Design of Markov Decision Problem

Internship – Vincent Leclère

Subjet

Consider the management of an electricity storage device over a day-ahead and intraday market. On the day-ahead market the owner decides at once how much and when he buys or sells for the next 24 hours. On the intraday market, the owner decides each hour how much he want to buy or sell for the next. Roughly speaking, most trade are done in the day-ahead market, but the most profitable ones are done in the intraday market. Hence the storage device manager needs to make profit in the day-ahead market while keeping flexibility for the intra-day.

When dealing with multistage stochastic optimization problem, there are two main approaches : Dynamic Programming (DP) and Stochastic Programming (SP). On the one hand, DP is adapted to the intra-day management problem, at least fo simple formulation. Unfortunately, handling simultaneously the day-ahead market, would require to add the day-ahead decisions in the state, immediately falling prey to the curse of dimensionality. On the other hand, SP is adapted to the day-ahead problem if the intraday problem is assumed to be deterministic, which overestimate the actual value of the intraday problem.

Actually managing the storage on the intraday market is a Markov Decision Process problem, with constraints depending on decisions taken for the day-ahead market. In this thesis we want to tackle the whole problem, akin to two-stage stochastic programming but where the second stage is a Markov decision problem instead of a deterministic problem. More generally, this applies to all investment or sizing problems, where long term decisions will impact the management of a short-term controlled stochastic dynamical system.

By use of duality we are able to compute sensitivity (multipliers) of the short term problem with respect to the design decisions. Unfortunately these sensitivities have to be evaluated by Monte Carlo, leading to an error in norme L^2 with high probability. Using these multipliers as part of a bundle method leads to difficult theoretical questions that will be adressed as part of the internship.

Skills required

Master 2 student with knowledge in mathematical optimization and probability.

Practical informations

5 or 6 months internship that could lead to a PhD thesis on the subject. Internship gratification.

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