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A Semi-Markovian Modeling of Limit Order Markets

R. Cont and A. de Larrard (SIAM J. in Financial Mathematics, 2013) introduced a tractable stochastic model for the dynamics of a limit order book, computing various quantities of interest such as the probability of a price increase or the diffusion limit of the price process. As suggested by empirical observations, we extend in this talk their framework to 1) arbitrary distributions for book events inter-arrival times (possibly non-exponential) and 2) both the nature of a new book event and its corresponding inter-arrival time depend on the nature of the previous book event. We do so by resorting to Markov renewal processes to model the dynamics of the bid and ask queues. We keep analytical tractability via explicit expressions for the Laplace transforms of various quantities of interest. We justify and illustrate our approach by calibrating our model to the five stocks Amazon, Apple, Google, Intel and Microsoft on June 21st 2012. As in Cont and Larrard, the bid-ask spread remains constant equal to one tick, only the bid and ask queues are modeled (they are independent from each other and get reinitialized after a price change), and all orders have the same size. (This talk is based on our joint paper with Nelson Vadori (Morgan Stanley)).