

# IE 516 – Applied Stochastic Processes

Harold and Inge Marcus Department of Industrial and Manufacturing Engineering  
The Pennsylvania State University, University PA

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<b>OFFICE:</b>	221 Leonhard Building
<b>OFFICE HOURS:</b>	TuTh 1:30 - 2:30pm or by appointment
<b>CLASS TIME &amp; PLACE:</b>	TuTh 3:05PM - 4:20PM Walker Building 012
<b>PREREQUISITE:</b>	IE 322: Probabilistic Models in Industrial Engineering

## TEXTBOOK

Introduction to Probability Models  
Sheldon M. Ross, 8<sup>th</sup> edition or later, Academic Press.

## REFERENCES

1. Ronald A. Howard, "Dynamic Probabilistic Systems, Volume I: Markov Models", Dover Publications (June 5, 2007), ISBN-10: 0486458709
2. Sheldon Ross, "Stochastic Processes", John Wiley & Sons, New York, NY, 2nd edition (February 8, 1995), ISBN-10: 0471120626
3. Vidyadhar G. Kulkarni, "Modeling and Analysis of Stochastic Systems", Chapman and Hall/CRC; 2nd edition (December 18, 2009), ISBN-10: 1439808759

## OBJECTIVES

Get exposed to the theory of mathematical probability and stochastic processes and build foundations for their decision support applications in engineering, healthcare, and finance.

## TOPICS

1. Crunch review of probability theory  
(*Events & probability spaces, Bayesian concepts, independence, functions of random variables, conditional probability & expectation, probability distributions & transformations*)
2. Poisson processes  
(*Bernoulli processes, merging & splitting of Bernoulli processes, interarrival distribution, properties of the  $k$ th arrival time, Pascal distribution, Poisson processes, merging & splitting of Poisson processes, Erlang distribution, random incidence paradox*)
3. Discrete-time Markov Chains  
(*Chapman-Kolmogorov equations, classification of states, steady-state behavior, random walk, absorption probabilities and expected time to absorption, branching processes, Markov Chain Monte Carlo methods, applications*)
4. Continuous-time Markov processes  
(*Chapman-Kolmogorov equations, Birth & death processes, yule process, transition probability function, limiting probabilities, queueing theory, applications*)
5. Renewal theory  
(*Limit theorems, renewal reward processes, regenerative processes, applications*)
6. Markov decision processes  
(*Markov reward process, Bellman Equation, policy/value iteration methods; applications*)

## GRADING POLICY

Quiz/Homework – 25%  
Exam I – 25%  
Exam II – 25%  
Final Exam – 25%

Exam dates will be announced as the course progresses. Final grade will be determined based on the student performance in different evaluation elements – as shown above. No make-up exams unless previous arrangements have been made. Students will be expected to attend class and prepare assignments. Habitual

failure to do so will result in a reduced grade. An incomplete grade will only be given when a student misses a portion of the semester because of illness or accident. Cheating on examinations, plagiarism and other forms of academic dishonesty are serious offenses and may subject the student to penalties ranging from failing grades to dismissal.

Grading scale will be used: A: 90+; B: 80+; C: 70+; D: 60+, F: <60

### CLASS POLICY

- Homework problem sets will be assigned during the semester. Please use the assignment page as the cover page of your homework submission. Homework solutions should be written neatly, papers **stapled**, and all steps **must** be shown clearly for full credit. Assignments not meeting these specifications will not be accepted.
- Homework is due one week after it is assigned. No late homework will be accepted. **Homework will be collected at the beginning of class on the assigned due date. If you do not hand in your homework at this time it will be considered late.**
- **Attendance:** Class attendance is strictly required. I *strongly encourage you to attend class* regularly and I will take attendance periodically during the course of the semester. Habitual failure to do so will result in a reduced grade. In the event of extenuating circumstances, please submit documentation (printed, signed, and dated by students and relevant authorities) to the instructor at least two days ahead of the class for approval. If it is not a university excuse, it will not be accepted. **Dropping an email to me without any documentation will not be accepted.**
- During class time, please **turn** your cell phones to **SILENT/VIBRATION** mode.
- Always bring your textbook to class. Also bring your calculator, notebook, pencils/pens, and eraser.
- **Exams must be taken on the scheduled exam dates.** Students are required to arrange with the instructor in advance for a make-up exam in the event of extenuating circumstances that prevent them from taking the exam as scheduled. In the event of an unforeseen emergency that prevents the student from taking the exam as scheduled, the student must provide documentation to the instructor before a make-up exam can be arranged.
- Exams will be closed book, closed notes. Please be sure to bring your calculator to the exam. There will be absolutely no sharing among students of calculators. Computer or laptop is not allowed in the exam
- If you believe there was an error in the grading of an exam, you may submit the entire exam for a regrade. This must be done **within one week** from the date the exam was returned. The entire exam will be regraded, so that you may gain, or lose, points by resubmitting.

### COMMUNICATION AND INSTRUCTION VIA CANVAS

Communication in the course will be through official electronic means: PSU assigned e-mail address and the course website in CANVAS (<https://psu.instructure.com/>). Students are responsible for all information conveyed during class and on CANVAS. It is the student's responsibility to make sure they are receiving their official PSU email and checking course updates in the CANVAS website.

**To access CANVAS, go to:** <https://psu.instructure.com/>

Go to Dashboard and then click on IE 516, Section 001: Apl Stoc Proc. Check this website frequently for: Course syllabus, important announcements, homework sets, lecture notes, emails, grades, and additional resources.

### INSTRUCTOR'S COMMITMENT

You can expect your instructor to be courteous, punctual, well-organized, and prepared for the lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if he is unable to keep them; and to grade uniformly and consistently according to the posted guidelines.

### STUDENTS WITH DISABILITIES SERVICES

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at <http://equity.psu.edu/ods/>.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at <http://equity.psu.edu/ods/guidelines/documentation-guidelines>). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

### **ACADEMIC INTEGRITY**

Violations of academic honesty will be dispatched in accordance with the university policy (<http://www.psu.edu/oue/aappm/G-9-academic-integrity.html>).

### **IMPORTANT DATES**

Classes Begin	Monday	January 9
Regular Drop - Deadline	Saturday	January 14 at 11:59 p.m. (ET)
Regular Add - Deadline	Sunday	January 15 at 11:59 p.m. (ET)
Late Drop Begins	Sunday	January 15
Martin Luther King Day - No Classes	Monday	January 16
Final Exam Conflict - Filing Period	Monday - Sunday	February 13 - March 5
Spring Break - No Classes	Sunday - Saturday	March 5 - 11
Late Drop - Deadline	Friday	April 7
Withdrawal - Deadline	Friday	April 28 at 5:00 p.m. (ET)
Classes End	Friday	April 28
Study Days	Saturday - Sunday	April 29 - 30
Final Exams	Monday - Friday	May 1 - 5
Commencement	Friday - Sunday	May 5 - 7

*Good luck and have a great semester!*