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Closed-Form Spectral Expansions for First-Passage Time Densities, Lookback and Barrier Options under New Families of Diffusions

In this talk I will present a general framework for obtaining closed-form spectral expansions for first-passage time (FPT) densities and corresponding transition probability densities for several new families of one-dimensional transformed Markov diffusions with killing. The transformed diffusions are characterized by nonlinear local volatility functions with multiply adjustable parameters and are generated by applying a so-called diffusion canonical transformation method on an underlying solvable diffusion with killing. Based on the transition and FPT densities, analytically closed-form (and rapidly convergent) spectral expansions are also obtained for lookback and (single and double) barrier options for such transformed processes. The approach is presented for a general class of diffusions and leads to several applications in finance. Specifically, this talk will discuss some analytically exact results for three new main families of diffusion models. The first-hitting time densities and option pricing formulas recover the recently derived expansions in the literature for the simpler processes that include the CEV and many other diffusion models as special cases of our new formulas.