Math Workshop Syllabus – Fall 2025

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Course Description

The Math Workshop provides a comprehensive review and practice of mathematical concepts essential for graduate economics courses. Foundational topics are delivered through pre-recorded video lectures, while more advanced material is covered in person. The primary goal is to ensure that all incoming graduate students begin the Fall term with a solid and consistent mathematical foundation.

Course Outcome

By the end of the workshop, students will have reviewed and practiced essential mathematical techniques, including univariate and multivariate calculus and linear algebra. The workshop emphasizes hands-on practice to strengthen skills and enhance preparedness for graduate coursework in economics.

Study Material

Pre-recorded videos are provided for some topics delivered through videos. They are sourced from:

- **MIT OpenCourseWare**: Comprehensive lecture series on linear algebra, calculus, and mathematical programming. Available at ocw.mit.edu.
- **Khan Academy**: Concise videos on precalculus, calculus, and linear algebra, with economics-relevant examples. Available at khanacademy.org.
- **Refresher Mathematics for Economics**: Over 80 videos tailored for economics students, covering arithmetic, algebra, calculus, and matrices. Hosted by the Economics Network, University of Warwick. Available at economicsnetwork.ac.uk/themes/refresher-mathematics-economics.
- **Economics in Many Lessons**: YouTube channel by Professor Antony Davies, offering concise videos on mathematical methods and economic applications. Available at youtube.com/@EconomicsinManyLessons.

The following textbooks are recommended but not mandatory:

- Hoy, M., J. Livernois, C. McKenna and R. Rees, T. Stengos (2001), Mathematics for Economics, 2nd edition, MIT Press.
- Martin J. Osborne's website for a comprehensive review of mathematical concepts https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc

Topics Covered and Suggested Readings

The workshop covers foundational and advanced mathematical topics through videos or in-person lectures. The table below outlines the topics, content, delivery method, and suggested readings. Topics and readings are tentative and subject to change.

Topic	Content	Delivery	Suggested Readings
Basic Review	1. Sets and Subsets 2. Numbers 3. Properties of Point Sets in $\mathbb{R}^n$ 4. Functions 5. Sequences, series and limits	Video	Hoy et al.: Ch. 2&3
Matrix Algebra	1. Matrices 2. Determinants and the inverse matrix 3. Systems of Linear equations	Video	Hoy et al.: Ch. 7-9 Osborne: 1.2, 1.3
Vector Spaces	1. Vector spaces 2. The eigenvalue problem	Video	Hoy et al.: Ch. 10 Osborne: 1.2
Continuity of Functions	1. Continuity of functions of one variable 2. Economic Application of Continuous and Discontinuous functions	Video	Hoy et al.: Ch. 4
Derivative and Differential for Functions	1. Definition of Tangent Lines 2. Definition of Derivatives and Differentials 3. Conditions for Differentiability 4. Rules for Differentiation 5. Concavity and Convexity	Video	Hoy et al.: Ch. 5
Optimization of Functions of one variable	1. Necessary Conditions for Unconstrained Maxima and Minima 2. Second Order Conditions 3. Optimization Over an Interval	In-Person	Hoy et al.: Ch. 6

Calculus and Optimization for Functions of n-Variables	1. Partial Differentiation 2. Second Order Partial Derivative 3. First Order Total Differential 4. Curvature Properties: Concavity and Convexity 5. Taylor Series Expansion 6. Optimization of Functions of n-Variable	In-Person	Hoy et al.: Ch. 11&12
Constrained Optimization and Comparative Statics	1. Constrained problems and approaches to solutions 2. Comparative Statics analysis 3. The Envelope Theorem 4. The Kuhn-Tucker Conditions	In-Person	Hoy et al.: Ch. 13-15

Schedule

The workshop begins with pre-recorded videos released in August 2025. In-person lectures start on September 2, 2025, at Dalhousie University. The schedule below lists video release dates, lecture dates, times, locations, and topics. Locations and topics are subject to change; updates will be communicated via Brightspace.

Date	Time	Building	Room	Topic
Aug. 1	--	Video	Brightspace	Basic Review
Aug. 8	--	Video	Brightspace	Matrix Algebra
Aug. 15	--	Video	Brightspace	Vector Spaces
Aug. 22	--	Video	Brightspace	Concavity & Convexity
Aug. 29	--	Video	--	Integral Calculus
Sept. 2	11:35–12:55	McCain	2116	Questions & Answers Optimization of functions of one variable
Sept. 5	09:00–12:00	McCain	2116	Optimization of functions of one variable In-class test *
Sept. 11	11:35–12:55	McCain	1116	Calculus and Optimization for Functions of n-Variables
Sept. 12	09:00–12:00	McCain	2116	Calculus and Optimization for Functions of n-Variables

Sept. 16	11:35–12:55	McCain	2116	Calculus and Optimization for Functions of n-Variables
Sept. 18	11:35–12:55	McCain	1116	Constrained Optimization and Comparative Statics
Sept. 19	09:00–12:00	McCain	2116	Constrained Optimization and Comparative Statics
Sept. 23	11:35–12:55	McCain	2116	In-class test *

* These tests will be graded and the grades will be shared with the graduate coordinators, but they will not appear in your official transcripts nor will they affect your academic record in the program. You are strongly encouraged to complete them. The purpose of these tests is to help you identify which areas of mathematics you are confident in and which areas may require further review. They are a useful tool for self-assessment as you prepare for your graduate courses.