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Multi-asset Option Pricing Problem: Both European and American Types



Client Profile

Chienmin Chuang
School of Mathematics
The University of Birmingham
Edgbaston
Birmingham
B15 2TT

Contact Details

chienmin@for.mat.bham.ac.uk

Product Used

Matlab

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Contributors

Daniel Loghin
Stephen P. Decent

Challenges

Options are financial derivatives giving their owners the right, but not obligation, to gain payoff if an agreed condition is met. European options restrict owners to exercise their rights on expiry date while those of American type allow owners exercise rights flexibly prior to expiry. Countless algorithms have been developed to price options linked to one and two assets. However, pricing multi-asset option is still a challenging problem in both academy and industry.

Background

The most popular way to pricing is to start with the celebrated Black-Scholes Partial Differential Equation (PDE), which turns to a high-dimensional PDE in a multi-asset case and brings the difficult called 'curse of dimension'. In the case of American options, the Black-Scholes theory produces a high-dimensional Partial Differential Inequality (PDI) instead of a PDE. This makes situation more complicated. Our algorithm is to employ Finite Element Technique to discretize the problem to turn the PDE and PDI to Ordinary Differential Equation (ODE) and Ordinary Differential Inequality (ODI). Then we can use one-step or multi-step methods to solve the PDE and optimization method to solve a Linear Complementary Problem (LCP). The latter problem is formed by ODI along with another complementary condition which arises from financial properties. From computational point of view, this is also an interesting problem due to the computational cost and efficiency of algorithms.

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For more information:

BEAR, IT Services
Elms Road Computer Centre (G5)
Edgbaston
Birmingham B15 2TT
Tel: 0121 414 5877
Email: bearinfo@contacts.bham.ac.uk
Website: www.bear.bham.ac.uk