

The Unified Model

This talk presents a unified approach to mathematical finance. It models the prices and cash flows of all instruments using a consistent framework. Every arbitrage free model is parameterized by a vector valued martingale and a positive adapted process: the deflator, or stochastic discount.

If the model includes repurchase agreements, then there is a canonical deflator: the reciprocal of the money market account resulting from rolling over an initial unit investment.

The Black-Scholes/Merton model is defined by the martingale $M_t = [r, s e^{\sigma B_t - \sigma^2 t/2}]$ and the deflator $D_t = e^{-\rho t}$, where B_t is standard Brownian motion. No need for partial differential equations, Ito's lemma, or the Hahn-Banach theorem.

One defect of the classical theory is that it is not possible to hedge in continuous time. Traders must decide when and how much to trade. The unified model incorporates this but leaves open the question of how good the hedge is. We will review some current research that uses reinforcement learning to handle this problem.

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