

The Chinese University of Hong Kong
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ECON 5100 Review of Quantitative Methods
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Syllabus

Course Description This course reviews mathematical methods that are required for graduate level courses in economic theory. Topics include logic, proof methods, sets, functions, basic topology, matrix, differentiation, exponential functions, concave functions, unconstrained optimization, constrained optimization, integration, differential equations, and optimal control theory. Related economic applications will also be discussed.

Learning Outcomes After taking this course, students should be familiar with mathematical methods that are required for graduate level courses in economic theory.

Reading Materials Teaching materials are based on the textbook [CW] and other references. Lecture notes will be distributed to students.

Mode of Teaching All classes will be conducted in face-to-face mode. Special arrangements will be made for those students who reside outside Hong Kong and cannot come to the University. Online teaching may replace face-to-face teaching in case the pandemic gets worse.

Assessment The course grade is counted as follows:

Mid-term	50%
Final	50%

There is no make-up exam for the mid-term examination. A student who is absent from the mid-term examination due to sickness should provide a medical certificate, and the final exam will count 100% of his/her grade in this course.

Academic Honesty Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and

procedures applicable to breaches of such policy and regulations. Details may be found at <http://www.cuhk.edu.hk/policy/academichonesty/>.

Discussion Topics

1. Logic and Proofs: connectives, quantifiers, proof methods
2. Sets, Functions, and Countable Sets
3. Basic Topology: sequence, limit, supremum, continuous functions, open sets, closed sets, convex sets, compact sets
4. Matrix: matrix operations, inverse, determinant, Cramer's Rule, rank
5. Differentiation (Single Variable): derivative, differential rules, Mean Value Theorem, L'Hôpital Rule, Taylor expansion
6. Differentiation (General Case): differential, partial and total derivative, Inverse Function Theorem, Implicit Function Theorem
7. Unconstrained Optimization (Single Variable): first-order conditions, second-order conditions
8. Exponential and Logarithmic Functions: natural exponential number, differentiation rules
9. Concave Functions: characterizations of concavity, negative (semi)definite matrices, eigenvalues and eigenvectors, quasiconcave functions
10. Unconstrained Optimization (General Case): first-order conditions, second-order conditions for local maximization, global maximization
11. Optimization with Equality Constraints: Lagrangian method, homogeneous functions, envelope method
12. Optimization with Inequality Constraints: Kuhn-Tucker conditions
13. Integration: indefinite integrals, definite integrals, improper integrals
14. First Order Differential Equations: solution existence, separable equations, linear equations, exact equations
15. Second Order Linear Differential Equations
16. Optimal Control Theory

References

- [BS] Bartle, R. G., and Sherbert, D. R. (2000). *Introduction to Real Analysis*, 3rd edition. John Wiley & Sons, New York.
- [CW] Chiang, A. C., and Wainwright, K. (2005). *Fundamental Methods of Mathematical Economics*, 4th edition. McGraw Hill Companies, New York.
- [M] Mas-Colell, A., Whinston, M. D., and Green, J. (1995). *Microeconomic Theory*. Oxford University Press, New York.
- [R] Rudin, W. (1976). *Principles of Mathematical Analysis*, 3rd edition. McGraw-Hill, New York.
- [SB] Simon, C. P., and Blume, L. (1994). *Mathematics for Economists*. W. W. Norton & Company, New York.
- [SHSS] Sydsæter, K., Hammond P., Seierstad, A., and Strøm, A. (2008). *Further Mathematics for Economic Analysis*, 2nd edition. Financial Times/Prentice Hall, New York.