

**Econ 628**  
**Econometrics I**  
**Professor Tim Halliday**  
**Class Time: MW 12:00-1:15**  
**Office Hours: Friday 2:00-3:00**

Course Description:

This is the first part of the graduate econometrics sequence at UHM. The course is divided into two parts. The first focuses on probability theory and will lay down the mathematical foundations of the theory and practice of modern econometrics. Topics will include probabilities, random variables, distributions, expectations, asymptotic theory, inference and testing. The second part, which covers econometric theory, will provide an introduction to the linear regression model before moving on to more advanced topics. Topics will include conditional expectations, Ordinary Least Squares (OLS), heteroskedasticity, measurement error, identification, Instrumental Variables (IV), 2-Stage Least Squares (2SLS), specification tests, weak instruments, treatment effects, propensity scores, non-parametric regression and panel data models.

Texts:

DeGroot, M.H. and M.J. Schervish 2002. *Probability and Statistics*. 3<sup>rd</sup> Edition, Addison-Wesley (required).

Hogg, R., McKean, J.W. and A. Craig 1995. *Introduction to Mathematical Statistics*, 6<sup>th</sup> Edition, Prentice Hall (optional).

Wooldridge, J.M. 2002. *Econometric Analysis of Cross Section and Panel Data*, MIT Press (required).

Lecture notes are also available on my website: [www2.hawaii.edu/~halliday](http://www2.hawaii.edu/~halliday).

Course Requirements:

The requirements of this course are 4-5 problem sets, a midterm exam and a final exam. Your grade will be determined by the following formula:

Problem Sets	-	1/3
Midterm + Final	-	2/3

The highest score among the midterm and final will be weighted 2/3 and the lowest will be weighted 1/3.

## Objectives

After completion of this course, students will be able to:

- Understand
  - Probability Theory
  - Estimation and Statistical Inference
  - Asymptotic Theory
  - Ordinary Least Squares (OLS)
  - Instrumental Variables (IV)
  - Propensity Score Estimation
  - Non-Parametric Estimation
  - Static and Dynamic Panel Data Models
- Derive the bias of the OLS estimator in the presence of
  - Measurement Error
  - Omitted Variables Bias
  - Simultaneity
- List the assumptions underlying consistency of OLS
- Identify methods for correcting the failures of OLS
- Discuss the benefits and limitations of an estimator
- Program in STATA
- Read empirical research critically
- Replicate published empirical research
- Read and implement published research in econometric theory

Outline (Tentative):

Probability (DS: Ch. 1, 2, 4)

Set Theory; Properties of Probabilities; Conditional Probability; Independence, Random Variables; Expectations

Distributions (DS: Ch. 3, 5)

Multivariate Distributions; Transformations; Conditional Distributions; Independence; Specific Distributions (Binomial, Poisson, Gamma, Normal, Chi Squared, t, F)

Asymptotic Theory (HMC: Ch. 4, W: Ch. 3, Lecture Notes)

Definitions of Convergence, Central Limit Theorem, Delta Method, Consistency, Stochastic Rates of Convergence

Estimation and Inference (DS: Ch. 6, 7)

Statistics, Order Statistics, Quantiles, Unbiasedness, Confidence Intervals, Hypothesis Testing

Maximum Likelihood (MLE) (HMC: Ch. 6, Lecture Notes)

Definition of MLE, Cramer-Rao Lower Bound, Efficiency, Numerical Algorithms (Newton-Raphson, EM)

Testing (DS: Ch. 8)

Most Powerful Tests, Uniformly Most Powerful Tests, Neyman Pearson Theorem, Likelihood Ratio Tests

Linear Regression (W: Ch. 2, 4, 6)

Geometric Interpretation, Conditional Expectation, Linear Projection, OLS, Gauss Markov Theorem, Asymptotic Properties of OLS, Heteroskedasticity, Omitted Variables Bias, Measurement Error, Generated Regressors, Clustering

Instrumental Variables (W: Ch. 5, 6)

Reasons for Using IV (Measurement Error, Omitted Variables, Simultaneity), Definition of IV, 2SLS, Asymptotic Properties, Pitfalls of IV, Specification Tests, Generalized Method of Moments (GMM)

Treatment Effects (W: Ch 18, Lecture Notes)

Average Treatment Effects, Propensity Scores, Balancing Scores, Selection on Observables, Local Average Treatment Effects

Nonparametric Regression (Lecture Notes)

Density Estimation, Kernels, Choice of Bandwidth, Nardaya-Watson Estimator, Local Linear Regression

Panel Data (W: Ch. 10)

Random Effects, Fixed Effects, Hausman Tests, Generalized Least Squares, Strict Exogeneity, Predeterminedness, GMM Estimation of Panel Data Models, Dynamic Models