

Fall 2021
IE 503 Stochastic Processes

Instructor: Barış Balcıoğlu
Office: FENS G001A
Email: balcioglu@sabanciuniv.edu
Phone: 483-9965
Office Hours: by appointment and via zoom

Lecture Hours:

- Tuesday 9.40 – 11.30 (FENS L055)
- Friday 12.40 – 13.30 (FENS L056)

Course Description: In this course, we will review the fundamental concepts of the theory of probability and learn about a variety of stochastic processes and we will also discuss some of their applications in engineering. The main objective of this course is to enable students to “think probabilistically,” and to develop and analyze probability models that capture the effects of randomness on systems under consideration.

Course delivery: Classes are planned to be given in classrooms. Those who prefer so can follow the courses remotely online. All lectures will be recorded and uploaded to SUCourse+. We expect you to observe social distancing and wear masks appropriately when in class. Online students can ask their questions in the Zoom chat box.

Zoom link:

<https://sabanciuniv.zoom.us/j/93654876579?pwd=T3RmNkxndWxGTWhMMG45dkRONUdOQT09>

Detailed Course Content:

- 1. Introduction to Probability Theory (Chapter 1)**
 - Sample Space and Events
 - Elementary Probability: Axioms, conditional probability, independence, total probability theorem, Bayes’ theorem

- 2. Random Variables (Chapter 2)**
 - Discrete and Continuous Random Variables
 - Expected Values: Properties of expectations, variance and standard deviation, covariance and correlation
 - Jointly Distributed Random Variables
 - Moment Generating Functions
 - Limits Theorems
 - Stochastic Processes

- 3. Conditional Probability and Conditional Expectation (Chapter 3)**
 - Discrete and Continuous Cases

- Computing Expectations, Variances and Probabilities by Conditioning

4. Markov Chains **(Chapter 4)**

- Chapman-Kolmogorov Equations
- Classification of States
- Limiting Probabilities
- Mean Time Spent in Transient States
- Time Reversible Markov Chains
- Markov Decision Processes

5. The Exponential Distribution and the Poisson Process **(Chapter 5)**

6. Continuous-Time Markov Chains **(Chapter 6)**

- Continuous-Time Markov Chains
- Birth and Death Processes
- Limiting Probabilities
- Time Reversibility

7. Renewal Theory (if time permits) **(Chapter 7)**

- Distribution of the number of renewals by time t ($N(t)$)
- Limit Theorems and Their Applications
- Renewal Reward Processes
- Regenerative Processes
- Semi-Markov Processes

Textbook: Introduction to Probability Models, Sheldon M. Ross, 9th Edition, 2006, Academic Press, ISBN-13: 978-0125980623.

Assessment Plan:

- Midterm I (%25)
- Midterm II (%35)
- Final exam (%40)

Some Reference Books:

An introduction to stochastic modeling: S. Karlin & H. M. Taylor, NY Academic Press, 1998.

Stochastic Processes, Sheldon Ross, 2nd Edition, NY John Wiley and Sons Inc., 1996.