TJHSST Senior Research Project
Investigating Black-Scholes with regards to Basic Financial Instruments
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Abstract

This project investigates creating an application that downloads stock information from the Internet and applies to it the famous Black Scholes algorithm, outputting the result. The Black Scholes algorithm is used in modeling price variaton over time of securities that are heavily traded. This application prompts the user for one of several available heavily traded stocks, pulls that stock's information from the Internet, asks for parameters such as strike price and length of option, and applies the Black Scholes algorithm accordingly. The goal of this project is to create an easy to use application that gives the user an insight into models such as Black Scholes can be very hazardous in trying to predict market behavior, as seen in the subprime meltdown that triggered today's current global recession.

Keywords: genetic algorithms, algorithmic composition, data importing

1 Introduction

1.1 Rationale

Fischer Black and Myron Scholes' Nobel Prize Winning European option valuation model lay the foundation for the proliferation of mathematical valuation models on Wall Street. Yet has the adoption of these methods by

hedge funds and investment banks around the world led us to a new age of fiscal vitality or into a hazardous territory of faulty logic and misapplication of mathematics? This project attempts to educate users by applying the famous Black Scholes model to real-life, heavily-traded securities to help dissect the true effects of using the mark-to-model method in financial instrument valuation.

1.2 Purpose

With the contemporary advancement of applied mathematics and statistics, hedge funds and investment banks on Wall Street are racing to find the most profitable algorithm that will give them an edge over the competition. Yet this zeal has led to the irresponsible adoption of and trust in purely mathematical models which are not able to accurately account for the hundreds of variables that affect the behavior of the stock market. This project explains how even celebrated algorithms cannot accurately measure the behavior of the market place by applying one such algorithm on real-life, heavily traded securities.

1.3 Importance of Topic

The recent global recession proves to us the hazard presented by using the mark-to-model method in derivative valuations, or in other words using mathematical models to assess or predict the performance of financial instruments. As the Government begins the arduous task of instituting financial reforms to prevent a future global recession, it is important to educate on some of the fundamental causes of the economic meltdown, so that these important areas of need do not go ignored.

2 Background

To appreciate this project, one must first have an understanding of the Black Scholes option pricing algorithm. The model operates on the premise that

the price variation of stocks and other financial instruments that are heavily traded follow simple Brownian motion, with constant velocity and drift.

Treating the fluctuations of stocks as small parts of a larger constant velocity allows one to then predict the future behavior of these financial devices. The specific algorithm deals with the valuation of European options.

1. An option is a contract between a customer and a stockholder. The stockholder agrees to give the customer the right to buy or sell a certain amount of stock at a predetermined price after or during a certain period of time, regardless of whether the stock goes up or down in real life. If the customer wants the right to buy the stock at an agreed upon price, the option is referred to as a call option. If the shareholder wants the right to sell the stock at an agreed upon price, the option is referred to as a put option. The predetermined price is referred to as the ?strike price?. If the option can be exercised during the time period agreed upon, it is called an American option. If the option can only be exercised at the end of the time period, it is called a European option. Black Scholes was developed only for European call options. The options themselves don't have to be exercised; the entity holding the right can choose not to exercise the option ever.

2. Brownian Motion is defined as the random movement of microscopic particles suspended in a liquid or gas, which is caused by collisions between the suspended particles and the surrounding medium. In other words, Brownian Motion is a way of looking at random flucutations, which is one reason the stock market is often cited as a real world application of this concept.

3. Black Scholes in this case involves four variables– the constant price variation of the stock, the time value of money, the option's striking price and the time to the option's expiry.

4. Black Scholes was discovered in 1973 by the men after whom the model is named: Fischer Black and Myron Scholes. Scholes and Robert Merton, the man who further developed the model, won the Nobel Economics Prize in 1997 for their work. The model was developed shortly after the introduction of options trading, which led many to be skeptical to the effectiveness of the algorithm. The use of stochastic differential equations, however, proved to be exceedingly effective.

5. Much of the contemporary research surrounding Black Scholes has to do with attempting to improve the algorithm. Black Scholes operates on

several restricting assumptions. One is that the volatility of the stock will remain constant. Another factor that the Black Scholes model does not take into account is risk aversion: the idea that the seller will want to avoid risk and adapt his/her behavior accordingly.

3 Procedure/Methodlogy

First the user is prompted for a stock symbol through a JDialog box. The user is also prompted to choose whether to run the algorithm on a call option or a put option. Once entered, the program imports the source data for the page of that specific stock from Yahoo! Finance. The source code is parsed into a String, and the program then searches the string for relevant information (such as the last trade price) due to previous identification. Once the real-time stock price has been identified, the program reports the price to the user and asks for a strike price, as well as the number of months till option expiration. Once the user enters those variables, the Driver calls on the Black Scholes class to run the algorithm. The result is then outputted to the user, along with an explanation of what the output means for the marketplace.

4 Expected Results

The expected result of this program is a fully customizable program where the user is able to pick any stock, receive the real-time price, choose a strike price accordingly, and pick how much time is left on the option. Along each of these steps, thorough descriptions of the variables and operations will be given. The program will then run Black Scholes using the given parameters and output the result, as well as analyzing what the result means in terms of affecting the marketplace.

5 Current Results

At this point I am able to read in stock information from Yahoo! Finance, with the specific stock inputted by the user. I have been able to read in the stock price and other information for the most recent update to the Yahoo! Finance page. The program then stores the last trade as a double, and it prints out the information as well. This is because I use the user

input to find the information from the source code of the Yahoo! Finance web page that I import. In the source code, the symbol is lower case. For development purposes, the program currently prints out the entire source code of the Yahoo! Finance page as a string. The program also outputs the source code to a program-generated text file. The program additionally loads a GUI that allows the user to prompt the program to run the Black Scholes algorithm. Earlier in the program, after the user inputs the stock symbol and the program pulls the information from on-line, the program reports the real-time stock price to the user and then asks for a strike price, as well as whether the user wants to run the algorithm on a call or put option. The program also asks for the number of months till expiration of the option. After receiving all these variables from the user, the program is ready to run the Black Scholes algorithm. After running the Black Scholes algorithm and outputting the result, the program analyzes what the output means for the marketplace.

6 Moving Forward

I have a clear plan moving forward. I want to add help buttons at every step of the process, with thorough descriptions describing the specific variable or concept in question. I also want to somehow graph the data I collect and compare it to theoretical Brownian Motion graphs to show the contrast between the behavior Black Scholes attributes to these securities and the actual behavior of these securities. Additionally, I would like to further develop the GUI and make my program more user friendly in general.

6.1 Software

I will be using Java for this program, because it is supported by almost every operating system and therefore can expose the program to more people.

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