

Economics 361: Advanced Econometrics
Amherst College, Fall 2022
T-Th 10:00 a.m. - 11:20 a.m. SMUD 206

Jun Ishii
Associate Professor of Economics
Office Hours: TBA

Converse Hall 315
jishii@amherst.edu

“Education: the inculcation of the incomprehensible into the indifferent by the incompetent.”
John Maynard Keynes

“Never have truer words been spoken about the teaching of econometrics.”
Anonymous

The course introduces students to statistical inference applied to economic data. The focus is on point estimation and hypothesis testing, with some discussion on prediction. After covering basic elements of modern mathematical statistics, key econometric estimators and associated test statistics are derived, based on the likelihood and method of moments principles. Students are shown how economists use these estimators and test statistics to conduct inductive reasoning. Students will learn enough to be able to engage in basic econometric analysis of their own. But the primary goal of the course is to allow students to be discriminating consumers of econometric/statistical analysis.

Prerequisites: as in catalog

Textbook: **NO** required textbooks but the course roughly follows [AG] *A Course in Econometrics*, by A. Goldberger, Harvard University Press (1991)

Other Optional: [DF] *Statistical Models: Theory and Practice*, by D. Freedman, Cambridge University Press (2005) [TA] *Introduction to Statistics and Econometrics*, by T. Amemiya, Harvard University Press (1994) [HTF] *The Elements of Statistical Learning*, by T. Hastie, R. Tibshirani, & J. Friedman, Springer (2009), available online at <https://hastie.su.domains/ElemStatLearn/> [BH] *Econometrics* by B. Hansen, Princeton University Press (2022)

Grading: Problem Sets (15%), Quizzes (15%), Midterm (30%), Final Exam (40%)

Problem Sets: Students are encouraged to work on problem sets together but each student must hand in their own copy. No late problem sets will be accepted.

Quizzes: There will be at least 6 in-class quizzes; students will be allowed to drop the two lowest (“freebies”). There is no excused absence for quizzes.

Exam: There will be a midterm in Week 7 or 8 (TBA). There is no “make-up” exam. If you miss the midterm for an approved, documented emergency, all other components will be re-scaled to fill the missing midterm grade. Any grading correction/inquiry must be made within 5 days after the graded exams are handed back. There is no excused absence for the final exam.

Course Outline: First Half (Subject to Change)

WEEK 1: Introduction

- Tools of Statistical Inference: Prediction, Estimation, Hypothesis Testing
- Probable, Possible, Countable
- Views on Probability: Classical/Frequentist/Bayesian, Objective/Subjective
- Basic Probability Theory & Notations

******* KNOWN DATA GENERATING PROCESS (DGP) *******

WEEK 2: Distributions

- Density and Mass Functions
- Cumulative, Joint, Marginal, Conditional
- Change of Variables
- Distribution Theory

WEEK 3: Statistics

- Expectations and Moments
- Loss/Risk Functions
- Best Predictor (BP) and Best Linear Predictor (BLP)

******* IMPERFECTLY KNOWN DGP *******

WEEK 4: Sampling Theory

- Population, Sample, Random Experiment
- Asymptotic Theory
- Principles of Estimation: Likelihood & Moments (Analogy)

WEEK 5: Example – Classical OLS

- OLS Estimator as a Moment-based Estimator
- Gauss-Markov Theorem
- Interpreting the OLS Coefficients

WEEK 6-7: Hypothesis Testing

- Neyman-Pearson Framework
- Power Function
- Small Sample and Asymptotic
- OLS Revisited

WEEK 8: Statistics and Econometrics

- DGP: Economic Models “or” Stochastic Processes
- Experimental and Observational Data

******* MIDTERM (Week 7 or 8) *******

Course Outline: Second Half (Subject to Change)

WEEK 9-10: Additional Examples of Moment-based Estimators

- Violations of the Gauss Markov Assumptions
- Non-spherical “Errors”: GLS
- Endogeneity: 2SLS/IV, Panel Regression

WEEK 11: Multi-Equation Linear Models

- Seemingly Unrelated Regressions Model (SUR) – GLS revisited
- Simultaneous Equations Model (SEM) – 2SLS/IV revisited
- Empirically Exploring Market Supply & Demand

WEEK 12: Maximum Likelihood Estimation (MLE)

- Distribution and Likelihood
- Asymptotic Properties of Maximum Likelihood Estimators
- OLS as a Maximum Likelihood estimator

WEEK 13-14: Other Prominent Examples of MLE

- Latent Variables and “Random Utility Maximization”
- Binary and Multinomial Choice: Probit and Logit
- Censorship and Truncation: Tobit
- Duration: Hazard Function models

WEEK ??: Introduction to Bayesian Statistical Inference

- If time available (most likely not ...)
- Bayes Theorem and Posterior Density
- Model Selection

***** FINAL EXAM *****

READING GUIDE

- WEEK 1-3: [AG] Ch.1-7 [TA*] Ch.1-5
- WEEK 4: [AG] Ch.8-11,13 [TA*] Ch.6,7.1-7.2
- WEEK 5: [AG*] Ch.14-17 [DF] Ch.2,4.1-4.3 [TA] Ch.12
- WEEK 6-7: [AG*] Ch.18-23,25 [DF] Ch.4.7-4.8 [TA*] 9-10
- WEEK 9-10: [AG*] Ch.27-28, 34.3 [DF] 4.4-4.5 [TA] Ch.13.1
- WEEK 11: [AG*] Ch.30-34 [DF] Ch.8 [TA] Ch.13.3
- WEEK 12: [AG] Ch.12 [DF*] Ch.6 [TA*] Ch.7.3-7.4
- WEEK 13-14: [AG] Ch.29.5 [DF*] Ch.6 [TA*] Ch.13.5-13.7
- MATRIX ALGEBRA: [AG] Ch.17 [DF] Ch.3 [TA] Ch.11

* is the reading most recommended for that Week’s topics

[BH] could be considered a more advanced, updated successor to [AG], would serve as a good reference book after completing Econ 361. [DF], [HTF] provide a more statistics perspective