Project on the Asian option

October 23, 2020

Abstract

The purpose of this text is to study the properties of the Black-Scholes price of Asian options by using analytical and numerical tools. The outline of the document is based on the project described in Chapter 3 in Ref. [1].

1 Solution of the project written exercises

This section contains the solutions of the written exercises in the project.

Task 3.1

The first task of the project is to prove the following put call parity identity on the Black-Scholes price of Asian call/put options:

$$\Pi_{\rm AC}(0) - \Pi_{\rm AP}(0) = e^{-rT}\left(\frac{e^{rT}-1}{rT}S_0 - K\right). \tag{1}$$

where $\Pi_{\rm AC}(0)$, resp. $\Pi_{\rm AP}(0)$, is the price at time $t = 0$ of the Asian call, resp. put, option, r is [...]. To prove (1) we write [...].

Task 3.2

[...]

Task 3.3

[...]

2 Solution of the Matlab exercise

The first part of this task requires to write two Matlab codes to compute the Black-Scholes price at time $t = 0$ of the Asian option, one using the crude Monte Carlo method and one using the control variate Monte Carlo method. These two codes can be found in Appendix. As shown in Figure 1, the control variate method is more precise than the crude method. In fact [...]. In Figure 2 the validity of the put-call parity is verified using the two methods. The result clearly gives further indication that the control variate method is more accurate than the crude method.

Figure 1: Short description of the plot

The second part of the task requires to do a parameter sensitivity analysis of the price of the Asian option. In Figures 3-7, the price of the Asian call is plot against the parameter σ, r, K, T, S_0, where σ is the volatility of the stock, r is [...]. In the same figures we also plot the price of the standard European call. From these pictures we can draw the following conclusions: [...].

References

[1] S. Calogero: *Projects in financial mathematics*. Available on the homepage of the course MVE172 (Basic Stochastic processes and financial applications, Chalmers), 2020

[2] [...]

A Appendix: Matlab codes

B ...