

American University of Beirut
MATH/STAT 238: Applied Probability Models
Course Syllabus (2025–2026 Fall)

General course information:

- Number of credits: 3
- Course level: Undergraduate
- Course format: Lectures
- Pre-requisites: MATH 218/219 + STAT 233 (or STAT 230 with consent of instructor)
- Schedule: TR 9:30–10:45 (August 26 – November 27)
- Location: Nicely 107

Instructor: Siamak Taati (Email: st71@aub.edu.lb; Office: Bliss Hall 312B; Extension: 4328)

Office hours:

- Mondays 14:00–15:00 and Thursdays 14:30–15:30 (to be updated at the beginning of the semester)

Course description: This is a second undergraduate course in probability theory without measure theory. The core of the course is the theory of discrete-time, finite-state Markov chains, but we will also discuss countable-state and continuous-time Markov chains. Central techniques (e.g., couplings, concentration inequalities, generating functions) and models (e.g., branching processes, random walks, queues) will be introduced throughout. Depending on time and student interest, we may cover additional topics such as Monte Carlo Markov chains, Martingales, Markov random fields, random graphs, or basic concepts in information theory.

Course learning outcomes: Upon completion of this course, you are expected to be able to

- Use the language of probability theory accurately;
- Translate intuitive probabilistic statements into rigorous mathematical statements and vice versa;
- Propose strategies for experimentally evaluating the validity of a probabilistic statement via simulations;
- Use and reproduce standard definitions, terminology and notations from probability theory (in particular, the theory of Markov chains) in a correct and consistent fashion;
- Recall (or quickly rediscover) the basic facts regarding Markov chains and related topics;
- Accurately reproduce the statements of central theorems in the theory of Markov chains and related topics;
- Apply abstract probabilistic facts and concepts to concrete settings;
- Follow probabilistic arguments and spot potential mistakes in them;
- Solve problems and develop proof strategies for probabilistic facts (in particular, from the theory of Markov chains) at an intuitive level;
- Turn intuitive proof strategies regarding probabilistic facts into rigorous mathematical proofs;
- Produce counter-examples or counter-arguments for false probabilistic statements;
- Present definitions and arguments from probability theory (in particular, the theory of Markov chains) orally and in writing;

Program learning outcomes addressed in the course:

- Communicate mathematical concepts orally and in writing.
- Carry out significant mathematical computations.
- State theorems and give examples where they are used.
- Develop clear, organized, and rigorous mathematical proofs.
- Define and give good concrete examples of mathematical structures.
- Understand the mathematical foundations of Probability and Statistics.

Textbooks:

- Primary: Pierre Brémaud, *Markov Chains* (2nd edition), Springer, 2020.
- Alternative: J. R. Norris, *Markov Chains*, CUP, 1997.
- Secondary: Pierre Brémaud, *Discrete Probability Models and Methods*, Springer, 2017.
- Secondary: Olle Häggström, *Finite Markov Chains and Algorithmic Applications*, CUP, 2002.
- Supplementary notes may be posted during the semester.

Note: The electronic versions of all the books listed above can be accessed via the [university library](#). You may be prompted to log in with your AUB account.

Tentative contents:

- Conditional probability and expectation
- Bernoulli processes
- Discrete-time finite-state Markov chains
- Recurrence and transience
- Stationarity and convergence theorem
- Empirical averages and ergodic theorem
- Discrete-time countable-state Markov chains
- Branching process
- Random walks on graphs
- Poisson process
- Continuous-time Markov chains
- (Markovian queueing theory)

Homework: Suggested problems will regularly be posted. These will not be graded.

Exams and projects:

- Midterm 1: Thursday, September 18, 18:30 (venue TBA)
- Midterm 2: Tuesday, October 14, 18:30 (venue TBA)
- Midterm 3: Friday, November 7, 18:30 (venue TBA)
- Final: To be scheduled by the Registrar's office

The exams will be cumulative. The midterms will be oral exams. You will be provided with the questions ahead of time. During the exam, you will be asked to demonstrate some of your solutions on the board for the rest of the students and to participate in the discussions. Policies regarding oral exams:

- You are allowed to discuss the questions with one another.
- If you come up with a solution in collaboration with other students, please clearly indicate their names. If you learn the solution or an idea from another student (entirely or in part), make sure to give them credit.
- If you use any resources other than the course textbooks and lectures, you must cite them.
- Evaluation criteria: correctness of solutions, clear and rigorous presentation, readiness for further clarifications, active participation.

Upon agreement with the instructor, students may replace or supplement the final exam with a final project.

Grading policy:

- 5% Active participation
- 55% or 40% Midterms
- 40% or 55% Final

Unique Learning Needs of Students with Disabilities: AUB strives to make learning experiences as accessible as possible. If you anticipate or experience academic barriers due to a disability (including mental health, chronic or temporary medical conditions), please inform your instructor so that we can privately discuss the options. In order to help establish reasonable accommodations and facilitate a smooth accommodation process, you are encouraged to contact the [Accessible Education Office](#) (Email: accessibility@aub.edu.lb; Phone: +961-1-350000 ext. 3168; Location: West Hall 304).

Academic Integrity: Please refer to [AUB Student Code of Conduct](#), in particular to Section 1.1, which concerns academic misconduct including cheating, plagiarism, in-class disruption, and dishonesty. Please be aware that misconduct is vigorously prosecuted and that AUB has a zero tolerance policy. The course policy is that credible evidence of cheating will result in failure in the course and referral to the disciplinary committee.

Non-Discrimination: In line with its commitment to the principle of equal opportunity in education and employment, AUB policies protect you from discrimination on the basis of protected characteristics, including discriminatory harassment and sexual harassment. Protected characteristics include: race, color, religion, age, national or ethnic identity, sex, gender or gender identity, sexual orientation, pregnancy, marital status, disability, genetic predisposition or carrier status, alienage or citizenship status, and political affiliation.

If you think you have experienced discrimination, discriminatory harassment, or sexual harassment, we encourage you to inform the Equity/Title IX Coordinator, Mitra Tauk at +961-1-350000 ext. 2514, or titleix@aub.edu.lb, report to a Title IX deputy at your faculty or at any other faculty [<https://www.aub.edu.lb/titleix>], or report online [<http://www.aub.ethicspoint.com>]. Reports may be submitted anonymously or not. Please know that the University will maintain the confidentiality of the complaint and privacy of the persons involved to the greatest extent possible, consistent with its goal of conducting a thorough and complete investigation and to the extent permitted by law.