Industrial and Management Engineering *IIT Kanpur*

IME625A: Introduction to Stochastic Processes 3-0-0-0-9

Course Objectives

IME625 introduces theories of the basic stochastic processes with applications. It primarily covers discrete-state processes such as Markov Chain, Branching Chain, Poisson Process, Renewal Process, and Continuous-time Markov Chain. It is expected to equip students with the modelling and analytical skills required for studying stochastic systems.

Prerequisites

Basic probability theory: ideally, an interested student should have taken a formal course on basic probability, e.g., IME602, MSO/HSO201, CS203. Those who have done a course on stochastic process, e.g., MTH412, should not opt for this course.

Course Contents

Module-0: Review of probability.
Module-1: Markov chain - definition and examples; Transition probabilities.
Module-2: Absorbing Markov chains; Gambler's ruin problem; Branching chains.
Module-3: Classification of states; Long-run fractions; Stationary and limiting distributions.
Module-4: Poisson process; Inter-event and waiting times; Superposition and thinning.
Module-5: Renewal process; Renewal equation and theorem; Renewal-reward process.
Module-6: Continuous-time Markov chain; Kolmogorov equations; Long-run behaviour.

Special Emphasis

- Theory building from scratch
- Exposure to real-life application through projects

Course delivery

Online classes will be held on Monday and Wednesday during 5:15 to 6:30 pm. Lecture notes will be provided beforehand *via mooKIT* and the same will be discussed during the class. Students are expected to come prepared and seek clarification for their doubts during the class. Recordings of the online classes will be shared afterwards.

Google Meet (for online classes): meet.google.com/gto-uwsn-ndo

Instructor

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TA

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Evaluation

1) Quizzes[1] 50%
2) Project[2] 15%
3) Class participation[3] 10%
4) End-sem exam[4] 25%

[1]There are a total of six quizzes, one for every four/five classes. Best five will be considered for grading. There will be no make-up for missed quizzes. Question papers will be shared through mooKIT and *hand-written answers* are to be uploaded in the same place.

[2]In the project, a real-life problem is to be studied using stochastic processes. A theoretical topic not covered in the course can also be taken up. It is to be done in groups of three. The project topic shall be identified by February 2022, and the project report must be submitted before the end-sem exams begin.

[3]Evaluation of class participation is subjective. It will be measured by student's preparedness and inquisitiveness during the classes. I may also take inputs from other components such as homework. Absenting from classes will negatively impact your marks.

[4]The end-sem exam may be conducted orally.

Homework

After most classes, to supplement the class discussions, a homework will be given, and its solution will be discussed in the next class. Students shall submit their hand-written answers in mooKIT. These assignments *will not be evaluated*.

Attendance Policy

It goes without saying that 100% attendance is compulsory. Any student who needs to take leave shall inform the instructor regarding his/her absence.

Grading Policy

A mix of absolute and relative grading policies will be adopted. First, a pass mark will be decided; students failing to secure the pass mark will get F grade. Then the interval between the pass mark and the maximum score will be split into four intervals corresponding to A, B, C, D grades. **UG and PG students will be graded separately**.

Books & References

This being a PG course, there is no prescribed textbook. However, the following books are recommended as references, with the first two likely to be the most useful.

1. Sheldon Ross, Introduction to Probability Models, Academic Press.
2. Taylor and Karlin, An Introduction to Stochastic Modeling, Academic Press.
3. Sheldon Ross, Stochastic Processes, Wiley India.
4. Karlin and Taylor, A First Course in Stochastic Processes, Academic Press.
5. Hoel, Port, and Stone, Introduction to Stochastic Processes, Waveland Press.

January 3, 2022 Sd/- Avijit Khanra