

Prefix, Number and Name of Course: ACM 652 Continuous-time Stochastic Processes

Credit Hours: 1

In Class Instructional Hours: 1 **Labs:** 0 **Field Work:** 0

Catalog Description:

Prerequisite: MAT 202 or equivalent

Exponential distribution; Poisson, Yule, pure birth, and birth and death processes; applications.

Reasons for revision:

To create a one-semester-hour module for the graduate Professional Applied and Computational Mathematics program in Intermediate Probability.

Student Learning Outcomes: Students will:	Content Reference:	Assessment:
1. develop and analyze theoretical models of real-world random phenomena.	I, II, III, IV.	Group work in class, individual homework assignments, examinations, and computer projects.
2. apply the analysis of theoretical models to real-world random phenomena.	II, III, IV.	Group work in class, individual homework assignments, examinations, and computer projects.
3. create computer simulations to calculate important features of continuous-time stochastic processes.	I, II, III, V.	Group work in class, individual homework assignments, examinations, and computer projects.

Course Content:

I. Exponential distribution

- A. Memoryless property
- B. Sums of independent exponential variables

II. Poisson processes

- A. Independent increments
- B. Stationary increments
- C. Definitions of the poisson process
- D. Interarrival distributions
- E. Properties of the poisson process
- F. Conditional distribution of arrival times
- G. Queueing examples

III. Definitions of other processes

- A. Continuous-time Markov chains
- B. Linear birth (Yule) processes

- C. Pure birth processes
- D. Two-state processes
- E. Birth and death processes

IV. Theoretical results

- A. Chapman-Kolmogorov equations
- B. Backward differential equations
- C. Forward differential equations
- D. Transition probabilities
- E. Mean value of a process

V. Calculating with technology

- A. Simulation of a process (generating exponential random variables)
- B. Computation of transition probabilities (multiplying matrices)
- C. Evaluation of theoretical results (calculating formula values)

Resources:

Scholarships in the Field:

Andersen, P., Borgan, O., Gill, R. and Keiding, N., *Statistical Models Based on Counting Processes*, corrected edition, Springer, 1996.

Bhat, U. and Miller, G., *Elements of Applied Stochastic Processes*, 3rd edition, Wiley-Interscience, 2002.

Brzezniak, Z. and Zastawniak, T., *Basic Stochastic Processes*, corrected edition, Springer, 2000.

Cox, D. and Miller, H., *The Theory of Stochastic Processes*, Chapman & Hall / CRC, 1977.

Doob, J., *Stochastic Processes*, Wiley-Interscience, 1990.

Durrett, R., *Essentials of Stochastic Processes*, corrected edition, Springer, 2001.

Hoel, P., Port, S. and Stone, C., *Introduction to Stochastic Processes*, Waveland Press, 1986.

Hsu, H., *Schaum's Outline of Probability, Random Variables, and Random Processes*, McGraw-Hill, 1996.

Karlin, S. and Taylor, H., *A First Course in Stochastic Processes*, 2nd edition, Academic Press, 1975.

Karlin, S. and Taylor, H., *A Second Course in Stochastic Processes*, Academic Press, 1981.

Kingman, J., *Poisson Processes*, Oxford University Press, 1993.

Kempen, N., *Stochastic Processes in Physics and Chemistry*, 3rd edition, North Holland, 2007.

Lawler, G., *Introduction to Stochastic Processes*, 2nd edition, Chapman & Hall / CRC, 2006.

Lefebvre, M., *Applied Stochastic Processes*, Springer, 2006.

Mikosch, T., *Non-life Insurance Mathematics: An Introduction with the Poisson Process*, 2nd edition, Springer, 2009.

Prabhu, N., *Stochastic Processes: Basic Theory and Its Applications*, World Scientific Publishing Company, 2007.

Resnick, S., *Adventures in Stochastic Processes*, Birkhäuser Boston, 1992.

Ross, S., *Stochastic Processes*, 2nd edition, Wiley, 1995.

Serfozo, R., *Basics of Applied Stochastic Processes*, Springer, 2009.

Varadhan, S., *Stochastic Processes (Courant Lecture Notes)*, American Mathematical Society, 2007.

Yates, R. and Goodman, D., *Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers*, 2nd edition, Wiley, 2004.

Periodicals:

Advances in Applied Probability

Annals of Applied Probability, The

Annals of Probability, The

Applied Stochastic Models and Data Analysis

Bernoulli

Chance

Electronic Journal of Probability

Journal of Applied Probability

Methodology and Computing in Applied Probability

Probability in the Engineering and Informational Sciences

Probability Theory and Related Fields

Scandinavian Actuarial Journal

Stochastic Analysis and Applications

Stochastic Processes and Their Applications

Theory of Probability and Its Applications

Theory of Stochastic Processes

Electronic and/or Audiovisual Resources:

Electronic Journal of Statistics

Link to electronic journals web site (<http://www.e-journals.org/>)