Course Description: Inventory management is the cornerstone of supply chain management. The goal of this course is three-fold: (1) identify problems and key trade-offs in inventory management, (2) introduce the main stream literature that model, solve and understand these problems, (3) bring students to the frontier of this active research area. The course is targeted at graduate (M.S. or Ph.D.) students in the areas of operations management, operations research, industrial engineering and management science. To prepare students to do research and to train students for the job market, this course combines lectures, literature reading and presentations.

Topics covered (tentative)
- Economic lot sizing models – lot scheduling, multi-echelon lot sizing models
- Single and multi-echelon stochastic inventory models
- Supply chain incentive issues and contract – coordination and competition
- Special topics – research frontiers

Prerequisite: It is recommended that students are familiar with the basic concepts of linear/non-linear optimization, probability, stochastic processes and stochastic dynamic programming.

Related Courses: Supply Chain Modeling & Algorithms, Supply Chain – Marketing Interfaces, Stochastic Models in Supply Chain and Marketing Sciences.


Course Policy

**Course Requirement:** Class grade is based on the following components with the stated weights:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem sets</td>
<td>20%</td>
</tr>
<tr>
<td>Mid-term</td>
<td>30%</td>
</tr>
<tr>
<td>Presentation &amp; Discussant</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>30%</td>
</tr>
</tbody>
</table>

**Class Participation:** Class participation is necessary. If you cannot attend a class, please notify me *in advance* with a good reason and a solid proof, such as interviews and illness.

**Active Learning:** To prepare you for a successful career in either academic or industry, this course is planned so that you can get involved in research activities. You will prepare and make presentation, serve as a discussant, search and review literature, and most importantly, identify research problems.

**Presentations:** depending on enrollment, each student will select several papers (listed below) and present these papers as if you were the author. You can also pick paper of your interest outside of the list (it could be your own research paper), but with my permission. In the presentation, you need to explain the research problem, the motivation, the models, and the solution to the problem. You also need to compare to existing results and point out the contribution. The time limit for a presentation is 1 hour (including Q&A, prepare it as if it is your *job talk!*).

The presentations will be graded based on how well you motivate the research, how clear is the model and results.

**Discussants:** Besides presenters, each paper will have a discussant. The main task of a discussant is to provide a critique of the papers presented: the significance of the problem, the suitability of the model, the limitations of modeling assumptions and the role that those assumptions play in obtaining results, the significance of the results, and possible extensions. In addition, discussant should look for common themes or key issues that link the papers and enhance our understanding of the topic. Lastly, discussant is expected to raise challenging questions that would guide class discussion.

The discussants will prepare referee reports to the paper presented.

**Referee Reports:** Papers submitted to refereed journal typically goes through a peer-review process, during which an associated editor (AE) assigns the paper to (at least) two referees. The referees will read the paper and provide suggestions to AE on either accepting or revising or rejecting the paper. A good referee provides constructive suggestions that allow the author to improve the paper. When you serve as a referee, remember one thing: *it is too easy to criticize a paper*; ask yourself two questions: what can I learn from this paper? How can I help the author(s) to improve the paper?
Project: The project is due on the second last class. It should be at most 30 typed pages without reference (12pt Times, Times New Roman, 1 inch margins on all sides, double-spaced). You have three options for the project:

1. **Research Proposal.** In your proposal you should
   a. Identify an open research question: either an interesting real world problem or a gap in the existing literature.
   b. Provide a literature review that makes clear the importance of the topic and how relevant papers fail to address the problem or do not provide a satisfactory answer.
   c. Outline a suitable model to address the question and sketch the analysis that one would want to carry out.

Think of your document as a proposal you are submitting to a funding agency (e.g., NSF or ONR), which relies on a peer-review process to allocate funds. You can expect that your reviewers are familiar with the general research area (Supply Chain Management), but are not experts in your particular subfield. You can also count on the reviewers to be very bright, but extremely busy academic or industry professionals. Your goal is to convince them that your research will address an important and timely problem (sections on the problem statement, problem motivation, literature review will serve to accomplish that), and that, if the agency gives you money, you are likely to succeed (sections on the model and the outline of the analysis should help them to make that decision).

The research proposal will be graded based on both the importance and the feasibility.

2. **Original Research.** Under this option, you should identify an open research question: either an interesting real world problem or a gap in the existing literature; and attempt to answer it. The objective is to obtain original results that contribute to the existing knowledge. Similar to the Research Proposal, your report for this alternative should make it clear what research problem you are solving and why this problem is important. But your report should particularly emphasize the results you obtained. You are encouraged to discuss with me on anything you are interested.

For an academician, there is nothing more challenging and rewarding than publishing in top journals and making an impact. Therefore, I do not expect that you will have a complete answer to a problem (especially, a difficult problem). Your work will be graded based both on the importance of the problem and the significance of the results.

3. **Software Implementation.** Thoroughly understand a solution, and implement it using AIMMS platform – build interface, database and engine; solve a real-world example.

**Homework:** Homework problems will be assigned for some well established results.

**Mid-term:** Covers well established results of the literature in class 7.
Weekly Schedule (Tentative)

1. **Introduction (9/1)**

Content: Course Policy, Course Overview, Examples. Costs and Concepts. Two basic models, Literature Tree.

Readings:
- S. Axsater 2006, Chapters 1 & 3

2. **Deterministic Models – Economic Lot Scheduling Problems (9/15)**

Content: EOQ Models, Economic Lot Scheduling Models

Readings:
- S. Axsater 2006, Chapter 4 (4.1-4.4) and Chapter 7 (7.1-7.2).

3. **Deterministic Models – Multi-Echelon Lot Sizing Problems (9/22)**

Content: Joint Replenishment, Multi-Echelon Lot Sizing Models

Readings:
- S. Axsater 2006, Chapter 7 (7.3) and Chapter 9 (9.1-9.2).


Readings:
- S. Axsater 2006, Chapter 5.

5. **Stochastic Models – Optimal Policies for Multi-Echelon Inventory Systems (10/6)**

Content: Optimal Ordering Policies for Serial, Assembly and Distribution Systems.

Readings:


Readings:
- S. Axsater (2006). Chapter 10 (10.2-10.4, 10.6)

7. **Hierarchical Planning & Mid-term (10/20)**


Readings:

8. **Game Theory Primer and Bullwhip effect (10/27)**

Content: Game Theory Primer. Supply Chain Dynamics

Readings:
- S. Axsater (2006). Chapter 10 (10.6)

9. **Supply Chain Contracts and Coordination (11/3)**

Content: Coordination Models in Inventory Management.

Readings:

10. **Supply Chain Incentive Issues and Competition (11/10)**

Content: Competition and Equilibrium Models in Inventory Management.

Readings:

11. **Special Topics 1 – Bridging Project and Supply Chain Management (11/17)**

Content: Supply Chain vs. Development Chain. Development Chain Integration.


12. **Special Topics 2 – Medical Decision Making (11/22)**

Content: Operations Research & Management Science Applications in Disease Prediction, Prevention, Diagnosis and Treatment

13. **Special Topics 3 – Reconciliation (12/1)**


14. **Term Paper Presentations I (12/8)**

15. **Term Paper Presentations II (12/15)**