

Abstract

An opportunity to make a profit without any chance of a loss may exist in a complete financial market, but it cannot continue for long before prices change to annihilate it due to the presence of arbitrageurs. Hence, financial derivatives, like options, are priced based on the fundamental no-arbitrage principle. By risk-neutral pricing, the fair value of an option can be represented by an expectation. Thus, even for path-dependent and multi-asset options, option pricing is simply reduced to the problem of solving high-dimensional integrals. The growing popularity of options, to be used in a speculation or hedging strategy, further motivates the need for fast and accurate option pricing methods. Since most options cannot be priced in closed form, numerical methods are often required in practice. In this project, we review Monte Carlo methods for approximating high-dimensional integrals, for option pricing. In particular, we compare standard Monte Carlo, Sequential Importance Sampling and Sequential Importance Sampling/Resampling. The benefits and drawbacks of each method are also discussed. The objective of this project is to assess if the latter two Sequential Monte Carlo methods outperform standard Monte Carlo in terms of accuracy and relative variance of the resulting price estimates. In our examples, we run Monte Carlo simulations for European call to illustrate the fundamentals of Monte Carlo, and for double and single knock-out European call options to assess our methods for pricing path-dependent options. Lastly, we hope to reach a possibly optimal importance sampling distribution that yields a more accurate estimation of less variability by introducing a monotonic transformation of the option's payoff term. Our results were able to show that Sequential Importance Sampling/Resampling works best and can be improved by the monotonic transformation introduced.