

Forward stochastic optimisation and its applications in optimal investment

Gechun Liang
Department of Statistics, University of Warwick

The fundamental problem in stochastic optimisation is to control a dynamical system driven by random noise to optimise certain criteria. However, the criteria are usually deterministic functions chosen at some fixed time in the future. The value function processes are constructed backwards in time and there is little flexibility to incorporate updating of risk preferences, rolling horizons, learning and other realistic “forward in nature” features. In the last decade, a new stochastic optimisation criterion, based on the so-called forward performance processes, was introduced by a world-leading control expert T. Zariphopoulou (and her co-authors) to study asset allocation problems. The criteria complement the existing ones and offer a construction of a genuinely forward dynamic mechanism for evaluating the performance of strategies.

I (together with T. Zariphopoulou) have recently found a new approach to construct forward performance processes using ergodic backward stochastic equations (see [1][2][3]). The results make an intrinsic connection with ergodic control and shed new light on how to construct forward performance processes in asset allocation problems. The proposed project aims to further develop a forward stochastic optimisation theory for the construction of forward performance processes, by using the tools from both ergodic backward stochastic equations and ergodic control.

The student is expected to be familiar with stochastic calculus and preferably stochastic control theory and ergodic theory. However, the latter two (stochastic control and ergodic theory) are not a requirement.

References

[1] Gechun Liang and Thaleia Zariphopoulou, Representation of homothetic forward performance processes in stochastic factor models via ergodic and infinite horizon BSDE, *SIAM Journal on Financial Mathematics*, Vol.8, No.1, (2017), 344–372.

[2] Wing Fung Chong, Ying Hu, Gechun Liang and Thaleia Zariphopoulou, An ergodic BSDE approach to forward entropic risk measures: representation and large-maturity behavior, *Finance and Stochastics*, Vol.23, No.1, (2019), 239—273.

[3] Ying Hu, Gechun Liang and Shanjian Tang, Systems of ergodic BSDE arising in regime switching forward performance processes, *SIAM Journal on Control and Optimization*, Vol.58, No.4, (2020), 2503-2534