

MATH2421 Probability
Course Outline-Fall 2024

1. Instructor(s)

Name: Ke Wang

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2. Teaching Assistant(s)

Name: CHEONG, Kha Man

Contact Details: kmcheong@connect.ust.hk

3. Meeting Time and Venue

Lectures:

Date/Time: Mon/Wed (12:00 - 13:20)

Venue: LG3009

Tutorials:

Section/Date/Time/Venueß:

T1A, Wed 15:00 - 15:50, 6580

T1B, Tue 18:00 - 18:50, 4580

4. Course Description

Credit Points: 4

Pre-requisite: MATH 1014 OR MATH 1020 OR MATH 1024

Exclusion: EDA 2510, IEDA 2520, MATH 2431, EEC 2600, ELEC 2600H, ISOM 3540

Brief Information/synopsis: The course covers the basic principles of probability theory. Topics include combinatorial analysis used in computing probabilities, the axioms of probability, conditional probability and independence of events, discrete and continuous random variables; joint, marginal, and conditional densities, moment generating function; binomial, Poisson, gamma, exponential, Gamma, Beta, Cauchy, univariate, and bivariate normal distributions; laws of large numbers; central limit theorem.

5. Intended Learning Outcomes

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

No.	ILOs
1	Recognize and use appropriately important technical terms and definitions.
2	Use axioms of probability to calculate various probabilities.
3	Understand discrete and continuous random variables and associate them with various random experiments.

4	Solve real and hypothetical problems using the laws of large numbers and central limit theorem.
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6. Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date (if applicable)
Homework	15%	Will be announced in Canvas
Midterm	35%	TBD
Final Exam	50%	TBD

Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework	ILO1, ILO2, ILO3, ILO4	The homework assesses students' ability of understanding the concepts and the logic, distilling the abstract setting from examples, and applying the theory to other fields.
Midterm	ILO1, ILO2, ILO3, ILO4	The mid-term exam assesses students' ability of understanding the concepts and the logic, distilling the abstract setting from examples, and applying the theory to other fields.

Final Exam	ILO1, ILO2, ILO3, ILO4	The final exam assesses students' ability of understanding the concepts and the logic, distilling the abstract setting from examples, and applying the theory to other fields.

Grading Rubrics

Marks for each problem will be specified. Full marks will be awarded for completely correct answers. Partial credit will be given for answers that are on the right track but not fully complete.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and theories of functional analysis taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of partial differential equations.
B	Good Performance	The student has mastered most theories of functional analysis taught in the course, yet the understanding of some challenging concepts may not be deep enough for their applications on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject but only in finite dimensions, 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 even in finite dimensions.

7. 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.

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 – especially those in pure mathematics – 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.

8. Student Learning Resources

Recommended Reading:

Textbook:

Sheldon M. Ross, “A First Course in Probability”, Pearson.

9. Teaching and Learning Activities

Scheduled activities: 4 hrs (lecture + tutorial)

10. Course Schedule

Week 1	Chapter 1: Principle of counting, permutations
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Week 2	Chapter 1: Combinations, Multinomial coefficients, number of integer solutions Chapter 2: Sample spaces and events
Week 3	Chapter 2: Operations on events, axioms of probability, properties of probability, Sample spaces having equally likely outcomes
Week 4	Chapter 3: Conditional probability, total probability, Bayes' Theorem, independence
Week 5	Chapter 4: Definition of random variables, discrete random variables, expected values, expectation of a function of a random variable, variance and standard deviation
Week 6	Chapter 4: Discrete random variables arising from repeated trials, Poisson random variable, hypergeometric random variable, expected value of sum of random variables
Week 7 (Midterm) Week 8	Chapter 5: Continuous random variables, probability density function, expectation and variance, uniform distribution, normal distribution, exponential distribution, Gamma distribution
Week 9	Chapter 5: Beta distribution, Cauchy distribution, approximations of binomial random variables, distribution of a function of a random variable
Week 10	Chapter 6: Joint distribution functions, independent random variables, sum of independent random variables, conditional distributions
Week 11	Chapter 6: Joint probability distribution function of functions of random variables Chapter 7: Expectation of sum of random variables, covariance/variance of sums and correlation
Week 12	Chapter 7: Conditional expectation, conditional variance, moment generating function, joint moment generating functions
Week 13	Chapter 8: Chebyshev's inequality and weak law of large numbers, strong law of large numbers, Central limit theorem