

Lawrence Technological University

EME 6663 – Applied Stochastic Processes

Spring 2012

Course Information:

Course No.: EME 6663
Course Title: Applied Stochastic Processes
Lecture: Tuesday, 5:45 pm - 8:25 pm
Classroom: E207
Office hours: Monday and Wednesday, 3:30 – 5:30pm or by appointment
Blackboard site: my.ltu.edu

Text:

Operations Research Applications and Algorithms, Wayne L. Winston, 4th Edition, 2004, Cengage Learning, ISBN-13: 9780534380588.

Faculty:

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Catalog Description:

This course provides applied knowledge of stochastic models to solve uncertain (stochastic) service operations and production systems. The concepts of random variables, stochastic processes, and random fields will be introduced. Methodologies covered include discrete and continuous time Markov processes, Poisson processes, Brownian motion, stochastic approximation including Kalman filtering and random search techniques. Applications relate to design and analysis of problems, inventory control, queuing systems, scheduling systems, services operations, game theory and decision analysis. Applications of stochastic processes will be demonstrated through student seminars.

Syllabus Topics:

- I. Random variables, stochastic processes, and random fields will be introduced
- II. Inventory Control
- III. Queuing Systems
- IV. Markov Processes
- V. Stochastic Approximation
- VI. Poisson Processes
- VII. Kalman Filtering
- VIII. Scheduling Systems
- IX. Decision Analysis

Grading Policy:

Midterm I - 20%, Midterm II - 20%, Final – 20%, Homework - 20%, Project - 20%

A 90, A- 87, B+ 84, B 81, B- 78, C+ 75, C 72, C- 69, D+ 66, D 63, D- 60, F < 60

Test:

All tests will be open book and open notes. There will be no make-up tests except in case of exceptional circumstances. The course instructor must be notified as soon as possible and normally prior to the exam.

Homework and Class Assignments:

Homework is due at the beginning of class. **Late Homework will not be graded and will receive NO CREDIT.** I will make exceptions only in extreme cases. Extensions to turn in homework due to exceptional circumstances will require appropriate documentation or prior permission. There will be no makeup class assignments.

Research Paper Review:

Students will have to review research papers and present in the class for specific topics assigned in the class. Technical paper review guidelines will be provided.

Course Outlines:

Week	Topics	Readings
1	Syllabus, Introduction and Random Number Generation	Chapter 21
2	Inventory Control	Chapters 15 and 16
3	Inventory Control	
4	Queuing Systems	Chapter 20
5	Mid-Term I	
6	Queuing Systems	Chapter 20
7	Markov Processes	Chapter 17
8	Stochastic Approximation Project Proposal Presentation	Notes
9	Kalman Filtering	Notes
10	Mid-Term II	
11	Poisson Processes, Stochastic Petri Nets Research Paper Presentation	Notes
12	Scheduling Systems	Notes
13	Decision Analysis	Chapter 13
14	<i>Project Presentation and Report Submission</i>	
15	Final	

Course Project:

A project is required from all students and should be related on real life applications where the course materials could be used for the project. However, it should be more in-depth than class materials. The main purpose of the project is to use advanced optimization techniques for real-life applications. The project will be based on *Applied Stochastic Modeling* in any applications but not limited to facility or process, applications of manufacturing systems, logistics, supply chain, hospital operations, chemical/pharmaceutical plants, and business operations. There will be an oral presentation of the project and the written documentation of the study in a clearly, concisely written report form. It should have: abstract, introduction, literature review, problem description, stochastic modeling, critical findings, conclusion, references and appendix (in any).

Academic Honor Code:

Academic integrity and honesty are basic core values of Lawrence Technological University. Lawrence Technological University is committed to creating an academic community that values both

individual and collaborative efforts that promote learning and discovery. Such a community expects honesty and integrity in the work of all its members.

Cheating will not be tolerated! LTU's Academic Honor Code is in effect. Students caught cheating will receive an F in the course without the chance of recomputation for GPA purposes. A note to this effect will be placed in the student's file. A second offence will result in expulsion from the university. For details about Academic Honor Code see: http://www.ltu.edu/currentstudents/honor_code.asp

Recommended References:

- An Introduction to Stochastic Modeling, Karlin, Samuel and Taylor, Howard M., Third Edition, 1998, Academic Press.
- Engineering Uncertainty and Risk Analysis, Second Edition: A Balanced Approach to Probability, Statistics, Stochastic Models, and Stochastic Differential Equations, Sergio E. Serrano, 2011.
- Factory Physics, Wallace Hopp, and Mark Spearman, McGraw-Hill/Irwin, Second Edition, 2000.
- Introduction to Modeling and Analysis of Stochastic Systems, Vidyadhar G. Kulkarni, 2010, Springer.
- Lectures on Stochastic Programming: Modeling and Theory, Alexander Shapiro, Darinka Dentcheva and Andrzej Ruszczyński, 2009.
- Markov Processes for Stochastic Modeling, Oliver C. Ibe, 2008.
- Modeling and Analysis of Stochastic Systems, Vidyadhar G. Kulkarni, Second Edition, 2009, Chapman & Hall/CRC.

Recommended Articles:

- Modeling a flexible manufacturing cell using stochastic Petri nets with fuzzy parameters, Tüysüz, Fatih; Kahraman, Cengiz, *Expert Systems with Applications*, vol. 37, no. 5, pp. 3910-3920, 2010.
- Application of generalized stochastic petri nets (GSPN) in modeling and evaluating a resource sharing flexible manufacturing system, Goli, Aryanejad Mir Bahador; Zileh, Zahra Honarmand Shah, *Proceedings of World Academy of Science, Engineering and Technology*, vol. 57, pp. 356-365, 2009.
- Designing integrated cellular manufacturing systems with scheduling considering stochastic processing time, Ghezavati, Vahidreza; Saidi-Mehrabad, Mohammad, *International Journal of Advanced Manufacturing Technology*, vol. 48, no. 5-8, pp. 701-717, 2010.
- A stochastic model for production loading in a global apparel manufacturing company under uncertainty, Wu, Yue, *Production Planning and Control*, v 22, n 3, p 269-281, 2011.
- A stochastic dynamic programming based model for uncertain production planning of re-manufacturing system, Li, Congbo; Liu, Fei; Cao, Huajun; Wang, Qiulian, *International Journal of Production Research*, vol. 47, no. 13, pp. 3657-3668, 2009.
- Multi-objective stochastic supply chain modeling to evaluate tradeoffs between profit and quality, Franca, Rodrigo B.; Jones, Erick C.; Richards, Casey N.; Carlson, Jonathan P., *International Journal of Production Economics*, vol. 127, no. 2, p.p 292-299, 2010.
- Coordinating a supply chain with effort and price dependent stochastic demand, He, Yong; Zhao, Xuan; Zhao, Lindu; He, Ju, *Applied Mathematical Modelling*, vol. 33, no. 6, pp. 2777-2790, 2009.
- A measure of the bullwhip effect in supply chains with stochastic lead time, Duc, Truong Ton Hien; Luong, Huynh Trung; Kim, Yeong-Dae, *International Journal of Advanced Manufacturing Technology*, vol. 38, no. 11-12, pp. 1201-1212, 2008.

A genetic algorithm and queuing theory based methodology for facilities layout problem, Raman, Dhamodharan; Nagalingam, Sev V.; Gurd, Bruce W., *International Journal of Production Research*, vol. 47, no. 20, pp. 5611-5635, 2009.

Queuing network model of uniformly distributed arrivals in a distributed supply chain using subcontracting; Bhaskar, Vidhyacharan; Lallement, Patrick, *Decision Support Systems*, vol. 51, no. 1, pp. 65-76, 2011.

An airline scheduling model and solution algorithms under stochastic demands; Yan, Shangyao; Tang, Ching-Hui; Fu, Tseng-Chih, *European Journal of Operational Research*, vol. 190, no. 1, pp. 22-39, 2008.

Journals:

- Stochastics: An International Journal of Probability and Stochastic Processes
- International Journal of Stochastic Analysis
- Journal of Applied Mathematics and Stochastic Analysis
- Stochastic Analysis and Applications
- Stochastic Systems journal
- Stochastic Processes and their Applications
- Statistical Inference for Stochastic Processes
- Applied Mathematical Modelling