Valuing discretely monitored barrier options

Reza Hamedi[*]   Kazem Nouri[†]   Behzad Abbasi[‡]

Department of Mathematics, Faculty of Mathematics, Statistics and Computer Sciences, Semnan University, P. O. Box 35195-363, Semnan, Iran

E-mails:[*]reza.hamedi@rocketmail.com,[†]knouri@semnan.ac.ir,
[‡]behzad.abbasi95@gmail.com

Abstract

Options with the barrier feature are considered to be the simplest types of path dependent options. Barrier options distinctive feature is that the payoff depends not only on the final price of the underlying asset, but also on whether the asset price has breached (one-touch) some barrier level during the life of the option. In this paper we explore the problem for pricing discrete barrier options utilizing the Black-Scholes model for the random movement of the asset price. We postulate the problem as a path integral calculation by choosing approach that is similar to the quadrature method. Also, we perform a numerical algorithm for fast and accurate valuation of the multi-dimensional integral that represents the formula for the double barrier option price. In addition, we present an error estimation of our approximation and derive for discrete barrier options an identity similar to the famous put-call parity. Our results for pricing discretely monitored one and double barrier options are in agreement with those obtained by other numerical and analytical methods in finance and literature.

Keywords and phrases: Discrete barrier options, Black-Scholes model, Quadrature method, Multi-dimensional integral.