IE 425: STOCHASTIC MODELS IN OPERATIONS RESEARCH

Summer 2018
Web Course

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Office Hours Office meetings can be requested by email; questions can also be asked by email or phone.

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Prerequisite Math 220 (Matrices) and IE 322 (Probabilistic Models in IE)

Objective The field of operations research focuses on model development, analysis, and implementation of quantitative methods to support effective management decision-making. The purpose of this course is to introduce students to several important types of mathematical and stochastic (probabilistic) models, and solution techniques, including dynamic programming models, stochastic processes, queueing models, queueing networks, inventory control, supply chain management, and revenue management. Such models and techniques can provide valuable insights into several design and planning problems, and thus facilitate their effective analysis.

Textbook F.S. Hillier, *Introduction to Operations Research*, 10th Ed., McGraw Hill, 2014. (ISBN: 9781259162985)

References A. Ravindran, D. Phillips, and J. Solberg, *Operations Research: Principles and Practice*, 2nd Ed., John Wiley & Sons, 1987.
W.L. Winston, *Introduction to Probability Models: Operations Research, Volume II*, 4th Ed., Cengage Learning, 2003.
H.A. Taha, *Operations Research: An Introduction*, 9th Ed., Prentice Hall, 2010.

Homepage CANVAS, Penn State's learning management system: http://canvas.psu.edu/.

Homework Assigned weekly; no collected; may use software that comes with text; solutions provided.

Case Study Novel application of OR in practice; team work (up to 3 students per team); grade based on final report.

Quizzes Seven quizzes are scheduled on CANVAS; see dates and material covered in "Course Schedule"; two hours limit to print, solve, and upload quiz in the dropbox; open-book; lowest quiz grade dropped; there will be no make-ups.

Exams Two midterm exams (closed-book, one sheet of notes is allowed) and a final exam (comprehensive, closed-book, three sheets of are notes allowed); duration: 2.5 hours; exams are proctored; see dates and material covered in "Course Schedule".

Grading

25% Midterm # 1	15% Quizzes	10% Case Study
25% Midterm # 2	25% Final	

Grading Disagreements Re-grade requests for grader omission or oversight only must be submitted within five days of the class period in which the graded item is returned. No requests will be considered after that time.

Academic Integrity According to the University Advising Handbook, academic integrity is the pursuit of scholarly activity free from fraud and deception, and is the educational objective of this institution. Academic dishonesty includes, but is not limited to cheating, plagiarism, fabrication of information or citations, facilitating acts of academic dishonesty by others, unauthorized possession of examinations, submitting work of another person, or work previously used without informing the instructor, or tampering with the academic work of other students. Any violation of academic integrity will be thoroughly investigated, and dealt with severely according to the limits of the code.

Note Scanner locations at University Park: IME PC lab (104 Leonhard), Engr. Continuous & Distance Education (301 Engr. Unit C), Engr. Copy Center (101 Engr. Unit A), and Pattee-Paterno Library.

Topic Outline

Class #	Topic	Reading Assignment
1	**Course Overview**	H&L: Chapters 1 and 2
2 - 7	**Dynamic Programming** (DP)**:** principle of optimality; formulation of deterministic and stochastic DP models - examples; discounting; computational effort.	H&L: Chapter 11 Handout # 1
8 - 18	**Stochastic Processes**: introduction and terminology; Markovian and stationary properties; transition and state probabilities; Chapman-Kolmogorov equations; discrete-time Markov chains; steady-state probabilities; first passage times and recurrence times; classification of states; absorption probabilities; continuous-time Markov chains.	H&L: Chapter 29 Handouts # 2 and 3
19 - 26	**Queueing Theory:** queueing processes and terminology; Little's formula; Exponential and Poisson distributions; balance equations; basic queueing models (M/M/1, M/M/s, M/M/1/N, and M/M/s/N); infinite queues in series and Jackson networks.	H&L: Chapter 17 Handouts # 4 and 5
27	**Applications of Queueing Theory:** waiting cost functions - examples; decision models - examples.	H&L: Chapter 26 Handout # 6
28 - 37	**Inventory Models:** setup, holding, and shortage costs; deterministic economic order quantity (EOQ) models; EOQ model with quantity discounts; dynamic programming models; newsvendor model; stochastic inventory models; applications to supply chain networks.	H&L: Sections 18.1 to 18.7 Handouts # 7, 8, 9 and 10
38	**Revenue Management:** demand management decisions; model for capacity-controlled discount fares; overbooking model.	H&L: Sections 18.7-18.8 Handout # 11

Calendar of Events

Date(s)	Event
May 14	Classes begin
May 17-18	Quiz # 1 (duration: 2 hours; time range: Thursday, May 17, 5 pm, to Friday, May 18, 10 pm, EST.)
May 24-25	Quiz # 2 (duration: 2 hours; time range: Thursday, May 24, 5 pm, to Friday, May 25, 10 pm, EST.)
May 28	Memorial Day Holiday
May 31, June 1	Quiz # 3 (duration: 2 hours; time range: Thursday, May 31, 5 pm, to Friday, June 1, 10 pm, EST.)
June 7-8	Quiz # 4 (duration: 2 hours; time range: Thursday, June 7, 5 pm, to Friday, June 8, 10 pm, EST.)
June 14-15	Midterm # 1 (duration: 2.5 hours; contents: Dynamic Programming and Discrete-Time Markov Chains.) Exam at University Park: Friday, June 15, 3 pm to 5:30 pm, EST, 103 Leonhard. Exam with Examity, time range: Thursday, June 14, 8 am, to Friday, June 15, 10 pm, EST.
June 19	Case Study: Team Formation & Start Date.
June 21-22	Quiz # 5 (duration: 2 hours; time range: Thursday, June 21, 5 pm, to Friday, June 22, 10 pm, EST.)
June 28-29	Quiz # 6 (duration: 2 hours; time range: Thursday, June 28, 5 pm, to Friday, June 29, 10 pm, EST.)
July 4	Fourth of July (Independence) Holiday
July 5-6	Midterm # 2 (duration: 2.5 hours; contents: Continuous-Time Markov Chains and Queueing Models.) Exam at University Park: Friday, July 6, 3 pm to 5:30 pm, EST, 103 Leonhard. Exam with Examity, time range: Thursday, July 5, 8 am, to Friday, July 6, 10 pm, EST.
July 12-13	Quiz # 7 (duration: 2 hours; time range: Thursday, July 12, 5 pm, to Friday, July 13, 10 pm, EST.)
July 20	Case Study: Final Report Due
July 26	Classes end
July 30-31	Final Exam (duration: 2.5 hours; questions in final exam: one question in Discrete-time Markov Chains or Queueing Theory; and three questions in Inventory Models, Supply Chain, and/or Revenue Management.) Exam at University Park: Monday, July 30, 3 pm to 5:30 pm, EST, 102 Leonhard. Exam with Examity, time range: Thursday, July 30, 8 am, to Friday, July 31, 10 pm, EST.