A PhD position is available at the University of Amsterdam, jointly at the Korteweg-de Vries Institute for Mathematics and the Amsterdam Business School.

Students with a MSc degree in (Applied) Mathematics, Operations Research, or Econometrics are invited to apply.

More information: Michel Mandjes, m.r.h.mandjes@uva.nl, +31(0) 20 525 5164; Marc Solomon, M.Salomon@uva.nl, +31(0)20 525 4221; Arnoud den Boer, a.v.denboer@uva.nl, +31(0)20 525 2497.

Project: Adaptive modeling in data-driven decision problems.

Description:

In the current information age where all sorts of data are abundantly available, business decisions are increasingly based on mathematical models and data instead of intuition and experience. This trend is reflected in the operations management literature, which has seen an explosive growth in research on how to learn optimal decisions from data as efficiently as possible. Insights from this research are increasingly and successfully being applied in practice, in a wide variety of fields and branches.

Scientific research on how to efficiently learn from data has received a certain level of maturity, but several important questions on the mathematical modeling aspect have thus far been neglected. In particular, the question of how to select a proper mathematical model in a data-driven optimization context has received little or no attention. Model selection is a subfield of statistics and information theory; in these fields a model is good if it gives a good description or prediction of the data. But in decision problems, the quality of a model should not be judged by `goodness-of-fit' or predictive power, but solely by its ability to produce good decisions.

A model produces good decisions when it hits the right balance between simplicity and complexity. That means that it achieves a good trade-off between modeling errors (arising from simplifying modeling assumptions), statistical errors (which are typically larger for more complex and realistic models), and optimization errors (complex, realistic models may not allow for exact computation of the optimal decision, resulting in additional errors). It would be tremendously useful to have a generic model selection method that identifies which model achieves this optimal trade-off.

Such a method should in particularly be able to handle the realistic, dynamic situation, where data is not something static but rather a continuously incoming stream. By continuously adapting the mathematical model upon which decisions are based, the complexity of the model is allowed to grow with the size of the data, such that at all decision moments the right balance is achieved between simplicity and complexity. This departs from the state-of-the-art in the scientific literature, where models are kept fixed throughout the time horizon, which negatively affects the quality of decisions in the short run (if overly complex models are used) or the long run (if models are too simplistic).

The goals of this research project are to

- develop and analyze model-selection methods for dynamic, data-driven decision problems;

- apply them to practical business optimization problems in pricing and revenue management.