# Proof-Based Math Readings Session: Proof Techniques

2023 Summer

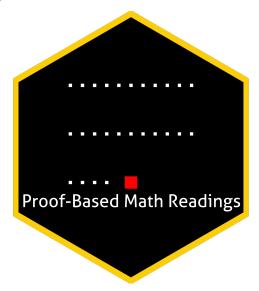
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# 0 Motivation

- 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 *Proof Techniques*.

# 1 Prerequisites

- CGPA: 3.00/4.00.
- Please use the **O** 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 [All are open-access]

## 3.1 Main Book and Main Book's Playlist

Book of Proof (3.3 Edition, 2022) by Richard Hammack is our main book because it is a well-written and well-structured pedagogical masterpiece. It is also open-access and provides detailed solutions for odd-numbered exercises at the end of the book.

Jeremy Teitelbaum's playlist on Book of Proof is our main playlist because his narrative is just great.

- Book of Proof Richard Hammack (3.3 Edition, 2022)
- ▶ Book of Proof Richard Hammack (3.3 Edition, 2022, Playlist by Jeremy Teitelbaum, Chapters 1-12)

### 3.2 Supplementary

### 3.2.1 **Proof**

Because our main playlist does not cover Chapters 13-14, we cover these chapters from Michael Penn's playlist.

- Book of Proof Richard Hammack (3.3 Edition, 2022, Playlist by Michael Penn, Chapters 1-14)
- Book of Proof Richard Hammack (3.3 Edition, 2022, Playlist by Valerie Hower, Chapters 1-12)
- Book of Proof Richard Hammack (3.3 Edition, 2022, Workbook by Justin Wright)
- Appendix A: Elements of Style for Proofs Dana C. Ernst (2024)

#### 3.2.2 Calculus

- Essence of Calculus 3Blue1Brown (2023)
- Single Variable Calculus David Jerison (2006)
- Multivariable Calculus Denis Auroux (2007)
  - Sequences and Series Calculator Geogebra
  - Function Graph Geogebra

#### Reading Schedule 4

I recommend the following study routine below:

- 1) First read a chapter from the book, then watch the playlist of the chapter
- 2) Solve odd-numbered exercises and check their solutions at the end of the book.
- 3) Solve even-numbered exercises and check their solutions from our unofficial solutions manual.
- 4) If you cannot solve/understand an exercise, discuss the exercise in our Discord.
- 5) Move on to the next chapter of the book

#### Book of Proof

Week 01

Chapter 1: Sets Chapter 2: Logic

Chapter 3: Counting

#### Book of Proof

Week 02-03 #

Chapter 4: Direct Proof

Chapter 5: Contrapositive Proof Chapter 6: Proof by Contradiction

#### Book of Proof

Week 04-05

Chapter 7: Proving Non-Conditional Statements

Chapter 8: Proofs Involving Sets

Chapter 9: Disproof

#### Book of Proof

Week 06

Chapter 10: Mathematical Induction

### Book of Proof

Week 07-08

Chapter 11: Relations Chapter 12: Functions

# Book of Proof

Week 09-10 #

Chapter 14: Cardinality of Sets

(If we struggle in this chapter, we should review Chapter 12)

#### Book of Proof

Week 11-12

Chapter 13: Proofs in Calculus

(It is natural to struggle in this chapter)

#### Further Readings (Optional) 5

- Mathematical Proofs A Transition to Advanced Mathematics Gary Chartrand, Albert D. Polimeni, Ping Zhang (Chapters 0-14, 4th Edition, 2018)
- Mathematical Proofs A Transition to Advanced Mathematics Gary Chartrand, Albert D. Polimeni, Ping Zhang (Chapters 0-14, 4th Edition, 2018, Slides)