The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus Template

Course Title: Probability and Statistics

Course Code: DSAA1085

No. of Credits: 4

Any pre-/co-requisites: *UFUG2103 Linear Algebra* or *UFUG2102 Matrix Algebra and Applications*.

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Course Description

This course provides a rigorous introduction to probability and foundational statistics for students in data science, smart manufacturing, and related disciplines. Topics include probability spaces and random variables; distributions (continuous and singular) and probability densities; expectations, variance, and key moment inequalities; moment generating functions; conditional expectations and independence; conditional distributions; modes of convergence (almost sure, in probability, and in distribution); the weak strong laws of large numbers; and the central limit theorem. The course emphasizes mathematical reasoning and problem solving, with examples drawn from finance, industrial engineering, and the life sciences. Teaching consists primarily of lectures (4 hours/week) with in-class worked examples and guided self-study.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Calculate and work effectively with probability spaces and measures, conditional expectations, and generating functions.

2. Distinguish between and determine the various types of convergence and select appropriate tools for analysis.

3. Apply the main results and techniques of probability theory and statistics, including laws of large numbers (weak/strong) and the central limit theorem.

4. Solve a variety of problems in probability and statistics using rigorous mathematical arguments.

5. Model randomness in practical settings and interpret probabilistic results in a statistical context.

Weekly Schedule and Weekly ILOs

Week	Topics	Weekly ILOs
1	Introduction	Understand course scope, expectations, and review

		prerequisite concepts; articulate what a probability model is (ILO5).
2	Probability spaces and random variables	Define a probability space and random variable; compute probabilities and expectations in basic settings (ILO1, ILO4).
3	Distributions	Distinguish discrete/continuous/singular distributions; work with CDFs and distributional properties (ILO1).
4	Probability densities	Compute and manipulate PDFs/PMFs of common distributions; transform variables and compute expectations (ILO1, ILO4).
5	Moment inequalities	Apply Markov/Chebyshev/Jensen/Cauchy–Schwarz and related inequalities to bound probabilities and moments (ILO1, ILO4).
6	Moment generating functions; Mid-term test	Use MGFs to characterize distributions and derive moments; demonstrate mastery of Weeks 1–6 in the mid-term (ILO1–ILO4).
7	Conditional expectations	Compute conditional expectations; use the law of total expectation and related identities (ILO1, ILO4).
8	Independence	Test and use independence; compute joint/conditional probabilities and expectations under independence assumptions (ILO1, ILO4, ILO5).
9	Conditional distributions	Derive and use conditional distributions; apply Bayes' rule and related results in modeling (ILO1, ILO5).
10	Convergence concepts	Differentiate almost sure, in probability, in Lp, and in distribution convergence; apply basic convergence tools (ILO2, ILO4).
11	Law of large numbers	State and apply weak/strong LLN; connect LLN to empirical averages and statistical intuition (ILO3, ILO5).
12	Central limit theorem	State and apply the CLT; use normal approximation and interpret implications for sampling distributions (ILO3, ILO5).
13	Review	Synthesize course concepts; solve comprehensive problems and prepare for the final examination (ILO1–ILO5).

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 tasks, weightings, and indicative timing are listed below.

Assessment Task	Contribution to Overall Course grade (%)	Due date
Mid-term test	30%	20/03/2026 (Week 6) *
Written assignment	10%	20/03/2026 (Week 12) *
Final examination	60%	11/05/2026 (Week 13) *

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

Mapping of Course ILOs to Assessment Tasks

The table below shows how each assessment task maps to the course ILOs.

Assessed Task	Mapped ILOs	Explanation
Mid-term test	ILO1–ILO4 (and partial ILO5)	Closed-book in-class test focused on core definitions, computations, and proofs/derivations. Assesses students' ability to work with probability models (ILO1), handle convergence ideas introduced to that point (ILO2, as applicable), and present rigorous solutions (ILO4).
Written assignment	ILO3–ILO5 (and ILO4)	Individual written work emphasizing modeling and interpretation. Assesses application of major theorems (ILO3), rigorous reasoning (ILO4), and the ability to translate a real scenario into a probabilistic model and interpret results (ILO5).
Final examination	ILO1–ILO5	Comprehensive closed-book exam covering the full syllabus, including LLN and CLT. Assesses mastery of concepts and techniques (ILO1–ILO3), rigorous problem solving (ILO4), and modeling/interpretation across contexts (ILO5).

Grading Rubrics

Rubrics will be provided on Canvas prior to each assessed task. In general:
• Mid-term test and Final examination: correctness of results (≈70%), soundness of reasoning/derivation (≈20%), and clarity/organization of solutions (≈10%).
• Written assignment: problem formulation and assumptions (≈20%), correctness of analysis/derivation (≈40%), interpretation and discussion (≈30%), and presentation/academic writing quality (≈10%).

Final Grade Descriptors:

Final grades follow HKUST(GZ) letter-grade standards (A, B, C, D, F) and are criterion-referenced.

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of probability theory and convergence concepts; solves unfamiliar problems with correct and rigorous arguments; communicates solutions clearly and accurately.
B	Good Performance	Shows solid understanding of most topics; solves standard problems correctly and can handle moderately novel questions with minor errors; communicates reasoning clearly overall.
C	Satisfactory Performance	Meets the minimum learning outcomes; solves familiar problems with adequate accuracy; reasoning may lack rigor or clarity in parts but demonstrates sufficient understanding to pass.
D	Marginal Pass	Shows threshold understanding of essential ideas but with notable gaps; solutions may be incomplete or contain significant errors; meets only the minimum requirements.
F	Fail	Does not demonstrate sufficient understanding of core concepts and techniques; unable to solve fundamental problems or provide coherent reasoning; does not meet passing standards.

Course AI Policy

Generative AI tools (e.g., ChatGPT or DeepSeek) may be used for learning support (e.g., explaining concepts, generating practice questions, or improving English writing). However, they must not be used to produce final solutions for graded work without explicit permission. For the written assignment, any AI assistance must be acknowledged in a statement describing the tool and the type of help received. Use of AI is strictly prohibited during in-class tests and the final examination.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback will highlight strengths, common errors, and actionable suggestions for improvement. Students who have questions about feedback or marks should consult the instructor within five working days after receiving the feedback.

Resubmission Policy

Resubmission is not normally available. Extensions may be granted only with prior approval and valid justification. Late submissions without approved extensions may incur a penalty according to the instructor’s announcement on Canvas.

Required Texts and Materials

Required/primary reference:

• Klenke, A. Probability Theory: A Comprehensive Course (3rd edition), Springer.

or

• Ross, S. A First Course in Probability (10th edition), Pearson.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST(GZ)'s Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Regulations for Academic Integrity and Student Conduct for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

Selected open-course videos/notes (e.g., MIT OpenCourseWare), Python-based coding notebooks, and online practice quizzes may be recommended throughout the term.