This is a Ph.D. course in applied econometrics of cross-section and panel data. The course will provide students with a working knowledge of asymptotic statistical methods and the application of these statistical concepts to study large-sample properties of estimators (defined as the solution to an optimization problem, under various assumptions regarding the true data generating process). The large sample results will be applied to linear and nonlinear (in parameters) generalized least squares (GLS) and maximum likelihood (ML) estimators. These results are extended to develop a nonlinear instrumental variables estimator, the generalized method of moments (GMM) and various asymptotic testing procedures are derived for this general modeling framework. Instrumental variables, panel data, simultaneous equations, discrete dependent, limited dependent and duration models, dynamic panel models, and their applications are covered.

**Prerequisites:** Statistics and Probability courses; and Econometrics (22:839:654), Introduction to Linear Statistical Models (26:960:577) or equivalent.

**Course References**
I will provide extensive lecture and background documents through Blackboard. Additionally, the references listed below will serve as your background material for the topics covered. Students are also encouraged to seek out whatever reference material facilitates their learning of each topic (this should be a given for you in all of your courses). The *Handbooks* (chapters can
be downloaded from the library) provide more detail and references for further research. Related empirical articles from the economics and finance literature will also be assigned, as well as selected material from the books listed as references below.


(HBE) *Handbook of Econometrics* Volumes 1-6, North-Holland, various years.

W is the primary reference text for this course. CT and G will serve well for background material for the topics listed below, as well as cover some topics not covered in W. HBE surveys various topics and provides references to further literature. Other econometrics and related empirical articles from the economics and finance literature will be assigned. Students are encouraged to seek out whatever other reference material facilitates their learning of each topic.

**Topics**

1. Introduction and overview
2. Review of the classical linear regression model
3. Asymptotic theory and OLS estimation (W 3, 4)
   - Maximum Likelihood (G 14)
   - Instrumental variables (W5)
   - Specification Tests (W 6)
4. Panel Data: fixed and random effects models (W 10)
5. Systems of Regression Equations, SUR, Simultaneous Equations Models, 2SLS, LIML, 3SLS, FIML. (W 7, 8, 9, 13)
6. Nonlinear (in parameters) Regression Models, NLS, QML and GMM (W 12, 13, 14)
   - Estimation Frameworks, Estimators
7. Models with Discrete Dependent Variables (W 15-22)
   - Limited Dependent Variable and Duration Models
Discrete-Continuous Models
Censored data and sample selection

8 Dynamic panel data models
9 Final Exam (May 3)

Other topics, depending on class interests, may be added as time permits.

There are a number of very good econometric software packages available. SAS and STATA (Rutgers has site licenses) and NLOGIT/LIMDEP are three such packages that are widely used. The examples I provide in the course will primarily use these packages. R, which is freeware, is increasingly popular. There are other possibilities as well, e.g., GAUSS and MATLAB. While no specific software package is required, the use of some computational software (or programming if you prefer) will be required to complete the requirements in this course and it is your responsibility to understand the details of the particular software you use. (Note that you may be asked to defend the accuracy of your chosen software.) Examples used in class will primarily be computed using STATA, LIMDEP (NLOGIT), or SAS; preprogrammed routines as well as matrix programming.

Rutgers University software availability and resources
http://libguides.rutgers.edu/c.php?g=336179&p=2271781
American Economic Association econometrics resources
https://www.aeaweb.org/RFE/toc.php?show=complete

Evaluation of your performance in this course
You are responsible for all problems and problem sets assigned in class, which you may be asked to demonstrate in class or may be randomly collected and graded. Presentations, class participation, quizzes and graded problems will comprise 20% of your grade.

There will be two short projects for the course, one cross-sectional and panel data. These projects will allow you to apply the econometric techniques developed in this course to your particular research interest. The projects will comprise 40% of your grade.

The comprehensive final exam will count for 40% of your course grade.
ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (http://academicintegrity.rutgers.edu/files/documents/AI_Policy_2013.pdf). I will strongly enforce this Policy and pursue all violations. Don’t let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.