Proof-Based Math Readings
Session: Proof Techniques
2023 Summer

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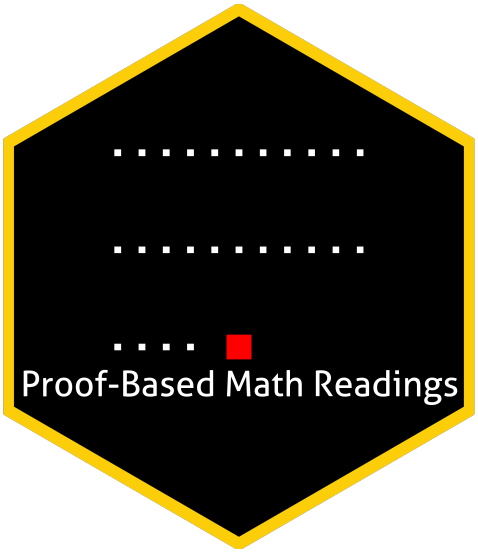

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0 Motivation

- *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 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 6 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, Companion playlist by Jeremy Teitelbaum, Chapter 1-12)

3.2 Supplementary

3.2.1 Proof

In case we need to watch a proof topic from another instructor, we have two additional companion playlists.
Because our main playlist does not cover Chapter 13-14, we cover these chapters from Michael Penn's playlist.

- Book of Proof - Richard Hammack (3.3 Edition, 2022, Companion playlist by Michael Penn, Chapter 1-14)
- Book of Proof - Richard Hammack (3.3 Edition, 2022, Companion playlist by Valerie Hower, Chapter 1-12)
- Book of Proof - Richard Hammack (3.3 Edition, 2022, Companion workbook by Justin Wright)

3.2.2 Calculus

In case we need to remember a topic from calculus, we can use these resources.

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

4 Reading Schedule

I recommend the following study routine below:

1) Read a chapter from the book.
2) Watch the playlist of the chapter.
3) Solve odd-numbered exercises and check their solutions at the end of the book.
4) Solve even-numbered exercises in the book.
5) If you cannot solve/understand an exercise, discuss the exercise in our Discord server.
6) 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**

Chapter 4: Direct Proof
Chapter 5: Contrapositive Proof
Chapter 6: Proof by Contradiction

Book of Proof **Week 03**

Chapter 7: Proving Non-Conditional Statements
Chapter 8: Proofs Involving Sets
Chapter 9: Disproof
Chapter 10: Mathematical Induction

Book of Proof **Week 04**

Chapter 11: Relations
Chapter 12: Functions

Book of Proof **Week 05-06**

We first read Chapter 14, then Chapter 13. These chapters are more challenging than the previous ones.
Chapter 14: Cardinality of Sets
Chapter 13: Proofs in Calculus

5 Further Readings (Optional)

We can use the following book to solve more problems. Although the book is not open-access, its official slides are.

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

You can check out our Real Analysis syllabus at github.com/zekiakyol/proof-based-math-readings