MATH 3332
Data Analytical Tools
2024-25 Fall

Lecture

Time	Monday and Wednesday 12:00pm-1:20pm
Venue	Room 4504
Instructor	**Dr. Guibo YE**
E-mail	magbye@ust.hk
Office	Room 3419, Department of Mathematics

Tutorial

Time	Thursday 18:00pm-18:50pm
Venue	Room 4579
Teaching Assistant	**Tong WU**
E-mail	twubi@connect.ust.hk

Course Description

Course outline: This course will introduce to the students some mathematical analysis tools that are useful for data analysis. The topics include basic calculus on functionals (norm, inner product, linear operators, differentiation, functional expansion, etc), and basic convex analysis (convexity, gradient descent). All are demonstrated by case studies in data analysis and machine learning.

Credits: 3

Prerequisites: Calculus (MATH 1013 and MATH 1014 or MATH 1023 and MATH 1024) and Linear Algebra (MATH 2121/2131/2111).

Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to:

(1) Grasp the basic mathematical tools such as calculus on functions and basic convex analysis.
(2) Use mathematical tools such as vectors, norms and convex functions to model the problems arising in machine learning.
(3) Grasp basic algorithms on optimization problems and use it in machine learning.
(4) Grasp some basic machine learning algorithms such as K-means and SVM and use it in machine learning problems.

Assessment and Grading

Homework: There will be 5 or 6 problem sets. Students should submit each homework in form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system for long questions before the deadline. No late homework is accepted.

Examinations: There will be a 2 quizzes held during the TA session, and a 3-hour final exam arranged by ARO.

Make-up quiz policy:

- Under any circumstance, students who are unable to attend the quiz will **not** be offered a make-up quiz that takes place after the regular exam session.
- For students who have valid reasons for missing a quiz (such as sickness), the instructor may approve to assign the quiz marks according to another quiz score.
- On other hand, for students who miss the quiz without a valid reason, the quiz score will be regarded as 0. This includes self-claimed sickness without any medical statement.

The course will follow the make-up exam policy set by ARO for the final exam. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam.

Grading Scheme:

This course will be assessed using **criterion-referencing**, and grades will **not** be assigned using a curve (nor a surface). Your course total will be calculated based on the following scheme:

	Scheme	Address ILOs
Homework	20%	1, 2, 3, 4
quizzes	20%	1, 2, 3, 4
Final	60%	1, 2, 3, 4
Course Total	100%	

Letter Grades: Students should aim at getting a course total of 85% or above for A-/A/A+, and about 40% or above for a passing grade.

Grade Descriptors:

Grades	Short Description A	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of data analytic tools taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of data science.
B	Good Performance	The student has mastered most analytic tools of data science taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic analytic tools of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations.

Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints, but are required to write up the solutions by themselves. You are required to **list the persons and references** you have consulted in every homework for all written homeworks.

The use of ChatGPT or other generative AI is allowed, and they are regarded as "persons" you have consulted, and therefore must be listed in your homework.

However, please be warned that at the current stage of development of AI, the response to problems in advanced courses is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework.

Textbooks and References

References: The major reference is the instructor's lecture notes posted on Canvas. In addition, the following reference books are recommended:

Convex Optimization, S. Boyd, L. Vandenberghe, Cambridge University Press, 2003. (Free Online). .

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct.