

**MATH 2431 Honors Probability
Course Outline --- Spring 2024**

1. Instructor(s)

Name: Bao, Zhigang (L1)

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2. Teaching Assistant(s)

- *Name: Li, Yuji (T1A)*

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3. Meeting Time and Venue

Lectures:

Date/Time: L1: TuTh 10:30AM - 11:50AM

Venue: Rm 1409, Lift 25-26

Tutorials:

Date/Time: T1A: Th 06:00PM - 06:50PM

Venue: Rm 4504, Lift 25-26

4. Course Description

Credit Points: 4

Pre-requisite: Grade A- or above in (IELM 2510 or ISOM 2500 or LIFS 3150 or MATH 2411)

Exclusion: ELEC 2600, ELEC 2600H, ISOM 3540, MATH 2421

Brief Information/synopsis:

This is an honors undergraduate course in probability theory. Topics include probability spaces and random variables, distributions (absolutely continuous and singular distributions) and probability densities, moment inequalities, moment generating functions, conditional expectations, independence, conditional distributions, convergence concepts (weak, strong and in distribution), law of large numbers (weak and strong) and central limit theorem. Some rigorous theoretical results in probability will be discussed.

5. Intended Learning Outcomes

Upon successful completion of this course, students should be able to:

No.	ILOs
1	Recognize and use appropriately the modern mathematical language of probability theory
2	Remember the most important distributions, their motivations, properties and applications
3	Understand the fundamental limiting theorems and the related techniques of the proofs

6. Assessment Scheme

a. Percentage of coursework, examination, etc.:

<u>Assessment 1</u>	<u>Assessing Course ILOs</u>
20% Assignments	<u>1,2,3,</u>
30% Mid-term Test	1,2
50% Final Examination	1,2,3,

b.

<u>Assessment 2</u>	<u>Assessing Course ILOs</u>
20% Assignments	<u>1,2,3</u>
0% Mid-term Test (in case the student cannot attend the midterm)	1,2
80% Final Examination (in case the student cannot attend the midterm)	1,2,3

c.

The final grade = $\max\{\text{Assessment 1}, \text{Assessment 2}\}$

7. Student Learning Resources

Textbook: G. Grimmett and D. Stirzaker, *Probability and Random Processes, Third Edition, Oxford.*

Lecture notes

8. Teaching and Learning Activities

Scheduled activities: 4 hrs (lecture + tutorial)

9. Course Schedule

Keyword Syllabus:

- **Chap 1 Events and their probabilities** (~3 hours)
 (1) Events; (2) Probability; (3) Conditional probability;
 (4) Independence of events ; (5) Completeness and product spaces.
- **Chap 2,3,4 Random variables and their distributions** (~12 hours)
 (1) Random variables; (2) Discrete and continuous variables and their distributions; (3) Random vectors;
 (4) Probability mass function and probability density function; (5) Independence of random variables;
 (6) Expectation; (7) Conditional distribution and conditional expectation; (8) Sum of random variables and

simple random walk; (9) Joint distribution and multivariate normal; (10) Poisson approximation

- **Chaps 5 Generating functions** (~ 8 hours)
(1) Generating functions; (2) Random walk and Branching processes;
(3) Expectation revisited; (4) Characteristic functions;
(5) Inversion and continuity theorems; (6) Two limit theorems; (7) Large deviations.

- **Chap 6 Convergence of random variables** (~13 hours)
(1) Modes of convergence; (2) Laws of large numbers; (3) The strong law;
(4) The law of the iterated logarithm; (5) Central limit theorem; (6) Martingales; (7) Martingale convergence theorem;
(8) Martingale CLT