Informal online workshop: mathematics for economics, Summer 2023

Supervisor:	Bruce McGough
E-mail:	bmcgough@uoregon.edu
TA:	Owen Jetton
E-mail:	ojetton@uoregon.edu

Preface.

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

Math camp is remotely delivered. It includes asynchronous provision of content, as well as synchronous, GE-lead group study. The synchronous component comprises zoom sessions with the TA 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 6th – Sept 19th, and is comprised of ten, two-hour periods: 9:00am - 11:00am each weekday.[1] The course is organized into five modules. A module is a collection of related content intended to be covered over four hours, i.e. two days. The module's delivery structure is as follows:

Day 1, hour 1. Zoom lecture by me covering the module's content.[2]
Day 1, hour 2. Discussion of materials led by GE: 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, twithout reliance on GE.
Day 2, hour 2. Discussion of practice problems led by GE.

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 really required, though anyone taking core micro will need it. **Reference Texts**

- *Mathematics for economists*, by Simon and Blume
- *An introduction to mathematical analysis for economic theory and econometrics*, by Corbae, Stinchcombe and Zeman.
- *Anything*, by Avinash Dixit

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.

[1] The schedule may have to be altered to accommodate orientation activities that will be held on Sept 18th and 19th.

Modules Schedule

1. Vector spaces and linear maps part 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 part II
    - Coordinates
    - Matrices as linear maps
    - The transpose and the determinant
    - Invertibility
    - Column and row space
    - Matrix decompositions and Jordan form
3. Metric spaces and continuous functions
    - Distance
    - Sequences and convergence
    - Compactness
    - Functions and continuity
    - Connectedness and fixed point theorems
4. Functions on $\mathbb{R}^n$
    - Normed vector spaces
    - Differentiability and the mean value theorem
    - Integration and the fundamental theorem of calculus
    - Logs and exponents
    - Differentiability and Taylor's theorem
    - Homogeneity and Euler's theorem
    - Concavity and the Hessian
    - Implicit function theorem
5. Optimization
    - Unconstrained maximization
    - Equality constraints and the method of Lagrange
    - Inequality constraints and the Kuhn-Tucker theorem
    - Theorem of the maximum
    - Envelope theorem