DMS625: Introduction to Stochastic Processes and their applications
2024-25 Odd Semester

First Course Handout

Course Objectives: This course will introduce elementary stochastic processes and their applications. The course will develop the theory from first principles and motivate their applications.

Prerequisites: Basic probability theory. It will be assumed that students enrolling in the course have undertaken a formal course in basic probability.

Course Contents:

- *Markov Chains*: Definitions and examples, Transition probabilities, Chapman-Kolmogorov equations, Classification of states, Stationary distribution
- *Poisson Processes*: Exponential distribution and properties, Definitions and examples, Interarrvial time and waiting time distributions, Nonhomgeneous Poisson process, Compound Poisson process
- *Continuous-time Markov Chain*: Definition and examples, Birth and Death processes, Kolmogorov equations, Limiting distributions
- *Renewal Theory*: Definition and examples, Renewal theorem, Renewal-reward processes, Regenerative processes
- *Topics in Martingales and Brownian Motion* (**Will be taken up only if time permits**): Martingales, Stopping times, Scaling limit of a random walk, Definition of Brownian motion, Reflection principle

References: Lecture notes would be made available to the students at HelloIITK. Being a PG course, there is no prescribed textbook. However, the following books would serve as useful references.

1. Hoel, Port, and Stone, Introduction to Stochastic Processes, Waveland Press.
2. Rick Durrett, Essentials of Stochastic Processes, Springer.
3. Sheldon Ross, Stochastic Processes, Wiley.
4. Sheldon Ross, Introduction to Probability Models, Academic Press.
5. Sidney Resnick, Adventures in Stochastic Processes, Birkhauser.

Classroom: C3, DoMS
Time: Monday and Thursday from 12:00-13:15

Instructor: Sourav Majumdar
Email: souravm@iitk.ac.in (Please include **DMS625** in the subject of your email for all course related correspondence)
Office: 301, DoMS
Office Hours: By appointment through email

Evaluation:

1. *Quizzes*: 30%
2. *Mid-Semester Exam*: 30%
3. *End-Semester Exam*: 40%

Course Policies:

- There will be 6 in-class quizzes, each contributing 5% towards the entire evaluation. Each quiz will be announced in the preceding class. There will be 3 quizzes before the mid-semester exam and 3 quizzes after the mid-semester exam. These shall be short quizzes of 15 mins, with MCQs/short answer type questions.
- Practice assignments would be provided periodically. These would be ungraded.
- Attendance is strongly encouraged. However, there is no weightage for attendance.
- Academic dishonesty in a quiz or exam would be penalized by assigning 0 to the entire component, i.e., any instance of dishonesty in one quiz would lead to 0 being assigned for all quizzes. All such instances would also be reported to DOAA.
- There will be no make-up opportunity for a missed quiz. Make-up for a missed mid-semester exam would be permitted upon producing a medical certificate from a doctor. Make-up for the end-semester exam would be as per DOAA guidelines.
- Students are allowed to withdraw from the course as per DOAA guidelines.