Optimize the Hedging Strategy for Option Writer with Genetic Programming

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1. Problem:

The Black-Scholes option pricing formula is developed by Fisher Black and Myron Scholes, who won the 1997 Nobel Prize in Economics. According to the Black-Scholes formula, theoretically the position of an option can be perfectly hedged by a dynamic strategy, called delta-hedging. For option traders, how to hedge their positions is a critical part of their trading strategies. For example, assume that 6 months ago you sold some Google call options with strike price $300 and expiration date in December 2005 for $10 each. Without hedging the positions, you may have lost around $100 for each option you sold.

![Figure 1](image1.jpg) The stock price for Google in the recent 6 months

![Figure 2](image2.jpg) The call option prices on Dec. 05, 2005

Based on the Black-Scholes formula, a dynamic hedging strategy, called delta-hedging, can be derived and it can hedge the option perfectly in the Black-Scholes world. In the previous example, you can use the proceeds from selling those options to build a portfolio with Google stocks and bonds in it. When the portfolio is maintained using the
delta-hedging strategy, theoretically you can earn exactly the same money from this portfolio as what you have lost in your Google options.

However in reality, the perfect delta-hedging strategy can never be implemented. Since the delta-hedging strategy ignores the transaction costs and it needs to balance the portfolio frequently, in practice the transaction costs for maintaining such a portfolio can easily exceed the portfolio itself. A practical hedging strategy should require much less adjustment to the hedging portfolio and be able to protect the positions at an acceptable level. In other words, it approximates the perfect hedging strategy in an efficient way. In this project, we are going to explore whether such an efficient hedging strategy can be discovered by the Genetic Programming algorithm.

2. Experiment:

Two types of experiments can be conducted, simulation and the real world data. In the simulated experiment, the stock price is assumed to have log-normal distribution and we can generate artificial stock prices using Monte Carlo simulation. Since the stock price volatility is a setting parameter, we can use the Black-Scholes formula to calculate the option price. The Genetic Programming can be trained based on the artificial data to discover a hedging strategy which balances the portfolio, say, every week. A similar experiment setting can be used on the real world data. The real time series data for a particular stock and its option prices are used to train the GP algorithm.