MAT1856/APM466 Assignment 2

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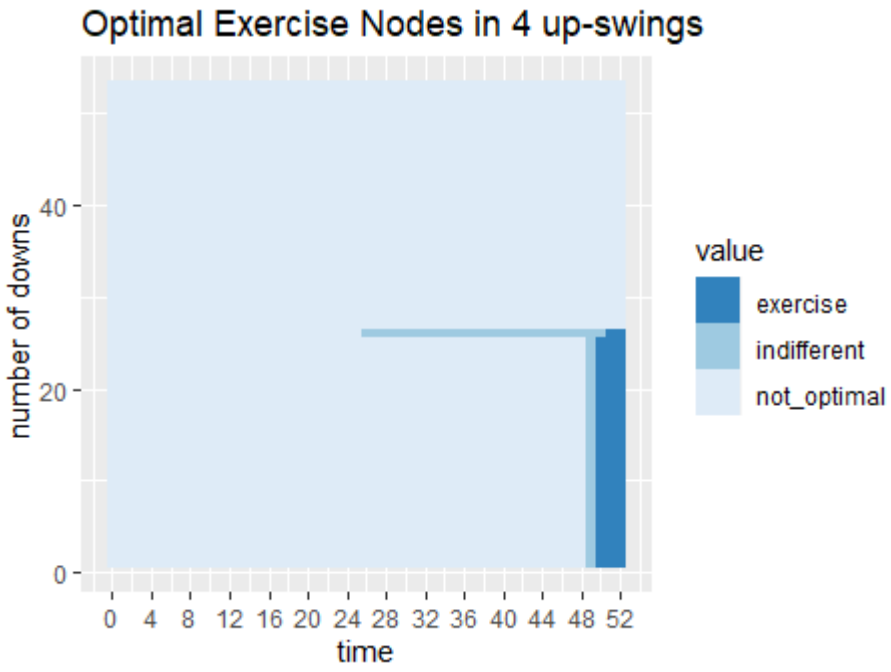
Call Option- 4 Upswing Tree

Cost of 4 Upswing Price Protection for Mr. Hamilton

According to the simulation, the price of a four upswing option is $1.0625/liter of gasoline. Mr. Hamilton would have to pay $53.125 for this price protection plan for 52 weeks period.

Optimal Exercising Periods

As the graph below shows, the four upswing option is not optimal to exercise in most holding periods. However, it becomes more worthy to exercise in the last few weeks. The reason is that if Mr. Hamilton decide not to exercise the option while it is still in the money, with limitation of one exercise per week, some options will expire worthless. Therefore, we see a thicker layer of optimal nodes to exercise close to the expiry date.



note: The y-axis of the graph is the number of time the price of underlying decreases.

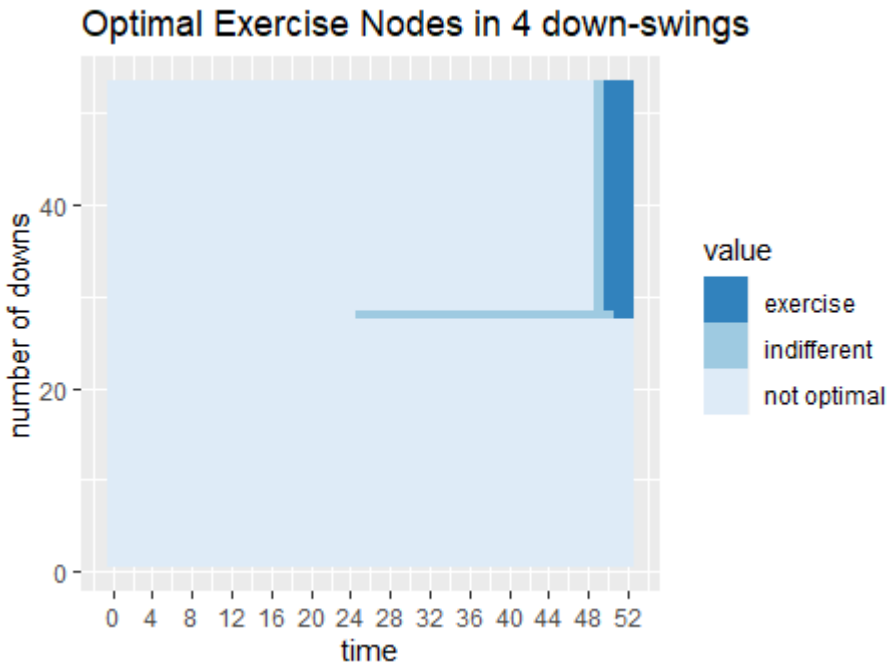
Put Option- 4 Downswing Tree

Price of 4 Downswing Price Protection Plan for Ms. Curie

For the 4 downswing option, according to our simulation, it costs \$1.0635/liter for the price protection plan. Thus, the price protection program would cost Ms. Curie \$53,175 to have the right to sell her gasoline at \$50,000 for the 52 weeks period.

Optimal Exercising Periods

The graph below shows the optimal exercising periods for Ms. Curie. We again observed that optimal exercising periods is concentrated closer to the end of the holding periods since while holding the put option, the option itself has time value in it.



Steps to Calculate Swing Option Price

1. Calculate all the possible outcomes of the underlying price at the end of 52 weeks period and subtract the final price by strike price to get the final period value for the European Options

2. Since the price of the underlying either moves up 10 percent or down 10 percent, we can use matrix below to back propagate all the option prices before the 52 week.

$$\begin{bmatrix} 1.1 & 0.1 \\ 0.909 & -0.909 \end{bmatrix}$$

3. The first time when we back propagate, we get the American Call/Put Option.

4. To get the 2 upswing/downswing option price, we again start from the 52nd period of the tree, calculate the price of the 51st period by simply adding the price of the nodes from the previous 1 upswing/downswing tree with the cash value of exercising the option at 51st period. After this step, we

obtain the intrinsic value of the option on the 51st week. Repeat the back propagation to get the price of the tree.

5. Repeat the same process for 3, 4 upswing/downswing trees. Note, the price in the last 2 periods in 2 upswing/downswing would be the same as 3 upswing/downswing tree since we have the limitation of 1 exercise per week.

6. Compare price of option in each node with the value after exercising one option at a time to identify the optimal exercising periods.

References and GitHub Link to Code

Citations

1. Mostovoy, J. (n.d.). Pricing Discrete Option. Retrieved March 13, 2021, from https://www.risklab.utoronto.ca/mostovoy-2/for-students