Econometrics is the application of statistical methods to the quantification and critical assessment of hypothetical economic relationships using data. This course gives students an opportunity to develop an understanding of econometrics to a standard that will equip them to understand and evaluate most applied analysis of cross-sectional data and to be able to undertake such analysis themselves.

Prerequisites
If taken as part of a BSc degree, courses which must be passed before this course may be attempted:
EC1002 Introduction to economics and ST104A Statistics 1 (half course) and MT105A Mathematics 1 (half course) or MT1174 Calculus

Co-requisites
Students can only take EC2020 Econometrics at the same time as or after ST104B Statistics 2 and MT105B Mathematics 2, not before.

The exception to this is students who are taking MT1174 Calculus. They must still take ST104b Statistics 2 at the same time or before EC2020 Elements of econometrics, but will not take MT105b Mathematics 2

Aims and objectives
The aims of this course are:
- To develop an understanding of the use of regression analysis and related techniques for quantifying economic relationships and testing economic theories.
- To equip students to read and evaluate empirical papers in professional journals.
- To provide students with practical experience of using mainstream regression programmes to fit economic models.

Learning outcomes
At the end of the course and having completed the essential reading and activities students should be able to:
- Describe and apply the classical regression model and its application to cross-section data.
- Describe and apply the:
  - Gauss-Markov conditions and other assumptions required in the application of the classical regression model
  - reasons for expecting violations of these assumptions in certain circumstances
  - tests for violations
  - potential remedial measures, including, where appropriate, the use of instrumental variables.
- Recognise and apply the advantages of logit, probit and similar models over regression analysis when fitting binary choice models.
- Competently use regression, logit and probit analysis to quantify economic relationships using standard regression programmes (Stata and EViews) in simple applications.
- Describe and explain the principles underlying the use of maximum likelihood estimation.
- Apply regression analysis to fit time-series models using stationary time series, with awareness of some of the econometric problems specific to time series applications (for example, autocorrelation) and remedial measures.
- Recognise the difficulties that arise in the application of regression analysis to nonstationary time series, know how to test for unit roots, and know what is meant by cointegration.

Essential reading
For full details please refer to the reading list. Dougherty, C. Introduction to Econometrics.

Assessment
This course is assessed by a three-hour unseen written examination.
This syllabus is intended to provide an explicit list of all the mathematical formulae and proofs that you are expected to know for the Elements of Econometrics examination. You are warned that the examination is intended to be an opportunity for you to display your understanding of the material, rather than of your ability to reproduce standard items.


**Simple regression analysis:** Simple regression model. Derivation of linear regression coefficients. Interpretation of a regression equation. Goodness of fit.

**Properties of the regression coefficients:** Types of data and regression model. Assumptions for Model A. Regression coefficients as random variables. Unbiasedness of the regression coefficients. Precision of the regression coefficients. Gauss–Markov theorem. t test of a hypothesis relating to a regression coefficient. Type I error and Type II error. Confidence intervals. One-sided tests. F test of goodness of fit.


**Dummy variables:** Dummy variables. Dummy classification with more than two categories. The effects of changing the reference category. Multiple sets of dummy variables. Slope dummy variables. Chow test. Relationship between Chow test and dummy group test.

restrictions. Tests of zero restrictions.

**Heteroscedasticity:** Meaning of heteroscedasticity. Consequences of heteroscedasticity. Goldfeld–Quandt and White tests for heteroscedasticity. Elimination of heteroscedasticity using weighted or logarithmic regressions. Use of heteroscedasticity-consistent standard errors.

**Stochastic regressors and measurement errors:** Stochastic regressors. Assumptions for models with stochastic regressors. Finite sample and asymptotic properties of the regression coefficients in models with stochastic regressors. Measurement error and its consequences. Friedman's Permanent Income Hypothesis. Instrumental variables (IV). Asymptotic properties of IV estimators, including the asymptotic limiting distribution of $\sqrt{n}(\hat{\beta} - \beta)$ where $\hat{\beta}$ is the IV estimator of $\beta$ in a simple regression model. Use of simulation to investigate the finite-sample properties of estimators when only asymptotic properties can be determined analytically. Application of the Durbin–Wu–Hausman test


**Binary choice models and maximum likelihood estimation:** Linear probability model. Logit model. Maximum likelihood estimation of the population mean and variance of a random variable. Maximum likelihood estimation of regression coefficients. Likelihood ratio tests.

**Models using time series data:** Static demand functions fitted using aggregate time series data. Lagged variables and naive attempts to model dynamics. Autoregressive distributed lag (ADL) models with applications in the form of the partial adjustment and adaptive expectations models. Error correction models. Asymptotic properties of OLS estimators of ADL models, including asymptotic limiting distributions. Use of simulation to investigate the finite sample properties of parameter estimators for the ADL(1,0) model. Use of predetermined variables as instruments in simultaneous equations models using time series data. (Section 11.7 of the text, *Alternative dynamic representations* ..., is not in the syllabus)


**Introduction to panel data models:** Definition of panel data set (longitudinal data set). Pooled OLS model. Definition of, and consequences of, unobserved heterogeneity. Within-groups fixed effects model. First differences fixed-effects model. Least squares dummy variable model. Calculation of degrees of freedom in fixed effects models.
Students should consult the appropriate EMFSS Programme Regulations, which are reviewed on an annual basis. The Regulations provide information on the availability of a course, where it can be placed on your programme’s structure, and details of co-requisites and prerequisites.