1 Introduction

Dynamic portfolio choice problems consider the optimal portfolio construction over time. These have a general solution in the absence of market frictions. However, when frictions such as transaction costs are introduced, the problem becomes significantly more complex, as a tradeoff of increased realism. In Dynamic Portfolio choice Dynamic programming schemes have been implemented to solve these problems numerically, but the computational complexity of these schemes suffer from the curse of dimensionality in a multitude of ways using multiple grid-based methods. In this regard the work of Gaegauf, Scheidegger and Trojani (2023) is of particular interest, as they develop a computational framework which reduces the need for grid-based methods. While much work has been put to developing a computational framework which reduces the need for grid-based methods, this has not been applied to a broader set of portfolio choice models, and we therefore only have a limited idea of the scope of applicability of these methods.

I therefore extend the framework of Gaegauf, Scheidegger and Trojani (2023), to new asset types and new cost functions. I analyze the impact of schemes with fixed and proportional transaction costs and with asset specific transaction costs. I also extend the asset types to include vanilla options, and analyze the impact of these on the computational complexity of the problem, and optimal portfolio construction. This paper therefore aims to provide a broader understanding of the class of dynamic portfolio choice problems, utilizing the newest insights in computational methods seen in the litterature.

Furthermore a novel extension to the computational framework is provided, which aims to reduce the computational burden in higher dimensions, by utilising structured kernel interpolation methods, which have been shown to increase the efficiency of the function approximator in high dimensions.

I implement the computational framework of Gaegauf, Scheidegger and Trojani (2023), which leverages Gaussian process (GP) regression to approximate the value function of the dynamic portfolio choice problem, which has otherwise been prone to the curse of dimensionality in past implementations. I likewise leverage their sampling scheme and quadrature methods to reduce the computational complexity of the problem.

I implement this framework on problems seen in the litterature, and find similar results. Following this i extend the framework to include options, as seeen in Cai, Judd and Xu (2020), and new cost functions, as seen in Dybvig and Pezzo (2020).

References

Cai, Yongyang, Judd, Kenneth L. and Xu, Rong (2020). *Numerical Solution of Dynamic Portfolio Optimization with Transaction Costs*. Tech. rep. arXiv: 2003.01809 [q-fin.PM]. URL: https://arxiv.org/abs/2003.01809.

Dybvig, Philip H and Pezzo, Luca (2020). "Mean-variance portfolio rebalancing with transaction costs". In: *Available at SSRN 3373329*.

Gaegauf, Luca, Scheidegger, Simon and Trojani, Fabio (2023). *A Comprehensive Machine Learning Framework for Dynamic Portfolio Choice With Transaction Costs*. Tech. rep. 23-114. Swiss Finance Institute, p. 70. URL: https://ssrn.com/abstract=4543794.