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*Option Pricing with Recurrent Variance Dependent Stochastic Discount Factors and Realized Volatility*

This paper develops an option pricing framework that integrates general Realized EGARCH return dynamics with an exponential linear stochastic discount factor (SDF), in which variance risk aversion is modelled using a recurrent neural network (RNN). Using S&P 500 index options, we show that the RNN-based SDF substantially improves the cross-sectional fit relative to standard autoregressive and constant variance-dependent specifications, with the largest gains for deep out-of-the-money and short-maturity contracts. The results indicate that allowing the pricing kernel to incorporate complex, state-dependent variance risk premia is essential for capturing option market nonlinearities. A GPU-accelerated implementation based on Libtorch (PyTorch's C++ API) and CUDA ensures computational feasibility for large-scale estimation.