

Markov Processes and Applications

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Material

- [Dropbox folder](#)
 - Solutions are password-protected. I'll give the password in class.
 - Some material also at: <https://appliedmaths.sun.ac.za/~htouchette/markovcourse/>
 - K. Jacobs, Stochastic Processes for Physicists, Cambridge, 2010.
 - G. A. Pavliotis, Stochastic Processes and Applications, Springer, New York, 2014.
 - G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, Oxford, 2001.
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Lecture 1: Introduction and Markov chains

- Introduction and material
 - Random variables, probability distributions, and expectations [Chap. 1, Secs 1, 3, 4]
 - Linear structure: From quantum mechanics to Markov processes
 - Markov chains [Chap. 2, Secs 1-6]
 - Exercises:
 - CW1: Q1
 - CW2: Q1
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Lecture 2: Continuous-time Markov chains

- Jump processes [Chap. 3, Secs 1-7]
 - Exercises: CW2: Q1, 2
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Lecture 3: Stochastic differential equations

- Random walks and Brownian motion [Chap. 4, Secs 2-5]
 - Differential equations [Chap. 5, Secs 1-3]
 - Stochastic differential equations [Chap. 5, Secs 4-6]
 - Exercises:
 - CW4: Q1
 - CW5: Q2
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Lecture 4: Simulations

- Random numbers [Chap. 1, Sec. 9]
- Samples and histograms [Chap. 1, Sec. 8]
- Monte Carlo sampling [Chap. 1, Secs 12, 13]
- Simulations of jump processes and examples [Chap. 3, Sec. 8]
- Simulations of SDEs and examples [Chap. 5, Sec. 4]

- Exercises:
 - Python exercise with Jupyter
 - CW1: Q7-Q11
 - CW2: Q6
 - CW3: Q5, 6
 - CW4: Q3-5
 - CW5: Q4
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Lecture 5: Other topics

- Markov chain Monte Carlo methods [Chap. 2, Sec. 8]
- Stochastic optimization
- Random walks on graphs [Chap. 2, Sec. 6.5]
- Exercises:
 - CW2: Q3, 5, 7, 8
 - CW5: Q3