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Black-Scholes Model for Option Pricing

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As option has been used more and more popular in the financial market, pricing an option became an important issue. Actually, this issue has been discussed for more than a decade. Black-Scholes model is the most well known mathematics model for option pricing.

Under the assumption that the stock price follows a random walk, the financial market is fully accessible, the stock is perfectly divisible, and there is no transaction fee and no dividend paying, the Black-Scholes equation was derived. In this model, the option price depends on the stock price and time, the expiry date of the option, the risk-free interest rate and the volatility of the stock. The last two are treated as constants for a small time interval.

There are two ways to derive the Black-Scholes equation. One is using the Ito's process from stochastic calculus; the other is using the binomial tree approach. The option price can be found by solving this equation with some terminal conditions. This terminal value problem can be transferred to an initial value of heat equation and hence can be solved analytically and numerically.

However, the terminal value problem of the Black-Scholes equation mentioned above is only suitable for a European option. How to price an American put option is what I am interested in. Since the option can be exercised any time before expire, it results in an obstacle problem of partial differential equation which is very difficult to solve analytically. The aim of my project is to study the numerical approach to various kind of problem regarding the American put option and try to improve the existing results in some cases.

I appreciate the opportunity that AMSI gives me to present what I have done in the first stage of my honours project. I really enjoyed working on this project in the last 6 weeks and getting involved in the Big Day In event sponsored by AMSI and CSIRO, where I met lots of mathematician and hence broadened my mind in mathematical career.

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