MA 485-QL PROBABILITY
SYLLABUS

Semester: Fall 2025
Course Instructor: Keren Li, PhD
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Office Hours: By appointment
Last Day of Submission: December 5, 2025

Course Info

Prerequisite: Undergraduate level MA 126 Minimum Grade of C or Undergraduate level MA 226 Minimum Grade of C
Credits: 3 semester hours
Required Textbooks: First Course in Probability, A, 10th edition, 2019. E-Book comes with UAB Opt-In through Pearson.
Lecture Notes: Pre-recorded video lectures with PowerPoint presentations will be available in Canvas.

Course Description

Combinatorics, probability spaces, combinatorics, conditional probabilities and independence, Bayes rule, discrete and continuous distributions, mean value and variance, random variables, joint distributions, correlation, Law of Large Numbers, Central Limit Theorem.

Learning Outcomes

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

- Apply combinatorial methods to solve problems involving permutations, combinations, and other counting principles.
- Understand and use the axioms of probability to calculate probabilities in finite and infinite sample spaces.
- Analyze events involving conditional probabilities and determine independence of events.
- Use Bayes' theorem to compute posterior probabilities in relevant contexts.
- Describe, analyze, and compute probabilities for discrete and continuous random variables using probability mass functions, density functions, and cumulative distribution functions.
- Compute and interpret the expected value, variance, and higher moments of random variables.
- Analyze joint distributions of multiple random variables, including marginal and conditional distributions.
- Evaluate and interpret the correlation and covariance between random variables.
- Apply the Law of Large Numbers and Central Limit Theorem to approximate probabilities and analyze the behavior of sums of random variables.

Course Content

The course will cover the following chapters:

(1) **Combinatorial Analysis:** Fundamental principles of counting, permutations, combinations, and their applications in probability.
(2) **Axioms of Probability:** Probability spaces, axioms, and properties of probability measures.
(3) **Conditional Probability and Independence:** Conditional probability, rules of probability, independence of events, and Bayes' theorem.
(4) **Discrete Random Variables:**
   - Part 1: Definitions, probability mass functions, cumulative distribution functions, and examples.
   - Part 2: Mean, variance, and common discrete distributions (e.g., Binomial, Poisson, and Geometric).
(5) **Continuous Random Variables:** Probability density functions, cumulative distribution functions, expected value, variance, and common continuous distributions (e.g., Uniform, Normal, and Exponential).
(6) **Jointly Distributed Random Variables:** Joint probability distributions, marginal and conditional distributions, independence, and joint moments.
(7) **Properties of Expectation:**
   - Part 1: Linearity, properties, and applications of expectation.
   - Part 2: Variance decomposition, covariance, and correlation.
(8) **Limit Theorems:** Weak and Strong Laws of Large Numbers, Central Limit Theorem, and their applications.

Course Grade

Your grade in this course is determined by the points earned through various assessments and activities throughout the semester. **There are no partial credits for any late submission.**

Quizzes: (40% total): Quizzes will be administered for each chapter, covering the following topics:
- Chapter 1: Combinatorial Analysis.
- Chapter 2: Axioms of Probability.
- Chapter 3: Conditional Probability and Independence.
- Chapter 4 (Part 1): Discrete Random Variables.
- Chapter 4 (Part 2): Discrete Random Variables.
- Chapter 5: Continuous Random Variables.
- Chapter 6: Jointly Distributed Random Variables.
- Chapter 7 (Part 1): Properties of Expectation.
- Chapter 7 (Part 2): Properties of Expectation.
- Chapter 8: Limit Theorems.
- Chapter 9-10: Additional Topics in Probability Simulation.

Tests: (60%): Four tests will be administered during the semester:
- **Test 1:** Covers Chapters 1-3.
- **Test 2:** Covers Chapter 4 (Parts 1 and 2).
- **Test 3:** Covers Chapters 5-6.
- **Test 4:** Covers Chapters 7-8.

Bonus Reflection Assignment: (Optional, up to 10% extra credit):
During the semester, students will have the opportunity to complete optional reflection assignments for extra credit. Each assignment will ask students to:

- Reflect on the concepts covered in class.
- Relate the material to real-world examples or personal experiences.

Students can complete one or more assignments to earn up to 10% extra credit. These assignments are optional and will not negatively impact your grade.

Points earned	Grade
85-100+	A
70-84	B
55-69	C
40-54	D
0-39	F

Course Policies

Learning Outcomes: Upon successful completion of this course, the students will be able to: analyze complex combinatorial problems to determine the appropriate counting techniques, apply the axioms of probability to solve probability problems, define problems that involve both conditional probability and independence, apply random variables to model real-world scenarios, use probability density functions to calculate probabilities for continuous random variables, define jointly distributed random variables and understand their joint probability distribution, understand how expectation is calculated and its significance in probability theory, apply limit theorems to analyze the behavior of random variables in different situations.

Time Commitment: You are expected to spend a substantial amount of time working through the course activities and assignments every week. Please know that time management and self-motivation are key components for success in this course and courses in general. There is a lot to be gained in this course, so approach it with an open mind.

Add/Drop and Course Withdrawal: Drop/Add: Deadlines for adding, dropping, or withdrawing from a course and for paying tuition are published in the Academic Calendar available online. Review the Institutional Refund Policy for information on refunds for dropped courses. It is the students responsibility to initiate add/drop procedures. Students may drop and add courses online after they have registered and until the drop/add deadline online using BlazerNET. Withdrawal: To avoid academic penalty, a student must withdraw from a course by the withdrawal deadline shown in the academic calendar and receive a grade of W (withdrawn). Failure to attend class does not constitute a formal drop or withdrawal. The official course withdrawal must be completed online in BlazerNET.

Divisive Concepts: All University faculty, instructors and teaching staff have the academic freedom to explore, discuss, and provide instruction on a wide range of topics in an academic setting. This class may present difficult, objectionable, or controversial topics for consideration, but will do so through an objective, scholarly lens designed to encourage critical thinking. Though students may be asked to share their personal views in the academic setting, no student will ever be required to assent or agree with any concept considered "divisive" under Alabama law, nor penalized for refusing to support or endorse such a concept. All students are strongly encouraged to think independently and analytically about all material presented in class and may express their views in a time, place, and manner,

consistent with class organization and structure, and in accordance with the University's commitment to free and open thought, inquiry, and expressions.

Shared Values Statement: Collaboration, integrity, respect, and excellence are core values of our institution and affirm what it means to be a UAB community member. A key foundation of UAB is diversity. At UAB, everybody counts every day. UAB is committed to fostering a respectful, accessible and open campus environment. We value every member of our campus and the richly different perspectives, characteristics and life experiences that contribute to UAB's unique environment. UAB values and cultivates access, engagement and opportunity in our research, learning, clinical, and work environments. Our CAS aims to create an open and welcoming environment and to support the success of all UAB community members.

Academic Integrity Code: Your success while at UAB and after graduation is valued by the University. To gain and grow in the knowledge and skills needed for your future career, it is vital that you complete your own work in your courses and in your research. The purpose of the Academic Integrity Code is to support our academic mission and to maintain and promote academic integrity. All students in attendance at UAB are expected to pursue all academic endeavors with integrity, honor, and professionalism and to observe standards of conduct appropriate to a community of scholars. Please be sure you understand the different forms of "academic misconduct" covered by the code. See what UAB students say about academic integrity and review the FAQs about the code for details on the Student Academic Integrity webpage.

Artificial Intelligence Use: Academic misconduct is present in an academic work wherever AI assistance has been used when unauthorized, or when authorized, has not been disclosed as required. Such behavior is considered deceit and a violation of UABs shared commitment to truth and academic integrity. Deceit constitutes academic misconduct and is subject to review according to UABs Academic Integrity Code.

Student Conduct Code: The purpose of the University of Alabama at Birmingham (University) student conduct process is to support the vision, mission, and shared values of the University and the tenets of the Universitys creed, The Blazer Way. Through a student-focused and learning-centered lens, the process strives to uphold individual and community standards; foster an environment of personal accountability for decisions; promote personal growth and development of life skills; and care for the well-being, health, safety, and property of all members of the University community. The Student Conduct Code (Code) describes the standards of behavior for all students and student organizations and outlines students rights and the process for adjudicating alleged violations. It is set forth in writing in order to give general notice of non-academic prohibited conduct. The Code should be read broadly and is not designed to define non-academic conduct in exhaustive terms. All students and student organizations are expected to conduct themselves in accordance with the Code. The current version of the Code, which may be revised periodically, is available from the Office of Community Standards & Student Accountability.

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Disability support Services (DSS): UAB is committed to providing an accessible learning experience for all students. If you are a student with a disability that qualifies under Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act, and you require accommodations, please contact Disability Support Services for information on

accommodations, registration and procedures. If you are registered with Disability Support Services, please contact DSS to discuss accommodations that may be necessary in this course. Disability Support Services can be reached at 934-4205 or www.uab.edu/dss or in the Hill Center Suite 409.

Title IX Statement: UAB is committed to providing an environment that is free from sexual misconduct, which includes gender-based assault, harassment, exploitation, dating and domestic violence, stalking, as well as discrimination based on sex, sexual orientation, gender identity, and gender expression. If you have experienced any of the aforementioned conduct we encourage you to report the incident. For more information about Title IX, policy, reporting, protections, resources and supports, please visit http://www.uab.edu/titleix for UAB's Title IX Policy, UAB's Equal Opportunity, Anti Harassment Policy and Duty to Report and Non-Retaliation Policy.

Violence Prevention and Response Policy: The University of Alabama at Birmingham (UAB) is committed to maintaining a safe and secure educational environment and workplace, one which seeks to ensure the well-being and safety of faculty and staff, employees, students and visitors. Violence and threatened violence are prohibited by UAB. Each member of the UAB community has the responsibility to understand, prevent and respond appropriately to campus/workplace violence. View the Violence Prevention and Response Policy.