ISE 412: Quantitative Models for Supply Chain Management
Fall 2018

Syllabus

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Class Hours: TR 9:20–10:35 AM, Mohler 375

Office Hours: By appointment

Course Description: The purpose of this course is to study quantitative models for fundamental topics in supply chain management (SCM). Topics include deterministic and stochastic inventory models, facility location problems, forecasting and demand modeling, supply disruptions, routing problems, supply chain contracting, and the bullwhip effect. Our primary focus will be on the *theory* of SCM. We will also, to a more limited extent, discuss how these theories are put into *practice*.

The goals of this course are to provide students with:

1. a thorough understanding of problems faced by supply chain managers and engineers
2. a set of quantitative tools for addressing these problems
3. an overview of the current topics in academic research on supply chain management to serve as a basis for students' own research in the field

Prerequisites: ISE 316 (optimization), or the consent of the instructor. Although not a formal prerequisite, some previous exposure to basic inventory models (EOQ, newsvendor, (r, Q), etc.) from a previous course on inventory, production, or logistics will be very helpful—undergraduate-level coverage is fine. In addition, we will be writing mathematical proofs in this class, so it will be very helpful if you have previous experience with formal proof-writing. (See below.)

Readings: The textbook for the course is

- Snyder, L. V. and Z.-J. M. Shen, 2011, *Fundamentals of Supply Chain Theory*, Hoboken, NJ: John Wiley and Sons.

Chapters from the textbook (including drafts of new chapters) will be assigned to supplement the material being covered in class. Lectures will follow the general outline of the book and supplementary materials. The book is best read right after the lecture to reinforce the concepts discussed. The book also provides details that we might not discuss in class. **It is your responsibility to keep up with the reading.**

Please make sure to check the list of errata (errors) at `http://coral.ie.lehigh.edu/~sctheory/errata/` (and let me know if you find any additional errors!).

You may also wish to consult the following books for reference throughout the course:

- Chopra, S. and P. Meindl, 2012, *Supply Chain Management: Strategy, Planning, and Operation*, 5th ed., Upper Saddle River, NJ: Prentice-Hall.
- Simchi-Levi, D., P. Kaminski, E. Simchi-Levi, and R. Shankar, 2007, *Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies*, 3rd ed., New York: McGraw-Hill.
- Silver, E.A., D.F. Pike, and R. Peterson, 1998, *Inventory Management and Production Planning and Scheduling*, 3rd ed., Hoboken, NJ: Wiley.
- Nahmias, S., 2005, *Production and Operations Analysis*, 5th ed., New York: McGraw-Hill Irwin.
- Tayur, S., R. Ganeshan, and M. Magazine (eds.), 1999, *Quantitative Models for Supply Chain Management*, International Series in Operations Research and Management Science, Boston: Kluwer.
- Simchi-Levi, D., X. Chen, and J. Bramel, 2014, *The Logic of Logistics: Theory, Algorithms, and Applications for Logistics and Supply Chain Management*, 3rd ed., New York: Springer.

Software: In this course, you will make heavy use of MATLAB, as well as other software such as AMPL and Excel. In addition, we will play a free computerized version of the "beer game."

Requirements:

1. Homework assignments (30%)

   You will be assigned homework every few weeks. The homework problems will be based on the readings and in-class material. They will challenge you to understand, interpret, and extend the models and solution techniques we discuss in class.

2. Mid-term exam (15%), Final exam (25%)

   You will be given an in-class mid-term exam and a take-home final exam. Both will test your understanding of the material covered in class. The mid-term is *tentatively* scheduled for Thursday, October 18. The final exam will be distributed on the last day of class (Thursday, December 6) and will be due one week later. You may use books, notes, and any other sources, except people (other than me) as you work on the take-home final.

3. Coding projects (20%)

   You will be assigned several coding projects throughout the semester that will require you to write computer code to execute various algorithms. Your programs must be written in MATLAB. The projects will become progressively more complex as the semester progresses. Typically, I will ask you to submit your program's solutions to certain instances of the problem, and then I will also test your code on additional instances. Therefore, I will ask you to submit your `m`-files electronically on CourseSite, in addition to your write-up.

   MATLAB is an essential computational tool for engineers of all sorts, and if you are not already familiar with it, now is the time to get started. None of the coding projects will require you to use particularly complicated MATLAB features, but you will need to understand the basics of how to write programs in MATLAB. To start learning how to use MATLAB, or to refresh your memory, I can recommend the primers by Kermit Sigmon (`http://www.math.toronto.edu/mpugh/primer.pdf`) or by MathWorks, the company that makes MATLAB (`http://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf`).

4. Class participation (10%)

   You are expected to attend class regularly, come to class prepared, participate in the discussions we have in class, and ask questions when you are confused.

Homework and Coding Project Policy: The homework assignments and coding projects are likely to take you a fair amount of time, so get started on them early. *No late homework assignments or coding projects will be accepted unless you clear them with me ahead of time.*

You may work on the homework assignments and coding projects individually or with a partner. If you work with a partner, you and your partner may submit a single write-up, or you may submit individual write-ups.

You may discuss the homework and coding projects with students other than your partner, but you must cite any people or sources that helped you on a particular problem. For example: "Smarty McPants and I worked on this problem together" or "I got help from Smarty McPants and consulted 'Facility Location for Dummies' when solving this problem." If you work with a partner but submit individual write-ups, make sure you cite your partner. I also encourage you to come to me for help when you are stuck.

Remember that you are ultimately responsible for mastering the material on your own, and your performance on the exams will depend on your ability to do so. Therefore, you should make sure you fully understand all of the details of the work you submit, whether you submit an individual or joint write-up.

Proofs: This course will contain quite a few mathematical proofs, some that we discuss in class and others that you will develop in your homework and exams. The course therefore demands a high level of mathematical maturity. There is a short primer about proof-writing in Appendix B of the textbook, but this is meant more as a refresher than as an introduction. If you are

not already somewhat familiar and comfortable with the material in Appendix B, you may wish to consider withdrawing from the course.

CourseSite: I will use CourseSite to post lecture notes, readings, homework assignments and their solutions, and other information about the course. Please check there regularly for updates.

Plagiarism Policy: Plagiarism is defined in the Lehigh student handbook as "the unacknowledged appropriation of another's work, words, or ideas in any themes, outlines, papers, reports, or computer programs." This includes "patchwork plagiarism," in which an author essentially quotes another author's work when attempting to paraphrase it. There will be a zero-tolerance approach to plagiarism in this class—plagiarized work will receive a grade of 0. For more information about what plagiarism is and what counts as plagiarism, see `www.lehigh.edu/library/guides/PlagiarismStudent.html`.

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both me and the Office of Academic Support Services, University Center 212 (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.

Use of Mobile Devices: The use of cell phones, tablets, laptops, and other electronic devices is prohibited in class. I understand that there may be some legitimate reasons to use such devices in class, but please wait until after class ends to perform these functions. Screens are a distraction both to the students and to the instructor and may not be used.

Tentative Schedule: The following is a **very tentative** outline of the course. I may add, subtract, or rearrange topics as the semester progresses. Chapter and section numbers refer to *Fundamentals of Supply Chain Theory*. A plus sign (+) indicates that supplementary reading material will be distributed.

Week of August 27:	Introduction; review of deterministic and stochastic inventory models
Reading:	Chapters 1, 3, 4
Week of September 3:	Risk pooling and postponement
Reading:	§6.1–6.3
Week of September 10:	Inventory models with supply uncertainty
Reading:	§6.5–6.8
Week of September 17:	Forecasting and demand modeling
Reading:	Chapter 2
Week of September 24:	Facility location
Reading:	§7.1–7.2, (+)
Week of October 1:	Tuesday: *No class* Thursday: The location model with risk pooling (LMRP)
Reading:	§8.1–8.2
Week of October 8:	Stochastic location models; facility location with disruptions
Reading:	§8.3–8.4
Week of October 15:	Tuesday: *No class (Pacing Break)* Thursday: *Midterm exam*
Week of October 22:	The traveling salesman problem (TSP)
Reading:	(+)
Week of October 29:	The vehicle routing problem (VRP)
Reading:	(+)
Week of November 5:	Tuesday: *No class (INFORMS)* Thursday: The bullwhip effect TBD: Additional class meeting to play beer game
Reading:	Chapter 10
Week of November 12:	Supply chain contracts
Reading:	Chapter 11
Week of November 19:	Tuesday: Supply chain auctions Thursday: *No class (Thanksgiving Break)*

Reading:	Chapter 12
Week of November 26:	Applications of supply chain theory
Reading:	(+)
Week of December 3:	Buffer/review