

# ISE-230-010 Fall 2018 — Introduction to Stochastic Models in Operations Research

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<b>Office:</b>	Mohler Lab #327	<b>Days:</b>	Mon-Wed-Fri
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## 1 Description

Stochastic models and methods in Operations Research are fundamental tools for the analysis, design, operation and improvement of systems subject to random inputs and perturbations. These techniques apply to systems in transportation, telecommunication, supply chain management, marketing, economics, finance, health care, energy, computing, and the military, to name a few.

Operations Research (OR) has been labeled as the “Science of the Better” thanks to its huge positive impact in the improvement of resource allocation, profits, safety, client satisfaction, etc., in numerous real-world settings.

This course will cover fundamental stochastic models and methods in Operations Research: Decision Analysis, Queuing Theory, Reliability Theory, and Markov Decision Processes.

## 2 Restrictions

Students cannot be enrolled in their Freshman year. All students should have taken a probability course at the undergraduate level, ISE-111 or MATH-231.

## 3 Goals

By the end of this course, students will be able to:

- Properly formulate a stochastic problem.
- Choose an adequate modeling technique for particular stochastic problems.
- Solve real-world stochastic problems with the aid of appropriate software tools.
- Analyze the solution of stochastic problems.

## 4 Textbook

The textbook for the course is

- F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research, Lehigh Edition*, McGraw-Hill, New York, NY, USA, 2016.

The course will cover the material of Chapters on: **Queueing Theory, Applications of Queueing Theory, Decision Analysis, Reliability Theory, Markov Chains, and Markov Decision Processes.**

**If you buy a different edition:** (e.g. 9th ed., 10th ed.) it is your responsibility to check you have access to the 6 chapters mentioned above: either your edition has them, or it gives you electronic access to the pdfs of the chapters that are not printed.

## 5 Prerequisites

Elements of probability theory are used during the lectures. The online appendices of the textbook website at [www.mhhe.com/hillier](http://www.mhhe.com/hillier) contains a chapter on **Probability Theory**.

Students with background in linear algebra tend to do better in the course. Therefore, please see the online appendices of the textbook, that has a chapter on the **Basics of matrix computations**, and a chapter on the **Solution to systems of linear equations**.

## 6 Course Site

Lecture slides will be posted on **Course Site** (<https://coursesite.lehigh.edu/>).

**Homework assignments**, solutions, and announcements **will be posted on Course Site**. Important information and urgent information will be sent by mass-email via **Course Site**. Email is the official way of communication for this course, so be sure to check your email often.

## 7 Software

In this course, students will have to use Matlab for some homework assignments.

Matlab is installed on Lehigh University computers.

If you do not have access to a library computer, you can use Matlab on your laptop by using virtualization software, described at

<https://lts.lehigh.edu/services/virtual-software>. With virtualization, you should run “Matlab R2017a On Demand”.

Follow the instructions in the link above, install the tools, and test your ability to **run Matlab on your laptop, today**. Do not wait for the first Matlab assignment.

## 8 Course Evaluation

The course evaluation is comprised of the following weighted elements:

Participation:	10%	
Homework:	20%	
Midterm #1:	20%	Monday Oct 1
Midterm #2:	25%	Friday Nov 9
Final exam:	25%	TBD

You cannot schedule a job interview on a midterm day that has been announced at the beginning of the semester. Therefore, carefully **write the midterm dates in your agenda, today.**

The date of the final exam day is made by the registrar. This semester, the last potential day is Wednesday December 19 (evening included.) Do not buy your flight prior to having confirmation of the date and hour of the final exam by the registrar.

The following conversion table between numeric and letter grades is used for grading:

Numerical Grade (%)	≥93	≥88	≥83	≥78	≥74	≥68	≥62	≥55	≥50	≥45	≥40	≥0
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

### 8.1 Homework

There will be regular and equally weighted individual homework assignments. The problem sets will be posted on Course Site.

#### Submission Format:

Electronic submissions on **Course Site** is the **only way to submit an assignment**. Do not send your assignment by email attachment to me or to the TA, we cannot keep track of it and we will not consider it. It is your responsibility to make sure the assignment has been properly submitted. You should each time **verify that the upload went through**.

If you want to submit a hand-written assignment, you have to scan your documents and merge them into a single pdf, e.g. using <http://www.pdfmerge.com/> or using <https://www.pdf labs.com/tools/pdftk-server/>). If you don't have a scanner at hand, a scanning app that works reasonably well is Genius Scan. Well-presented, well-structured, easy-to-read submissions receive higher-quality feedback. The TA will not have the time to reverse-engineer scribbles from a photographed homework, so just make everybody's life easy by submitting neat scans.

If your homework has computer exercises, you are asked to give in appendix your commented code as well as the output of your code when you run it, in addition to your written answers to the question.

#### General recommendations:

Do your homework responsibly. Do not leave homework submission to the last day since you may encounter connectivity issues with coursesite, or unexpected events on campus may happen. It is your responsibility to check that your homework is correctly uploaded: always double-check that the uploading process went through.

You are allowed to discuss about the assignments in small group of students registered to the course. However, you must work out the solution by yourself, and you must write up and submit your own homework. For computer exercises, discussions must stop when you start writing code.

**Due Date and Late Submission Policy:** Due dates are indicated in Course Site. In general, expect electronic submissions on Course Site to be due on Tuesdays or Thursday, 11:55pm, with a grace period until 5:55am. You have to contact me in advance by email if you will need an extension. Late submissions will receive the F grade. You are not late if you are within the grace period. Beyond the grace period, extensions with 100% of the grade are granted if (i) you emailed me in advance to obtain an extension with a valid reason, (ii) force majeure, such as campus-wide power outage, (iii) medical. For (iii) you have to bring the appropriate documentation once you're back in class (check the rules with the Associate Dean of Students Office).

Talk to me at the beginning of the year if you will require special accommodations (e.g. student athlete competitions.)

## 8.2 Midterms and Final Exam

The midterms and the final exam will cover the material presented in class, the examples and exercises of the textbook, and the homework assignments.

The midterms and final exam are closed-book, closed-notes exams. I will clarify in class during the year which formulae are provided with the questions.

Midterm 1 is on queueing theory, and midterm 2 is on decision analysis and reliability theory. The final exam is cumulative.

The midterms are during class time, so they can last only 50 mins.

## 9 Tentative Calendar

The following class schedule is tentative. We reserve the right to change it.

Week	Dates			Topics	Remarks
1	8/27	8/29	8/31	Queueing Theory	
2	9/3	9/5	9/7	Queueing Theory	
3	9/10	9/12	9/14	Queueing Theory	
4	9/17	9/19	9/21	Queueing Theory	
5	9/24	9/26	9/28	Decision Analysis	
6	10/1	10/3	10/5	Decision Analysis	10/1 Midterm #1
7	10/8	10/10	10/12	Decision Analysis	
8	—	10/17	10/19	Reliability Theory	10/15-16 Pacing Break
9	10/22	10/24	10/26	Reliability Theory	
10	10/29	10/31	11/2	Reliability Theory	
11	11/5	11/7	11/9	Markov Chains	11/9: Midterm #2
12	11/12	11/14	11/16	Markov Chains	
13	11/19	—	—	Markov Chains	11/21-23 Thanksgiving
14	11/26	11/28	11/30	Markov Decision Processes	
15	12/3	12/5	12/7	Markov Decision Processes	

## 10 Policies for the course

### 10.1 The Principles of our Equitable Community

Lehigh University endorses The Principles of Our Equitable Community [[http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity\\_Sheet\\_v2\\_032212.pdf](http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf)]. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

### 10.2 Attendance

Attendance is required at lectures. Contact me in advance if you require special accommodations. Provide feedback during the lectures, so that we can make the best use of our time during class.

### 10.3 Appointments

See me or the TA during office hours or by appointment if your questions could not be addressed during class time. Please understand that our availability cannot be guaranteed on the week prior to a midterm or the final exam.

### 10.4 Missed Midterm

Arrange to have friends able to wake you up on the day of the exam, should your alarm malfunction. In case of medical or other acceptable reasons, please inform us (once you are safe) and follow the normal procedures for obtaining an Absence Information Report through the Associate Dean of Students Office (U.C. Room 210). Upon receipt of the report, we will arrange the details for a make-up.

### 10.5 Email communications

In email communications, observe business etiquette and write your message carefully. By sending your email, you acknowledge that I may post your message to Course Site to share the answer with the rest of the class.

### 10.6 Electronic Devices

Laptop use is permitted during class for the purpose of this course, such as viewing slides.

Not allowed: “collaborative” homework completion, online shopping, social networking, distracting or seeking attention of others, etc. Also, please don’t get offended if I momentarily ask for laptops to be put aside.

Audio or video recording may be done only with the approval of everyone in the classroom. Please let me know in advance if you need to use audio or video recording.

### 10.7 Accommodations for Students with Disabilities

If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, Williams Hall, Suite 301 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

## 10.8 Academic Integrity

**Please consult the material about Academic Integrity available in Course Site.** There are many forms of irresponsible behavior that can ruin opportunities for you or for others in this course; there is no room and no excuse for bad behavior. Examples of irresponsible behavior cover a wide range, and include cheating, plagiarism, creating hazards or disruptions, slacking on responsibilities, unfairly exploiting the efforts of others, etc. Further explanation and guidelines on academic integrity at Lehigh can be found on the University Student Conduct System web page <https://studentaffairs.lehigh.edu/node/31> and on the Fostering Academic Integrity at Lehigh University web site <https://studentaffairs.lehigh.edu/content/academic-integrity-resources>. It is firm policy in this course that cheating or plagiarism are unacceptable violations of academic integrity, and will earn an F as the semester grade in the course. Please meet requirements in good spirit, and do your part in advance of deadlines. For example, do not copy data or sections of homework reports from students currently or previously enrolled. While students are encouraged to discuss homework problems together, the final solution should be obtained independently, and the writing of the homework report is an individual responsibility. . . do not ask for other student's work, and do not share yours with others. Various forms of carelessness or disregard for safety considerations, abuse of others, compromising opportunities for others, failing to participate in good faith, etc., can also have serious consequences. Appropriate penalties should be expected. Offenders may lose points from their course totals, and serious offenders may be dropped from the course.

## 10.9 Course Site Material

Material and electronic documents downloaded from course site is for your personal use only. You are not allowed to share material from course site.

## 10.10 Other Relevant University Policies

Religious Holidays: <https://chaplain.lehigh.edu/>

Lehigh Computer Security: <https://lts.lehigh.edu/services/security>

Lehigh Computer Policies: <https://lts.lehigh.edu/services/library-computing-policies>