Department of Mechanical and Industrial Engineering
University of Toronto

MIE 1607S: Stochastic Modeling and Optimization

Instructor: Professor V. Makis

Office: MC223, email: makis@mie.utoronto.ca

Prerequisites: Background in stochastic modeling (MIE236F and MIE1605F or equivalents and permission from instructor for M.Eng. students)

Course Overview: A course in renewal theory, Markov renewal theory, regenerative and semi-regenerative processes, Markov, semi-Markov and decision processes with emphasis on applications in production/inventory control, maintenance, and reliability.

Required Texts:
1. S.M. Ross: Introduction to Probability Models, 11th edition, Academic Press (Chapters 4-7).

2. E. Cinlar: "Markov Renewal Theory: A Survey", Management Science, Vol.21, No.7, pp.727 – 752, 1975.
3. H. Schellhaas: "Semi-Regenerative Processes with Unbounded Rewards", Mathematics of Operations Research, Vol.4, No.1, pp.70 – 78, 1979.

Recommended Text:
1. Mario Lefebvre: Applied Stochastic Processes, Springer 2007 (Chapters 1-3, 5).
2. H.C. Tijms: Stochastic Models – An Algorithmic Approach, Wiley, 1994 (Chapters 1-3).
3. V.G. Kulkarni: Modeling and Analysis of Stochastic Systems, Chapman&Hall/CRC.

Week	Topic
1-3.	Markov chains with OR applications. Classification of states. Limiting Probabilities. Periodicity. Mean time spent in transient state. Applications: communication system, production process, drug testing.
4.	Discrete time Markov decision process. Problem formulation. Markov policy. Stationary policy. Computational methods: linear programming, policy iteration, value iteration algorithms. Applications in maintenance and inventory control.
5-7.	The exponential family of distributions. Hyperexponential, Erlang, hypoexponential and Coxian distributions. Counting process. Homogeneous Poisson process. Conditional distribution of the arrival times. Thinning and sampling Poisson Process. NHPP and compound Poisson process. Approximation. Applications: system reliability and remaining life, queuing,

estimating software reliability.

8-10. Continuous time Markov process. Birth and death processes. The transition probability function. Transient analysis: Kolmogorov backward and forward differential equations. Limiting probabilities. Computation of the transition probability function: uniformization and approximations. Phase method. Application: modeling repairable systems.

11-13. Renewal process. Renewal function and renewal equation. Key renewal theorem. Asymptotic expansions. Distribution of the residual life. Renewal-reward process. Regenerative process. Alternating renewal process. Introduction to Markov renewal theory. Markov renewal equation. Limit theorems. Histories and stopping times. Semi-regenerative process. Semi-Markov process. Applications: inventory, production systems, reliability and maintenance.

Grading:	2 Assignments	20% each
	Project	15%
	Final Examination	45%

The Project details will be discussed in the class.