# MATH 4424
# Multivariate Statistical Analysis
## 2024-25 Fall
https://canvas.ust.hk/courses/59224

### Lecture

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|---|---|
| **Time** | Monday 13:30-14:50 and Friday 9:00-10:20 |
| **Venue** | Room 1032, *LSK Bldg* |
| **Instructor** | **Prof. Dong XIA** |
| E-mail | madxia@ust.hk |
| Office | Room 3431, Department of Mathematics |

### Tutorial

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|---|---|
| **Time** | Wednesday 15:00-15:50pm |
| **Venue** | Multi-function room, LG4, LIB |
| **Teaching Assistant** | **Ms. Congyuan DUAN** |
| E-mail | cduanac@connect.ust.hk |
| **Programming** | (TA will give several R programming tutorial sessions in the first few weeks.) |

### Course Description

**Course outline:** Inferences of means and covariance matrices, Hotelling's T test, multiple linear regression, canonical correlation, multivariate ANOVA, principal components analysis, factor analysis, classification, linear and quadratic discriminant analysis.

**Credits:** 3

**Prerequisites:** Statistical Inference (MATH 3423) and Regression Analysis (MATH 3424).

### Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to:

(1) Get familiar with multivariate normal distribution, random sample, the distributions of sample mean and covariance, Linear combination of normal random variables;
(2) Understand the testing of mean vector, Hotelling's test, Likelihood ratio test, Confidence regions and Large sample inference, Comparing mean vectors from two populations, and one-way MANOVA;
(3) Understand the population principal components, Sample variation summarisation;
(4) Understand Canonical variates, correlation, interpretation of canonical variables, Sample canonical correlation;
(5) Understand classification, Linear and quadratic classification rules, Evaluating classification performance.

### Assessment and Grading

**Homework:** There will be 5 Assignments. Students should submit each homework in form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system before the deadline. Late homework will NOT be accepted. Team work is NOT allowed!

**Examinations:** There will be a 90-min midterm exam during lecture time(exact date to be confirmed), and a 3-hour final exam arranged by ARO.

Make-up midterm policy:

- Under any circumstance, students who are unable to attend the midterm exam will NOT be offered a make-up midterm.

Final exam policy:

- 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.
- You can bring a computer to final exam, but the screen must ONLY shows the **RStudio** interface.

**Grading Scheme:**

This course will be assessed using **criterion-referencing**, and grades will **not** be assigned using a curve. Your course total will be calculated by taking the **maximum of two schemes** in order to encourage students to work harder in the final exam in case the midterm result is not desirable or some student missed the midterm exam:

| | Scheme A | Scheme B | Address ILOs |
|---|---|---|---|
| Homework | 15% | 15% | 1, 2, 3,4,5 |
| Midterm | 30% | 0% | 1, 2, 3,4,5 |
| Final | 55% | 85% | 1, 2, 3,4,5 |
| **Course Total** | 100% | 100% | |

**Letter Grades:** Students should aim at getting a course total of 85% or above for A-/A/A+, and about 60% or above for B-/B/B+.

**Grade Descriptors:**

| Grades | Short Description | Elaboration on subject grading description |
|---|---|---|
| A | Excellent Performance | The student has mastered almost all concepts and techniques of multivariate statistics taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of advanced statistics. |
| B | Good Performance | The student has mastered the application of the statistical methods taught in this 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 knowledge of the taught statistical methods, 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 apply some of the easiest statistical methods |
| F | Fail | The student does not have sufficient understanding of even some fragments of topics, and is not even able to apply some of the easiest statistical methods. |

**Course AI Policy**

The use of ChatGPT or other generative AI is allowed for Assignments ONLY, but needs to be declared in your submissions.

Please be warned that at the current stage of development of AI, the response to problems in advanced statistics 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.

## Textbook and Learning Resources

**Lecture notes and slides** (on canvas)

**Textbook**: Johnson and Wichern, Applied Multivariate Statistical Analysis, Sixth Edition (*not required*.)

## 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.