# GameStop: A study in the Black-Scholes Formula

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**Abstract**

This is a simple paragraph at the beginning of the document. A brief introduction to the main subject.

## 1 Introduction

In the first section of my essay, I plan to outline what happened in February with GameStop and the internet, showing graphs of the situation, for example in GameStop, in order to motivate the reader in our analysis of the Black-Scholes formula under the bizarre situation of GameStop. I can also talk about similar situations in the past of similar significant "short squeezes", and consider how analysing GameStop could allow us to predict future short squeezes with different companies by analysing their financial situation.

I would then move on to explaining the Black-Scholes Model, and could attempt a simple derivation of the Black-Scholes Formula. I can then move on to solving the formula for different intial conditions and variables, using my tools from Programming for Scientists last year to generate graphs of the predicted stock value (and value of options) in Python, where suitable. I will then take a conclusion from my calculations, deciding whether the prelevence of GameStop on messageboards and the internet is what caused the large spike, or if the high short interest in GameStop meant that it was inevitable to happen anyway.

I would expect to use Jupyter notebook and Python for graph sketching, and I plan to reference "Stochastic Differential Equations: An Introduction with Applications" by Bernt Karsten Øksendal, and "Options, Futures and Other Derivatives" by John C. Hull as part of writing my essay, as they contain critical information relevant to my topic. Below is the Black-Scholes formula:

$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$ Where t is time in years, r is the interest rate, S is the price of the underlying asset and $\sigma$ is the standard deviation of the stock's returns.

I can also talk about other, more complicated financial models and how they compared to Black-Scholes, for example which assumptions they start to calculate which are ignored in Black-Scholes.

$A(t) = rA(t)$

# 2 What are shares, options, and short selling?

# 3 What happened to GameStop?

# 4 Asset dynamics

## 4.1

# 5 Options

# 6 The Black-Scholes Model

# 7 Modelling GameStop

# 8 Extensions to the Black-Scholes Model

# 9 Conclusion