Course Schedule: STAT 333– Stochastic Processes I

The following is a week-by-week breakdown for the course, with suggested reading.

Before Feb 7

Livestream held via MS Teams

Live-stream hours: Mondays at 10-11.20, Wednesdays at 14.30-15.50

After Feb 7

Lec 001: MW 14.30 - 15.50 in RCH 103

Lec 002: MW 10.00 - 11.20 in DWE 3522

Week 1: Introduction

Lec 1: Stochastic Processes, Markov Chains,
Transitions Recording, Notes

Suggested reading: Chap 1.1-1.2+ Appendix [D], Chap 2.1 [R] and Stat 230 Lecture notes

Week 2: Markov Chains and Initial data

Lec 2: Transition matrices, Chapman-Kolmogorov,
Visualization Recording, Notes

Lec 3: Conditional probability, conditional expectation, initial data, matrix vector formalism Recording, Notes

Suggested reading: Chap 1.1-1.2+1.4+ Appendix [D], Chap 2.1-2.3 [R]

Week 3: Stationary Measures

Lec 4: Stationary distributions and invariant measures. Recording, Notes

Lec 5: Communication, transience, and recurrence. Recording, Notes

Suggested reading: Chap 1.3-1.5 + Appendix [D]

Due this week: Problem Set 1 due Jan 21 at 11pm ET

Week 4: Classification of states

Lec 6: The strong Markov property, closedness, and the decomposition theorem. Recording, Notes

Lec 7: The equivalent condition to recurrence, and communicating class properties. Recording, Notes

Suggested reading: Chap 1.3 [D]

Week 5: Limit behaviour

Lec 8: Existence and uniqueness, ergodicity and periodicity Recording, Notes

Lec 9: The fundamental convergence theorems Recording Notes

Suggested reading: Chap 1.6, 7, 8 [D]

Due this week: Problem set 2 due Feb 4 at 11pm ET

Week 6: Midterm 1 (**Note: in-person lecture starting this week)**

Feb 7th - Midterm 1

Venue: Available online via crowdmark from 9.30 am - 4.20 pm ET

Duration: 1h50 [1h20 for the exam + 30 min grace period for uploading to Crowdmark]

Lec 10: Reversibility

Suggested reading: Chap 1.5 [D]

Week 7: The convergence theorem

Lec 11: Proof of the convergence theorem I

Lec 12: Proof of the convergence theorem II

Suggested reading: Chap 1.8 [D], Chap 2.12-13 [R]

Note: for more on a.s. convergence see below

Due this week: Problem set 3 due Feb 18 at 11pm ET

Reading Week

Week 8: Exit distributions and exit times

Lec 13: Exit distributions

Lec 14: Exit times

Suggested reading: Chap 1.9-10 [D]

Week 9: Infinite state space and Branching processes

Lec 15: Infinite state space and positive recurrence

Lec 16: The Galton-Watson process

Due this week: Problem set 4 due March 11 at 11pm ET

Suggested reading: Chap 1.11 [D], Chap 0 [W]

Week 10: Mid-term 2 and Poisson Process

March 14: Mid-term 2

Lec 17: Poisson Process (Intro)

Suggested reading: Chap 2.1-2 [D]

Week 11: Poisson Processes

Lec 18: Poisson Process and waiting times

Lec 19: More complex models

Suggested reading: Chap 2.1-3 [D]

Week 12: Transformations

Lec 20: More complex models and Poisson Thinning

Lec 21: Poisson Thinning, Superposition, and Conditioning

Due this week: Problem set 5 due April 1 at 11pm ET

[Note: there is a special late submission policy for HW5 as stated on the problem set]

Suggested reading: Chap 2 [D]

Week 13: Poisson Processeses/Wrap-up

Lec 22: TBA

Final exam: Apr 23 at 16:00 in M3 1006

References:

[D]: Durrett, "Essentials of Stochastic Processes"

[R]: Resnick, "Adventures in Stochastic Processes"

[230]: Stat 230 lecture notes

[B+T]: Bertsekas, Tsitsikilis, "Introduction to Probability" 2nd Ed

[W]: Williams, "Probability with Martingales"

Note re: almost sure convergence:

Just like [R], we will only be using the concept of almost sure convergence insofar as required for the statement and proof of the ergodic theorem. If you're interested in understanding this concept and the other modes of convergence, a great (and not super technical) reference is Chap. 5 [B+T].

Note: The readings are suggested, not required. Durrett and Resnick are different presentations of the same material so the suggestions are where they cover the material of that weeks lecture (so you do not "have" to read both).