ID de Contribution: **128** Type: **Contributed talk**

Optimal multiperiod portfolio risk-distribution based on reinforcement learning

mardi 29 juillet 2025 15:00 (30 minutes)

In an early paper we have studied the correspondence between second order interval stochastic dominance (ISD-2) and interval conditional value-at-risk (ICVaR), a tail risk measure carrying specific properties and generalizing the popular conditional value-at-risk.
Relying on the ICVaR, in this paper, we present a reinforcement learning approach to solve a trade-off problem based on one side on a risk parity paradigm and on the other on an ICVaR function enforcing second order dominance with respect to a benchmark strategy. The bi-criteria objective helps clarifying the risk-budgeting implications induced by a progressive switch from risk parity towards SD against the benchmark for portfolio construction in a dynamic model. Throughout the model formulation we focus jointly on the evolution of the risk- and the asset-composition of optimal asset portfolios. We consider a 1-year investment problem with monthly rebalancing and exclude short portfolio positions. The asset universe, or decision space of the problem, is based on exchange traded funds (ETF) and market benchmarks spanning different risk classes. The adoption of a reinforcement learning (RL) approach, under the given assumptions, has two main motivations: the relevant curse of dimensionality associated with a multistage stochastic programming (MSP) or stochastic dynamic programming (SDP) formulations as well as the
recent advances in machine learning thanks to the development of convex reinforcement learning (CRL) techniques, which are here thoroughly evaluated. An extended in- and out-of-sample validation is performed on market data from 2018 to 2024 with a discussion on the computational properties of the problem.

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Classification de Session: Application in energy, finance or logistics

Classification de thématique: Applications in energy, finance or logistics