

ECN 521 Topical Outline

1. Introduction to Random Variables—The course begins with a discussion of axioms of probability, random variables, probability distributions, joint distributions, conditional distributions, mean, variance, correlation, and covariance. Continuous vs. discrete distributions. The mathematical rules for the use of the expectations, conditional expectations, and variance operators are introduced. Introduction to the normal, standard normal, log normal, uniform, binomial, Poisson, F , t , and χ^2 distributions.
2. Sampling, Estimators, and Estimates—This section discusses the use of samples and estimators to get estimates of economic parameters of interest from the population under study. Populations vs. samples. Random sampling with and without replacement. The analogy principle as a guide to forming estimators. Estimating population means. Estimators are random variables. Precision and the variance of an estimator. Adjusting for degrees of freedom. Histograms. The Central Limit Theorem and the distribution of an estimator. Finite and large-sample statistical properties of estimators are introduced: unbiasedness, efficiency, minimum mean squared error, consistency.
3. Hypothesis Testing—Type I and Type II errors; t -tests; p -values; confidence intervals; F -tests.
4. Application of techniques to economic data derived from randomized controlled trials (RCTs): Rubin’s potential outcomes framework, the selection problem, randomization, intent-to-treat, treatment-on-the-treated, randomization bias, power in experimental design.
5. Simple Linear Regression—Ordinary Least Squares (OLS) regression is introduced for a single explanatory variable. OLS as the best linear approximation to an unknown conditional mean. The formula for the estimator is derived both as an application of the analogy principle and as a minimization problem. The variance of the OLS estimator is derived and discussed. Gauss-Markov Theorem and BLUE. Large-sample properties.
6. Application of Simple Linear Regression—types of economic data (cross-section, time-series, panel); dummy variables; intent-to-treat estimation from RCTs using OLS; using and interpreting logs, first-differences, and log first-differences; re-scaling data, goodness of fit and R^2 .
7. Simple Instrumental Variable Regression—Endogeneity and IV as a solution with one explanatory variable and a single instrument. Identification. Structural vs. Reduced-Form; First-Stage. Conditions for an instrument (relevance, exogeneity, excludability). The IV estimator and 2SLS. The variance of the IV estimator and relative efficiency with OLS. Finite-sample bias of IV. Estimation of treatment-on-the-treated from RCTs using IV. Applications.
8. Non-Parametric Density Estimation—More on histograms. Kernel density estimation. Bandwidth. Local linear regression. Applications.

Syllabus

This course introduces you to the statistical techniques used in economic analysis. Successful completion of this course should allow you to understand better the empirical literature that majors will encounter in upper division courses. The statistical software STATA will be used in the application of statistical techniques.

Pre-Requisites: Completion of the mathematics basic-skills requirement.

Textbook: There is no textbook for the course. The course is designed around detailed notes that will be available on Blackboard.

Grading: The course grade is composed as follows: ten problem sets worth 2 percent each, the first exam worth 25 percent, and the second exam worth 55 percent of the final grade. Grading of all assignments and exams is done a straight percentage basis: 95-100 = A; 90-94 = A-; 85-89 = B+; 80-84 = B; 75-79 = B-; 70-74 = C+; 65-69 = C; 60-64 = C-; 55-59 = D; 0-54 = F. Only in rare circumstances will the grade distribution be curved. Historically, the median grade earned in this class has been a B. The problem set due dates and exam dates will be posted under the announcements section on Blackboard; they will not be rescheduled to meet the specific needs of students. Students with religious activities or competing in NCAA national competitions or tournaments should contact me as soon as possible after qualification for such events to resolve any scheduling conflicts.

Office Hours: Tuesdays, 8:00-10:00 a.m. Office hours are on a first-come, first-served basis. I may be reached by e-mail at gvengelh@syr.edu.

Teaching Assistant: Jooyoung Kim, jkim266@syr.edu. The TA will run all recitations.

Academic Integrity: The Syracuse University Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the Policy and know that it is their responsibility to learn about instructor and general academic expectations with regard to proper citation of sources in written work. The policy also governs the integrity of work submitted in exams and assignments as well as the veracity of signatures on attendance sheets and other verifications of participation in class activities. Serious sanctions can result from academic dishonesty of any sort. For more information on the complete policy, see <http://academicintegrity.syr.edu>.

Disabilities: Students who may need academic accommodations due to a disability are encouraged to discuss their needs with the instructor at the beginning of the semester. In order to obtain authorized accommodations, students should be registered with the Center for Disability Resources (CDR), 804 University Avenue, Room 309, 315-443-4498 and have an updated accommodation letter for the instructor. Accommodations and related

support services such as exam administration are not provided retroactively and must be requested in advance.

Economics Department Undergraduate Learning Outcomes and Goals:

In all undergraduate courses, the Economics Department develops a set of economic modeling tools for analyzing individual and aggregate economic conditions in a systematic way that thoughtfully informs individual decision-making, civic participation, and understanding of public policy. To this end, ECN courses will

- Correctly define advanced/field specific level economics vocabulary.
- Correctly utilize advanced/field specific level economic vocabulary.
- Effectively identify the applications of advanced/field specific level graphical economic tools and analytic techniques.
- Independently choose and effectively utilize appropriate advanced/field specific level economic graphical analysis to policy analysis.

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2. Sampling, Estimators, and Estimates—This section discusses the use of samples and estimators to get estimates of economic parameters of interest from the population under study. Statistical properties of estimators are introduced.
3. Hypothesis Testing
4. Application of techniques to economic data derived from randomized controlled trials (RCTs): Rubin's potential outcomes framework, the selection problem, randomization, intent-to-treat, treatment-on-the-treated, randomization bias, power.
5. Simple Linear Regression—Ordinary Least Squares (OLS) regression is introduced for a single explanatory variable. The formula for the estimator is derived. The variance of the OLS estimator is derived and discussed. Gauss-Markov Theorem and BLUE.
6. Multiple Regression—OLS, IV estimation, endogeneity, measurement error, omitted variable bias, Hausman tests, fixed effects, serial correlation, heteroscedasticity, Lagrange multiplier tests, Chow tests.
7. Probit Maximum Likelihood—probit estimation, sample selection bias, Heckman selection correction.