

# Proof-Based Math Readings

## Session: Real Analysis

2023 Fall

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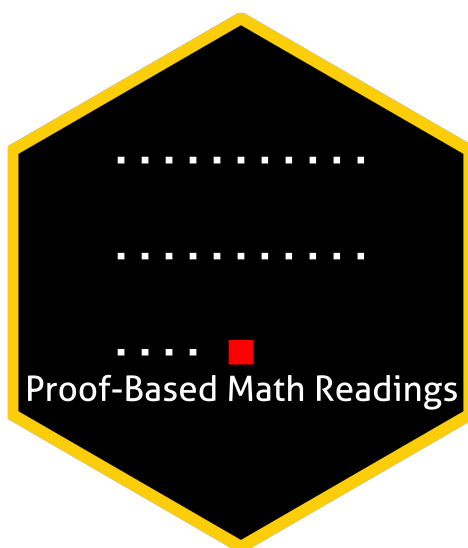
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## 0 Motivation

- *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 *Real Analysis*.

## 1 Prerequisites

- CGPA: 3.00/4.00 and **Book of Proof - Richard Hammack (3.3 Edition, 2022)**.
- Please use our  **Application Form** to join our reading group anytime.
- People who applied will be informed about their application results within a week.

## 2 Format




- This session will last 13 weeks from 31 July 2023 to 29 October 2023.
- We will discuss the topics/exercises that we struggle with at  **Proof-Based Math Readings [Discord]**.
- We will not have face-to-face/online meetings due to 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

**Basic Analysis I: Introduction to Real Analysis [Volume I]** by Jiri Lebl is our main book for this session because it is well-written, well-structured, and open-access.

Casey Rodriguez's playlist is our main playlist because his narrative is just great.





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

### 3.2 Supplementary




#### 3.2.1 Real Analysis

-  **Real Analysis - Michael Penn (2021)**
-  **Real Analysis - Wrath of Math (2023)**
-  **Understanding Analysis - Stephen Abbott (2nd Edition 2016, Playlist by Marc Renault)**
-  **Understanding Analysis - Stephen Abbott (2nd Edition 2016, Solutions by Ulisse Mini, Jesse Liby)**
-  **Introduction To Metric Spaces - Paige Bright (2023)**

#### 3.2.2 Calculus

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

#### 3.2.3 Proof

-  **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)**
-  **Book of Proof - Richard Hammack (3.3 Edition, 2022, Companion playlist by Michael Penn, Chapter 1-14)**

## 4 Reading Schedule

- **BAI** is the abbreviation of Basic Analysis I: Introduction to Real Analysis [Volume I] - Jiri Lebl (Version 6.0, 2023) in the previous page.
- We use Understanding Analysis - Stephen Abbott (2nd Edition 2016, Solutions) for exercises.

### Week 01-02-03

📅 31 July - 20 August

- 📖 **BAI, List of Notation** (Page 309-312)
- 📖 **BAI, Chapter 0: Introduction**
  - BAI, Chapter 0.1: About this book
  - BAI, Chapter 0.2: About analysis
  - BAI, Chapter 0.3: Basic set theory
- 📖 **BAI, Chapter 1: Real Numbers**
  - BAI, Chapter 1.1: Basic properties
  - BAI, Chapter 1.2: The set of real numbers
  - BAI, Chapter 1.3: Absolute value and bounded functions
  - BAI, Chapter 1.4: Intervals and the size of  $\mathbb{R}$
  - BAI, Chapter 1.5: Decimal representation of the reals

### Week 04-05-06

📅 21 August - 10 September

- 📖 **BAI, Chapter 2: Sequence and Series**
  - BAI, Chapter 2.1: Sequences and limits
  - BAI, Chapter 2.2: Facts about limits of sequences
  - BAI, Chapter 2.3: Limit superior, limit inferior, and Bolzano-Weierstrass
  - BAI, Chapter 2.4: Cauchy sequences
  - BAI, Chapter 2.5: Series
  - BAI, Chapter 2.6: More on series

### Week 07-08

📅 11 September - 24 September

- 📖 **BAI, Chapter 3: Continuous Functions**
  - BAI, Chapter 3.1: Limits of functions
  - BAI, Chapter 3.2: Continuous functions
  - BAI, Chapter 3.3: Extreme and intermediate value theorems
  - BAI, Chapter 3.4: Uniform continuity

### Week 09-10-11-12

📅 25 September - 22 October

- 📖 **BAI, Chapter 4: The Derivative**
  - BAI, Chapter 4.1: The derivative
  - BAI, Chapter 4.2: Mean value theorem
  - BAI, Chapter 4.3: Taylor's theorem
- 📖 **BAI, Chapter 5: The Riemann Integral**
  - BAI, Chapter 5.1: The Riemann integral
  - BAI, Chapter 5.2: Properties of the integral
  - BAI, Chapter 5.3: Fundamental theorem of calculus

### Week 13

📅 23 October - 29 October

- 📖 **BAI, Chapter 6: Sequence of Functions**
  - BAI, Chapter 6.1: Pointwise and uniform convergence
  - BAI, Chapter 6.2: Interchange of limits