JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Applied Mathematics and Statistics 553.426/626
Introduction to Stochastic Processes
Spring 2026 (4 credits, EQ)

Instructor

Professor Eliza O'Reilly (she/her), eoreilly@jhu.edu
Office hours: Tuesday 2-4pm, Wyman Park Building N448

Teaching Assistants

James D'Alleva-Bochain, pdallev1@jh.edu
Office Hours: Monday 5-7pm, Wyman Park Building S425

Andy Wang, awang124@jh.edu
Office Hours: Wednesday 5-7pm, Wyman Park Building S425

Meetings

Lectures: Tuesday and Thursday 9am–10:15am, Bloomberg 278
TA session: Friday, 1:30–2:20pm, Hodson 301

Textbook

Required: Robert P. Dobrow, Introduction to Stochastic Processes with R, J.W. Wiley.

References

(Students are not required to have access to these books)
Sheldon Ross, Stochastic Processes, 2nd edition, J.W. Wiley.
Sheldon Ross, Introduction to Probability Models, 11th edition, AP.
Richard Durrett, Essentials of Stochastic Processes, 2nd edition, Springer-Verlag. S. Karlin and H. Taylor, A First Course in Stochastic Processes, 2nd edition, AP.

Online Resources

Please log in to Canvas for online information related to this course. Homeworks and homework solutions will be posted to Canvas, and announcements for the class will be made through Canvas.

Course Information (Objectives and Prerequisites)

- This course concerns the mathematical theory of stochastic processes. Emphasis will be placed on deriving the dependence relations, statistical properties, and sample path behavior of stochastic processes including random walks, Markov chains (both discrete and continuous time), Poisson processes, renewal processes, Brownian motion, and Gaussian processes Applications that illuminate the theory will be discussed.
- **Prerequisites:** Introduction to Probability (EN.553.420/620 or the equivalent) Linear Algebra (EN.553.291 or AS.110.201 or AS.110.212 or the equivalent)

Course Topics

The following is a tentative list of planned topics we will cover in this course, each with a rough indication of the corresponding sections in the required text and the approximate amount of time we will spend on the topic.

- Preliminaries/Probability Review (1 week)
- Discrete-time Markov chains: (3 weeks)
    - 2.1-2.4: Introduction and examples; Chapman–Kolmogorov equations; classification of states
    - Chapter 3: Long term behavior; stationary distribution; time reversibility; Strong Markov property
- Poisson processes: (2 weeks)
    - 6.1-6.2: Definition; exponential distributions and memorylessness; inter-arrival and waiting-time distributions
    - 6.4-6.5: Thinning and superposition
    - 6.7-6.8: inhomogeneous Poisson processes; arrival time paradox; Spatial Poisson processes
- Renewal processes (1.5 week)
- Continuous-time Markov chains: (2 weeks)
    - 7.1-7.3: Introduction and connection with discrete-time Markov chains; birth-and-death processes; Kolmogorov backward and forward equations; long-term behavior; reversibility
- Brownian motion (2.5 weeks)
    - 8.1-8.4: Definition; limit of random walk; transformations; hitting times

Course Expectations & Grading

There will be 10 weekly homework assignments, bi-weekly quizzes, an in-class midterm exam, and a final exam. There will also a project with an in-class presentation the last week of the semester. We highly encourage students to attend all live lectures and TA sessions. If you cannot attend lecture for any reason, notes for each lecture will be posted to Canvas the same day after the lecture and you are highly encouraged to read these and ask any questions you have on the covered material by email or in office hours before the next lecture.

The **grading breakdown** for the course will be:
Homework: 40%
Midterm Exam: 20%
Final Exam: 20%
Quizzes: 10%
Final Project: 10%

The letter grade for the class will be assigned according to the following table:

A+	**A**	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**
98-100	93-97	90-92	87-89	83-86	80-82	77-79	70-76	< 70

If any grades within 1 standard deviation below the mean are below a B *or* any grades above 1 standard deviation of the mean are below an A with this grading scheme, there will be a curve to ensure this is the case.

Assignments

- Homework submission will be through Gradescope
- There will be 10 graded homework assignments, announced in class and posted to Canvas on Tuesdays, and they will be due the following Tuesday by 11:59pm
- *No late homework will be accepted*, but lowest **two** HW grades will be dropped
- Homework solutions will be put on Canvas on Wednesdays the day after the homework is due

Quizzes

- There will be 5 (30 minute) Quizzes in the Friday TA session on the following dates: January 30, February 13 and 27, March 27, and April 10.
- The lowest quiz grade will be dropped

Key Dates (NOTE: Dates are subject to change.)

The midterm will be held Thursday, March 5, in class.

The final exam will be held Thursday, April 16, in class.

There will be no classes or TA sessions during spring break week (Monday, March 16 through Friday, March 20).

Final Project Presentations will take place Tuesday April 21 and Thursday April 23, in class, and Friday April 24, in the TA section.

The last lecture for the course will be held Thursday, April 23.

The last TA session for the course will be held Friday, April 24.

For other key dates, see https://registrar.jhu.edu/academic-calendar/

Disability Services

Johns Hopkins University values diversity and inclusion. We are committed to providing welcoming, equitable, and accessible educational experiences for all students. Students with disabilities (including those with psychological conditions, medical conditions, and temporary disabilities) can request accommodations for this course by providing an Accommodation Letter issued by Student Disability Services (SDS). Please request accommodations for this course by reaching out directly to the instructor as early as possible to provide time for effective communication and arrangements.

For further information or to start the process of requesting accommodations, please contact Student Disability Services at Homewood Campus, Shaffer Hall #101, call: 410-516-4720 and email: studentdisabilityservices@jhu.edu or visit the website.

Academic Integrity

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

Report any violations you witness to the instructor. You can also contact:

- For undergraduates: the associate dean of student conduct (or designee) by calling the Office of the Dean of Student Life at 410-516-8208 or via email at studentconduct@jhu.edu
- For KSAS Graduate Students: rseitz5@jh.edu
- For WSE Graduate Students: christinekavanagh@jhu.edu

You can find more information about university misconduct policies on the web at these sites:

- For undergraduates: http://e-catalog.jhu.edu/undergrad-students/student-life-policies/
- For graduate students: http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/

In addition, the specific academic integrity policies for this course are:

- You may (and are encouraged to) collaborate on homework problems with classmates, but you must write up your own solutions without looking at another student's written solutions.

Mental Health Statement

HU has several resources to support students. Many students struggle with stress at times with stress, anxiety, and depression. The Counseling Center has many resources available to students:

Johns Hopkins University Student Well-Being (jhu.edu)

In addition, The Johns Hopkins University Behavioral Health Crisis Support Team (BHCST) pairs experienced, compassionate crisis clinicians with specially trained public safety officers on every shift on and around the Homewood campus, seven days a week. The BHCST will provide immediate assistance to those who need it and, just as importantly, link individuals in crisis to ongoing support services in the days and weeks that follow. Call Public Safety, 410-516-5600, and ask for a BHCST clinician.

If you have concerns about a specific student, please contact:

- For emergencies (threat to self or others): 410-516-4600 or 911
- For on-scene mental health support: BHCST at 410-516-4600
- For undergraduates: Student Outreach & Support at 410-516-7857 or studentoutreach@jhu.edu (undergraduates)
- For KSAS Graduate Students: Renee Eastwood, Assistant Dean for Graduate and Postdoctoral Academic and Student Affairs
- For WSE Graduate Students: Megan Barrett, Assistant Dean for Engineering Student Affairs

Inclusivity

Johns Hopkins University is committed to creating a classroom environment that values the diversity of experiences and perspectives that all students bring. Everyone here has the right to be treated with dignity and respect. Fostering an inclusive climate is important because research and experience show that students who interact with peers who are different from themselves learn new things and experience tangible educational outcomes. Please join us in creating a welcoming and vibrant classroom climate. Note that you should expect to be challenged intellectually by the instructor, the TAs, and your peers, and at times this may feel uncomfortable. Indeed, it can be helpful to be pushed sometimes in order to learn and grow. But at no time in this learning process should someone be singled out or treated unequally on the basis of any seen or unseen part of their identity.

If you ever have concerns in this course about harassment, discrimination, or any unequal treatment, or if you seek accommodations or resources, please reach out to your instructor or the TAs who will take your communication seriously and will seek mutually acceptable resolutions and accommodations. Reporting will never impact your course grade. You may also share concerns with the department chair, the Director of Undergraduate Studies (WSE Department Heads and DUSes), the WSE Assistant Dean for Diversity and Inclusion (Darlene Saporu, dsaporu@jhu.edu), the KSAS Assistant Dean for Diversity and Inclusion (Araceli Frias, afrias3@jhu.edu) or the Office of Institutional Equity (oie@jhu.edu). In handling reports, people will protect your privacy as much as possible, but faculty and staff are required to officially report information for some cases (e.g., sexual harassment).

Classroom Climate

As instructor, I am committed to creating a classroom environment that values the diversity of experiences and perspectives that all students bring. Everyone in the course has the right to be treated with dignity and respect. I believe fostering an inclusive climate is important because research and my experience show that students who interact with peers who are different from themselves learn new things and experience tangible educational outcomes. Please join me in creating a welcoming and vibrant classroom climate. Note that you should expect to be challenged intellectually by me,

the TAs, and your peers, and at times this may feel uncomfortable. Indeed, it can be helpful to be pushed sometimes in order to learn and grow. But at no time in this learning process should someone be singled out or treated unequally on the basis of any seen or unseen part of their identity.

If you ever have concerns in this course about harassment, discrimination, or any unequal treatment, or if you seek accommodations or resources, I invite you to share your concerns directly with me or the Teaching Assistants. I promise that we will take your communication seriously and seek mutually acceptable resolutions and accommodations. Reporting will never impact your course grade. You may also share concerns with the Applied Mathematics and Statistics (AMS) Department Head (Professor Fadil Santosa, mailto:fsantos9), the AMS Associate Head and Director of Graduate Studies (Professor Daniel Naiman, mailto:daniel.naiman@jhu.edu), the AMS Director of Undergraduate Studies (Professor Donniell Fishkind, mailto:dfishki1@jhu.edu) the Assistant Dean for Diversity and Inclusion (Darlene Saporu, mailto:dsaporu@jhu.edu), or the Office of Institutional Equity (mailto:oie@jhu.edu). In handling reports, people will protect your privacy as much as possible, but faculty and staff are required to officially report information for some cases (e.g., for sexual harassment).