Efficient pricing of Bermudan options using recombining quadratures

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Abstract

Sullivan (2000) used the Gauss-Legendre quadrature and the Chebyshev approximation to price the American put option. Starting from his work we construct a systematic way of pricing the Bermudan option with long-term maturity using numerical integrations. At each exercise time we approximate the option values multiplied by the discounted transition density function as a whole by the Chebyshev approximation. Then, at one step earlier exercise time we evaluate the option values by the exact integration of the Chebyshev approximation, i.e., by the summation of all the Chebyshev approximation values weighted by Clenshaw-Curtis weights at Chebyshev extremal nodes, which is known as the Clenshaw-Curtis quadrature. In this way we construct a recombining tree and using this recombining tree we price the Bermudan option. So we call this pricing method the recombining Clenshaw-Curtis quadrature. Using the same recombining tree we are also able to obtain Greeks easily.

We search several different quadratures, construct recombining trees, and develop pricing methods. We compare the performance of various recombining quadratures with the benchmark Geske and Johnson (1984) and FDM method. Among all these pricing methods including the Geske and Johnson and FDM we find our recombining Clenshaw-Curtis and Gauss-Legendre-Lobatto quadrature are by far the most efficient and accurate in pricing the Bermudan option.

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