

PKU Globex Julmester

Simulation Methods for Optimization and Learning (3 Credits)

优化和学习的模拟方法

(Course Code: 00333145)

Instructor	Bernd HEIDERGOTT, Vrije Universiteit, Amsterdam, The Netherlands (b.f.heidergott@vu.nl)	
Synopsis	<p>This course gives a broad treatment of the important aspects of the use of computer simulation for the analysis and optimization of dynamic stochastic models. The emphasis is on modeling the stochastic system as a discrete event dynamic system, and analyzing and improving its performance by means of discrete event simulation. Applications will stem from a wide range of domains: from Social Networks to Computer Networks, and Financial Engineering to Business Processes. The course will introduce students to the use of computer simulation in analyzing dynamic stochastic models through simulation-based/data-driven methods for optimization and learning. The leading question of the course is how to use simulation to make better and more responsible decisions for real-life problems. The course will also reflect on the technological and mathematical developments we witness in our societies. While actively working on simulation projects, the course will provide space for reflecting on the mathematical/technological paradigm. That is, next to learning the actual techniques, students will be stimulated to reflect on the history of science and the technological developments around them.</p>	
Audience	Year 3 &4 Undergraduate and Graduate Students	
Classroom		
Schedule	<u>Class</u> : 9-12 AM, M-F, July 1 – 19, 2024	<u>Total Contact Hours</u> : 45
Objective	<p>Students learn how to model and analyze real-life problems by Monte Carlo simulation. After successful completion of this course, students will be able to conduct a Monte Carlo simulation based analysis of a problem, provide an output analysis, and place their research into the broader historical and societal context.</p>	
Topics	<ol style="list-style-type: none">1. Programming language is Python (basic programs will be provided). Other programming languages, such as Matlab, are also fine but are not supported.2. Basics of Monte Carlo Simulation: random number generation, discrete event simulation, output analysis3. Standard simulation models: queuing systems, social networks, financial products, inventory systems, news vendor problem4. Data and simulation: combining simulation with available historical data5. Estimation of gradients via simulation and their application in learning and optimization: stochastic gradient method, stochastic approximation, supervised learning, non-supervised learning	
Reference	<p>Material will be provided during the course.</p> <p>Additional recommended reading: <i>Handbook of Monte Carlo Methods</i>, D. Kroese, T. Taimre, Z. Botev, Wiley, 2011 Chapters 1,2,5,6,7,8,9 of <i>Simulation Modeling and Analysis</i>, A. Law, Mc Graw Hill, 4-th or 5-th edition. Chapter 11 of <i>Introduction to Discrete Event Systems</i>, C. Cassandras and S. Lafortune, Springer, 2nd edition 2008.</p>	

Note	Students need to bring their own laptops for this course.	
Grading	Presentation and written report	30%
	Simulation project written report	30%
	Final exam	30%
	Attendance and discussion	10%
	Total	100%