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Pricing Risk through Simulation: Revisiting Tilley Bundling and Least Squares Monte Carlo Methods

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Simulation methods were deemed impossible in the early 1990s for pricing derivatives with early exercise features. However, Tilley's seminal paper (Transactions of the Society of Actuaries, 1993, 45, 83–104) provided the first method to price American style stock options.

On the twentieth anniversary of this breakthrough, our work revisits Tilley's approach to approximating the value of a derivative through simulation and compares it to the Least Squares Monte Carlo Method developed by Longstaff and Schwartz (Review of Financial Studies, 2001, 14(1), 113–47). We introduce these two using simple numerical examples, compliment them by estimating the risk profile of an American stock option using the two approaches, present the results applied over a large number of paths and finally discuss possible hybrid techniques

Monte Carlo techniques are widely used in the financial industry, but often applied separately for pricing and risk applications. Lately, a shift to joint simulations is necessitated by the pricing of CVA (credit value adjustment) and requirements from regulators for consistent capital treatment of exotic derivatives. Although this development is facilitated by increased access to high performance computing, the application of efficient algorithms such as those reviewed in this article remains an active area of research for real-time estimation of quantitative risk measures such as value-at-risk, potential future exposure and expected future exposure.