Part IIA Paper 6, 2016-2017
Mathematics and Statistics for Economists
Paper Co-ordinator: Dr S. Reiche
skr29@cam.ac.uk

Course Content

This paper covers essential mathematics for econometrics and problems of optimal choice. Faculty teaching is by lecture and example sheets for each component. College based supervisors will also provide instruction on class exercises.

Aims and Objectives

This paper builds upon the material covered in Part I Paper 3. As such it is assumed that students have a basic grasp of statistical reasoning, linear algebra and univariate calculus. The principal objective of this paper is to provide students with tools that are required to understand and develop theoretical models of economic processes and evaluate economic hypotheses.

Lecture Courses

Mathematics for economists (Dr. Sönje Reiche, 16 lectures, Michaelmas term). The course will present recent work in theoretical economics with particular emphasis on behavioural and information economics. The analytical tools used are static and dynamic optimization techniques. The first part of the course contains a revision of some basic mathematic concepts and a full presentation of the Lagrange (Kuhn-Tucker) method. We will then study economic applications of those methods. The second part is an introduction into dynamic optimization, in particular optimal control. We will review the necessary concepts in differential equations and study some applications in macroeconomics. There will be 4 problem sets.

Probability and Statistics (Prof. Oliver B. Linton, 16 lectures, Lent term). The course covers essential mathematics for econometrics: Probability theory, linear algebra, and statistics. A detailed course outline is provided below. There will be typed up notes in pdf format. We encourage students to learn a computer language such as matlab/R/mathematica, which can be used to solve problems and present results. There will be four problem sets, mostly involving analytic work, but some may involve computer calculation using matlab/R.

Outline for Mathematics for Economists Course (16 hours)

Static Optimization (10 hours)
1. Review of Mathematical Tools
    a. Sequences, Sets, Convergence
    b. Functions, Continuity, Rules of differentiation, Concavity
    c. Integration
2. Static Optimization
    a. Lagrange
    b. Kuhn-Tucker
    c. Interpretation of Multipliers
    d. Envelope Theorem
3. Applications
    a. Utility Maximization: Loss Aversion, Self-Control and Temptation
    b. Information Economics: Regulation, Auctions

<u>Dynamic Optimization (6 hours)</u>
4. Review of Mathematical Tools
    a. Differential Equations
5. Dynamic optimization
    a. Optimal Control
    b. Hamiltonian
    c. The Maximum Principle
6. Applications

<u>Outline for Probability and Statistics Course</u> (16 hours)
1. Probability Theory (6 hours)
    a. Probability, conditional probability and independence
    b. Expectation and Regression Function
    c. Law of Large Numbers and Central Limit Theorem
2. Statistics (5 hours)
    a. Estimation by Maximum Likelihood and Analogue Principle
    b. Hypotesis Testing and Confidence Intervals
    c. Bootstrap
3. Linear Algebra (5 hours)
    a. Matrix Algebra
    b. Eigenvalues and Eigenvectors
    c. Linear Equations
    d. Projection method