

Proof-Based Math Readings

Session: Large Sample Theory*

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0 Motivation

- *Proof-Based Math Readings* is a free, independent online reading group where we study the mathematics required for economics master's and PhD programs through an intuitive approach. Active since May 2023.
- This session of the reading group is on *Large Sample Theory*.

1 Prerequisites

- Proof Techniques and Real Analysis resources below.
- Please use the  **Application Form** to join our reading group; you will receive a response within a week.

2 Format







- This session takes 12 weeks. We do not have face-to-face/online meetings due to the size of the group.
- Members read the main book and discuss the topics/exercises in the Proof-Based Math Readings Discord .

3 Resources

3.1 Main Book and Main Book's Playlist

Elements of Large-Sample Theory - Erich L. Lehmann (1999) is our main book for this session because it is well-written and well-structured.

Jingyi Jessica Li's playlist is our main playlist because her narrative is great.

-  Elements of Large-Sample Theory - Erich L. Lehmann (1999) → Easier but doesn't contain solutions
-  Elements of Large-Sample Theory - Erich L. Lehmann (1999, Errata)
-  A Course in Large Sample Theory - Thomas S. Ferguson (2002) → Harder but contains solutions
-  A Course in Large Sample Theory - Thomas S. Ferguson (2002, Errata)
-  A Course in Large Sample Theory - Thomas S. Ferguson (2002, Playlist by Jingyi Jessica Li)
-  A Course in Large Sample Theory - Thomas S. Ferguson (2002, Notes by Jingyi Jessica Li)

3.2 Supplementary

3.2.1 Large-Sample Theory

-  Notes for a Graduate-Level Course in Asymptotics for Statisticians - David R. Hunter (2025)
-  Understanding Convergence Concepts: A Visual-Minded and Graphical Simulation-Based Approach - P. Mischeaux, B. Liqueur (2009)

3.2.2 Proof Techniques

-  Book of Proof - Richard Hammack (3.4 Edition, 2025)
-  Book of Proof - Richard Hammack (3.4 Edition, 2025, Playlist by Jeremy Teitelbaum)
-  Book of Proof - Richard Hammack (3.4 Edition, 2025, Playlist by Michael Penn)


3.2.3 Real Analysis

-  Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.1, 2024)
-  Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.1, 2024, Playlist by Casey Rodriguez)
-  Introduction To Metric Spaces - Paige Bright (2023)

4 Reading Schedule


- ELST is the abbreviation of **Elements of Large-Sample Theory** - Erich L. Lehmann (1999).

ELST, Chapter 1: Mathematical Background

Week 01-02 


- 1.1 The concept of limit
- 1.2 Embedding sequences
- 1.3 Infinite series
- 1.4 Order relations and rates of convergence
- 1.5 Continuity
- 1.6 Distributions

ELST, Chapter 2: Convergence in Probability and in Law

Week 03-04-05-06 


- 2.1 Convergence in probability
- 2.2 Applications
- 2.3 Convergence in law
- 2.4 The central limit theorem
- 2.5 Taylor's theorem and the delta method
- 2.6 Uniform convergence
- 2.7 The CLT for independent non-identical random variables
- 2.8 Central limit theorem for dependent variables

ELST, Chapter 3: Performance of Statistical Tests

Week 07-08-09 

- 3.1 Critical values
- 3.2 Comparing two treatments
- 3.3 Power and sample size
- 3.4 Comparison of tests: Relative efficiency
- 3.5 Robustness

ELST, Chapter 4: Estimation

Week 10-11-12 

- 4.1 Confidence intervals
- 4.2 Accuracy of point estimators
- 4.3 Comparing estimators
- 4.4 Sampling from a finite population

5 Further Readings (Optional)

-  Asymptotic Theory for Econometricians - Halbert White (Revised Edition, 2000)