Optimal Trade Execution with Market Impact using Stochastic Control

Bhavish Jain
M.Sc Mathematics, IIT Delhi

1 Introduction

Large institutional trades cause market impact and adverse price movement. This project studies optimal execution using the Almgren–Chriss model and formulates the trading problem as a stochastic control problem.

2 Model

The price dynamics are given by

$$S_{t+1} = S_t + \sigma\epsilon_t - \eta v_t,$$

where v_t is the trading volume at time t. The objective is to minimize

$$\mathbb{E}[C] + \lambda R,$$

where C is execution cost and R is inventory risk.

3 Naive Execution

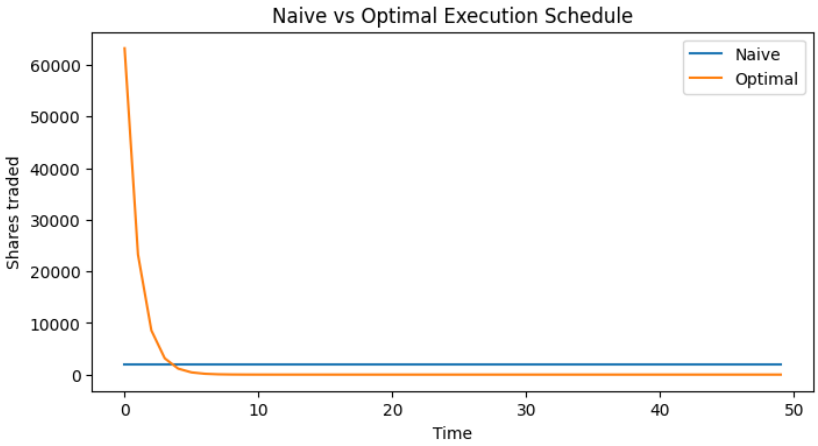

Figure 1: Price evolution under naive execution.

4 Optimal Execution Schedule

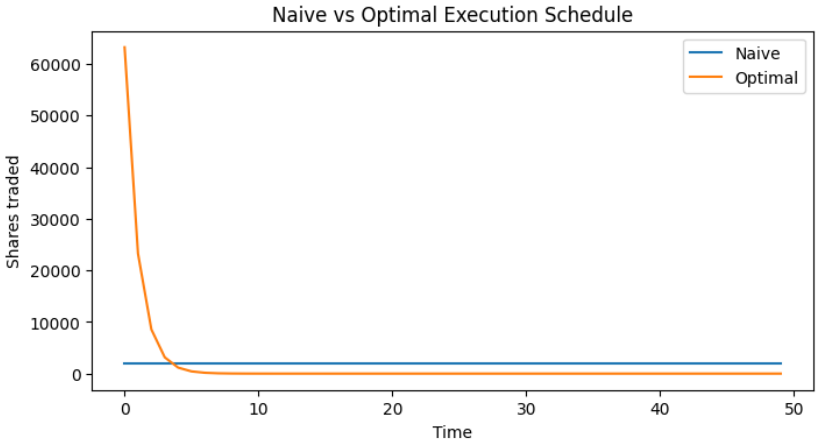

Figure 2: Naive vs optimal execution schedule.

5 Performance Comparison

Metric	Naive	Optimal
Execution Cost	13986	-3336
Risk Term	1.62×10^{11}	1.56×10^{9}

6 Inventory Dynamics

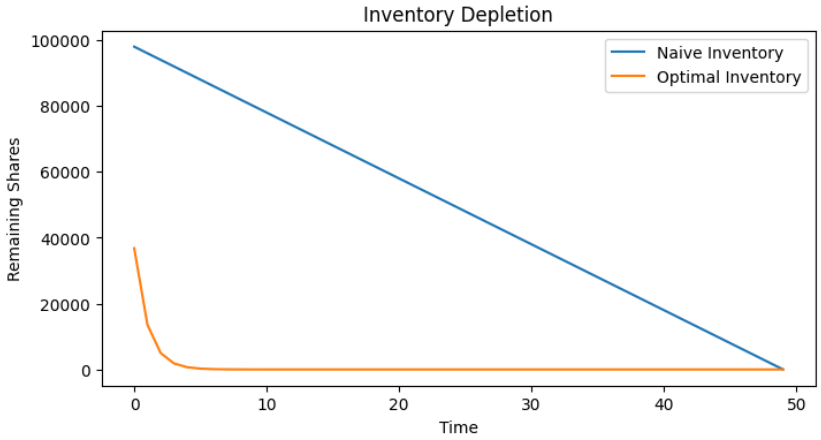

Figure 3: Inventory depletion under naive and optimal strategies.

7 Conclusion

The stochastic control based optimal execution strategy significantly reduces both execution cost and inventory risk, demonstrating the effectiveness of operations research methods in quantitative trading.