Economics 770
Introduction to Econometric Theory

Prof. Jonathan B. Hill

Lecture Time, Zoom
Tues, Thurs. 8am-9:15am
Venue: GA 307
jbhill@email.unc.edu

Office Hours, Email
T,TH 11am-12pm in GA 200F
or M,W 3-4pm Zoom (appoint.)

Sakai: https://sakai.unc.edu/portal/site/Econ770Hill (official course site)
Canvas: https://uncch.instructure.com/courses/3062 (experimental: mimics Sakai)

Office hours are

1. **Tues. and Thurs. 11am-12pm in my office GA 200F**
2. **Or Mon. and Wed. 3pm-4pm on Zoom (https://unc.zoom.us/j/93338743833)**

You *must* set an appointment to meet by Zoom: I will not be waiting on Zoom for random students.

T.A. (email, hours)

Tianqi Li (tianqili@live.unc.edu), GA 412
Office hours: TBA.

Covid Announcement

I am fully vaccinated and boosted, and I hope all students are too. If you have **ANY *symptoms*** of any sort (runny nose, congestion, fever, etc.): **DO NOT COME TO LECTURE/RECITATION**. Please socially distance in the classroom as much as the classroom permits.

Devise Use

Students may only use a laptop or tablet for taking notes . ***Students may not use their phone (text, browse) for any reason during lecture***. If you have an emergency that requires a phone, you may leave the classroom to use their phone. This is a doctoral level course: there is no excuse for checking your phones during lecture. *I will call students out if I see phone use (sadly, it happens regularly).*

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 afternoon or evening (2 hours) on a date TBD, a final exam (40%) in class (3 hours) on a date/time set by UNC, 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 student 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, Python, 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, Python, 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** often due to its greater volume of examples and deeper theory. In terms of your studies, Hansen's text is inadequate since it lacks examples for some subtopics and lacks deepness at times. Casella and Berger's fills in these gaps, as do the course lectures and other textbooks.

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

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

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, 11	6.1-6.4