf in Sakai resources)

I will focus lectures on **Hansen's** textbook material but will use **Casella and Berger's** from time to time due to its greater volume of examples. In terms of your studies, Hansen's text is inadequate since it lacks examples for some subtopics. Casella and Berger's fills in these gaps, as do the course lectures and other textbooks. Another good introductory book on statistics for economics students is Amemiya's *Introduction to Statistics and Econometrics* listed below.

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[1]Go to https://software.sites.unc.edu/.

Suggested Readings

Any graduate level textbook or monograph on the theory of probability, expectation, point estimation, and large sample theory will be helpful. Some that I have found helpful include the following, separated into texts written for econometricians and for statisticians.

Econometrics:
> Amemiya, T. (1985). *Advanced Econometrics*, Harvard Univ. Press
> Amemiya, T. (1994). *Introduction to Statistics and Econometrics*, Harvard Univ. Press
> White, H. (1996). *Estimation, Inference, and Specification Analysis*, Cambridge Univ. Press
> White, H. (2001). *Asymptotic Theory for Econometricians*, Academic Press

Statistics:
> Ash, R.B. and C.A.Doleans-Dade (2000). *Probability and Measure Theory*, Academic Press
> Dudley, R.M. (2002). *Real Analysis and Probability*, Cambridge Univ. Press
> Fristedt, B. and G. Gray (1997). *A Modern Approach to Probability Theory*, Bikhäuser
> Kallenberg, O. (1997). *Foundations of Modern Probability*, Springer (*e-book* at UNC Libraries)
> Shao, J. (2003). *Mathematical Statistics*, Springer (*e-book* at UNC Libraries)

Topics (*these may change during the semester*)	**Hansen Ch.**	**C/B Ch.**
1. Probability Theory	1	1.1-1.3
2. Real Random Variables and Expectations	2	1.4-1.6, 2.1-2.3, 3.6
3. Distributions	3, 5	3.1-3.4
4. Multivariate Distributions and Conditional Expectations	4, 5	4
5. Sampling, Point Estimation, Estimator Properties	6	5.1-5.3, 7.3.1, 7.3.2
6. Asymptotics: Law of Large Numbers, Central Limit Th.	7, 8	5.5
7. Confidence Intervals and Hypothesis Testing	12, 13	8.1, 8.2.1, 8.3.1,2,4, 9.1, 9.2.1, 9.3
8. Maximum Likelihood	10	6.1-6.4
9. Method of Moments	9	