Proof-Based Math Readings
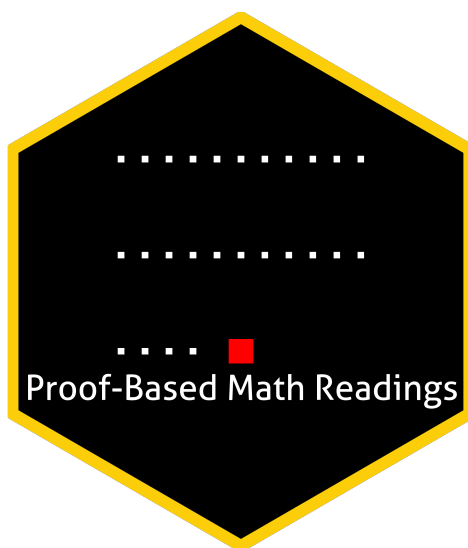# Session: Large Sample Theory
2024 Summer

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Click here for the most recent versions of the syllabuses

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Proof-Based Math Readings

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0 Motivation

- *Proof-Based Math Readings* is a free and independent online reading group where we study mathematics required in economics master's/PhD programs using an intuitive approach.
- This session of the reading group is on *Large Sample Theory*.

1 Prerequisites

- CGPA: 3.00/4.00.
- Proof and Real Analysis resources below are the prerequisites for this session.
- Please use the 🔗 Application Form to join our reading group.
- Applicants are informed about their application results within a week via email.

2 Format

- This session takes 12 weeks.
- We discuss the topics/exercises that we struggle with at 😀 Proof-Based Math Readings [Discord].
- We do not have face-to-face/online meetings due to the size of the group.
- Members are expected to read the chapters, and watch the chapter videos from the book's playlist.

3 Resources

3.1 Main Book and Main Book's Playlist

Elements of Large-Sample Theory 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 just great.

- 📘 Elements of Large-Sample Theory - E. L. Lehmann (1999)　　　→ Easier to read but doesn't contain solutions
- 📘 Elements of Large-Sample Theory - E. L. Lehmann (1999, Errata)
- 📘 A Course in Large Sample Theory - Thomas S. Ferguson (2002) → Harder to read 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 Proof

- 📘 Book of Proof - Richard Hammack (3.3 Edition, 2022)
- ▶️ Book of Proof - Richard Hammack (3.3 Edition, 2022, Playlist by Jeremy Teitelbaum)
- ▶️ Book of Proof - Richard Hammack (3.3 Edition, 2022, Playlist by Michael Penn)

3.2.2 Real Analysis

- 📘 Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.0, 2023)
- ▶️ Basic Analysis I: Introduction to Real Analysis - Jiri Lebl (Version 6.0, 2023, Playlist by Casey Rodriguez)
- ▶️ Introduction To Metric Spaces - Paige Bright (2023)

3.2.3 Large-Sample Theory

- 📘 Notes for a Graduate-Level Course in Asymptotics for Statisticians - David R. Hunter (2024)
- 📘 Asymptotic Theory for Econometricians - Halbert White (Revised Edition, 2000)

4 Reading Schedule

- **ELST** is the abbreviation of **Elements of Large-Sample Theory - E. 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)

You can check out our Bayesian Statistics and Measure Theoretic Probability syllabuses at ⏻ github.com/zekiakyol/proof-based-math-readings