Informal Online Workshop: Mathematics for Economics, Summer 2024

University of Oregon, Department of Economics

Instructor: Owen Jetton
E-mail: ojetton@uoregon.edu

Preface.

Math camp introduces students to the mathematics and level of abstraction they can expect to see in first year curriculum of the Economics Doctoral Program. This workshop is optional, informal and solely for the benefit of the student: there is no registration and no performance record (i.e. no grade).

Math camp is remotely delivered. It includes asynchronous provision of content, as well as synchronous, group study. The synchronous component is comprised of Zoom sessions with the instructor and peers, with the goal being to answer questions and to provide students with the opportunity to get to know each other (to the extent possible on Zoom), and to set the stage for continued group study for those who find it beneficial.

Face.

The synchronous component of math camp runs Sept 9th – Sept 20th, and is comprised of ten, two-hour periods: 9:00am - 11:00am each weekday. The course is organized into six modules. A module is a collection of related content intended to be covered over four hours, i.e. two days, with a caveat explained below. The module's delivery structure is as follows:

Day 1, hour 1.	Zoom lecture by me covering the module's content.
Day 1, hour 2.	Discussion of materials: Q&A, example problems. Practice problems posted at end of session.
Day 2, hour 1.	Group work on practice problems – idea here is that students work together, without reliance on instructor.
Day 2, hour 2.	Discussion of practice problems.
Caveat.	Fridays are always day 1's. But so are Mondays. So Friday and Monday share Tuesday as their day 2.

Math camp content, including zoom links to synchronous sessions, is accessed via GitHub.

"Required Text." *Microeconomic theory*, by Mas-Colell, Whinston and Green. (It's not required for math camp, though anyone taking Core Micro sequence will need it.)

Reference Texts

- *Mathematics for Economists*, by Simon and Blume
- *Mathematics for Economics*, by Hoy, Livernois, McKenna, Rees, and Stengos
- *Mathematical Reasoning: Writing and Proof*, by Ted Sunstrom, access online here

Lecture Notes and Slides I will present materials on Zoom using pdf slides, which will be made available in advance of each lecture. I will provide typed lecture notes in advance as well. I encourage you to read through each Module before the lecture date.

Modules Schedule

0. Logic and Proofs
   - Mathematics in Economics
   - Principles of Logic
   - Methods of proof
   - Numbers
1. Vector spaces and linear maps I
   - Linear spaces
   - Linear dependence and spanning sets
   - Linear functionals
   - Linear maps and the rank-nullity theorem
   - Vector-space decompositions and eigenspaces
2. Vector spaces and linear maps II – Linear Algebra
   - Coordinates
   - Matrices as linear maps
   - The transpose and the determinant
   - Invertibility
   - Column and row space
   - Matrix decompositions and Jordan form
   - Definiteness
3. Metric spaces and continuous functions
   - Distance
   - Normed vector spaces
   - Continuity
   - Sequences and convergence
   - Compactness
   - Fixed point theorems
4. Functions on $\mathbb{R}$
   - Continuity and the intermediate value theorem
   - Differentiability and the mean value theorem
   - Integration and the fundamental theorem of calculus
   - Logs and exponents
5. Functions on $\mathbb{R}^n$
   - Differentiability and Taylor's theorem
   - Homogeneity and Euler's theorem
   - Concavity and the Hessian
   - Implicit function theorem
6. Optimization
   - Unconstrained maximization
   - Equality constraints and the method of Lagrange
   - Inequality constraints and the Kuhn-Tucker theorem
   - Theorem of the maximum
   - Envelope theorem