Proof-Based Math Readings Session: Large Sample Theory[*]
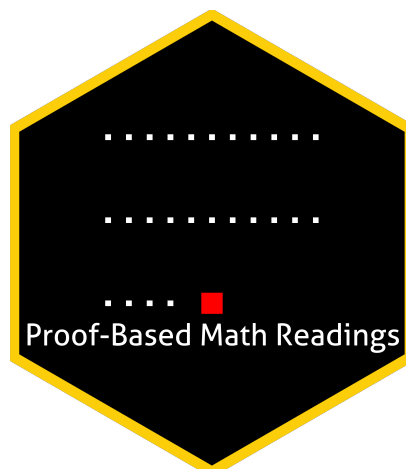
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0 Motivation

- *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 and Format

- 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.
- 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 💬.

2 Resources

2.1 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)

2.2 Supplementary

2.2.1 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. Micheaux, B. Liquet (2009)

2.2.2 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)

2.2.3 Real Analysis

- 📖 Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.2, 2025)
- ▶ Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.2, 2025, Playlist by Casey Rodriguez)
- ▶ Introduction To Metric Spaces - Paige Bright (2023)

3 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

4 Further Readings (Optional)

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