Comparing Accuracy and Efficiency of Finite Difference Methods for Solving the Black-Scholes Equation - Project Outline

Yamini Ananth, Vincent Zhao

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Abstract

This project presents analytical and numerical problem solving methods for the Black-Scholes equation, which is used for option pricing. An analytic solution is deducted first considering specific boundary conditions and the solutions of multiple numerical methods are cross-validated with respect to convergence and accuracy.

1 Introduction

Here, we will explain the context of the model and situations it can be useful. We will furthermore define the model equation we plan to use for the situation we are posing.

2 Analytic Solution of a Boundary Value Problem of Black-Scholes Equation

We will establish the specific boundary conditions and other parameters involved. For example, we are interested in looking at Black-Scholes for a European call option with constant interest rate and volatility placing boundary conditions at $x = 0$ and $x = \infty$. A closed-form solution will be obtained after solving the related heat diffusion equations. Due to the conditions we put on the model, we will be able to obtain such a closed-form solution.

3 Numerical Methods for Solving the Boundary Value Problem

3.1 Gauss-Seidel Method

We will demonstrate that the method converges analytically. We will also detail the code implementation we have picked and compare with the analytic solution

in terms of convergence, accuracy.

3.2 Successive Over-Relaxation Method

We will demonstrate that the method converges analytically. We will also detail the code implementation we have picked and compare with the analytic solution in terms of convergence, accuracy.

3.3 Monte Carlo Method

We will give a background on the method we are using and why we are using it in comparison with other solver methods, and go into detail on the implementation we are using and compare with the analytic solution in terms of convergence, accuracy.

4 Conclusion

We will compare the three implementations with each other in terms of accuracy, convergence, and computation time and go over the results and any expected/unexpected results to consider why they may have occurred. We will also discuss here any potential causes that may have come from our code, and how we may wish to extend/further pursue this topic if applicable.

5 References

As needed