SMALL-TIME ASYMPTOTICS OF STOPPED LÉVY BRIDGES AND SIMULATION SCHEMES

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We characterize the small-time asymptotic behavior of the exit probability of a Lévy process out of a two-sided interval and of the law of its overshoot, conditionally on the terminal value of the process. The asymptotic expansions are given in the form of a first order term and a precise computable error bound. As an application of these formulas, we develop a novel adaptive discretization scheme for the Monte Carlo computation of functionals of killed Lévy processes. The considered functionals appear in several domains of mathematical finance (e.g. structural credit risk models, pricing of barrier options, and contingent convertible bonds) as well as in natural sciences. The proposed algorithm works by adding discretization points sampled from the Lévy bridge density to the skeleton of the process until the overall error for a given trajectory becomes smaller than the maximum tolerance given by the user. The resulting schemes are several orders of magnitude faster than the traditional approaches based on uniform discretization, and provide an explicit control of the bias.

References

[1] Figueroa-Lopez, J.-E., and P. Tankov *Small-time asymptotics of stopped Lévy bridges and simulation schemes with controlled bias.* Arxiv preprint 1203.2355v2.