PG Course Outline

EC5051: Mathematical Methods

2017/18

Autumn: Mathematical Methods
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Aims

The aim of this course is to give students a mathematical and statistical background necessary for studying Economics at postgraduate level. The course will cover basic analytical methods used in Economics and Finance with a particular emphasis on optimisation, but will also introduce basic matrix analysis and statistics.

Learning Outcomes

Upon completion of the course students should be:

1. confident in differentiation and integration of standard functions;
2. able to understand and solve various optimisation problems, both unconstrained and constrained with equality or inequality constraints;
3. understand how to solve optimisation problems where time is involved;
4. confident with the probability and distribution theory

Course Delivery

The course will be delivered through a two-hour lecture and a one-hour seminar each week. Specific learning outcomes and prescribed reading are provided for each week of the course. Seminars will be based upon assigned problems distributed in the lecture. I will be available for consultation during advertised office hours or by appointment.

Assessment

- 2 on-line tests (1 hour each), which contributes 10% of the final grade (6th and 11th week, 5% each test).
- 2-hour unseen final exam, which contributes 90% of the final grade.
- These exams will test your knowledge and understanding of the material covered in the course.
- There are three unassessed take-home assignments (4th, 9th and 12th week)

Reading

- **Alpha C. Chiang & Kevin Wainwright: "Fundamental Methods of Mathematical Economics", McGraw-Hill**
- The "**Mathematical methods for economic theory: a tutorial" by Martin J. Osborne** is very useful and it is strongly recommended to use it. You find it at the following URL: https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc/c
- The statistics element is adequately covered in the appendices of
  William Greene, Econometric Analysis, 7th Edition, Prentice Hall, 2006. (G)

- The lectures will follow Lectures 2, 3 and 4 of Herman Bennett's course which can be found on MIT Open Courseware https://ocw.mit.edu/courses/economics/14-30-introduction-to-statistical-method-in-economics-spring-2006/lecture-notes/ These notes themselves are not self explanatory.
- Lawerence Leemis provides a YouTube channel which covers most of the material very well, https://www.youtube.com/channel/UC0XVQ0xV2VOk3XrREv5061w/videos the course will employ some examples from here.
- Precise readings will be provided during lectures.

TIMETABLE

Please note that the following *planned* lecture schedule is only indicative and changes are possible. It may be the case that more (or less) time needs to be spent on certain topics, so the actual lectures may not be in complete correspondence with the plan. Therefore, coverage of topics may sometimes overflow from one session to the other.

MATHEMATICS

Lecture 1

Unconstrained optimisation: First and second order condition for local and global extrema

Lectures 2 and 3

Optimisation with equality constraints: Lagrange multipliers, first order conditions, validity of Lagrange's theorem and examples where it fails, second order conditions, the bordered Hessian, the Envelope theorem and its economic applications

Lecture 4:

Optimisation with inequality constraints: The Kuhn-Tucker theorem, with examples of cases where it works and where it doesn't. When Kuhn-Tucker condition are necessary and sufficient.

Lecture 5

Integration: Definite and indefinite integrals of one and several variables.

Lecture 6

First order differential equations, higher order differential equations. Economic applications.

Lecture 7

First order difference equations, higher order difference equations. Economic applications.

Lecture 8

Dynamic Optimisation, the maximum principle/Hamiltonians.

STATISTICS

Lecture 9

Continuous and discrete random variables. Multiple random variable. Marginal distribution. Conditional distribution. Independence.

Lecture 10

Moments: Expected value of random variables. variance, covariance and correlation. Moment Generating Functions. Revision (time permitting).