Equity Analysis
FINC 772

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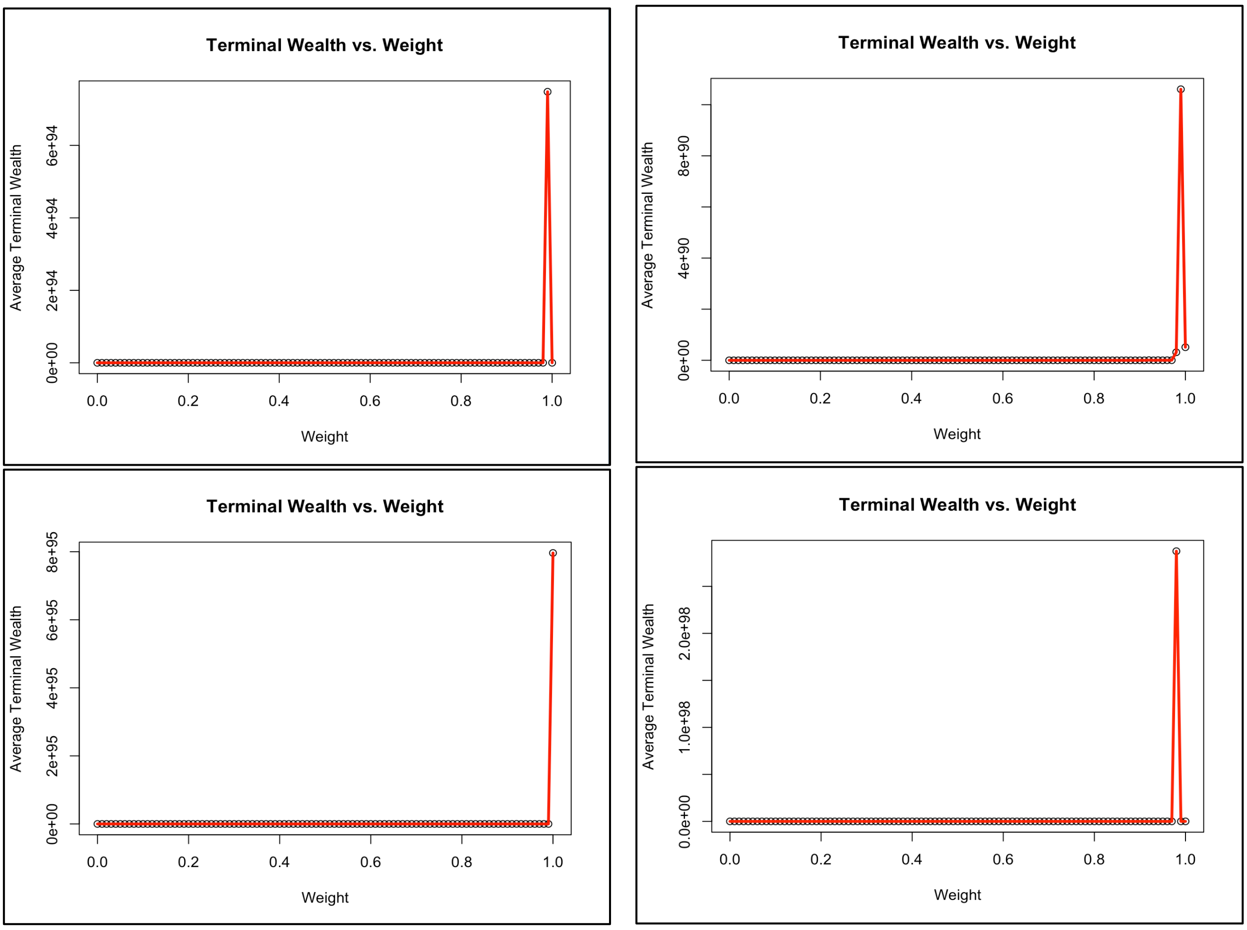
Project 1

Testing Results

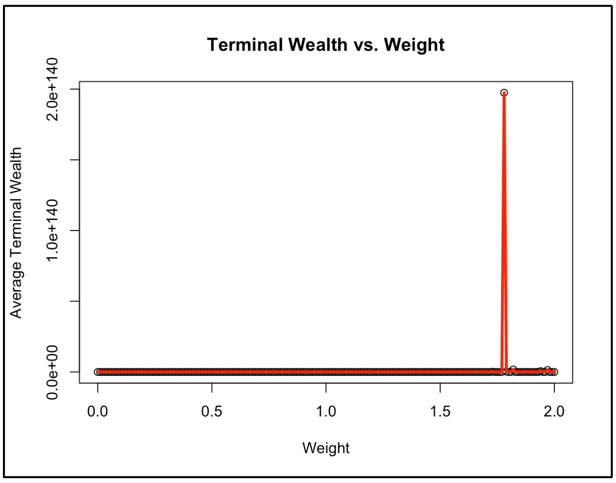
US Stock Market case i.e. with drift set to 10% and volatility is set to 20%, and the maximum allowed weight is set to 1, implying we won't ever want to deal in the market on margin, and can use a 100% of our income. Other constants are as follows:

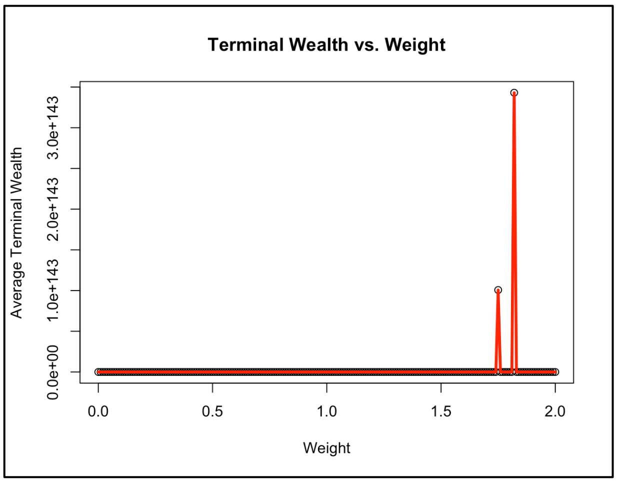
Initial Weight = 1
Minimum Weight = 0
Number of Rounds = 2,500
Number of Simulations = 50
Search Step = 0.01

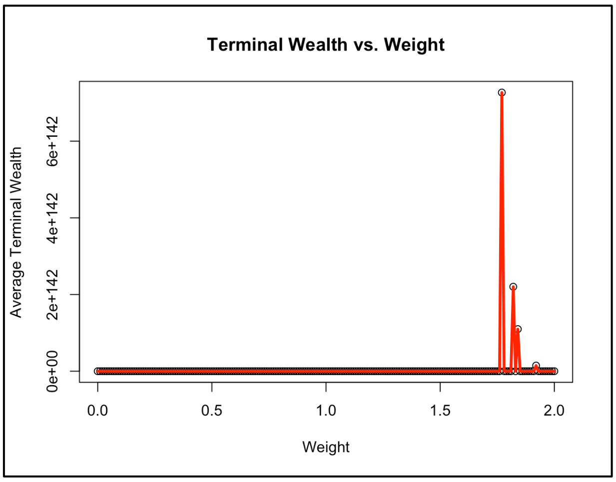
When simulating stock returns using the Geometric Brownian Motion on R, the optimal weights were always around 1. Here are the results plotted on a graph (0.98, 0.99, 1.00, 0.97):

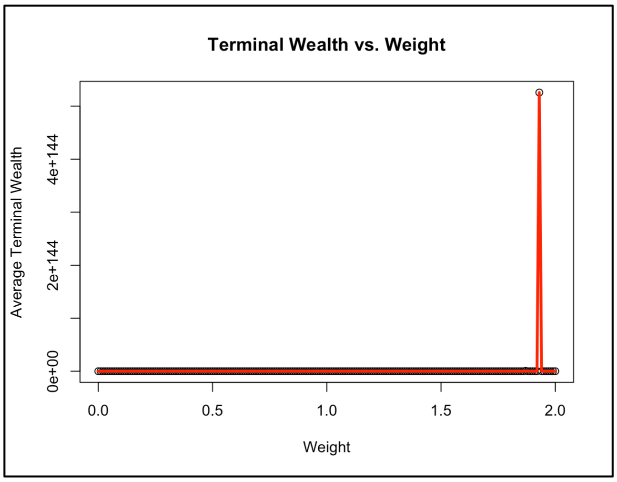


When we allowed ourselves a maximum leverage of a 100%, i.e. set the maximum weight to 2, we got the following results (1.78, 1.82, 1.77, 1.93):







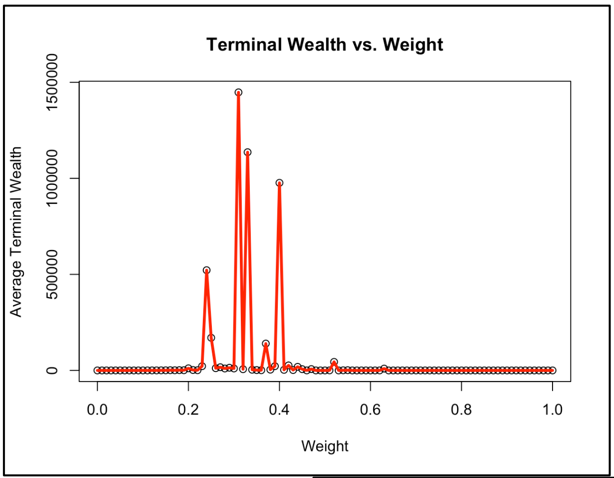


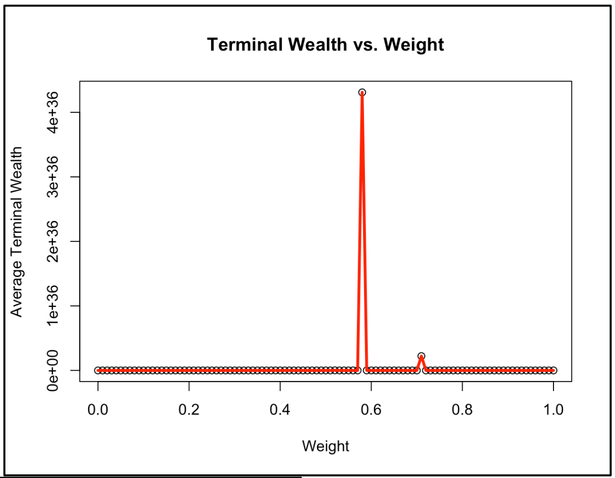
Testing Other Cases:

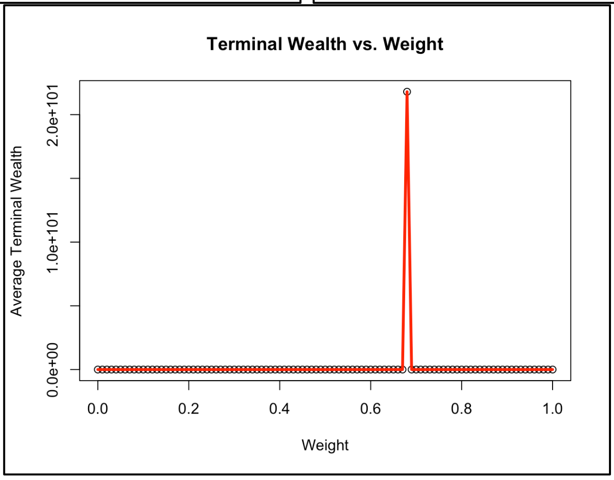
Here are theoretical values of Drift (mu), and Volatility (sigma) that give the optimal weights as 0.2, 0.5, and 0.8, :

mu	**sigma**	**W***	**W*(Simulated)**
0.018	0.3	0.2	0.31, 0.30, 0.32, 0.28
0.08	0.4	0.5	0.58, 0.67, 0.56, 0.53
0.2	0.5	0.8	0.68, 0.69, 0.7, 0.65

Here are the optimal weights







Conclusion

In the first two cases, where the theoretical optimal weights (0.2 & 0.5) as calculated by the Kelly Criterion's with Normal Distribution expression, the simulated optimal weights have always been higher. Whereas, in the third case, where the theoretical equation gave us optimal weight of 0.8, the simulated optimal weights have always been lower.

The differences observed in the theoretical optimal weights vs. simulated optimal weights may be credited to the fact that theoretical optimal weight calculation is done by maximizing the expected logarithmic growth of wealth, whereas while coding on R and simulating, we used a regular arithmetic mean, which is more sensitive to few extreme high-value outcomes—which would have been otherwise smoothed out by the logarithm theoretically.

When I researched more using ChatGPT, it gave me the following reasoning:

"*For the cases where the theoretical optimum is low (0.2 or 0.5), it appears that a slightly higher bet fraction in the simulation can capture a few rare but very high outcomes. These rare outcomes push up the arithmetic average, causing the simulated optimal weight to be higher than the Kelly prediction.*

Conversely, when the theoretical optimal weight is high (0.8), the risk of ruin becomes much more pronounced. The simulation's "wipe-out" mechanism—where wealth is set to zero if it becomes negative—means that betting too aggressively results in many instances of catastrophic losses. These losses drag down the arithmetic average, so the simulation ends up favoring a lower weight than the theoretical 0.8."