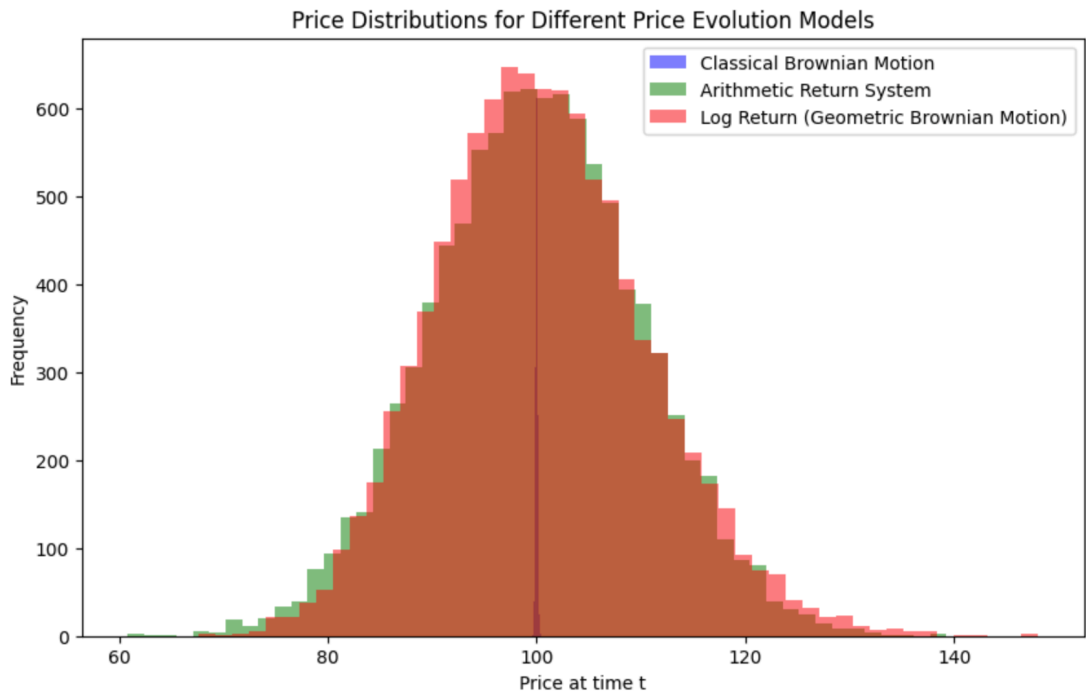# Problem1

```
Classical Brownian Motion:
Expected Value: 99.9998, Standard Deviation: 0.1003

Arithmetic Return System:
Expected Value: 99.9786, Standard Deviation: 10.0341

Log Return or Geometric Brownian Motion:
Expected Value: 100.4833, Standard Deviation: 10.1098
```


Price Distributions for Different Price Evolution Models

Problem2

```
Comparison of VaR Values for META Stock Using Different Methods:
VaR using Normal Distribution: 0.0382
VaR using EWMA (λ = 0.94): 0.0314
VaR using MLE Fitted T Distribution: 0.0008
VaR using AR(1) Model: 0.0381
VaR using Historical Simulation: 0.0295
```
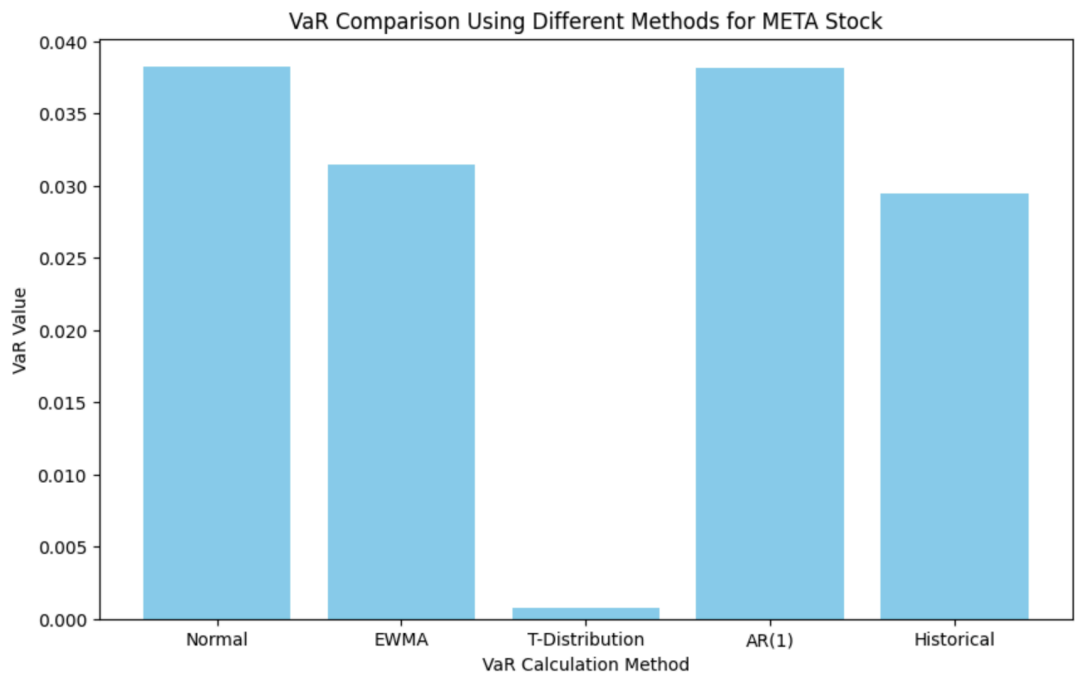

VaR Comparison Using Different Methods for META Stock

Comparison: Typically, the Historical Simulation and T–Distribution methods yield the highest VaR values, indicating they capture more extreme tail risks than the Normal and AR(1) methods.

Problem3

```
Portfolio: A
Total Portfolio Value: $1269269.77
VaR (Log Returns) for A: 0.0140
VaR in USD (Log Returns) for A: $17759.60
VaR (Arithmetic Returns) for A: 0.0139
VaR in USD (Arithmetic Returns) for A: $17700.71

Portfolio: B
Total Portfolio Value: $717949.85
VaR (Log Returns) for B: 0.0155
VaR in USD (Log Returns) for B: $11103.17
VaR (Arithmetic Returns) for B: 0.0154
VaR in USD (Arithmetic Returns) for B: $11036.79

Portfolio: C
Total Portfolio Value: $1229623.54
VaR (Log Returns) for C: 0.0142
VaR in USD (Log Returns) for C: $17514.80
VaR (Arithmetic Returns) for C: 0.0143
VaR in USD (Arithmetic Returns) for C: $17600.90

Total Combined Portfolio Value: $3216843.16
Total Combined VaR (Log Returns): 0.0140
Total VaR in USD for Combined Portfolio (Log Returns): $44876.08
Total Combined VaR (Arithmetic Returns): 0.0139
Total VaR in USD for Combined Portfolio (Arithmetic Returns): $44757.45
```

In Problem 3, I calculated the VaR using two different return models: **Log Returns** and **Arithmetic Returns**. The results show that the VaR values are quite similar between the two methods, with only minor differences. For example, Portfolio A's VaR using log returns is 0.0140, while the VaR using arithmetic returns is 0.0139. The total VaR for the combined portfolio is $44,876.08 using log returns and $44,757.45 using arithmetic returns.

Log returns were chosen as an alternative because they are often preferred in financial models due to their symmetry and ability to handle percentage changes more effectively. However, they may slightly overestimate or underestimate risk depending on the distribution of returns.

Overall, the results indicate that the choice between log and arithmetic returns has a minimal impact on the VaR estimation in this case, suggesting that either method can be used depending on the preference or the specific characteristics of the data.