

**Optimization Models for Supply Chain and Operations Management
OM 392, Spring 2010**

Unique Number: 03945

Professor Anant Balakrishnan

Classroom: CBA 4.338
Class time: Th 2 to 5 p.m.
Course web: via *Blackboard*

Office: CBA 6.486
e-mail: anantb@mail.utexas.edu
Office hours: Tue 1 to 2 pm or by appointment

Teaching Assistant: Kursad Derinkuyu, kursad@mail.utexas.edu

Course Description and Objectives

Supply Chain Management involves planning and coordinating the value-adding activities and flow of materials and information among the organizational units or firms that participate in the product fulfillment process—from procurement to manufacturing and distribution. Effectively managing manufacturing, distribution, and service systems requires careful design, planning, and coordination. These decisions are very challenging because supply chain systems are complex, often consisting of highly interdependent units, and the number of available decision alternatives are too numerous to enumerate and evaluate intuitively. Management science techniques have, therefore, proved very successful in formally addressing and supporting various decision tradeoffs in supply chain design, planning, and management.

This course, designed primarily for advanced masters' and doctoral students who are interested in research on supply chain and operations management, focuses on the study of (deterministic) **optimization** models to support system design, planning, and operational decisions. The course complements other related doctoral courses such as those on stochastic (inventory and queuing) models and economic models for supply chain and operations management.

The goals of the course are to:

- (a) acquaint students with the classical and contemporary literature on operations and supply chain optimization models and methods, and the different design, planning, and decision-making contexts for which optimization models are appropriate;
- (b) expose students to the way in which management science researchers conceptualize and develop models for operations management, and to the various optimization methodologies that have proven effective to solve these models;
- (c) help students critically evaluate the research literature, assess and appreciate the research issues and contributions, and identify opportunities for conducting research in this field; and,
- (d) develop an understanding of how to exploit special problem structure and accordingly tailor appropriate optimization methodologies to effectively solve supply chain models.

The operations modeling literature, describing the theory and application of optimization to operations and supply chain design, planning, and control, is very vast. The need to tailor models and methods for each specific context contributes in part to this huge body of work. We certainly cannot expect to cover all of the interesting topics addressed in the literature. Instead, we will focus on select topics and papers, chosen based on the influence they have had on the field or

because they illustrate well the application of a particular technique, favoring depth of understanding over breadth of coverage. Students are expected to learn and understand not only the application context and modeling issues that each paper addresses, but also the technical details of the work.

The course is based on selected papers on strategic, tactical, and operational issues in supply chain and operations management from leading management science, operations research, and operations management journals. Representative topics covered include:

- facility location and network design;
- capacity planning and flexibility;
- strategic inventory placement;
- hierarchical, aggregate, and tactical planning;
- production planning and lot sizing;
- sequencing and scheduling;
- project management
- revenue management; and,
- applications in specific contexts (e.g., airlines, electronics assembly).

The papers on these topics will also illustrate the development and application of a broad range of analytical and solution methods including decomposition approaches (such as Benders decomposition, Lagrangian relaxation, cutting planes, column generation), heuristics, stochastic programming, robust optimization, and worst-case analysis.

Course Format and Requirements

Because the course is intended to prepare students to perform academic research in this field, we will follow a seminar format that entails presentation of specific papers followed by discussion. Students are assumed to have adequate prior background in mathematical programming, particularly linear programming, and preferably network optimization and integer programming. Each week, the class consists of two sessions. In each session, we will discuss one or two papers in depth. Students are expected to carefully read all the assigned papers (required reading), and browse through recommended supplementary readings.

Students take turns to make formal **presentations** of the selected paper(s) for each session. These presentations (45 minutes to one hour) should focus on the details and technical content of the paper, assuming that class participants have already read the paper and understood the context. The student who is presenting the paper is expected to go beyond the assigned paper. For instance, the presenter should read closely related papers to understand the technical details, position the paper in a broader context, and assess its relative contributions. Following each presentation, we will engage in a discussion of the paper—to better understand the material (e.g., the properties or assumptions that drive the methodological developments and results), critically evaluate the work, and consider variants and potential extensions. Students are expected to actively participate in these class discussions.

Every student who is not presenting a paper in a particular week must turn in a **written assignment** based on the readings for that week. Some assignments consist of answering specific questions on the paper(s) that we will discuss in class. In other cases, students may be asked to submit a one-page critical review of the paper, summarizing the problem that is being addressed, the results and fundamental contributions of the paper, and any shortcomings and possible extensions of the work. These summaries should go beyond just replicating the abstract or introduction of the paper, but should provide a critical review of the paper – its contributions, assumptions, and so on. Unless specified otherwise, all homework assignments are *individual*

(not group) assignments. You are permitted to discuss the broad approach and seek clarifications from other students (if so, provide the names of people you consulted), but must work out the details and write up the assignments on your own. Do NOT copy from other students' work or use other sources (e.g., material from past years, web sites, etc.).

The course requires completing and presenting an individual **term paper**. The main purpose of the term paper is to provide an opportunity for students to explore a topic of their choice (dealing with optimization of operations) in greater depth. Students have two choices for the term paper:

1. *Original work*

In this option, the student develops original results—either by extending some existing work or addressing a new problem or model—that can add to the published work in the area. This is the first step towards performing original research, and doctoral students are strongly encouraged to pursue this option. The contributions of this kind of work can range from developing a new model for a known problem or modeling a new problem to deriving new analytical results or algorithmic strategies and/or implementing or applying of an existing method to a known problem.

2. *Review of the literature*

For this type of project, the student must select a particular context to study, identify and read all papers related to this topic, and prepare a critical assessment and synthesis of the literature (e.g., a framework that can help to classify and inter-relate the literature). This assessment should address the issues such as the following:

- a. How do the papers relate to each other, i.e., how are they similar or different? What are their relative contributions? What framework to use to categorize and understand this literature?
- b. What are the major modeling assumptions? How do they facilitate the analysis and results?
- c. What are the major results? What are the practical and theoretical significance of these results?
- d. What the open questions? What additional research opportunities are present? What approaches are likely to be promising to address these opportunities?

Students can frame the topic or context to review in many different ways, e.g., focusing on a particular industry, or a particular class of decisions or models .

Students should begin exploring research topics during the first half of the semester, and submit a short (one page) proposal immediately after Spring break. The final paper should be 15 to 20 pages long. Students must present their work in class during the last week of the course.

Grading

The grade for the course will be based on class participation, written assignments, presentations, and the term paper, weighted as follows:

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| Class participation | 20% |
| Individual presentations | 30% |
| Written assignments | 20% |
| Term paper | 30% |

For class participation, the level of preparation, contribution to class discussions, and the quality of comments—questions, clarifications, ideas, insights—is valued. For the presentations, depth of knowledge about the topic and related literature, organization and delivery of the material, and

effective response to questions is important. Written assignments and term paper will be judged based on their clarity, comprehensiveness, and creativity.

Course Materials

Most of the required readings for the course, together with suggested supplementary readings including surveys, methodologies, and a sampling of related work, will be provided via *Blackboard*. Students are responsible for printing the documents and making their own individual copies.

Academic Integrity

By enrolling in this class, you agree to abide by the Honor System. Unless otherwise stated, please do not use any materials (presentations, handouts, solutions, etc.) from previous semesters or from other universities, and do not consult or use prior analysis done by anyone (at UT or elsewhere) who has already participated in a discussion of the material. If the application of the Honor System to this course is unclear in any way, it is your responsibility to ask for clarification. Thank you in advance for your cooperation on this very important issue.

Feedback

Your feedback is valuable, and motivates continuous course improvement. Please do not hesitate to suggest ways to improve the course and the learning experience it provides.

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. If you have a condition (e.g. learning disability, chronic medical condition, etc.) or event that needs accommodation, please see me early in the semester so that we can take appropriate steps. For additional information about the University's policies, contact the Office of the Dean of Students at 471-6259 or 471-4641.