ISE 425: Advanced Inventory Theory
Spring 2014

Syllabus

Instructor: Prof. Larry Snyder

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Class Hours: T/Th 10:45 AM–12:00 PM, Mohler 375

Office Hours: M 11:00 AM–12 PM, Th 1:00–2:00 PM, and by appointment

Course Description: This course will provide an in-depth study of classical models for inventory management and their extensions. We will study both deterministic and stochastic inventory models, with more emphasis on the latter. Although many of the topics we will cover are of great interest to managers, our focus will be not on practice but on theory.

The goals of this course are to provide students with:

1. a thorough understanding of classical inventory models like the EOQ, Wagner-Whitin, and newsvendor problems, as well as important policies such as base-stock, (r, Q), and (s, S) policies
2. a set of quantitative tools for studying inventory models and policies, including evaluating solutions, proving analytical properties, developing and coding algorithms, and interpreting solutions
3. an understanding of the relationships among the classical models, and of which is most applicable for a given setting
4. a thorough knowledge of the approaches to multi-echelon inventory systems that have been proposed in the literature
5. a sampling of the more complex models that have been developed using classical models as a basis

Prerequisites: ISE 111, 339, or an equivalent probability course, or the consent of the instructor

Reading: The following textbook is required for the course and is available at the Lehigh bookstore, or on-line:

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

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!).

We will also use sections of the following book, which will be available electronically on CourseSite:

- Zipkin, Paul H. *Foundations of Inventory Management*. Boston: McGraw–Hill, 2000.

You may also wish to consult the following books:

- Axsäter, Sven. *Inventory Control*, 2nd ed. Norwell, MA: Kluwer, 2006.
- Porteus, Evan L. *Foundations of Stochastic Inventory Theory*. Stanford, CA: Stanford University Press, 2002.
- Silver, Edward A., David F. Pike, and Rein Peterson. *Inventory Management and Production Planning and Scheduling*, 3rd ed. Hoboken, NJ: Wiley, 1998.
- Simchi-Levi, David, Xin Chen, and Julien Bramel. *The Logic of Logistics: Theory, Algorithms, and Applications for Logistics Management*, 2nd ed. New York: Springer–Verlag, 2004.

Requirements:

1. Homework assignments

   You will be assigned homework every few weeks. The homework problems will be based on the textbooks 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 and final exam

   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 Tuesday, March 18. The final exam will be handed out on the last day of class (Thursday, April 24) 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

   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, 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

   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.

Your grade will be calculated as follows:

Item	Percentage
Homework assignments	25%
Mid-term exam	20%
Final exam	25%
Programming projects	20%
Class participation	10%

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 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 'EOQ 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, coding projects, 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 Cell Phones: The use of cell phones, smart phones, MP3 players, and other hand-held 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. Cell phones are a distraction both to the students and to the instructor and may not be used.

Equity: Lehigh University endorses The Principles of Our Equitable Community (`http://www4.lehigh.edu/diversity/principles`). 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.

***Tentative* Course Outline:**

(Readings from Zipkin (2000) are denoted by ⓩ; all others are from Snyder and Shen (2011).)

Single-Echelon, Deterministic Models

Week of January 13: Introduction, classifying inventory models, the EOQ model and extensions.
Reading: Sections 3.1–3.2

Week of January 20: EOQ w/imperfect quality, present-value criterion, Wagner-Whitin model.
Reading: Sections 3.6–3.7ⓩ, Section 3.3

Single-Echelon, Stochastic Models

Week of January 27: Preliminaries, (r, Q) policies.
Reading: Sections 4.1–4.3

Week of February 3: Base-stock policies, the newsvendor problem.
Reading: Section 4.4

Week of February 10: (s, S) policies, approximations.
Reading: Section 4.5, Section 6.4ⓩ

Week of February 17: Worst-case bound for (r, Q) approximation.
Reading: Zheng, Y.–S. On properties of stochastic inventory systems. *Management Science* 38(1):87–103, 1992.

Week of February 24: Policy optimality: Base-stock policies.
Reading: Section 4.6.1

Week of March 3: [*Spring Break*]

Week of March 10: Policy optimality: (s, S) policies.
Reading: Section 4.6.2

Multi-Echelon, Deterministic Models

Week of March 17: [*Midterm: March 18*]; Serial systems.
Reading: Section 5.3ⓩ

Week of March 24: Serial systems (cont'd).
Reading: Section 5.3ⓩ (cont'd)

Multi-Echelon, Stochastic Models

Week of March 31: Stochastic service models.

Reading:	Sections 5.1–5.2, Section 8.3ⓩ
Week of April 7:	Stochastic service models (cont'd), guaranteed service models.
Reading:	Section 5.3
Week of April 14:	Guaranteed service models (cont'd).
Reading:	Section 5.3 (cont'd)
Week of April 21:	Wrap-up, review.