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New State Dependent Diffusions and their Application to Option Pricing

In recent years a new methodology (called "diffusion canonical transformation") was developed for generating new families of analytically solvable one-dimensional Markovian diffusions with multiple adjustable model parameters. In this talk we discuss some of the most recent, and ongoing, developments and applications of such new diffusion models to option pricing. We show that certain subfamilies of these processes properly describe forward (discounted) asset prices as martingales under a risk-neutral measure. Risk-neutral transition densities, first-passage time densities, and option prices for standard Europeans, barrier options and lookback options are derived in analytically closed-form. The newly derived analytical formulas for these families are supersets of previously derived formulas given for other popular models such as the CEV and others. Implied volatility surfaces for these models, however, exhibit a wide range of pronounced smiles and skews of the type observed in the option markets. These diffusion models are also applicable to pricing more generally path-dependent as well as multi-asset options. We conclude by discussing some numerical implementations for pricing Asian and Bermudan options via path integral approaches.