Mathematics Review Course

University of Minnesota
Department of Applied Economics

Summer 2023

Instructor:	Ryan McWay	**Time:**	MTWRF 9:00 – 12:00
Email:	mcway005@umn.edu	**Place:**	143 Ruttan Hall

Course Pages:

1. Primary Github Repository: https://github.com/mcwayrm/apec_math_review_2023
2. Canvas Site: TBA

Office Hours: After class, or you may reach out directly via email. Discussing math in-person or over zoom is preferred to email.

Course Description: This is a survey course for graduate-level mathematics skills for masters and doctoral students entering the Applied Economics (APEC) program in the Fall, 2023. Additionally, this course is open to similar incoming students from adjacent fields (Public Policy, Business, Health Economics, etc.). Concepts are likely a mixture of material students will be familiar with as well as novel methods and applications necessary for success in this program. Through recitation and practice problems, this course will prepare students for the mathematical rigor of the core microeconomics theory (APEC 8001 – 04) and econometrics (APEC 8211 – 14) during the first-year sequence. Generally, will cover the following broad categories of mathematics will application to the economic science: set theory, topology, probability, statistics, algebra, calculus, proofs, linear algebra, and optimization.

This is a non-credit course. The course content consists of lectures, encouraged readings, supplementary reinforcing materials, and optional problem sets. This course will be offered in a hybrid format (in-person and online). I encourage in-person attendance.

The best way to learn and reinforce mathematics is to practice math... not just to digest lectures on mathematics. Therefore, the structure of this course is to introduce material you have both seen before and likely not seen before. Clarify this material and demonstrate both applications in economics as well as through exercises in class. Active participation by students will be required (both in-person and via zoom) to attempt these exercises. These exercises are reinforced through at-home problem sets for students' individual practice. Only by doing will you (the student) grasp concepts wholly and feel comfortable applying this knowledge.

This course has been structured with consultation of the APEC department chair (Terry Hurley), the APEC graduate director (Terry Hurley), along with the instructors for the microeconomics series (Paul Glewwe, Rodney Smith, Steve Polasky, Jay Coggins) and the econometrics series (Joe Ritter, Paul Glewwe, Marc Bellemare). The initial teaching assistants for microeconomics (Matthew Braaskma) and for econometrics (Shunkei Kakimoto) have reviewed this course material. The course content relies heavily upon previous instruction of this review course by Mwaso Mnensa (2022), Matthew Bombyk (2021), Ling Yao (2020), Natalia Ordaz Reynoso (2019), and Vanee Dusoruth (2017, 2016).

Main References: This is a restricted list of various interesting and useful books that will be touched upon during the course. You need to consult them occasionally. These materials are readily available through internet archives, online bookstores, the university bookstore, as well as the department library (Waite Library).

TODO: Only include books referenced in lectures and in problem sets

Mathematics:

- [Hansen Stats] Hansen. (2022). *Probability and Statistics for Economists.*
- [SB] Simon, and Blume. (1987). *Mathematics for Economists.*
- [Chiang] Chiang. (2004). *Fundamental Methods of Mathematical Economics.*
- [Hammack] Hammack. (2013). *Book of Proof.*
- [Velleman] Velleman. (2006). *How to Prove It: A Structured Approach.*
- [B&S] Bartle, and Sherbert. (2010). *Introduction to Real Analysis.*
- [D&S] DeGroot, and Schervish. (2012). *Probability and Statistics.*
- [Strang] Strang. (2006). *Linear Algebra and Its Applications.*

Microeconomics:

- [MWG] Mas-Colell, Whinston, and Green. (1995). *Microeconomic Theory.*
- [Sundaram] Sundaram. (1996). *A First Course in Optimization Theory.*

Macroeconomics:

- [Stokey] Stokey, Lucas, and Prescott. (1989). *Recursive Methods in Economic Dynamics.*

Econometrics:

- [Hansen Metrics] Hansen. (2022). *Introduction to Econometrics.*
- [Kennedy] Kennedy. (2008) *A Guide to Econometrics.*
- [Greene] Greene. (2017) *Econometric Analysis.*

Objectives: By the end of the course, students should be able to:

- Identify areas of weakness in mathematics, and be able to address them through individual study, practice, and seeking assistance appropriately.
- Understand the fundamentals of mathematics applications in economics.
- Comfortably perform proofs and optimization.
- Comfortably perform problem sets under time constraints.
- Confidence starting the first year sequence.

Important Dates:

Start of Math Review Course ..... August, 7th
Start of Coding Review ..... August, 14th
End of Coding Review ..... August, 14th
End of Math Review Course ..... August, 25th
APEC Graduate Student Orientation ..... August, XXth
Start of Fall 2023 Academic Semester ..... September, 5th

Problem Sets:

This course is optional and not graded. To reinforce material, and to determine for yourself deficiencies in your math background worth improving in particular, daily problem sets will be assigned corresponding with the material covered in each lecture. Completing these problem sets is optional and will not be graded. But it is highly encouraged. If you are struggling, this helps me identify the issue with better clarity.

Problem sets may be completed in groups, but are strongly encouraged to be first attempted individually. I highly recommend creating cohorts to assist with questions and comprehension of the material.

Solution sets will be made available via the Github repository the following day.

Tentative Course Outline:

TODO: Restructure so main sources are: Hansen Metrics, Hansen Prob, MWG, Hammack, Velleman Others are Supplementary Look at some math for economists graduate course syllabus' for help structuring.

The chronology of topics is subject to change. Encouraged readings are intended to be reviewed before the lecture. Supplementary material should be referenced as necessary following the lecture. Assignments are intended to be completed following the assigned lecture prior to the next lecture period.

Lecture		Topic	Encouraged Reading	Supplementary Material	Assignment
1	Aug. 7	Logic & Proofs	B&S App. A Hammack Ch. 4 & 10	Hammack Ch. 1 & 2 B&S Ch. 1 & 2 S&B Ch. A1.3	PS01
2	Aug. 8	Sets & Topology	B&S Ch. 11 S&B Ch. 12	MWG App. M.G. S&B Ch. A1.1	PS02
3	Aug. 9	Derivatives	MWG App. M.A. B&S Ch. 6	Sundaram Ch. 2	PS03
4	Aug. 10	Integration	S&B Ch. 2, 3, & 4	S&B Ch. A4	PS04
5	Aug. 11	Multi-variate Calculus	S&B Ch. 14, 15, & 20	...	PS05
6	Aug. 14	Matrices	MWG App. M.D., & M.M.	Sundaram Ch 1.3	PS06
7	Aug. 15	Linear Algebra	S&B Ch. 7, 8, & 9	Hansen Metrics Ch A18, A19, & A20	PS07
8	Aug. 16	Numbers & Functions	Hammack Ch. 12 MWG App. M.B. & M.C. MWG App. M.F. & M.I.	Sundaram Ch. 7 & 8 B&S Ch. 3, 4, & 5 S&B Ch. 13, & 21	PS08
9	Aug. 17	Optimization	MWG App. M.J., & M.K.	Sundaram Ch. 2, & 4	PS09
10	Aug. 18	Optimization	MWG App. & M.L. S&B Ch. 17, 18, & 19	Sundaram Ch. 5, & 6	PS10
11	Aug. 21	Probability	Hansen Metrics Ch. 1	...	PS11
12	Aug. 22	Statistics	...	...	PS12
13	Aug. 23	Dynamic Programming	MWG App. M.N.	Sundaram Ch. 11 & 12	PS13
14	Aug. 24	Ancillary Material	...	...	...
15	Aug. 25	Coursework Preview & Review	...	...	...

Course Policy:

- Course content is subject to change (including during the course period). Changes will be publicly

announced. Refer to the Github repository for an updated syllabus and material as needed.

- Enrollment will be determined via the list of participants provided the instructor through the APEC department. If you wish to be added, consult your program coordinator.

Class Policy:

- Regular attendance is essential and encouraged, but is optional. Attendance will be recorded.
- A regular zoom link will be available for remote access to this course. The link will be sent out via email. You may request the link via email if you have not received it.
- Lectures will not be recorded. If you wish to learn, attend the live session. Conflicting commitments may be seen as a minor inconvenience, as this course is a non-requisite for your graduate studies.
- The course material is the instructor's intellectual property. Dissemination is at the discretion of the instructor – Ryan McWay.
- Respect of your fellow classmates and the instructor is expected while in the classroom. You will be asked to leave if you are inconsiderate of your peers, or are disrupting the learning process.