EE5137 : Stochastic Processes (Spring 2021)

Vincent Y. F. Tan

1 Teaching Staff

The instructor for this class is Vincent Y. F. Tan.

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- Office Hours: TBD
- Email: vtan@nus.edu.sg
- Grader: Ms Haiyun He (haiyun.he@u.nus.edu)
- Class time: 6pm–9pm each Friday (with a 10-15 min break in between)
- Location: LT1

2 General Information

This is a course on stochastic processes. The emphasis of this course is on *mathematical rigor* of principles and concepts in stochastic processes with an eye towards modeling of real-world systems. Students are expected to do simple proofs in addition to rudimentary calculations.

We will use the book by Robert G. Gallager "Stochastic Processes: Theory for Applications". Specifically, we will spend approximately 2-3 weeks each on probability review (Chapter 1), Poisson processes (Chapter 2), finite-state Markov chains (Chapter 4), detection theory (Chapter 8) and estimation theory (My own notes). The rough schedule can be found at Section 7.

All the information for this class can be found on LumiNUS.

3 Assessments

- Homeworks (10%)
- Quiz 1 on 5 Feb (12%)
- Quiz 2 on 12 March (18%)
- Final Exam on 30 April (60%)

4 Homeworks

- There will be approximately eleven homework assignments due *once every week*.
- No extensions will be allowed because solutions will be posted once the homeworks are due.

- You are strongly encouraged to collaborate with each other in solving the homework problems but you must write up the solutions on your own. These are meant to help improve your understanding of the subject matter, and you should treat the homework very seriously in order to gain the most out of this course.
- A strict subset of the compulsory problems will be graded.
- There will be many problems labelled as *optional*. You don't have to do these problems but they are meant as an important vehicle for learning.
- Solutions to all (compulsory and optional) problems will be provided.
- Each homework set will be graded coarsely. You will receive one of four numerical grades–0, 1, 2, 3. 0 means that the homework was not turned in and 3 means that the homework was done almost perfectly. 1 and 2 interpolate in between.
- You're allowed to drop two homework sets that have the worst numerical scores in the final computation of your homework grade. Thus, I'll not entertain any requests to turn in the homeworks late.

5 Quizzes and Final Exam

- There will be two one-hour quizzes (on 5th Feb and 12th Mar) during the course of the semester.
- The final exam is scheduled on the finals week and will be comprehensive, i.e., covering all topics in the course. The final exam will focus primarily on topics that are not examined in the previous quizzes (Markov chains + detection and estimation).
- All assessments will be open book.
- Past year quizzes and exams and their solutions will be posted at appropriate times.

6 Prerequisites

This is a serious course that will train you to *think* precisely and to do mathematical proofs as well as calculations. To fully appreciate this course, you are expected to have a *very* firm grasp of undergraduate probability and statistics. You should know what is a random variable, probability mass functions, joint and conditional distributions, Markov chains, probability bounds (such as Markov and Chebyshev inequalities), laws of large numbers, conditional independence, etc. Even though we will have a thorough review of the material in the first three classes, we will proceed at a pace that is too fast if one is not already familiar with these concepts taught in a good undergraduate probability class.

7 Tentative Schedule (Subject to Change)

- Week 1 (15 Jan): Introduction and review of probability (Sections 1.1–1.3)
  Homework 1 Posted
- Week 2 (22 Jan): Introduction and review of probability (Sections 1.4–1.6)
  Homework 2 Posted; Homework 1 Due
- Week 3 (29 Jan): Introduction and review of probability (Sections 1.7–1.8)
  Homework 3 Posted; Homework 2 Due

- Week 4 (5 Feb): Poisson processes (Sections 2.1–2.2.2)
  Quiz 1 (on Probability)
  Homework 4 Posted; Homework 3 Due
- Week 5 (12 Feb): No class, rescheduled to the Recess Week in view of Spring Festival
- Week 6 (19 Feb): Poisson processes (Sections 2.2.3–2.3.1)
  Homework 5 Posted; Homework 4 Due
- *Recess Week (26 Feb): Poisson processes (Section 2.3.2, 2.5, Exercises on Poisson Processes)*
  Homework 6 Posted; Homework 5 Due
- Week 7 (5 Mar): Finite-state Markov chains (Sections 4.1–4.2)
  Homework 7 Posted; Homework 6 Due
- Week 8 (12 Mar): Finite-state Markov chains (Section 4.3)
  Quiz 2 (on Poisson Processes)
  Homework 8 Posted; Homework 7 Due
- Week 9 (19 Mar): Finite-state Markov chains (Sections 4.4, 4.5 and 4.6.1)
  Homework 9 Posted; Homework 8 Due
- Week 10 (26 Mar): Detection theory (Sections 8.1–8.2.2)
  Homework 10 Posted; Homework 9 Due
- Week 11 (02 Apr): Detection theory (Sections 8.2.3–8.3)
  Homework 11 Posted; Homework 10 Due
- Week 12 (09 Apr): Estimation theory (My own notes) (Public holiday, No class, Video will be posted)
  Homework 12 Posted (never due, solutions provided); Homework 11 Due
- Week 13 (16 Apr): Estimation theory (My own notes)
- **Exam (30 Apr): 9am – 12noon**

8 References

All students are to have a copy of Gallager's book (posted on LumiNUS) as assignments will be taken from the problems therein.

- Robert G. Gallager, "Stochastic Processes: Theory for Applications", Cambridge University Press, 2014

Ross' book is also a classic and can be used as a secondary reference.

- Sheldon Ross, "Stochastic Processes", Wiley, 2nd Edition, 1995