Dept. of Economics Fall 2013
UNC

Economics 770
Introduction to Econometric Theory

Prof. Jonathan B. Hill

Time and Place
Lecture: T, Th. 11am-12:15pm
Recitation: F 10:30am-11:45am in GA 007

Office Hours
T, Th. 10am-11am
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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 and measure theory, mathematical statistics and asymptotics for estimators, and minimum discrepancy estimators including nonlinear 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: measure theory, 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.

Students are expected to incorporate any major statistics software as they see fit, including possibly Gauss, Matlab, Fortran, R, Ox, and so on. Students will be required to program simulations, so a point-and-click software will not satisfy our needs (e.g. Eviews, SPSS). See UNC's links[1] for students for free software.

Reading and Textbooks

Required Reading

Bierens, H.J. (2004). *Introduction to the Mathematical and Statistical Foundations of Econometrics*, Cambridge University Press.

Suggested Readings

Any graduate level textbook or monograph on the theory of probability, expectation, measure, and asymptotics will be helpful. Some that I have found helpful include the following, separated into texts written for econometricians and for statisticians. I will use Amemiya (1994), Fristedt and Gray (1997) and Kallenberg (1997) for some lecture material due to gaps in Bierens (2004), but any related texts suitable to your tastes will work. I dictate those that are available in their entirety as *e-books* via UNC’s Libraries, but others have limited access via Google Book.

Econometrics:

Amemiya, T. (1985). *Advanced Econometrics*, Harvard Univ. Press
Amemiya, T. (1994). *Introduction to Statistics and Econometrics*, Harvard Univ. Press
Davidson, J. (1994). *Stochastic Limit Theory*, Oxford Univ. Press (*e-book* at UNC Libraries)

[1]Go to http://its.unc.edu/SoftwareAcquisition/index.htm and https://software.unc.edu/order/login.php?f=/order/.

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
Davidson, J. (1994). *Stochastic Limit Theory*, Oxford Univ. Press (*e-book* at UNC Libraries)
Doob, J.L. (1994). *Measure Theory*, Spring-Verlag
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 course of the semester*)	**Source (B. is required)**[2]
1. Probability and Measure	B. most of chapt. 1
1.1 Sample space	B. p. 1-3
1.2 Algebras and sigma-Algebras of events, Borel sets	B. p. 3-4, 11-14
1.3 Properties of sigma-algebras	B. p. 11-13, *D. 15-17*
1.3 Measure, probability measure, Lebesgue measure	B. p. 4-5, 10, 15, 19-20, *D. 36-39*
1.4 Combinatorics, Binomial, Hypergeometric	B. chap. 1, 4.1.1, 4.1.2, *A. chap. 2.3-2.5*
2. Real Random Variables	B. chapt. 1,2, 4
2.1 Random variables and vectors	B. 20-25, *D. 8.1-8.3*
2.2 Probability functions and the induced measure	B. 20-25
2.3 Density functions	B. 25-56, *A. chapt. 3*
2.4 Borel functions	B. 37-42
2.5 Measurable transformations	*D. 50-56*
2.6 Integrals: measure and Lebesgue integral, properties	B. 37-49, D. 36-39, 45,
2.7 Mathematical expectation, moment generation	B. 49-53, 55-59, *D. chapt. 9*, *A. chapt. 4*
2.8 Distributions: discrete, continuous	B. chapt. 4.1-4.3, 4.5-4.8, *A. chapt. 5*
3. Joint and conditional probability, expectations	B. 27, 28-30, chapt. 3, 4.4
3.1 Conditional Probability and Independence	*D. 10.1-1.04, 10.6*
3.2 Independence of random variables	
3.3 Conditional expectation, conditional variance	B. chapt. 3
3.4 Joint moments: covariance, conditional covariance	B. 50, *A. 4.3*
3.5 Best predictor, best linear predictor	B. chapt. 3, *A. 4.3-4.4*
4. Sampling, Estimator Properties, Modes of Convergence	B. chapt. 6
4.1 Convergence in probability, almost surely, in norm	B. 137-145
4.2 Weak and Strong Law of Large Numbers	B. 140-149
4.2 Convergence in distribution	B. 149-155
4.4 Central Limit Theorem	B. 149-157
5. Point/Interval Estimation and Hypothesis Testing	B. chapt. 5, 8
5.1 Point/interval estimation - properties	
5.2 Maximum Likelihood- large sample properties	B. chapt. 5.6-5.7, 145-147
5.3 Ordinary Least Squares	
5.4 Hypothesis Testing	B. 5.7, 6.10, 8.5, *A. chapt. 9*

[2] **B = Bierens** is required. **A = Amemiya** (1994) gives overly simplified probability theory details, and **D = Davidson** is recommended background reading on measure and asymptotic theory.