DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Economics
Math Workshop
Fall 2023/2024

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people. We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years

Instructor

Yongpei Cai
Email: Yongpei.Cai@dal.ca

Course Description

This mathematics workshop is designed to provide economics students with essential mathematical tools to excel in their core courses, including Macroeconomics, Microeconomics, and Econometrics, as well as other elective economics courses. Throughout the workshop, students will engage in interactive sessions and practical exercises that focus on key mathematical concepts relevant to economics. The course will cover fundamental topics such as calculus, linear algebra, optimization, and probability theory, with an emphasis on their applications in economic analysis.

Course Material

Textbook: *Fundamental Methods of Mathematical Economics* by Alpha Chiang (1984)
Textbook: *Mathematical Methods for Economics* by Michael W. Klein (2002)
Textbook: *Mathematics for Economists* by Carl P. Simon and Lawrence Blume (1994)
Textbook: *Introductory Econometrics: A Modern Approach* by Jeffrey M. Wooldridge (2019)

Students are also welcome to refer to a recommended website by Martin J. Osborne found below. This website provides a deep review of the math needed for an economics student and will be referred to during the workshop.

https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc.

Table 1: Topics Covered and Suggested Readings

Topics	Content	Suggested Reading
Basic Review	Mathematical notation; proofs; properties of functions; types of functions; graphical representation of functions	Chiang $\rightarrow$ Ch.1-2, 6.4-6.6, 10; Klein $\rightarrow$ Ch.1-3; Simon & Blume $\rightarrow$ Ch.1-2, 5; Osborne $\rightarrow$ 1.1, 1.4, and 1.7
Matrix & Linear Algebra	Matrix operations; systems of linear equations; determinants; inverse of a matrix; rank; Cramer's rule; eigen values and eigen vectors; differentiation of matrices/vectors	Chiang $\rightarrow$ Ch.3-5; Klein $\rightarrow$ Ch.4-5; Simon & Blume $\rightarrow$ Ch.6-11; Osborne $\rightarrow$ 1.2 and 1.3; Wooldridge $\rightarrow$ Appendix D
Differential Calculus	Derivatives; differentiation; rules of differentiation; chain rule; Taylor theorem; partial derivatives; homogenous functions; Euler's theorem; implicit functions; comparative statics	Chiang $\rightarrow$ Ch.6-8; Klein $\rightarrow$ Ch.6-8; Simon & Blume $\rightarrow$ Ch.3-4, 14; Osborne $\rightarrow$ 1.5, 1.6, 2.1-2
Concavity & Convexity	Definitions; convex sets; definiteness and semi-definiteness of a matrix; concave and convex functions; quasiconcavity and quasiconvexity	Simon & Blume $\rightarrow$ Ch.21; Osborne $\rightarrow$ 3.1-3.4; TBD
Optimization	Extreme values; first and second order conditions (uni-and multi-variate cases); necessary and sufficient conditions; Hessian matrix; unconstrained vs. constrained optimization; envelope theorem; bordered Hessian; Lagrange technique; Kuhn-Tucker method (inequality constraints); economic applications	Chiang $\rightarrow$ Ch.9, 11, 12; Klein $\rightarrow$ Ch. 9-11; Simon & Blume $\rightarrow$ Ch.17-19; Osborne $\rightarrow$ 4.1-4.3, 5.1-5.3, 6.1-6.3, 7.1-7.5
Integral Calculus	Indefinite integrals; definite integrals; rules of integration; improper integrals; economic applications	Chiang $\rightarrow$ Ch.14; Osborne $\rightarrow$ 1.5; TBD
Dynamic Optimization and Dynamic programming	Finite vs. infinite horizon models; discrete vs. continuous settings; etc.	TBD

Tentative Schedule

The following is a *tentative* schedule for the workshop.

Date	Time	Building	Room	Topics Covered
Sept. 5	16:05 - 18:05			Basic Review
Sept. 6	16:05 - 18:05			Matrix and Linear Algebra
Sept. 7	16:05 - 18:05			Differential Calculus
Sept. 8	10:00 - 12:00			Differential Calculus
Sept. 8	16:05 - 18:05			Concavity and Convexity
Sept. 11	16:05 - 18:05			Concavity and Convexity; Optimization
Sept. 12	16:05 - 18:05			Optimization
Sept. 13	16:05 - 18:05			Optimization
Sept. 14	16:05 - 18:05			Optimization; Integral Calculus
Sept. 15	10:00 - 12:00			Integral Calculus
Sept. 15	16:05 - 18:05			Dynamic Optimization and Dynamic Programming
Sept. 18	16:05 - 18:05			Dynamic Optimization and Dynamic Programming
Sept. 19	16:05 - 18:05			Dynamic Optimization and Dynamic Programming
Sept. 20	16:05 - 18:05			Dynamic Optimization and Dynamic Programming