UNIVERSITÉ DU LUXEMBOURG

Doctoral School in Finance and Economics

Course ID Stochastic models of supply chain operations

1. Course details

Semester:	1
Credit rating:	2 ECTS /30TU
Pre-requisite(s):	Probability Theory (Poisson process, generating functions, Markovian processes)
Lecturer(s):	Joachim Arts (joachim.arts@uni.lu)
Administrator:	Roswitha Glorieux
Tutor(s):	
Seminar times and rooms:	Block/Semester Course
Tutorial times and rooms:	None
Communications	**It is important that students should regularly read their University emails, as important information will normally be communicated this way.**
Mode of assessment:	Grading: homeworks/assignments 100% (3 homework assignments)
Examination Periods:	
Course WebPage:	Moodle.uni.lu

2. Aims and objectives

Aims
This course introduces students to advanced stochastic models and computational techniques in operations research/applied probability. We will especially study how these models and techniques are applied in supply chain management. These techniques are essential to our understanding of the role of uncertainty in many supply chain operations. We will give special attention to demand uncertainty and to the role of finite capacity in production systems with uncertain arrivals and processing times.

Learning Objectives

The student who followed this course

- Can use decomposition results to analyse supply chains with many stages (ClarkScarf and Rosling decomposition, nested newsvendor characterization of optimal policies).
- Can use Phase-type distributions to computationally analyse multi-echelon inventory systems.
- Can apply mean value analysis and generating functions to analyse simple queueing situations.
- Can use insensitive systems to models various common mechanism such as transportation systems and base-stock inventory policies.
- Knows the renewal reward theorem and how to apply it.
- Understands basic notions of asymptotic optimality.

3. Plan of semester

2,4,9,11,16,18,22 and 25
Feb 2/4 Mar 13.30-16h
LCL class room B16 TO BE PLANNED

4. Course details (by topics)

- Markovian and (quasi) birth-death queues (M/M/1, M/M/c, M/Er/1, G/M/1)
- Mean value analysis for M/G/1 queues (Priorities, Unreliable machines, Setup times, batch arrivals)
- Insensitive systems (Erlang loss queue, Palm's Theorem)
- Single location inventory theory (simple newsvendor)
- Phase-type and mixed-Erlang distributions (closure, algorithmic tractability, moment matching)
- Two-echelon inventory systems (Clark-Scarf decomposition, Newsvendor equations, Computational approaches)
- Multi-echelon inventory systems (a selection of topics such as divergent systems and the balance assumption, convergent systems and Rosling decomposition, recent research papers).
- Renewal Reward Theory
- Asymptotic optimality notions

5. Reference list/ Bibliography

The content of the course will be mostly based on:

- Adan, I. and Resing, J. (2015). Queueing Systems, Eindhoven University of Technology Lecture notes
- Houtum, van, G. J. J. A. N. (2006). Multi-echelon production/inventory systems: optimal policies, heuristics, and algorithms. In M. P. Johnson, B. Norman, & N. Secomandi (Eds.), Tutorials in operations research: models, methods, and applications for innovative decision making (pp. 163-199). (INFORMS Tutorials in Operations Research Series). Hanover, MD, USA: INFORMS.
- Ross, S.M. (1996) Stochastic Processes, Wiley Series in Probability and Mathematical Statistics

Additional reading material:

- Zipkin, P. (2000) Foundations of Inventory Management, McGraw-Hill
- Porteus, E.L. (2002) Foundations of Stochastic Inventory Theory, Stanford Business Books
  - Kulkarni, V.G. (1999) Modeling Analysis Design and Control of Stochastic Systems, Springer
- Huh, T.W., Janakiraman, G., Muckstad, J.A., Rusmevichentong, P. (2009) Asymptotic Optimality of Order-Up-To Policies in Lost Sales Inventory Systems
- Arts, J.J. (2017) Maintenance modeling and optimization, Lecture notes

6. Further information about assessment

Students will receive 3 homework assignments with equal weights. In these assignments, students need to prove results for slight variations of models and they need to implement computational models.