

## 1 Faculty

The Kühne Logistics University (KLU) has invited Professor Yale T. Herer, a distinguished scholar in the field of inventory and supply chain management, to conduct a Ph.D. class in inventory research. Prof. Herer graduated with a Ph.D. from Cornell University in 1990 and is presently the Head of the Industrial Engineering Area at the Technion. He has published numerous articles in journals like IIE Transactions, Naval Research Logistics, Transportation Science and Management Science. He spent sabbaticals at Northwestern University in 2005 and at INSEAD in 2011. His research interests include inventory and supply chain management, especially when integrated with transshipments. More information is available on his website: <http://ie.technion.ac.il/yale.phtml>.

## 2 Title

Inventory Research

## 3 Outline

### 3.1 Content

The purpose of the course is to introduce students to advanced models in supply chain management, especially as they relate to inventory management. The objective is not only to become familiar with some of the latest models, but also to delve into their development, understand how they work and why the models are as presented. To do this we will read papers in the field, have lectures that illuminate these papers and the associated topics, and have exercises that will further deepen understanding.

### 3.2 Course format

The course consists of a combination of lectures and practical exercises. The topics for the course are listed below. Each subject will be covered, more or less, in a single day. Each day, students will learn about specific methodologies and understand how they are applied in research. Students will solve related exercises to deepen their understanding and will present and discuss their solutions.

### 3.3 Specific topics

Due to the intense nature of the schedule students are asked to read the papers before the start of the course. The papers used in the class should also be considered as representative examples of high-quality inventory management research.

#### 1. EOQ sensitivity and power-of-two policies.

Pre-reading:

- Roundy, R. 98%-Effective 1985. Integer-Ratio Lot-Sizing for One-Warehouse Multi-Retailer Systems. Management Science, 31 (11): 1416-1430.

- Muckstadt, J. A. and R. O. Roundy. Analysis of Multistage Production Systems. Chapter 2 in Logistics of Production and Inventory, S.C. Graves, A. H. G. Rinnooy Kan and P. H. Zipkin eds. North Holland, New York. 1993.

This paper was chosen as one of the most influential papers of Management Science (one of INFORMS publications) (see <http://www.informs.org/content/view/full/6817>). We will discuss the ideas behind this work, discuss why it is considered so important, and explore the inner workings of the results.

## **2. Transshipments, a method of virtual inventory pooling.**

Pre-reading:

- Krishnan, K.S. and V. R. K. Rao. 1965. Inventory Control in N Warehouses. Journal of Industrial Engineering 16: 212–215.
- Herer, Y.T., Tzur, M., and Yücesan, E., 2006. The multi-location transshipment problem, IIE Transactions 38: 185–200.

This subject will discuss the idea of inventory pooling in the framework of the stochastic lot-sizing problem, especially through its implementation via transshipments.

## **3. Risk pooling using RFID enabled information.**

Pre-reading:

- Avrahami, Herer, and Levi. 2012. The Value of Information in a Retailer-Based Distribution Network. Technion, Working paper.
- Avrahami, Tzimerman, Herer, and Shtub. 2012. The Value of Inventory Accuracy in Supply Chain Management. Working paper.

This topic will continue the topic of risk pooling and discuss the development and implementation of a risk pooling in the “real world”. Both theoretical and practical issues will be discussed in a single model.

## **4. Multi-echelon systems.**

Pre-reading

- Cachon, G. P. 2003. Supply chain coordination with contracts. A. G. de Kok, S. C. Graves, eds., Handbooks in Operations Research and Management Science: Supply Chain Management. Elsevier. Amsterdam. Chapter 6.

We will continue in the framework of the stochastic lot-sizing problem and explore two types of two echelon models. The first is where two separate participants are each trying to optimize their own profits, i.e. the topic of double marginalization. The second is where a central controller is trying to optimize a complicated two echelon system.

## **4 Administration**

### **4.1 Schedule (preliminary)**

#### **04.03.2013 (Day 1: EOQ sensitivity and power-of-two policies)**

- 08:30 – 9:15 Introduction & Who is Who
- 09:30 – 13:00 Session 1: EOQ sensitivity
- 13:00 – 14:00 Lunch break
- 14:00 – 16:15 Session 2: Power-of-two policies
- 16:30 – 18:30 Exercises
- 19:30 – 22:00 Welcome Dinner

#### **05.03.2013 (Day 2: Transshipments, a method of virtual inventory pooling)**

- 08:30 – 9:15 Discussion of exercises
- 09:30 – 13:00 Session 3: Transshipments
- 13:00 – 14:00 Lunch break
- 14:00 – 16:15 Session 4: Virtual Inventory Pooling
- 16:30 – 18:30 Exercises
- 19:30 – 22:00 Supply Chain Games

#### **06.03.2013 (Day 3: Risk pooling using RFID enabled information)**

- 08:30 – 9:15 Discussion of exercises
- 09:30 – 13:00 Session 5: Risk Pooling using RFID
- 13:00 – 14:00 Lunch break
- 14:00 – 18:30 Plant tour
- 19:30 – 22:00 Exercises

#### **07.03.2013 (Day 4: Multi-echelon systems)**

- 08:30 – 9:15 Discussion of exercises
- 09:30 – 13:00 Session 6: Installation Stock and Echelon Stock Policies
- 13:00 – 14:00 Lunch break
- 14:00 – 16:15 Session 7: TBD
- 16:30 – 18:30 Exercises
- 19:30 – 22:00 Dinner

#### **08.03.2013 (Day 5)**

- 08:30 – 9:15 Discussion of exercises
- 09:30 – 10:30 Wrap-up
- 10:45 – 13:00 Final Exam

Time	EOQ models/ Power of Two Monday, March 4	Transshipments Tuesday, March 5	Risk Pooling Wednesday, March 6	Multi-Echelon Systems Thursday, March 7	Wrap-up and Exam Friday, March 8
08:30 - 09:15	Introduction & Who is Who	Discussion of exercercises	Discussion of exercercises	Discussion of exercercises	Discussion of exercercises
09:30 - 10:30					Wrap-up
10:45 - 11:45	Session 1	Session 3	Session 5	Session 6	Final Exam
12:00 - 13:00					
13:00 - 14:00	Lunch break	Lunch break	Lunch break	Lunch break	
14:00 - 15:00	Session 2	Session 4	Plant tour	Session 7	
15:15 - 16:15					
16:30 - 18:30	Exercises	Exercises		Exercises	
19:30 - 22:00	Dinner	Supply Chain Games	Exercises	Dinner	

#### 4.2 Location

Kühne Logistics University  
Brooktorkai 20  
20457 Hamburg

A limited number of rooms at the nearby 25hours Hotel (300m) can be booked at a discounted KLU rate upon request.

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#### 4.3 Max. number of participants

The number of participants is limited to 12.

#### 4.4 Cost

The course fee amounts to EUR 600.

The fee includes daily refreshments, two joint dinners and the plant tour. Accommodation is not included in the fee.

## 5 Prerequisites

The course intended for Ph.D. students with interest in inventory models or quantitative supply chain management in the first and second year of the program. Students are expected to have knowledge of basic inventory models (EOQ, Newsvendor).

## 6 Course Material (Reading List)

No book will be used in class, but rather readings will be taken from the literature. Students are expected to have through knowledge in basic inventory management literature. Basic readings include:

- Simchi-Levi, David, Philip Kaminsky, and Edith Simchi-Levi. *Designing and Managing the Supply Chain*. McGraw Hill/Irwin, 2007. ISBN: 9780073341521. Chapter 2.
- Nahmias, Steven. *Production and Operations Analysis*. McGraw-Hill/Irwin, 2000. ISBN: 9780072417418. 5<sup>th</sup> ed. Chapters 4 and 5.
- Silver, Edward A., David F. Pyke, and Rein Peterson. *Inventory Management and Production Planning and Scheduling*. 3<sup>rd</sup> ed. Wiley, 1998. ISBN: 9780471119470. Chapters 5, 10, and 12

More advanced readings include:

- Bramel, J. and Simchi-Levi, David. *The Logic of Logistics : Theory, Algorithms, and Applications for Logistics Management*, 1999. Springer. Chapters 9 and 11.
- Zipkin, Paul H. *Foundations of Inventory Management*, 2000. McGraw-Hill. Chapter 3, 5, and 6.
- Axsäter, Sven. *Inventory Control*, 2010. Springer. Chapters 4, 5, 7.1, 9.2,

## 7 To prepare

Due to the intense nature of the schedule students will be asked to read the papers listed under 3.3 before the start of the course. The papers used in the class should also be considered as representative examples of high-quality inventory management research. Students who are not familiar with basic inventory models should carefully work through the reading list.

## 8 Assessment

The final grade will be calculated as follows:

- *20% Class participation*. Each student is expected to be an active participant in all aspects of the course.
- *30% Exercises*. At the end of each day the students will receive exercises to accomplish for the next day. Each student will be assigned to present the solution to one problem during the morning discussion session.
- *50% Exam*. The 120 minute exam will be open book.

## **9 Credits**

The course is eligible for 6 ECTS. A certificate of participation with grade will be issued.