

# Optimal Market-Making Strategies Under Synchronised Order Arrivals with Deep Neural Networks

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## ABSTRACT

This study investigates the optimal execution strategy of market-making for market and limit order arrival dynamics under a novel framework that includes a synchronised factor between buy and sell order arrivals. Using statistical tests, we empirically confirm that a synchrony propensity appears in the market, where a buy order arrival tends to follow the sell order's long-term mean level and vice versa. This is presumably closely related to the drastic increase in the influence of high-frequency trading activities in markets. To solve the high-dimensional Hamilton–Jacobi–Bellman equation, we propose a deep neural network approximation and theoretically verify the existence of a network structure that guarantees a sufficiently small loss function. Finally, we implement the terminal profit and loss profile of market-making using the estimated optimal strategy and compare its performance distribution with that of other feasible strategies. We find that our estimation of the optimal market-making placement allows significantly stable and steady profit accumulation over time through the implementation of strict inventory management.