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Data-Driven Optimal Trading of Renewables on Intraday Energy Markets

Abstract

The growing penetration of weather-dependent renewable generation in European power markets increases intraday price volatility and exposes market participants to imbalance penalty risks imposed by transmission system operators, creating a need for robust quantitative trading tools. We develop a data-driven, continuous-time stochastic optimal control (SOC) framework for intraday electricity trading on continuous exchanges. Wind production and energy prices are modeled by forecast-driven Itô–Lévy stochastic differential equations, which incorporate market asymmetries in jumps. The associated Hamilton–Jacobi–Bellman (HJB) partial integro-differential equation (PIDE) is solved via a a proposed semi-implicit finite difference scheme, yielding optimal trading policies that balance expected revenues, liquidity costs, and imbalance penalties. Numerical experiments on German intraday data demonstrate the economic value of forecast-driven and jump-aware strategies, highlighting robustness to volatility and tail risks.