Proof-Based Math Readings
Session: Proof Techniques
2023 Summer

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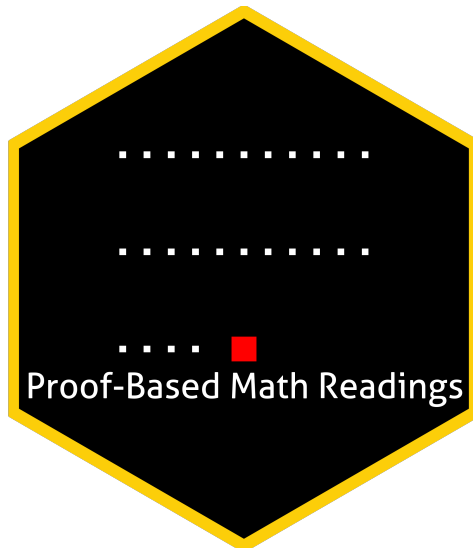Department of Economics
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Table of contents

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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.
- Applicants are informed about their application results within a week via email.

2   Format

- This session takes 8 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

In case we need to watch a proof topic from another instructor, we have two additional playlists.

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)

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 03-04** 📅

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

📕 **Book of Proof**   **Week 05-06** 📅

    Chapter 11: Relations
    Chapter 12: Functions

📕 **Book of Proof**   **Week 07-08** 📅

    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

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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 (**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)

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