

Coupled continuous time random walks in finance

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Continuous time random walks (CTRWs) are used in physics to model anomalous diffusion, by incorporating a random waiting time between particle jumps. In finance, the particle jumps are price returns and the waiting times measure delay between transactions. These two random variables (price change and waiting time) are typically not independent. For these coupled CTRW models, we can now compute the limiting stochastic process (just like Brownian motion is the limit of a simple random walk), even in the case of heavy tailed (power-law) price jumps and/or waiting times. The probability density functions for this limit process solve certain coupled space-time fractional partial differential equations. In some cases, these equations can be explicitly solved to yield descriptions of long-term price changes, based on a high-resolution model of individual trades that includes the statistical dependence between waiting times between trades and the subsequent price changes. In the heavy tailed case, this involves operator stable space-time random vectors that generalize the familiar stable models. In this talk, we will review the fundamental theory and present an application using some high-resolution LIFFE futures data from 1997.

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