TRAIL

Research School for Transport, Infrastructure and Logistics

Beta

Research School for Operations Management and Logistics

Course
Quantitative Modelling and Analysis of Supply Chains

Date:	**30 September, 21 & 28 October, 16 December 2020**
Time:	**10.00 -16.00 h**
Location:	**Utrecht**
Course leader:	**Prof. Ton de Kok (TUE)**
Days:	**4**
ECTS:	**1 (attendance) / 4 (attendance + assignment)**
Course fee:	**Free for TRAIL/Beta/OML members, others please contact the TRAIL office**
Registration:	**info@rstrail.nl**

Objectives

- Students will learn to develop models of supply chains under different modelling assumptions;
- Students will understand the implications of alternative modelling assumptions;
- Students will be able able to mathematically analyze supply chains under specific structural assumptions (serial, convergent, divergent);
- Students get an appreciation of the open questions regarding optimal strategies for multi-item multi-echelon inventory systems.

Course description

The course starts with a description of supply chains as multi-item multi-echelon inventory systems. We discuss relevant performance characteristics and objective functions. We provide an overview of the most important results to date, thereby providing insight into optimal policy structures, relations between state variables at different echelons in the system and numerical methods to find optimal policies.

It is generally accepted that optimal policies for divergent and general multi-item multi-echelon systems are intractable due to the curses of dimensionality. This has led to the development of heuristics, i.e. non-optimal policies. The students should be aware that such non-optimal policies come in large variety based on many different analytical methods. Due to the structural complexity of real-world multi-item multi-echelon systems, the derivation of optimal parameters of the policies discussed during the course is a mathematical challenge by itself. We also pay attention to specific classes of approximation methods that have shown to deliver accurate results.

Assignments

After each lecture students have to solve a set of problems. The objective of the assignments is to derive important results using methods and techniques that have shown wider applicability. Another objective is to develop further qualitative insights. Finally, some assignments require implementation of algorithms, such that students can experiment themselves with stylized cases.

Methodology

The course starts from formulating optimization problems for real-world supply chains. Apart from special cases, these problems are mathematically intractable when pursuing exact analysis and optimization. Thus we discuss mathematical models, algorithms and policies that can be used as heuristics. We extensively build on probability theory, but also discuss linear programming, quadratic programming and nonlinear optimization techniques as tools for developing control policies for the multi-item multi-echelon systems under consideration.

Program

Lecture 1	Defining multi-item multi-echelon inventory systems Optimal policies for single-item single-echelon systems Optimal policies for serial systems
Lecture 2	Optimal policies for convergent systems Optimal policies for divergent systems Qualitative insights into optimal policies
Lecture 3	Synchronized base stock policies for general multi-item multi-echelon systems Numerical methods for solving optimality equations
Lecture 4	Guaranteed service models for multi-item multi-echelon systems Rolling schedule models for multi-item multi-echelon systems

Prerequisite
Master courses on probability theory, statistics and optimization. As the course uses an extensive set of quantitative models and methods, the student should feel comfortable with applying such models and methods to a range of different problems.

Course material
The course material consists of a reader containing the papers discussed and lecture notes.