# Proof-Based Math Readings Session: Large Sample Theory

2024 Summer

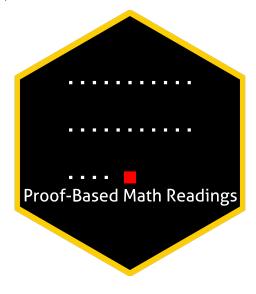
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### 0 Motivation

- 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

- CGPA: 3.00/4.00. 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 just great.

- $\blacksquare$  Elements of Large-Sample Theory Erich L. Lehmann (1999)  $\rightarrow$  Easier but doesn't contain solutions
- Elements of Large-Sample Theory Erich L. Lehmann (1999, Errata)
- $\blacksquare$  A Course in Large Sample Theory Thomas S. Ferguson (2002)  $\rightarrow$  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 (2024)
- \*Understanding Convergence Concepts: A Visual-Minded and Graphical Simulation-Based Approach P. Micheaux, B. Liquet (2009)

#### 3.2.2 Proof Techniques

- 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)

### 3.2.3 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)

## 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

- 2.2 Applications
- 2.3 Convergence in law
- 2.4 The central limit theorem

2.1 Convergence in probability

- 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

### **E** 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

#### Further Readings (Optional) 5

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