

# Proof-Based Math Readings

## Session: Large Sample Theory

2024 Summer

**Zeki Akyol\***

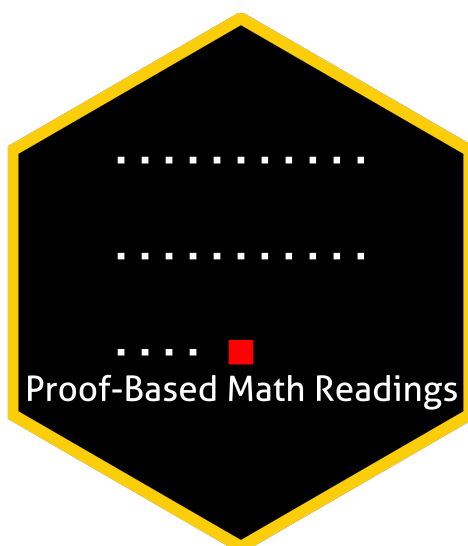
Department of Economics  
Istanbul Technical University

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\*[zekiakyol.com](http://zekiakyol.com)


## 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 anytime.
- 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, 2021)**
-  **A Course in Large Sample Theory - Thomas S. Ferguson (2002, Notes by Jingyi Jessica Li, 2021)**

### 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, Companion playlist by Jeremy Teitelbaum)
-  Book of Proof - Richard Hammack (3.3 Edition, 2022, Companion playlist by Michael Penn)

#### 3.2.2 Real Analysis

-  Basic Analysis I: Introduction to Real Analysis [Volume I] - Jiri Lebl (Version 6.0, 2023)
-  Real Analysis - Casey Rodriguez (2020, Companion playlist)
-  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