Optimized Option Stocks Trading with use of Simulation and Machine Learning

Summary

We have developed a method for Option Trading using Simulation, Machine Learning and optimization. Distribution of the pricing for desired stock(s) is/are predicted for any given day in future by means of simulation. The predicted distributions are then linked to the existing option strikes, to calculate probabilities and profit/loss, geared with a particular option strategy. Optimization techniques will then adjust the short and long positions to maximize profit for a given strategy, and any desired probability cut-off will serve as a constraint in the optimization process.

Introduction

Predicting any exact stock price for a given day in future is a challenging task, instead in this work we use simulation methods to come up with a range (distribution) predicted stock price. Having the distribution of any stock price for a certain day in future, enable us to calculate probability, and profit/loss, once is geared with available option strikes and a particular option strategy.

Workflow & Methodology

Step 1, Simulation:

We first read the past history of stock(s) pricing, from publicly available data, for a long enough lookback period, like 60 months, and calculate the past Daily Return Distribution (DRD)

We then Perform simulation to produce the distribution of price for a given day in future:

- I) Price for tomorrow = price for today multiply by a random sample from the DRD
- II) Price for the day after tomorrow = Price for tomorrow by a random sample from the DRD, we repeat this sequence until reaching the desired day in future
- III) Repeat the step I & II for 'n' times (n should be large enough like 100000 times)

The predicted 'n' samples, establish a price distribution for us, and will be used later for probability & profit/loss calculation. Figure 1, represent doing simulation, for n times, for the desired day in future; in the figure the desired day is 9 days from last know day for pricing.

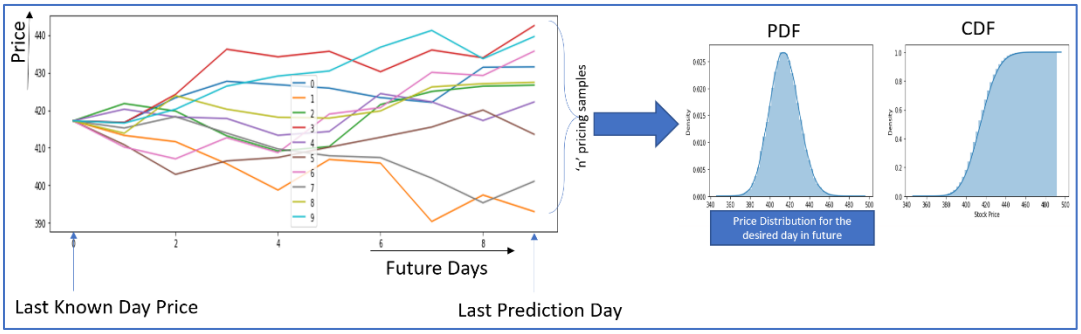


Figure 1, simulation for 'n' times, for illustration in this figure 'n' is 9, for a desired day in future; the desired day in futures is 9 days from the last know day in this figure however n need be large enough like 100000 times in real practice. This n-samples for the desired day in future will be used later for probability & profit/loss calculation

Step 2, Option Strategy:

Now that we have the price distribution for the desired day in future, we then proceed with reading the option strike prices for that day. Figure 2 shows the strategy that we follow, we sell (write) two strikes equal to L and H, L is a call and H a put option, and we buy two other strikes equal to L2 and H2, H2 is a call and L2 a put option. Based on the earlier simulation results, it is expected the price to stay between of L & H, with considerable high probability, let's say 95%. The L2 and H2 purchased options will serve as safety factors, to limit the loss, in case price drops lower than L or goes higher than H. Green and red brackets show potential profit and loss:

- If price stay between L & H will produce profit for us
- If price stay between L & L2 or H & H2 will cause loss for us
- If price goes beyond H2 or drops below L2 will generate profit for us

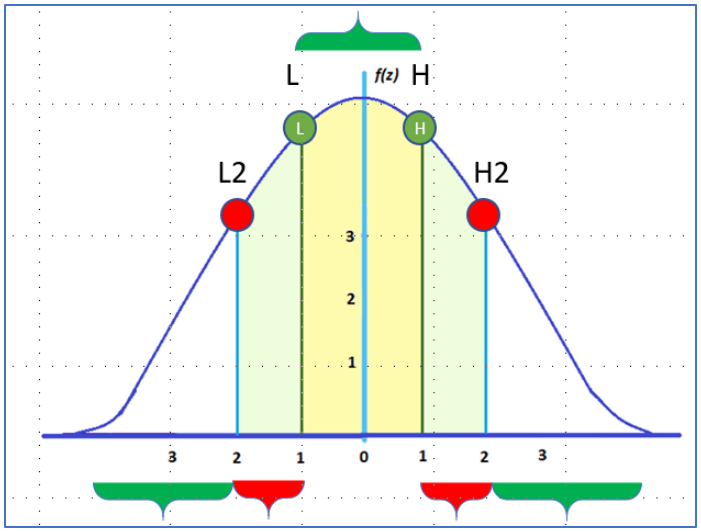
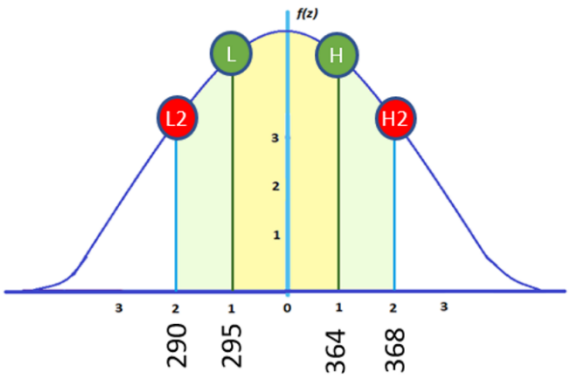


Figure 2, Option Strategy: Write (sell) option strikes at L and H, and buy option strikes at L2 & H2

Figure 3, represents a real example for the stock 'QQQ', performed on 6th of May 2021 for the desired day in future on 19th of May. L, H, L2 and H2 were strike prices at $295, $364, $290 and $368. The bid/ask prices for such strikes were $0.02, $0.41, $0.32 and $0.02.

The calculated expected profit for 2000 stocks of 'QQQ', following this option chain strategy, was $113.24 with 97% probability, and the immediate reward, once the transactions are performed, was $180:



Immediate reward calculation for 2000 stocks:

Gain: 2000*0.02= 40
2000*0.41=820

Loss: -2000*0.32=-640
-2000*0.02=-40

Total: Gain-Loss = 180

Calculated Expected profit & Probabilities for 2000 stock:

			H	L	L2	H2	Probabilities
Stocks List	Method_3_Expected_profit	Latest Price	Nearest Call to P10 : bid	Nearest Put to N10 : bid	Nearest Put to N12 : ask	Nearest Call to P12 : ask	P<P10, P>N10, N12<P<N10, P10<P<P10+2
QQQ	113.24	330.450012	{364.0: 0.02}	{295.0: 0.41}	{290.0: 0.32}	{368.0: 0.02}	[0.995, 0.992, 0.008, 0.005]

Figure 3, an example of immediate reward, calculated expected profit and probabilities calculation following this option strategy

Step 3, Optimization:

We can tweak the L, H, L2 and H2 points, to maximize the profit, while maintaining probability cutoff, for the stock price to remain in between of L & H, with optimization methods. Figure 4, shows for 'QQQ' and 'SPY' stocks, how tweaking the L, H, L2 and H2, while maintaining the probability of price to stay between L and H more than 95%, can change the profit. Obviously, we are after maximizing profit while keeping the chance for price happening in between of L & H higher than any desired cutoff, recommend to be above 95%.

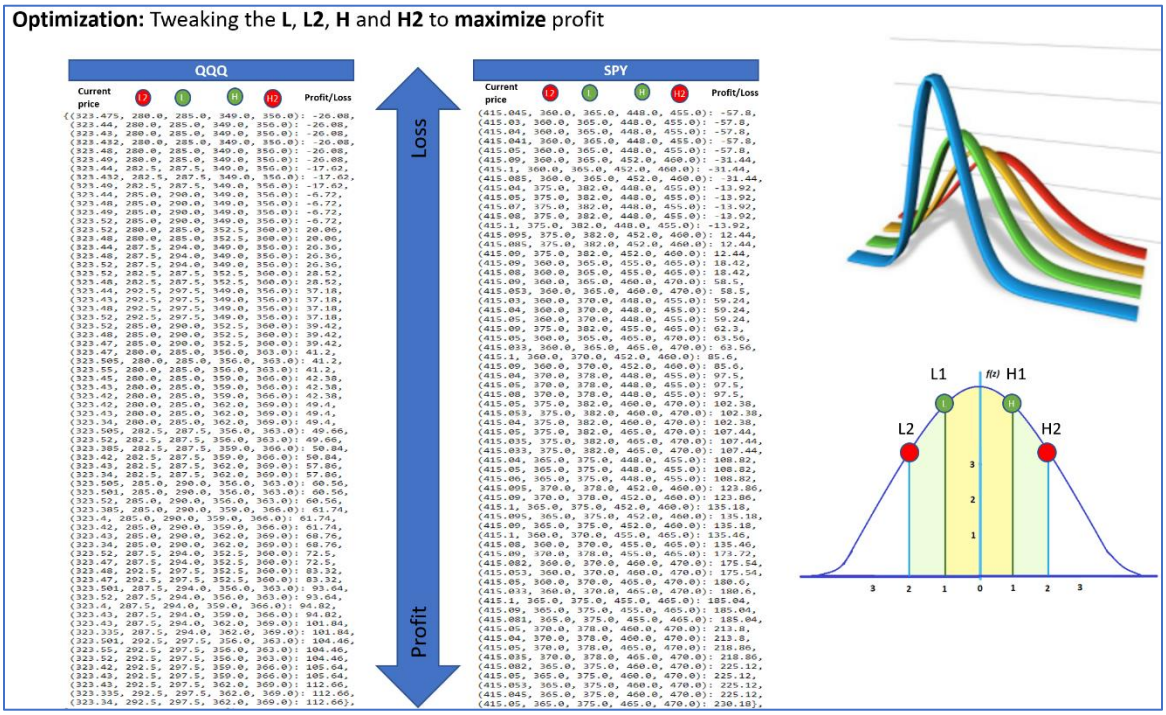


Figure 4, Tweaking L, L2, H and H2 to maximize profit for 'QQQ' and 'SPY'

Once we optimized our profit for a particular day, now we can loop through various days and finally select the day to trade for, the day that produce the optimum margin for us. Figure 5 illustrates, the analysis that was done on 17th of May, the maximized profit for available option strike days from 19th of May to 2nd of June are illustrated. The arrows indicate the days where the maximized profit looks good for trading.

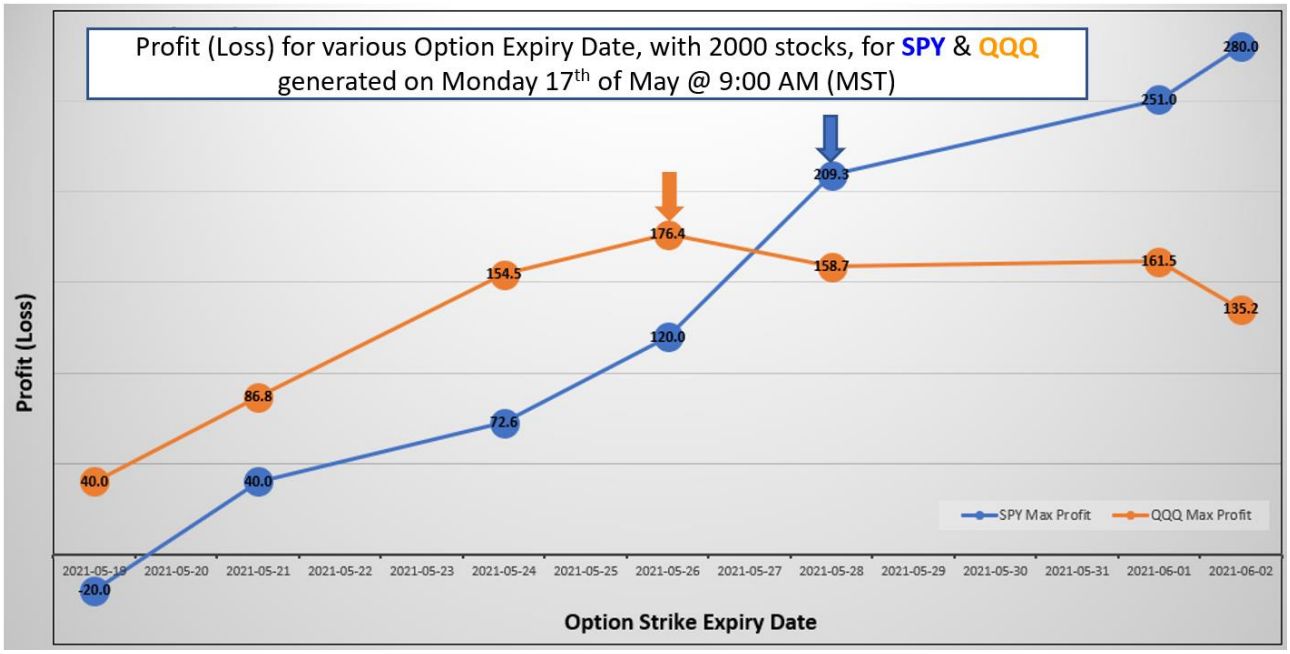


Figure 5, selecting the days in short-term future, based on the maximized profit trends. The arrows suggest the days with promising profits.