

# Operational Math

*DoSS Summer Prep Bootcamp 2024*

## 1 Time & Place

July 8 to 26, online synchronous. Exact times TBA.

## 2 Instructor

[Ichiro Hashimoto](#), 2nd year PhD candidate, Department of Statistical Sciences

## 3 Course Outline

Review of proof techniques. Selected topics in set theory, real analysis and linear algebra.

Topics include symbolic logic, logical quantifiers, types of proof, proof by induction, elementary set theory, image and pre-image of functions, cardinality of sets, metrics and norms, open and closed sets, sequences, complete metric spaces, equivalent definitions of continuous functions on metric spaces, equivalent metrics, limit superior and inferior, topology of metric spaces, density, compactness, vector spaces and subspaces, linear independence, spans, bases, linear maps, range and null space, rank nullity theorem, determinants of matrices, eigenvalues and eigenvectors of matrices, matrix decompositions, inner product spaces, differentiation, Riemann integration.

## 4 Practice Problems

A problem set will be made available for each lecture. All students are expected to submit at least one problem solution (students may submit more) to the instructor via email, [ichiro.hashimoto@mail.utoronto.ca](mailto:ichiro.hashimoto@mail.utoronto.ca) within 3 days of the class.

## 5 Textbooks

The main reference for this course are the lecture notes, which will be made available on the course website as we progress through the course. The following books were used in preparing the course, and are optional texts for the different areas we will cover. All books are freely available online, however some require a U of T log-in.

**Proofs:**

1. *An Introduction to Mathematical Structures and Proofs* by Larry J. Gerstein

**Set theory and topology:**

2. *A Taste of Topology* by Volker Runde

**Analysis:**

3. *Real Mathematical Analysis* by Charles C. Pugh

**Linear algebra:**

4. *Linear Algebra Done Right* by Sheldon Axler
5. *Linear Algebra Done Wrong* by Sergei Treil

**Additional resources:**

6. *Lecture notes in Mathematics for Economics and Statistics* by Piotr Zwiernik
7. *Real Analysis Lecture Notes* by Laurent Marcoux
8. *Understanding Analysis* by Stephen Abbott

## 6 Tentative Lecture Schedule

The lecture topics and corresponding texts are outlined below. This schedule is tentative and may be changed as the course progresses.

Lecture	Topics	References
1	Review of logic & proof techniques	1
2	Set theory	2, 6, 7
3	Set theory II	2, 6, 7
3	Metric spaces I	2, 3, 6
4	Metric spaces II	2, 3, 6
5	Metric spaces III	2, 7
6	Linear algebra I	4 & 5
7	Linear algebra II	4 & 5
8	Linear algebra III	4 & 5
10	Differentiation and integration	3, 6