

## Subject 15.762x – Supply Chains and Manufacturing Systems: Planning

**Course Syllabus**

As part of the Principles of Manufacturing MicroMasters program, this course will expose learners to concepts and models important in supply chain and manufacturing system planning, so that you can better coordinate various resources and assets to optimize the delivery of goods, with an emphasis on key tradeoffs and phenomena. There will be a particular emphasis on (i) how to cope with variability as it arises across a supply chain or manufacturing system; and (ii) how to manage these systems in light of economies of scale and/or limited resources in the supply processes. The course will introduce a set of concepts, models and operational tactics for dealing with variability and resource constraints. The overriding intent is to provide learners with a knowledge foundation of applicable methods and tools that will allow them to apply these learnings to practice with positive impact.

**Instructors****Stephen Graves**

Abraham J. Siegel Professor of Management Science, MIT

**Sean Willems**

Haslam Chair in Supply Chain Analytics, University of Tennessee Knoxville

**Time Commitment**

- Length: 8 Weeks + 1 Exam Week
- Weekly Effort: 10-hours
  - includes lectures, readings, concept checks and 7 weekly assignments.

**Pre-requisites**

- Engineering Undergraduate preparation
- Some knowledge of basic manufacturing systems and/or supply chains: helpful but not necessary
- Knowledge of probability theory: Learners need to have a base knowledge of probability concepts and random variables that is sufficient to complete the assignment in week 1.

**Deadlines**

- Modules are released weekly starting on June 5, 2018 @ 15:00 UTC
- Assignments are usually due two weeks after release @ 15:00 UTC
- Lecture content ends on July 31, 2018 15:00 UTC and a timed exam will be released on that date, which must be completed by August 7, 2018 by 15:00 UTC

## Grading

**Weekly Assignments**      *(each of 7 assignments counts 5%)*      35%  
Usually due 2 weeks after the respective week has launched. Maximum of 3 attempts allowed per question. (except binary questions and open responses)

**Exam**      65%  
The Final exam will be released 7/31/18 and is due by 8/7/18. The questions on the exam will be similar in content, style and difficulty to the questions on the weekly assignments from week 2 to week 7. (The week-1 assignment is on fundamental concepts from probability, and is intended to establish a base level of prerequisite knowledge that will be required throughout the class.)

**Concept Checks**  
These should be completed within the week of their release. They are simple questions pulled from the lecture videos to make sure you've understood the main topics covered. Answers/explanations are usually available. They should be helpful to do prior to attempting the weekly assignment, and are not graded.

The grading scheme used for the **Principles of Manufacturing MicroMasters** is:

- A**    90-100%
- B**    75-89%
- C**    60 – 74%
- F**    <60%

*(A passing grade (A or B or C) is required for the certificate.)*

**Academic Policy**

We will follow the edX honor code pledge:

By enrolling in an edX course, you have already agreed that you will:

- Complete all graded material (homework, midterm and final exams) with your own work and only your own work. You will not submit the work of any other person.
- Maintain only one user account and not let anyone else use your username and/or password. Having two user accounts in any single course is grounds for immediate and permanent dismissal.
- Not engage in any activity that would dishonestly improve your results, or improve or hurt the results of others.
- Not post answers to problems that are being used to assess student performance.

We will strictly enforce this honor code pledge. Students found violating this pledge will be dealt with directly. If we become aware of any suspicious activity we reserve the right to remove credit, not award or revoke a certificate, ban from any and all POM courses as well as notify edX for other actions. With the introduction of the MicroMasters Credential, the importance of honesty in work has been elevated to a much higher level than before. We will diligently monitor this and be very proactive. So please, do your own work.

**Discussion**

- The Discussion Forum is available to all registered students of this class. It is the online community of learners that you joined when you registered.
- You may use the forum to ask questions, to seek clarifications, or to start or reply to topical discussions.
- Please do not use the Discussion Forums for questions or help on Graded Assignments or on the Final Exam. If you have clarification questions or other problems on these topics - email your question (stating the specific problem number and issue) to **15.762x-help@mit.edu**. We will respond as quickly as possible.

## Forum Best Practices

The forum can be a very useful tool to get help! The discussion forum helps improve your ability to search and talk about many different topics throughout the course. Here are some simple guidelines to help you successfully navigate and interact on the forum:

- When starting a discussion thread, it will either be a QUESTION or a COMMENT.
- If your question or comment is on a specific Lecture Video or Finger Exercise, be sure to use its associated "New Post" button.
- Before posting a question, check to see if it has already been posted.
- If you have a question on a Graded Assignment or a Final Exam problem DO NOT USE THE DISCUSSION FORUM! Instead, send an email to [15.762x-help@mit.edu](mailto:15.762x-help@mit.edu).
- Use a descriptive and specific title to your post. This will attract the attention of other students having the same issue.
- Reply to an already existing discussion if you see someone had the same question.
- Actively upvote other posts, and other students will upvote yours! The more upvotes your posts have, the more likely they are to be seen.
- Follow "netiquette" or common writing practices for online communication. Your writing should be neutral and not try to express emotions (positive or negative).
- For example: To post mathematical equations, enclose the equation within dollar signs (\$) to activate "math mode". If you want to practice, go to the discussion forum and try typing the following into your text box:  $x_i = y^2 + 5 \cdot y$

**The instructors and TA's are here to ensure you have the best opportunity to learn the material. We will monitor the discussion forum and email for the course every day, and strive to respond to questions as quickly as possible. Some delay may occur owing to time of day or week, and in the interest of collecting similar questions before issuing an answers. In that case we will try to at least acknowledge receipt of an inquiry.**

## Class Schedule

Please note:

- Material for each week will be released on Tuesdays at 15:00 UTC.
  - Graded Problem Sets are also always due at 15:00 UTC on the specified day.
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### WEEK 1: INTRODUCTION

Released 6/5/2018

This week we provide an overview of the class, and discusses challenges that arise in planning of supply chains and manufacturing systems. We will also discuss guidelines for the application of models for decision support and for trade-off studies. We will use an assignment to convey the expectations on the prerequisite knowledge of probability.

**Graded Problem Sets #1 is due 6/19/2018**

### WEEK 2: DEMAND FORECASTING

Released 6/12/2018

We discuss types of forecasts and intent, and guidelines for implementing a forecast model. We introduce common time series methods for forecasting, and measures for forecast error. We show how to set parameters for these forecast models, depending upon the nature of the variability in the underlying time series. We show how to include seasonality and trend factors in the forecast models.

**Graded Problem Sets #2 is due 6/26/2018**

### WEEK 3: INVENTORY BASICS I

Released 6/19/2018

We start with a discussion of types, functions and costs of inventory in manufacturing systems and supply chains. We then introduce the newsvendor model and derive its solution. This model captures the critical trade-offs in matching supply to uncertain demand, and provides a means for optimizing the order quantity. We also cover a periodic review inventory model, namely the base stock model (or order-up-to model). We illustrate how to measure expected costs and the service levels for these fundamental inventory models.

**Graded Problem Sets #3 is due 7/3/2018**

### WEEK 4: INVENTORY BASICS II

Released 6/26/2018

In this week we continue our coverage of fundamental inventory models that are the building blocks for planning supply chains and manufacturing systems. We introduce the economic

order quantity (EOQ) model, which captures the tradeoff between inventory and order frequency under constant, known demand. We develop a total cost equation from which we obtain the optimal order quantity. We also introduce and analyze a continuous review inventory model, which extends the EOQ model to a context with uncertain demand.

**Graded Problem Sets #4 is due 7/10/2018**

WEEK 5: MODEL APPLICATIONS AND EXTENSIONS

Released 7/3/2018

The intent of this week is to demonstrate how the fundamental inventory models developed in prior two weeks can be used for various tactical planning applications. The examples include: an application of cyclic scheduling of two product families; an application to evaluate a dual sourcing option; an analysis of shipping options, by ship or by air; and an evaluation of the benefits from a cross-dock operation. One theme in several of the examples is how simple inventory models can be used to assess the benefits from risk pooling. We also cover an important extension to accommodate uncertainty in the replenishment lead times.

**Graded Problem Sets #5 is due 7/17/2018**

WEEK 6: MULTI-STAGE MODELS FOR SUPPLY CHAINS

Released 7/10/2018

We introduce and discuss the guaranteed service model as a model for a single inventory stage. We show how to use this single-stage model as a building block to model a supply chain as a multi-stage network. We show how to use this network model to determine the placement of safety stocks across a supply chain; the network model can also be used for identifying and evaluating various supply chain improvement opportunities.

**Graded Problem Sets #6 is due 7/24/2018**

WEEK 7: MULTI-STAGE MODELS FOR MANUFACTURING SYSTEMS

Released 7/17/2018

We discuss two approaches for the tactical modeling of multi-stage manufacturing systems. One approach assumes that the planning system relies on planned lead times, and that each stage in the system has some amount of production flexibility. In this case there is a tradeoff between the planned lead times (and the resulting inventory) and the production variability. We present a model for examining this tradeoff. The second approach is to extend the guaranteed-service single-stage model to account for a capacity constraint as would exist in manufacturing systems. We show the insights from this model and how to use it to determine where within a manufacturing system one might place a decoupling stock.

**Graded Problem Sets #7 is due 7/31/2018**

WEEK 8: SUPPLY CHAIN PLANNING IN PRACTICE

Released 7/24/2018

In this week we will present and discuss large-scale real-world applications that illustrate how some of the concepts in class have been implemented. A particular emphasis will be on the lessons and challenges from these implementations, as well as on the achievable benefits.

**No problem set for week 8**

EXAM 7/31/2018

This is a timed exam that covers all material presented to date. You have one week to complete the test.

**The exam is due on or before 8/7/2018.**