Advanced Modelling (Mathematics)

ECO-R003 - Fall 2020

School *of* Economics
University of East Anglia

Syllabus

Lectures:	MF 3-5pm, W:1-3pm	Instructor:	Farasat A.S. Bokhari
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Rationale and Aims. The course is designed to complement other courses/modules in the PhD program designed to meet the demand for increased theory and quantitative skills. Such skills are increasingly necessary where researchers are required to provide evidence based policy recommendations based on cutting edge methodologies and theory.

To that end, this course provides students with an introduction to select topics in mathematics that are likely to be used in other PhD level economic courses such as micro, macro, econometrics and game theory as well as in their research papers. Thus, using select topics from discrete math, linear algebbra and real analysis, the course aims to introduce students to the formal "axiom-theorem-proof" style of mathematics used in economics, as well as to simultaneously do so in a manner so that a standard graduate level economics text books such as *Microeconomic Theory* by Mas-Colell, Whinston and Green (or other equivalent texts) becomes accessible.

Learning Outcomes. By the end of this compact 2-week course, students will be able to understand and use concepts related to introductory (real) analysis and related topological concepts to then make use of them in other modules that teach/use fixed point theorems, maximization and dynamic optimization.

Course Content and Outline. The course is designed to be a two week 'boot-camp' style training in mathematics. Accordingly there will be a limited number of topics that we will be able to cover. The first week will be spent covering the fundamentals: logic, sets, relations, fields, vector spaces and norms. The second week focus on topics from real analysis: open/closed sets, distance, metric spaces, sequences, and notions of complete, compact and connected metric spaces. These topics will may be used in micro and macro modules (particularly, in the macro module, the instructor will pick up from where we left-off, and build on these to teach maximization and dynamic optimization).

There is no primary text for this course and I will distribute my lecture notes (co-written with Mich Tvede who will use the same notes in the Macro module) on the course blackboard. In addition, names of a few other text books are given blow that you can use for reference, as they also are the sources we used to write these lecture notes.

- Rudin, W., *Principles of Mathematical Analysis*, 3rd. Ed., McGraw-Hill, 1976.
- Rosenlicht, M., *Introduction to Analysis*, Dover Publications, 1986.

- Damiano, D.B. and Little, J.B.n *A Course in Linear Algebra*, Harcourt Brace Jovanovich, Publishers, 1988.
- Simon, C.P. & Blume, L., *Mathematics for Economists* Norton, 1994.

The following is an approximate outline of main topics covered during this course.

(a) Building Blocks: Sets, Relations and Functions
- Logic
- Sets and Relations
- Functions

(b) Vector Spaces
- Definitions and subspaces
- Inner product and Norm

(c) Metric Spaces
- Distance, open/closed balls, limits, closure, boundary
- Sequences (convergence, bounded, monotone, cauchy)
- Completeness, connectedness and compactness

- Time willing, we will also cover continuity (epsilon-delta, open pre-images, limits and convergence) and functions on metric spaces (Weierstrass extreme value, intermediate value theorem, fixed point theorems).

Assessment and feedback. There is no formal assessment. Nonetheless, I will be distributing problem sets on the blackboard, and later on solutions. Since mathematics is not really a spectator sport, students are strongly encouraged to solve the problems individually or in small groups.

Schedule. There will be total of 6 lectures, each of length 2 hours with a short break in between. The schedule is given below and we will be meeting on-line.

	Date	Time
1.	Oct/12 (Mon)	3-5pm
2.	Oct/14 (Wed)	1-3pm
3.	Oct/16 (Fri)	3-5pm
4.	Oct/19 (Mon)	3-5pm
5.	Oct/21 (Wed)	1-3pm
6.	Oct/23 (Fri)	3-5pm