Simulation with Monte Carlo Technique

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Problem and Objective

Application Domain

Financial Analysis: evaluating financial impact of different decision. Simulation can be used to understand the financial implications of different business decisions. This can help organizations make decisions that align with their financial goals

Objective

Simulating Future Stock Growth Projections: NVIDIA stock prices are hard to predict and we are looking to simulate and forecast future prices for investors and financial analysts

Problem

Problem Statement: Should we invest in NVIDIA this upcoming year?

Variables and Data Distribution

- **Data Distribution**
  - Geometric Brownian Motion (GBM) is the most common random model used for simulating stock price movements.
  - It assumes that stock prices follow a **log-normal distribution** .
  - The Geometric Brownian Motion assumes that stock prices follow a log-normal distribution which means that the prices cannot be negative and the price of the stock can fluctuate randomly but with a predictable trend based on constant drift and volatility.
- **Variables:**
  - **Log Return**
    - the continuous percentage change in the price of the stock
  - **Drift**
    - μ - the average return calculated from historical log returns
  - **Volatility**
    - **std, σ** - measure of how much the stock price fluctuates.
  - **Delta**
    - **Δt - time step (ex: 1/252)** is the small interval of time over which the stock price is updated in the simulation. This prevents the simulation from simulating one day 252 times as opposed to 252 different days
  - **Starting Closing Price**
    - $85.91 - closing price on 4/4/2024

$$\frac{\Delta S}{S} = \mu \Delta t + \sigma \epsilon \sqrt{\Delta t}$$

where:

S = the stock price

ΔS = the change in stock price

μ = the expected return

σ = the standard deviation of returns

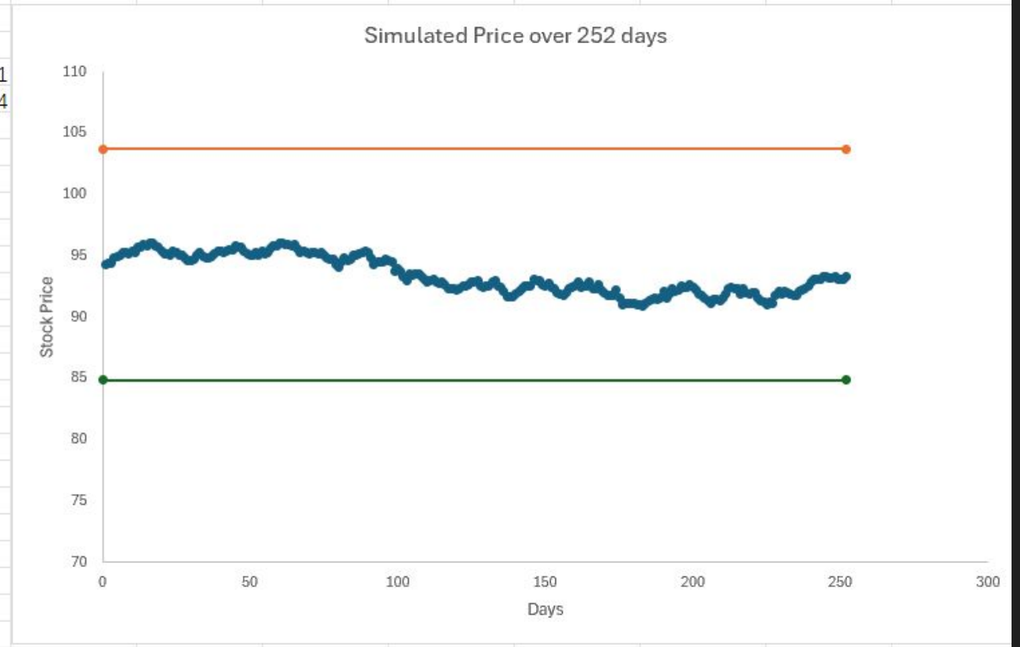
ϵ = the random variable

Δt = the elapsed time period

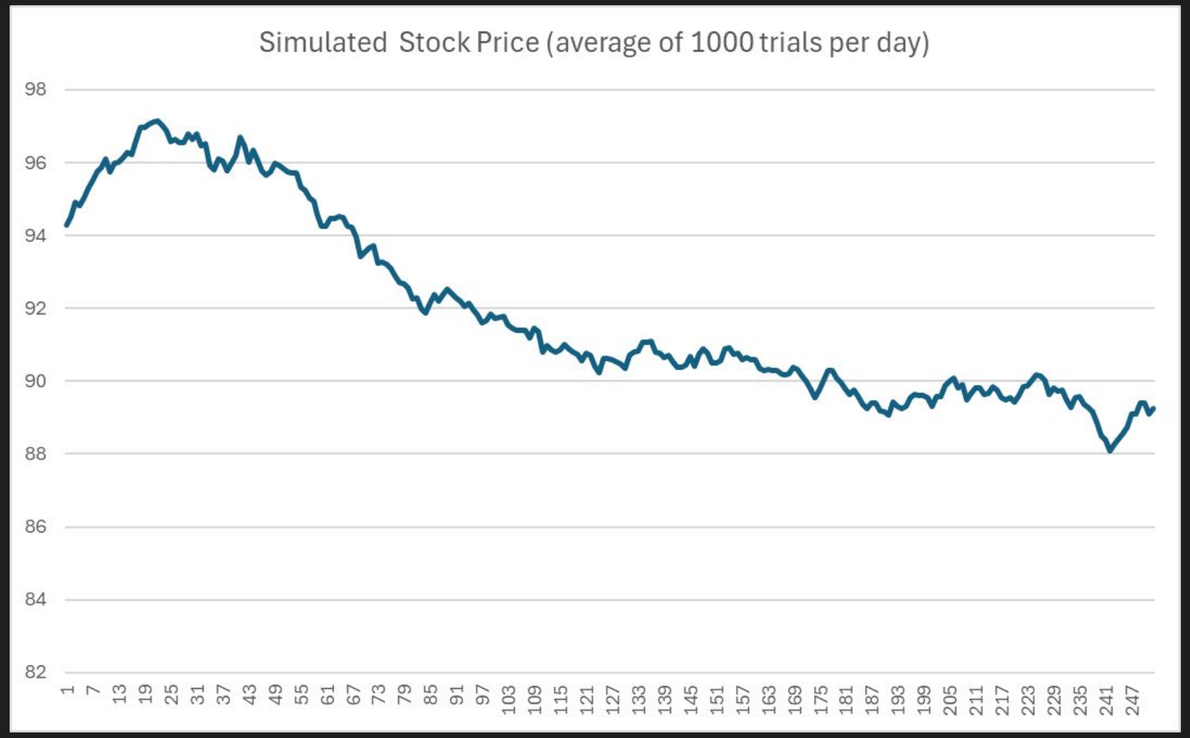
Simulation

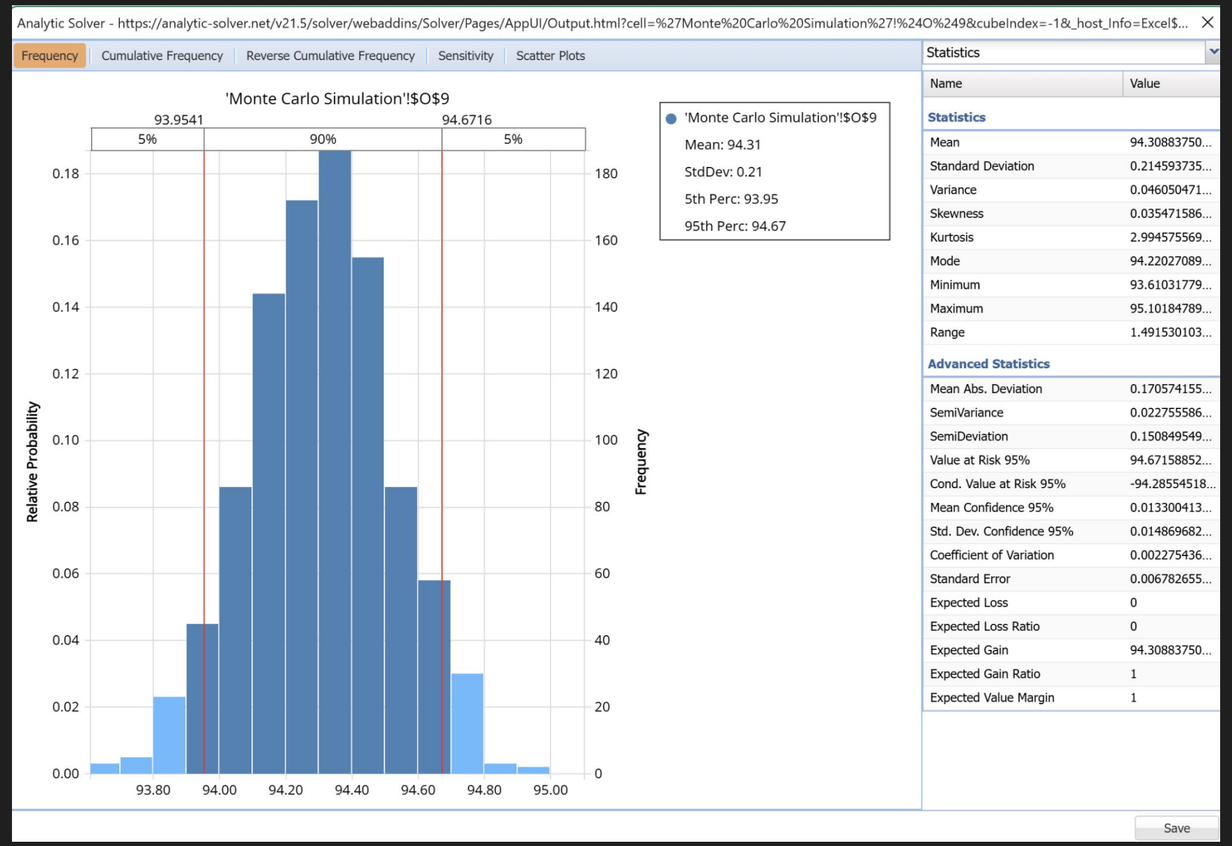
Single Simulation: 252 days (1 trial per day)

	A	B	C	D	E	F
1	**Starting Price**	85.91				
2	**Drift (μ)**	0.000371661				
3	**Volatility (σ)**	0.036409615				
4	**Total trading days**	252				
5	**Delta(Δ)**	0.003968254				
6	**Price of the previous day**	94.31				
7						
8		days (trials of 1 year)	simulated price	Increase or Decrease from the previous day		
9		1	94.33863793	TRUE		
10		2	94.39729045	TRUE	**Mean of the year**	93.42115861
11		3	94.37953163	FALSE	**Standard Deviation**	1.533005144
12		4	94.84726934	TRUE		
13		5	94.97921105	TRUE		
14		6	95.01020286	TRUE		
15		7	95.23934224	TRUE		
16		8	95.27326585	TRUE		
17		9	95.20140629	FALSE		
18		10	95.41441678	TRUE		
19		11	95.31970559	FALSE		
20		12	95.72387575	TRUE		
21		13	95.66862366	FALSE		
22		14	95.88536569	TRUE		
23		15	95.83663119	FALSE		
24		16	96.05329202	TRUE		
25		17	96.03074659	FALSE		
26		18	95.81173694	FALSE		
27		19	95.70111272	FALSE		
28		20	95.35702634	FALSE		
29		21	95.1850686	FALSE		
30		22	95.21607163	TRUE		
31		23	95.08528153	FALSE		
32		24	95.34079694	TRUE		
33		25	95.28071753	FALSE		
34		26	95.09033745	FALSE		
35		27	95.07685943	FALSE		



Summary Statistics





- Using Analytic Solver to run 1000 trials for each day of the year
- Average Stock Price trends downwards
- Distribution for 1 day, the Mean is 94.31
- Distribution for 1 day, 95% Chance that the stock per day will not go over 94.67 which is less than our 10% profit margin
- Therefore, we should **NOT** invest in NVIDIA

Additional Features

Feature 1:

- Conditional Formatting
  - The cell will be highlighted green if the stock price increased from the previous day and will be highlighted red if it decreased.

Feature 2:

- 10% Profit or Loss Threshold
  - Added two lines to our graph that indicate a 10% profit or loss.
  - A 10% profit from the starting stock price is 103.74
  - A 10% loss from the starting stock price is 84.88

Advantages and Drawbacks to using Monte Carlo

Advantages:

- Able to simulate a years worth of possible stock prices
- Quantify risk and return
- Visualize the effect of volatility and drift on stock prices
- Data-Driven Decision
- Create Distributions
- Confidence Intervals

Drawbacks:

- The model is not able to fully capture real market dynamics
- Dependent on Historical Data
- Not able to take into account external factors such as economic conditions or real world events
  - Ex: Tariffs leading to a sudden 7.8% drop in price