Machine Learning Methods in Portfolio Optimisation

Yektasadat Erfan[1], *Ralf Korn*[1,2]

[1] Department of Mathematics, RPTU Kaiserslautern-Landau, Kaiserslautern 67663, Germany

[2] Department of Financial Mathematics, Fraunhofer ITWM, Kaiserslautern 67663, Germany

This study investigates the use of machine learning and reinforcement learning methods to determine optimal investment strategies that maximise the expected utility of terminal wealth. The proposed framework connects classical stochastic control methods with computational learning approaches in both one-dimensional and two-dimensional financial market models.
Portfolio optimisation problems are formulated within the binomial market model and the two-dimensional Rendleman-Bartter model [2]. Solution techniques, including the martingale optimality principle [1], backward induction, forward induction, and dynamic programming, provide the theoretical foundation. Reinforcement learning methods, particularly Q-learning [3] and Q-learning with a neural network, are then applied to approximate optimal investment decisions. In the Q-learning approach with a neural network, a radial basis function neural network is used to approximate the Q-function and to represent the relationship between wealth states, investment actions, and expected terminal utility.
The framework is further extended to include transaction costs in the binomial market model, allowing investment decisions to be examined under more realistic market conditions. The numerical results illustrate how reinforcement learning methods can approximate the optimal strategies obtained using classical stochastic control approaches.

References:

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