

Fredholm approach to nonlinear propagator models

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Abstract

We formulate and solve an optimal trading problem with alpha signals, where transactions induce a nonlinear transient price impact described by a general propagator model, including a power-law decay. Using a variational approach, we demonstrate that the optimal trading strategy satisfies a nonlinear stochastic Fredholm equation with both forward and backward coefficients. We prove the existence and uniqueness of the solution under a monotonicity condition reflecting the nonlinearity of the price impact. Moreover, we derive an existence result for the optimal strategy beyond this condition when the underlying probability space is countable. We introduce a novel iterative scheme and establish its convergence to the optimal trading strategy. We also provide a numerical implementation of the scheme that illustrates its convergence, stability, and the effects of concavity on optimal execution strategies under exponential and power-law decays.

Intraday jumps and 0DTE options: pricing and hedging implications

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Abstract

Trading in zero-days-to-expiry (0DTE) options has exploded in popularity over the last few years, surpassing half of all SPX options volume [1]. Despite the recent surge in trading volumes, the literature on 0DTEs is relatively scarce. Existing research in option pricing barely considered specifics of ultra-short-dated options, with a notable exception of some recent working papers [2]–[7].

In this paper, I examine the impact of intraday jumps on the pricing of ultra-short-term options and the associated hedging strategies. I use a continuous-time stochastic volatility model with Poisson jumps and derive semi-closed-form expressions for European option prices to assess market-implied risk premia for return diffusion, volatility and jump risks. I infer the model parameters by applying the Efficient Method of Moments proposed by Gallant and Tauchen [8] on the 9,164 SPX five-minute bars. I use the diurnal adjustment from the Autoregressive Conditional Duration model of Engle and Russell [9] to represent diurnal patterns in intraday data.

I show that intraday jumps in the underlying index are significant in frequency and size. Jump intensity tends to cluster near the market opening and closing hours, exhibiting a stronger pattern than diurnal volatility. Furthermore, using a sample of 22,410 five-minute observations of SPXW options with the same-day expiry, I find that jump risk premia are significant and almost double in magnitude than the combined premium for return diffusion and volatility risks. I employ these results to argue that the 0DTEs represent a natural hedge against extreme intraday movements in the market.

Keywords: Ultra short-dated options, Diurnal patterns, Jump risk premium, Extreme price movements, Event-based trading

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Continuous-time persuasion by filtering

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Abstract

We frame dynamic persuasion in a partial observation stochastic control Leader-Follower game with an ergodic criterion. The Receiver controls the dynamics of a multidimensional unobserved state process. Information is provided to the Receiver through a device designed by the Sender that generates the observation process. The commitment of the Sender is enforced. We develop this approach in the case where all dynamics are linear and the preferences of the Receiver are linear-quadratic. We prove a verification theorem for the existence and uniqueness of the solution of the HJB equation satisfied by the Receiver’s value function. An extension to the case of persuasion of a mean field of interacting Receivers is also provided. We illustrate this approach in two applications: the provision of information to electricity consumers with a smart meter designed by an electricity producer; the information provided by carbon footprint accounting rules to companies engaged in a best-in-class emissions reduction effort. In the first application, we link the benefits of information provision to the mispricing of electricity production. In the latter, we show that even in the absence of information cost, it might be optimal for the regulator to blur information available to firms to prevent them from coordinating on a higher level of carbon footprint to reduce their cost of reaching a below average emission target.