Department of Applied Economics, University of Minnesota
Math Review
Summer, 2020

Instructor	Ling Yao
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Class meetings	9:00 a.m. – 12:00 p.m. GMT-5 on Zoom (Meeting ID: 921 608 1396) Monday through Friday, August 10-28, 2020
Office hours	2:00 p.m. GMT-5 or by appointment (Meeting ID: 921 608 1396)

Course description

This is a non-credit course for incoming students of the Applied Economics graduate program and other related programs. Current graduate students are welcomed to join if interested. The goal of the course is to prepare students with mathematical skills for the PhD level Microeconomics and Econometrics sequences. We will focus on the intercorrelated topics among basic real analysis, calculus, and linear algebra.

The course is held mainly in the form of lecture, while encouraging you to actively participate in class through interactive questions and discussions. At the end of each day's lecture, you will be given time to work on short exercise questions, often related to Microeconomics and Econometrics course content. Solutions will be discussed immediately after. You will have chance to practice on 4 after-class problem sets, which I will correct and return to you. The problem sets will not be graded. You will receive the lecture slides and problems sets via email the day before class.

Due to the COVID-19 situation, the course will be held online using the Zoom platform. Recordings will be made for students in difficult time zones or on travel and will be available upon request. For the optimal learning experience, it is strongly suggested that you participate in class meetings when situation permits.

References

There is no required textbook for this course. The main references are

1. Simon, C., & Blume, L. (1994). *Mathematics for economists (1st ed.)*. New York: Norton.
2. Davidson, J. (2018). *An introduction to econometric theory*. Hoboken, NJ: John Wiley & Sons. (available online through UMN library)

and the mathematical appendices of

3. Mas-Colell, A., Whinston, M., & Green, J. (1995). *Microeconomic theory*. New York: Oxford University Press.
4. Hansen, B. (2020). *Econometrics.* https://www.ssc.wisc.edu/~bhansen/econometrics/.

5. Greene, W. (2018). *Econometric analysis (8th ed.).* Boston: Prentice Hall. (Appendices available at http://people.stern.nyu.edu/wgreene/Text/econometricanalysis.htm).
6. Jehle, G. & Reny, P. (2011). *Advanced Microeconomic Theory (3rd ed.)*. Harlow: Pearson.

Schedule

1. Introduction — Aug 10
2. Logic — Aug 10
   - Logic statements
   - Ways to prove

   (Jehle & Reny A1.1; Simon & Blume A1.3)
3. Sets — Aug 11
   - Basic topology
   - Convex sets
   - Separating hyperplane theorem

   (Jehle & Reny A1.2; Simon & Blume A1.1, Ch.12.3-12.5; MWG M.G)
4. Functions — Aug 11-12
   - Relations
   - Continuity
   - Fixed-point theorems
   - Concavity and quasiconcavity

   (Jehle & Reny A1.3; MWG M.H, M.I ; Simon & Blume Ch.13), 21
5. One-variable calculus — Aug 13
   - Derivatives
   - Chain rule
   - L'Hopital's rule
   - Approximation by differentials
   - Mean value theorem
   - Convexity and critical points
   - Integrals

   (Simon & Blume Ch. 2, 3, 4 and A4)
6. Multiple-variable calculus — Aug 14, 17-19
   - Matrix representation
   - Partial and total derivatives
   - Implicit function theorem
   - Homogeneous functions
   - Homothetic functions
   - Concavity and convexity

   (Hansen A1, 3, 4 and 10; Davidson Ch.2; Greene A1-2; Simon & Blume Ch.14, 15, 20 and 21; MWG M.B; Jehle & Reny A2.1.3)
7. Optimization — Aug 20-21, 24

- Maximization and minimization
- First and second order conditions
- Lagrange method
- Kuhn-Tucker conditions
- Envelope theorem
- Comparative statics

(Simon & Blume Ch. 17, 18 and 19; MWG M.J, M.K, M.L; Jehle & Reny A2.2-2.4)

8. Linear algebra Aug 25-28
    - Linear systems
    - Rank, matrix operations, linear independence
    - Matrix inversion, determinants and Cramer's rule
    - Linear implicit function
    - Matrix calculus
    - Eigenvalues and eigenvectors

    (Simon & Blume Ch. 7, 8 and 9; Davidson Ch. 3, 4.1-4.4, 9; Hansen A18-20; Greene A3, 4, 6 and 8)