# 3. Making Sense of Option Price in the Market

On 16 November 2021, the market prices of call option on Tesla stock is as follows. The expiration date of these option is 20 May 2022.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TSLA220520C00950000 | 2021-11-15 3:03PM EST | 950.00 | 214.00 | 0.00 | 0.00 | 0.00 | - | 24 | 0 | 0.00% |
| TSLA220520C00960000 | 2021-11-15 3:27PM EST | 960.00 | 203.75 | 0.00 | 0.00 | 0.00 | - | 5 | 0 | 0.00% |
| TSLA220520C00970000 | 2021-11-15 2:57PM EST | 970.00 | 193.55 | 0.00 | 0.00 | 0.00 | - | 13 | 0 | 0.00% |
| TSLA220520C00980000 | 2021-11-15 1:35PM EST | 980.00 | 174.10 | 0.00 | 0.00 | 0.00 | - | 8 | 0 | 0.00% |
| TSLA220520C00990000 | 2021-11-15 2:41PM EST | 990.00 | 168.00 | 0.00 | 0.00 | 0.00 | - | 43 | 0 | 0.00% |
| TSLA220520C01000000 | 2021-11-15 3:57PM EST | 1,000.00 | 183.10 | 0.00 | 0.00 | 0.00 | - | 320 | 0 | 0.00% |
| TSLA220520C01025000 | 2021-11-15 3:43PM EST | 1,025.00 | 167.00 | 0.00 | 0.00 | 0.00 | - | 15 | 0 | 0.39% |
| TSLA220520C01050000 | 2021-11-15 3:15PM EST | 1,050.00 | 165.00 | 0.00 | 0.00 | 0.00 | - | 68 | 0 | 0.78% |
| TSLA220520C01075000 | 2021-11-15 3:59PM EST | 1,075.00 | 152.28 | 0.00 | 0.00 | 0.00 | - | 52 | 0 | 1.56% |
| TSLA220520C01100000 | 2021-11-15 3:40PM EST | 1,100.00 | 140.00 | 0.00 | 0.00 | 0.00 | - | 107 | 0 | 3.13% |
| TSLA220520C01125000 | 2021-11-15 2:35PM EST | 1,125.00 | 118.94 | 0.00 | 0.00 | 0.00 | - | 16 | 0 | 3.13% |
| TSLA220520C01150000 | 2021-11-15 3:19PM EST | 1,150.00 | 129.90 | 0.00 | 0.00 | 0.00 | - | 34 | 0 | 3.13% |

[source: Yahoo finance]

We find that the market price of call with strike price of \$1,000 is \$183.10. Assuming that this option is European, we want to compare the market price to the theoretical price that we can obtain from a binomial tree. The current stock price is \$1,013.39 and the risk-free interest rate is 0.5% per annum. In constructing the binomial tree, we make the following assumptions:

- We approximate that the time to expiration is six months.
- We use a 10-step binomial tree.

(a) What are $u$ and $d$ in the binomial tree? Use the volatility estimate for Tesla stock from Assignment 7 Question 4.

(b) Construct the table showing the possible stock prices and option payoff at the option maturity and their probabilities as follows:

| Number of up | Number of down | Stock price at maturity | Probability | Option Payoff |
|---|---|---|---|---|
| 10 | 0 | | | |
| 9 | 1 | | | |
| ⋮ | ⋮ | | | |

(c) What is the option price?

(d) Compare the theoretical price to the market price. Are they close to each other? What can we do to better estimate the option price?