Statistical inference for the doubly stochastic Hawkes process in high-frequency financial data

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Abstract

We introduce and show the existence of a Hawkes self-exciting point process with exponentially-decreasing kernel and where parameters are time-varying. The quantity of interest is defined as the integrated parameter $T^{-1} \int_0^T \theta_t^* dt$, where θ_t^* is the time-varying parameter, and we consider the high-frequency asymptotics. To estimate it naïvely, we chop the data into several blocks, compute the maximum likelihood estimator (MLE) on each block, and take the average of the local estimates. The asymptotic bias explodes asymptotically, thus we provide a non-naïve estimator which is constructed as the naïve one when applying a first-order bias reduction to the local MLE. We show the associated central limit theorem. Monte Carlo simulations show the importance of the bias correction and that the method performs well in finite sample, whereas the empirical study discusses the implementation in practice and documents the stochastic behavior of the parameters.