

# ECONOMICS PhD BOOTCAMP: MATHEMATICS FOR ECONOMISTS

Summer 2023  
(July 31 – August 18)

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<b>Instructors:</b>	Hanjoon Ryu, Yasin Simsek	<b>Time:</b>	M – F 0900 – 1200
<b>Emails:</b>	<a href="#">Hanjoon</a> , <a href="#">Yasin</a>	<b>Place:</b>	Social Sciences 111

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## Course Pages:

1. For accessing course materials: [Sakai](#)
2. For uploading homework: Gradescope (access via Sakai on the left menu)

**Office Hours:** M – F 1400 – 1500, by Zoom. Questions through email are also welcomed.

## Objectives:

- Prepare you with the necessary mathematical tools for the first year economics PhD classes.
- Help you get comfortable with writing formal math proofs.
- Provide some reference points for your future research.

**Prerequisites:** There is no official prerequisite, but we expect you to have exposure to undergraduate level of analysis, linear algebra and probability theory. If any of the topics seems completely new, you are recommended to go to the corresponding references in the next page.

## Topics to be covered:

0. Prerequisites (2 days, Yasin): sets, sequences and functions on  $\mathbb{R}$ , convergence and continuity, integration and differentiation;
1. Analysis (3 days, Hanjoon): metric and topological spaces, sequences and functions, convergence and continuity, fixed point theorem
2. Linear algebra (4 days, Yasin): vector spaces, eigenvalues, orthogonality and projections
3. Optimization (2 days, Hanjoon): Lagrange, Kuhn-Tucker; convexity and concavity
4. Probability (3 days, Hanjoon): introduction to measure-theoretic probability theory

**Grading Policy:** Your grade will be based on 10% homework and 90% final exam.

## Important Dates:

First Class ..... July 31 (Mon)  
PS0 due ..... August 3 (Thu)  
PS1 due ..... August 6 (Sun)  
PS2 due ..... August 11 (Fri)  
PS3 due ..... August 15 (Tue)  
PS4 due ..... August 18 (Fri)  
Final Exam ..... August 18 (Fri)

**Homework Policy:**

- There will be five problem sets as we move along with the course. They must be submitted online via Gradescope. In general, late homework will not be accepted.

**Academic Honesty:** Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation.

**Main References:**

Class notes will be provided, and **no textbook is required**. Suggested readings are

- General reference
  - Simon C.P. and Blume L. (1994), *Mathematics for Economists*, New York, NY: W.W. Norton & Company.
  - This book offers general coverage of all the topics discussed in class.
- More specific references. I haven't read many of these books myself, but am passing along the recommendations from a previous instructor.
  - Munkres J.R. (2000), *Topology*, 2nd. Edition, Upper Saddle River, NJ: Prentice Hall, Inc.
  - This book is a very good reference for the topology part of the class. Classnotes for the Topology section will follow parts of this book. It is a very nice read with many examples and counter-examples which make it easier to approach and understand the abstract notions of topology. It may be helpful to students who have not covered topology before to read this book while we go through topology in class.
  - Ok E.A. (2007), *Real Analysis with Economic Applications*, Princeton, NJ: Princeton University Press.
  - This book is clear and has many examples addressed to economists. It is often used as a reference in the Real Analysis summer class at the end of the first year.
  - Reed M. (1997), *Fundamental Ideas of Analysis*, Hoboken, NJ: Wiley.
  - This book has a very good introduction on how to write proofs.
  - Rudin W. (2006), *Principles of Mathematical Analysis*, 3rd Edition, New York, NY: McGraw-Hill Publishing Company.
  - I find this book very clear and it's a good reference for real analysis, although it goes beyond what we will cover and is not addressed to economists.
  - Sundaram R.K. (2008), *A First Course in Optimization Theory*, Cambridge, UK: Cambridge University Press.
  - This book is a very good reference for the optimization part of the class. Classnotes for the Optimization section will follow parts of this book. It is an easy read with clear explanations of the results and details of proofs. It may be helpful to students who have not covered optimization before to read this book while we go through optimization in class.
  - Casella G. and Berger R.L. (2001), *Statistical Inference*, Pacific Grove, CA: Duxbury Press.
  - This book is the reference for the Econometrics 01 class in the first year. The Probability part of the math camp will follow its first chapter.