Vanderbilt University · Department of Economics

ECON 8000: Math for Economists

Econ PhD Math Camp · Fall 2026 · August 4–18, 2026

Course details

Instructor	Maria “Masha” Titova
Teaching assistant	Saayili Budhiraja
Location	Calhoun 413B
Meeting time	11:00 a.m.–2:00 p.m. every day

Calendar

August 2–22, 2026

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
2	3	**4** Lecture 1 *Sets, Functions, Logic, and Proofs*	**5** Lecture 2 *Real Analysis in R^n*	**6** Lecture 3 *Linear Algebra* **PS1 DUE**	**7** Lecture 4 *Differential Calculus*	8
9	**10** Lecture 5 *Curvature, Convexity, and Separation* **PS2 DUE**	**11** Lecture 6 *General Optimization*	**12** *In-class review* **PS3 DUE**	**13** **In-class midterm**	**14** Lecture 7 *Constrained Optimization*	15
16	**17** Lecture 8 *Comparative Statics, Envelopes, and Fixed Points*	**18** Lecture 9 *Dynamic Programming and the Bellman Equation* **PS4 DUE**	**19** No class: international student orientation	**20** **Take-home final**	**21** **Take-home final**	22

Assessment

- Four problem sets: 5% each
- In-class midterm: 30% (August 13)
- Take-home final: 50% (August 20–21)

Problem sets

- PS1 covers Lectures 1 and 2; due at Lecture 3.
- PS2 covers Lectures 3 and 4; due at Lecture 5.
- PS3 covers Lectures 5 and 6; due at the in-class review.
- PS4 covers Lectures 7 and 8; due at Lecture 9.

Topic outline

Lecture 1: Sets, Functions, Logic, and Proofs

- Sets: definition and operations; Cartesian product and $\mathbb{R}^n$
- Functions: vocabulary and properties; inverse function
- Logic: logical statements and operations; implication and equivalence; properties and quantifiers
- Proofs: what a proof is; direct proof and contrapositive; proof by contradiction; proof by induction

Lecture notes (PDF) Slides (PDF)

Lecture 2: Real Analysis in $\mathbb{R}^n$

- Distance and sequences: norm and distance; convergence, subsequences, and limits
- Suprema and compactness: suprema and maximizing sequences; closed, bounded, and compact sets
- Continuity and existence: continuity; the Weierstrass theorem; intermediate values and fixed points

Lecture notes (PDF) Slides (PDF)

Lecture 3: Linear Algebra

- Matrix algebra
- Linear maps and linear systems
- Square matrices and invertibility; eigenvalues and eigenvectors

Lecture notes (PDF) Slides (PDF)

Lecture 4: Differential Calculus

- Functions of one variable
- Real-valued functions of several variables
- Vector-valued functions

Lecture notes (PDF) Slides (PDF)

Lecture 5: Curvature, Convexity, and Separation

- Second-order approximation and curvature
- Convex sets and concave functions
- Concavity criteria, global optimality, and separation

Lecture notes (PDF) Slides (PDF)

Lecture 6: General Optimization

- The problem and existence
- Necessary local conditions
- Global certification

Lecture notes (PDF) Slides (PDF)

Lecture 7: Constrained Optimization

- Equality constraints and the Lagrangian
- Inequalities and the KKT conditions
- Global certification

Lecture notes (PDF) Slides (PDF)

Lecture 8: Comparative Statics, Envelopes, and Fixed Points

- The implicit function theorem
- Comparative statics of optimizers and values
- Fixed-point theorems

Lecture notes (PDF) Slides (PDF)

Lecture 9: Dynamic Programming and the Bellman Equation

- Sequential problems and their recursive form
- First-order and envelope conditions; the Euler equation
- Finite horizons, fixed points, and a Bellman equation solved by hand

Lecture notes (PDF) Slides (PDF)

References

No textbook is required; the lecture notes are self-contained. The core references for the course are:

- Michael Carter, *Foundations of Mathematical Economics* (MIT Press, 2001).
- Angel de la Fuente, *Mathematical Methods and Models for Economists* (Cambridge University Press, 2000).
- Efe A. Ok, *Real Analysis with Economic Applications* (Princeton University Press, 2007).
- Walter Rudin, *Principles of Mathematical Analysis*, 3rd edition (McGraw-Hill, 1976).
- Carl P. Simon and Lawrence Blume, *Mathematics for Economists* (W. W. Norton, first U.S. edition, 1994).
- Nancy L. Stokey and Robert E. Lucas, Jr., with Edward C. Prescott, *Recursive Methods in Economic Dynamics* (Harvard University Press, 1989).
- Rangarajan K. Sundaram, *A First Course in Optimization Theory* (Cambridge University Press, 1996).

Additional references for particular topics are:

- Daron Acemoglu, *Introduction to Modern Economic Growth* (Princeton University Press, 2009).
- Richard Bellman, *Dynamic Programming* (Princeton University Press, 1957).
- Kim C. Border, *Fixed Point Theorems with Applications to Economics and Game Theory* (Cambridge University Press, 1985).
- Dean Corbae, Maxwell B. Stinchcombe, and Juraj Zeman, *An Introduction to Mathematical Analysis for Economic Theory and Econometrics* (Princeton University Press, 2009).
- Ulrich Daepp and Pamela Gorkin, *Reading, Writing, and Proving: A Closer Look at Mathematics*, 2nd edition (Springer, 2011).
- Richard Hammack, *Book of Proof*, edition 3.2 (2018).
- Lars Ljungqvist and Thomas J. Sargent, *Recursive Macroeconomic Theory*, 4th edition (MIT Press, 2018).
- David Romer, *Advanced Macroeconomics*, 5th edition (McGraw-Hill Education, 2019).
- Daniel J. Velleman, *How to Prove It: A Structured Approach*, 3rd edition (Cambridge University Press, 2019).