OPM 661 Business Analytics: Robust Planning in Stochastic Systems

Business Analytics helps to optimize decisions for the design and management of operations systems and production processes. A major driver of the performance of operations systems is stochastic variability. For example, production systems often operate in an uncertain environment due to uncertain demand, unreliable machines, or random processing capacities.

In order to support robust decisions, we apply analytical solution approaches based on techniques from predictive and prescriptive analytics. The basic concepts of the analysis of Markovian queueing systems are explained in detail and performance evaluation approaches are implemented in Python. To create digital twins of operating systems, simulation techniques are introduced and implemented. This allows to analyze the sensitivity of system parameters on the main performance measures. Advanced topics such as queueing systems with general distributions, heterogeneities, and time-dependent input parameters are covered. Additionally, general managerial insights, for example economies of scale and the value of flexible capacities are discussed. Methods and performance measures of robust planning and optimization are introduced. Students become familiar with concepts and tools for predictive and prescriptive business analytics.

General Information

Lecturer	Prof. Dr. Raik Stolletz
Course Format	Integrated (lectures, exercises, self-study)
Credit Points	8 ECTS
Language	English
Grading	Assignments Written exam or oral exam
Term	Spring Semester
Range of Application	M.Sc. MMM, M.Sc. Bus. Edu., M.Sc. Bus. Inf., M.Sc. Bus. Math., M.Sc. Econ.

Moreover, we will implement those concepts using the programming language Python to perform sensitivity analyses and to develop managerial insights for stochastic operations systems. During the course the students will work on several case studies and assignments (individual and in groups).

Learning Goals

Students will

- understand the impact of stochastic variability in operations systems
- be familiar with the theory and practice of the analysis of stochastic systems
- implement, adapt and to apply methods and tools from Business Analytics
  e.g. analytical approximations or robust planning methods to support managerial decisions

UNIVERSITY OF MANNHEIM Business School

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Version: January 25, 2024

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Prerequisites:

- Modules OPM 560 and OPM 561
- Replacements of those prerequisites by courses passed at other Universities upon request
- Alternative for Bus. Math./ Inf. Students: OPM 561 and „Schlüsselqualifikation 1: Programmierkurs Python“

Registration/Enrolment

The course requires a registration through Portal2. More information can be found there.

Detailed Agenda

I Introduction to performance evaluation and simulation
- Queueing systems, decisions, and applications
- Performance measures and simulation of queueing systems

II Performance analysis of Markovian queueing systems
- Analysis of stochastic processes and Markov chains
- Performance analysis and economies of scale

III Impact of variability in queueing
- Queueing systems with general distributions
- Time-dependent analysis of queueing systems

IV Optimization and queueing
- Optimization concepts and approaches
- Robust planning with scenarios

V Practical insights
- Predictve and prescriptive analytics with Python
- Guest lecture

Literature

- Bolch, G., S. Greiner, H. de Meer, and K. S. Trivedi (2006). Queueing networks and Markov chains: modeling and performance evaluation with computer science applications. John Wiley & Sons
- Curry, G. L. and R. M. Feldman (2011). Manufacturing Systems Modeling and Analysis (2 ed.). Springer
- Gross, D., J. F. Shortle, J. M. Thompson, and C. M. Harris (2008). Fundamentals of Queueing Theory (4 ed.). John Wiley & Sons.

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