Course: STAT 333– Stochastic Processes I

LEC 001 : T Th 10:00-11:20 in DC 1351
LEC 002 : T Th 14:30-15:50 in DC 1350

Schedule:

Week 1: Markov chains and transition matrix

Lec 1: Stochastic Processes, Markov Chains, Transitions

Lec 2: Transition matrices, Chapman-Kolmogorov, Visualization

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

Week 2: Conditional expectation and Stationary measures

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

Lec 4: Stationary distributions and invariant measures.

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

Week 3: Classification of states

Lec 5: Communication, transience, and recurrence.

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

Suggested reading: Chap 1.3 + Appendix [D]

Due this week: Problem Set 1 due May 18 at 11pm ET

Week 4: Communicating class properties, limiting behavior

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

Lec 8: Existence and uniqueness, ergodicity and periodicity

Suggested reading: Chap 1.3 + 1.6 [D]

Week 5: Limit behaviour, Midterm 1

Lec 9: The fundamental convergence theorems

Lec 10: Reversibility

Suggested reading: Chap 1.5, Chap 1.6, 1.7 [D]

Due this week: Problem set 2 due June 1 at 11pm ET

June 3: Midterm 1, Time: 6:30 PM - 7:50 PM; Location: M3 1006

Week 6: 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

Week 7: Exit distributions and exit times

Lec 13: Exit distributions

Lec 14: Exit times

Suggested reading: Chap 1.9-1.10 [D]

Due this week: Problem set 3 due June 15 at 11pm ET

Week 8: Infinite state space and Branching processes

Lec 15: Infinite state space and positive recurrence

Lec 16: The Galton-Watson process

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

Week 9: Midterm 2 and Poisson Process

June 28: Midterm 2

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 17: Exponential distributions

Suggested reading: Chap 2.1 [D]

Week 10: Poisson Processes

Lec 18: Constructing the Poisson Process

Lec 19: Poisson Process and waiting times

Suggested reading: Chap 2.1-2.2 [D]

Week 11: Poisson Processes – More complex models

Lec 20: More complex models

Lec 21: Compound Poisson Processes and Poisson Thinning

Suggested reading: Chap 2.2 - 2.3 [D]

Due this week: Problem set 4 due July 13 at 11pm ET

Week 12: Transformations/Wrap-up

Lec 22: Poisson Thinning(cont.), M/G/infinity Queue

Lec 23: Superposition, and Conditioning

Suggested reading: Chap 2.4 [D]

Week 13+: Exam period

Due this week: Problem set 5 due July 25 at 11pm ET

Final exam: Time: 12:30 PM - 2:30 PM, August 10, 2022;
Location: M3 1006.

Assignments due on:

May 18, June 1, June 15, July 13, July 25

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).