Operational Math

DoSS Summer Prep Bootcamp 2022

1   Time & Place

July 11 to 29, online synchronous

2   Instructor

Emma Kroell, 2nd year PhD student, Department of Statistical Sciences

3   Course Outline

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

Topics include symbolic logic, logical quanitifiers, types of proof, proof by induction, elementary set theory, ordered sets, 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, basics of a topology, 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   Textbooks

The following books 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

5   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	Metric spaces and sequences I	2, 3, 6
4	Metric spaces and sequences II	2, 3, 6
5	Topology	2, 7
6	Linear algebra I	4 & 5
7	Linear algebra II	4 & 5
8	Linear algebra III	4 & 5
9	Differentiation and integration	3, 6
10	Multivariable calculus	3, 6