

IE 516 – Applied Stochastic Processes

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

INSTRUCTOR:	Dr. Hui Yang
PHONE:	814-865-7397
EMAIL:	All emails must be sent through Canvas to ensure that I receive all of your emails and for you to receive a reply timely. This ensures that your email does not get mixed in my general email.
OFFICE:	221 Leonhard Building
OFFICE HOURS:	TBA <i>For online students, Zoom teleconference by appointment</i>
CLASS TIME & PLACE:	Online delivery through Canvas
PREREQUISITE:	IE 322: Probabilistic Models in Industrial Engineering

TEXTBOOK

Introduction to Probability Models
Sheldon M. Ross, 8th 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, case study and applications*)
4. Continuous-time Markov processes
(*Chapman-Kolmogorov equations, DTMC approximation of CTMC, Birth & death processes, uniformization, transition probability function, limiting probabilities, case study and applications*)
5. Renewal theory
(*Renewal Processes, limit theorems, renewal reward processes, Semi-Markov processes, long-term analysis, case study and applications*)
6. Queueing theory
(*Queueing Systems, Birth and death queues with infinite capacity ($M/M/1$, $M/M/s$, $M/M/\infty$), Birth and death queues with finite capacity ($M/M/1/K$, $M/M/s/K$, $M/M/K/K$), little's law, network of queues, case study and applications*)
7. 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, clearly scanned**, 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. **Please submit and upload your solutions as a single PDF file to the CANVAS website. Please DO NOT submit through emails or hardcopies. Email and hardcopy submission will not be accepted and graded. If you do not submit your homework on the assigned due date it will be considered late.**

– 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.

- **For online students only:** If you do not take the exam on the University Park campus, you will be required to take the exam using the online proctoring service, "Examity". If you do take the exam on campus, we will arrange a time and place for you to take the exam on campus for each exam. Since some of you will be using Examity, I have been instructed that the following statement must be included in this course syllabus:

"This course may require you to take exams using certain proctoring software that uses your computer's webcam or other technology to monitor and/or record your activity during exams. The proctoring software may be listening to you, monitoring your computer screen, viewing you and your surroundings, recording and storing any and all activity (including visual and audio recordings) during the proctoring process. By enrolling in this course, you consent to the use of the proctoring software selected by your instructor, including but not limited to any audio and/or visual monitoring which may be recorded. Please contact your instructor with any questions."

- **For online students only:** If you are going to take the exams online in Canvas using Examity Proctoring. These exams must be scheduled through Examity during a 2-day period. Students will have 90 minutes to take each exam. You must submit a single scanned PDF version of your exam (i.e., all pages in one PDF file) with your name clearly written on each page of your exam. If we have difficulty reading your responses, we will not be able to grade them so please ensure that your writing and the scanned copy of your exam is legible and clear.

Please do not wait until the last minute to schedule your exam. Also ensure that the room you will use to take the exam has the printer and scanner (if applicable) in the view of your webcam so you will be able to print the exam, work the problems directly on a copy of the exam, and scan and upload the exam so you can receive partial credit for any questions you miss. Exams represent a solely individual effort. Students will not be permitted to collaborate in any way on exams or use unauthorized content, tools, or material in preparing for or completing exams as this constitutes academic dishonesty.

- **For on-campus students:** *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. *Anyone missing exams without notifying me ahead of time (and/or for a reason not deemed justifiable) will not be able to make it up.*

- 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.
- 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: 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 the scheduled appointments 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>).

Good luck and have a great semester!