# Exploring the Extent of the Predictive Power of a Monte Carlo Simulation in Forecasting 7-Day Ahead Closing Stock Prices for Palantir Technologies Inc. (NYSE: PLTR)

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## Abstract:

This paper applies a Monte Carlo simulation to model short-term movements in Palantir Technologies' stock price. Using the Geometric Brownian Motion (GBM) framework, 50,000 simulated price paths were generated over a 7-day horizon beginning at an initial value of $177. The simulation produced an average Day 7 price of $182.21 with a standard deviation of 18.74. The distribution of outcomes was wide, ranging from a minimum of $103 to a maximum of $283, with a slight positive skew (0.41) and excess kurtosis (2.9). These results confirm that the Monte Carlo approach captures both central tendencies and tail risks, enabling the calculation of measures such as Value at Risk (VaR) and Conditional Value at Risk (CVaR). However, the findings also highlight limitations of the GBM model, including its assumption of constant volatility and its tendency to exaggerate extreme outcomes. The study concludes that Monte Carlo simulation is best understood as a tool for quantifying uncertainty and risk rather than for producing precise short-term forecasts.

## Introduction:

The stock market is inherently uncertain. Prices fluctuate due to company fundamentals, macroeconomic conditions, investor sentiment, and countless other factors. For decades, analysts and investors have searched for methods to model or predict these movements. One such approach is the Monte Carlo simulation, a computational technique that leverages randomness to explore possible outcomes. Originally developed during World War II by Stanislaw Ulam and John von Neumann while working on nuclear weapon research at Los Alamos, Monte Carlo simulations were later applied in diverse domains ranging from statistical mechanics to financial engineering. The name "Monte Carlo" itself was inspired by the famous casino in Monaco, highlighting the role of randomness and probability in the method. In finance, Monte Carlo simulations are used to estimate option prices, calculate value-

at-risk (VaR), stress test portfolios, and model the evolution of stock prices. The advantage of Monte Carlo over deterministic models is that it produces a full probability distribution rather than a single number. This allows traders, investors, and analysts to gauge not only the expected outcome but also the range of risks and uncertainties. For this paper, I selected Palantir Technologies (NYSE: PLTR) as the stock to test the Monte Carlo method on. Palantir is a data analytics and artificial intelligence company that has drawn significant media and investor attention since going public. Its stock has been volatile, with sharp swings driven by both optimism about AI and skepticism about long-term profitability. Because of this volatility, Palantir provides a good test case for examining how Monte Carlo simulations perform in predicting short-term stock movements.

The goal of this paper is not to generate a trading strategy or guarantee returns but rather to evaluate the predictive power of the Monte Carlo simulation in a realistic financial setting. Specifically, I will apply a Monte Carlo model to estimate Palantir's stock price distribution over a 7-day horizon and assess whether the results provide meaningful insights about future price behavior.

## Methodology:

The methodology consists of three steps:

1. **Model selection**: Using the Geometric Brownian Motion (GBM) framework to describe stock price dynamics.

2. **Parameter estimation**: Converting annualized return and volatility into daily values.

3. **Simulation implementation**: Running 50,000 trials in Google Sheets to generate a distribution of outcomes.

### 1. Model Selection

Stock prices are commonly modeled using Geometric Brownian Motion (GBM). GBM is given by the stochastic differential equation:

$dS_t = \mu S_t dt + \sigma S_t dW_t$

where:

- $S_t$ = stock price at time t
- $\mu$ = expected return (drift)
- $\sigma$ = volatility
- $dW_t$ = Wiener process (random shock from a normal distribution)

Discretizing this into a formula suitable for simulation gives:

$S_{t+1}=St\times e^{(\mu-1/2\sigma^2)\Delta t+\sigma\sqrt{\Delta t}Z)}$

where $Z\sim N(0,1)$. This formula ensures that prices remain positive and that returns are normally distributed on a log scale.

**2. Parameter Estimation**

The simulation started with an initial price $S_0$=177 (Yahoo Finance). Annualized return Annualized return ($\mu_{annual}$) and volatility ($\sigma_{annual}$) were assumed based on historical data. Because stock prices are modeled daily, these values must be converted:

$$\mu_{daily} = \frac{\mu_{annual}}{252}, \sigma_{daily} = \frac{\sigma_{annual}}{\sqrt{252}}$$

where 252 is the approximate number of trading days in a year.

The annual standard deviation is listed at 0.4636, therefore daily standard deviation (or daily volatility) would be:

$$\sigma_{daily} = \frac{0.4636}{\sqrt{252}} = 0.0292$$

**3. Simulation Implementation**

The simulation was built in Google Sheets, which allowed random sampling using built-in functions.

● Day 0 price was set at $177 (Yahoo Finance).

● For each day t, a new Z value was generated using NORMINV(RAND(),0,1).

● The next day's price was computed using the GBM formula.

● This was repeated for 7 days to generate one path.

To capture uncertainty, the process was repeated 50,000 times, producing a large sample of possible outcomes. This number of iterations ensures convergence of the averages and a smooth probability distribution.

**Average Path Results:**

The average simulated prices were:

Table 1: Simulated Prices

| ay: | ay 0: | ay 1: | ay 2: | ay 3: | ay 4: | ay 5: | ay 6: | ay 7: |
|---|---|---|---|---|---|---|---|---|
| verages: | 77.73 | 77.72 | 78.43 | 79.19 | 79.98 | 80.69 | 81.46 | 82.21 |

# Results

The Monte Carlo simulation generated 50,000 sample paths for Palantir Technologies' stock price over a 7-day horizon. The starting price was $177 (Yahoo Finance), and the results at Day 7 were:

- **Mean (Day 7):** $182.21
- **Standard deviation (Day 7):** 18.74
- **Median (Day 7):** $181.76
- **Minimum observed value:** $103
- **Maximum observed value:** $283
- **Skewness:** 0.41
- **Excess kurtosis:** 2.9

Most simulated outcomes fell in the range $170–195, though extreme paths extended further in both directions. The theoretical 95% confidence interval (mean ± 1.96σ) was [$145, $219], while the empirical 95% range from the simulations was approximately [$149, $217].

On **August 14, 2025**, which was 7 trading days after the initial date, Palantir's actual closing price was **$182.41** (Yahoo Finance). This value falls almost exactly on the simulated mean and within the densest portion of the predicted distribution.

# Discussion

The fact that the actual stock price landed at $182.41, nearly identical to the simulated mean of $182.21, provides evidence that the model's central tendency captured short-term price behavior accurately in this case. This alignment, however, should be interpreted with caution:

1. **Match to the mean.** The observed outcome supports the idea that the GBM framework, even with simplifying assumptions, can approximate expected short-term movement reasonably well.

2. **Range of outcomes.** Although the observed value matched the mean, the model also produced extreme paths ranging from $103 to $283. This shows that while the average was accurate, the simulation overstated the likelihood of extreme deviations.

3. **Risk measures validated.** The actual closing price lies well inside the 95% confidence interval of [$145, $219]. This suggests that, for short horizons, Monte Carlo can provide reliable probability bounds even if tail outcomes are overstated.

4. **Predictive caution.** One correct prediction does not prove predictive power in general. The close match could partly reflect chance. If the same experiment were repeated across multiple 7-day windows, the observed prices would not always align as neatly with the simulated mean.

# Conclusion

This study used a Monte Carlo simulation with 50,000 paths under a Geometric Brownian Motion model to estimate Palantir's stock price over a 7-day horizon. The predicted Day 7 mean was $182.21, with a wide distribution ranging from $103 to $283 and a standard deviation of 18.74.

On **August 14, 2025**, Palantir's actual closing price was **$182.41**, only $0.20 away from the simulated mean. This close agreement shows that the model's central forecast was consistent with observed market behavior during this

period. At the same time, the large simulated range illustrates the method's main limitation: while the mean may be accurate, the spread of outcomes can exaggerate the likelihood of extreme scenarios.

The results reinforce the idea that Monte Carlo simulations are most valuable for **describing the range of potential outcomes and quantifying risk**, rather than for pinpointing exact prices. In this case, the method successfully contained the realized price within its predicted distribution and even matched the mean closely, but such accuracy should not be expected every time. For practical forecasting, Monte Carlo should be combined with other models—such as volatility clustering models (GARCH) or jump-diffusion processes—and with fundamental analysis to improve robustness.

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