IE 425: STOCHASTIC MODELS IN OPERATIONS RESEARCH
Summer 2016
Web Course

Instructor 
Dr. José A. Ventura, 356 Leonhard Bldg., 865-3841, javentura@psu.edu
Office Hours 
Office meetings can be requested by email; questions can also be asked by email or phone.

TA 
Sang Jin Kweon, 232 Leonhard Bldg., 863-2844, svk5333@psu.edu
Office Hours 
Office meetings can be requested by email; questions can also be asked by email or phone.

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 

References 

Homepage 
ANGEL, Penn State’s web-based Course Management System (CMS): https://cms.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 ANGEL; 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.

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
25% Midterm # 2 
10% Case Study
25% Final

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**

<table>
<thead>
<tr>
<th>Class #</th>
<th>Topic</th>
<th>Reading Assignment</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Course Overview</strong></td>
<td>H&amp;L: Chapters 1 and 2</td>
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<tr>
<td>2 - 7</td>
<td><strong>Dynamic Programming</strong> (DP): principle of optimality; formulation of deterministic and stochastic DP models - examples; discounting; computational effort.</td>
<td>H&amp;L: Chapter 11 Handout # 1</td>
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<td>8 - 18</td>
<td><strong>Stochastic Processes</strong>: 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.</td>
<td>H&amp;L: Chapter 29 Handouts # 2 and 3</td>
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<td>19 - 26</td>
<td><strong>Queueing Theory</strong>: 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.</td>
<td>H&amp;L: Chapter 17 Handouts # 4 and 5</td>
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<td>27</td>
<td><strong>Applications of Queueing Theory</strong>: waiting cost functions - examples; decision models - examples.</td>
<td>H&amp;L: Chapter 26 Handout # 6</td>
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<td>28 - 37</td>
<td><strong>Inventory Models</strong>: 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.</td>
<td>H&amp;L: Sections 18.1 to 18.7 Handouts # 7, 8, 9 and 10</td>
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<td>38</td>
<td><strong>Revenue Management</strong>: demand management decisions; model for capacity-controlled discount fares; overbooking model.</td>
<td>H&amp;L: Sections 18.7-18.8 Handout # 11</td>
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**Calendar of Events**

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<tr>
<th>Date(s)</th>
<th>Event</th>
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<tbody>
<tr>
<td>May 16</td>
<td>Classes begin</td>
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<tr>
<td>May 19-22</td>
<td>Quiz # 1 (duration: 2 hours; Thursday, May 19, 5 pm, to Sunday, May 22, 10 pm)</td>
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<td>May 26-27</td>
<td>Quiz # 2 (duration: 2 hours; Thursday, May 26, 5 pm, to Friday, May 27, 10 pm)</td>
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<td>May 30</td>
<td>Memorial Day Holiday</td>
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<td>June 2-3</td>
<td>Quiz # 3 (duration: 2 hours; Thursday, June 2, 5 pm, to Friday, June 3, 10 pm)</td>
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<td>June 9-10</td>
<td>Quiz # 4 (duration: 2 hours; Thursday, June 9, 5 pm, to Friday, June 10, 10 pm)</td>
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<td>June 16-17</td>
<td>Midterm # 1 (duration: 2.5 hours; Thursday, June 16, 8 am, to Friday, June 17, 10 pm) Exam contents: Dynamic Programming and Discrete-Time Markov Chains.</td>
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<td>June 21</td>
<td>Case Study: Team Formation &amp; Start Date.</td>
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<td>June 23-24</td>
<td>Quiz # 5 (duration: 2 hours; Thursday, June 23, 5 pm, to Friday, June 24, 10 pm);</td>
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<td>June 30 - July 1</td>
<td>Quiz # 6 (duration: 2 hours; Thursday, June 30, 5 pm, to Friday, July 1, 10 pm)</td>
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<td>July 4</td>
<td>Fourth of July (Independence) Holiday</td>
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<td>July 7-8</td>
<td>Midterm # 2 (duration: 2.5 hours; Thursday, July 7, 8 am, to Friday, July 8, 10 pm); Exam contents: Continuous-Time Markov Chains and Queueing Models.</td>
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<td>July 14-15</td>
<td>Quiz # 7 (duration: 2 hours; Thursday, July 14, 5 pm, to Friday, July 15, 10 pm)</td>
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<td>July 22</td>
<td>Case Study: Final Report Due</td>
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<td>July 27</td>
<td>Classes end</td>
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<tr>
<td>July 28-29</td>
<td>Final Exam (duration: 2.5 hours; Thursday, July 28, 8 am, to Friday, July 29, 10 pm); Exam contents: Distribution of Final Exam: One question in Discrete-time Markov Chains or Queueing Theory; and three questions in Inventory Models, Supply Chain, and/or Revenue Management.</td>
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