TESLA OPTION PRICING

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Introduction :

In finance, a call option is when a seller promised the buyer has the right, not the obligation to buy or sell a security at a specified price up until, or at, its expiration date. There are two popular style options, American and European style. American allows for buyers to exercise their right up until the expiration date whereas European allows buyers to exercise their right on the expiration date. The Black Scholes Model and the Binomial Models are both popular methods on predicting call prices. We decide to use both of the models in predicting call options for Tesla.

Tesla is an American automaker, energy storage company, and solar panel manufacturer based in Palo Alto, California. Founded in 2003, the company specializes in electric cars, lithium-ion battery energy storage, and residential photovoltaic panels (through the subsidiary company SolarCity).The additional products Tesla sells include the Tesla Powerwall and Powerpack batteries, solar panels and solar roof tiles. Tesla is barely a decade old and is making incredible leaps in the automotive industry. With the realization that high performance electric vehicles can give 100 torque in an instant, and the idea that electric cars don’t have to look like electric cars, Tesla flourished.

Tesla innovates and changes the way not just electric vehicles are viewed, but the automotive industry too, it cases curiosity on how

they have been doing in the stock market. We used the Binomial Model and the Black-Scholes Model to help determine prices and compared them to the value of the actual price of the call option. These models were developed to determine accurate prediction of the market and fair pricing on the call options., If the models provide accurate data, then it can be concluded that it would be a relatively accurate way to estimate the value of Tesla stock in the future. This is important for investors that are interested in Tesla, and want to have an idea of what the market will entail in the future.

Methodology:

1. Binomial Option Pricing :

The binomial option pricing model is an options valuation method developed in 1979. The binomial option pricing model uses an iterative procedure, allowing for the specification of nodes, or points in time, during the time span between the valuation date and the option's expiration date. The model reduces possibilities of price changes, and removes the possibility for arbitrage.

Here, our starting time [t(0)] is December 08, 2017 and we are calculating it for 10 period ending on February 16, 2018. Our each period is 1 week.

Periods = 10

Time (T) = 10 weeks = 7 * 10 / 365 = 0.19

Price : $315

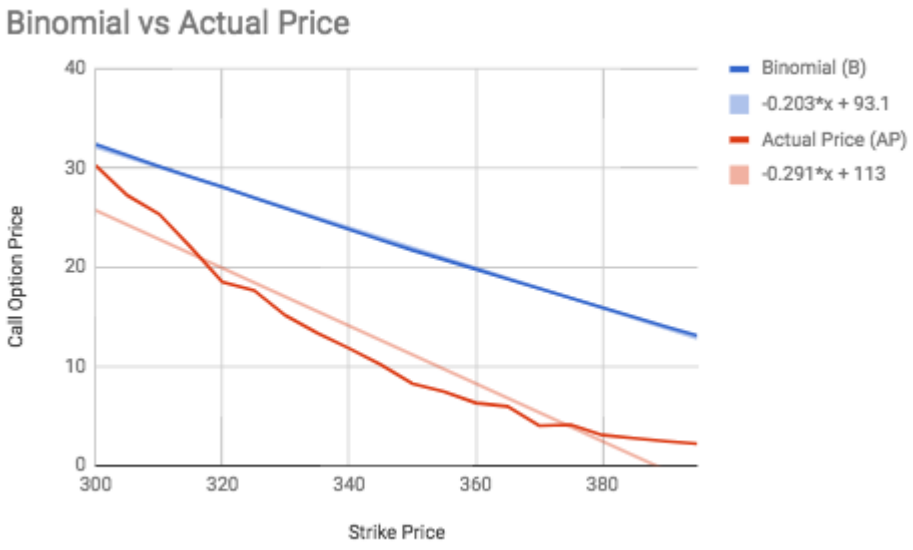
$p = ((1 + r)^t - d) / (u - d)$

Up (u) = 6 %

Down (d) = - 6 %

Risk-free rate = 20%

$Call\ Option\ (C) = (p\ C_u + (1-p)\ C_d) / (1+ r)^T$



Black-Scholes Model:

The Black-Scholes Model was developed by Fischer Black, Myron Scholes, and Robert Merton. It is used to calculate the theoretical value of European-style options using current data. Below is the Black-Scholes formula.

$$V_c = P_0 N_{d1} - \frac{X}{e^{Rft}} N_{d2}$$

$$d_1 = \frac{\ln\left(\frac{P0}{X}\right) + (Rf + .5\sigma^2)t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

Where,

V_c = value of the call

P_0 = stock price, $315

N_d = from standard normal distribution table

X = exercise price ,$300 to $395 moving in increments of $5

R_f = Risk free rate, 20%

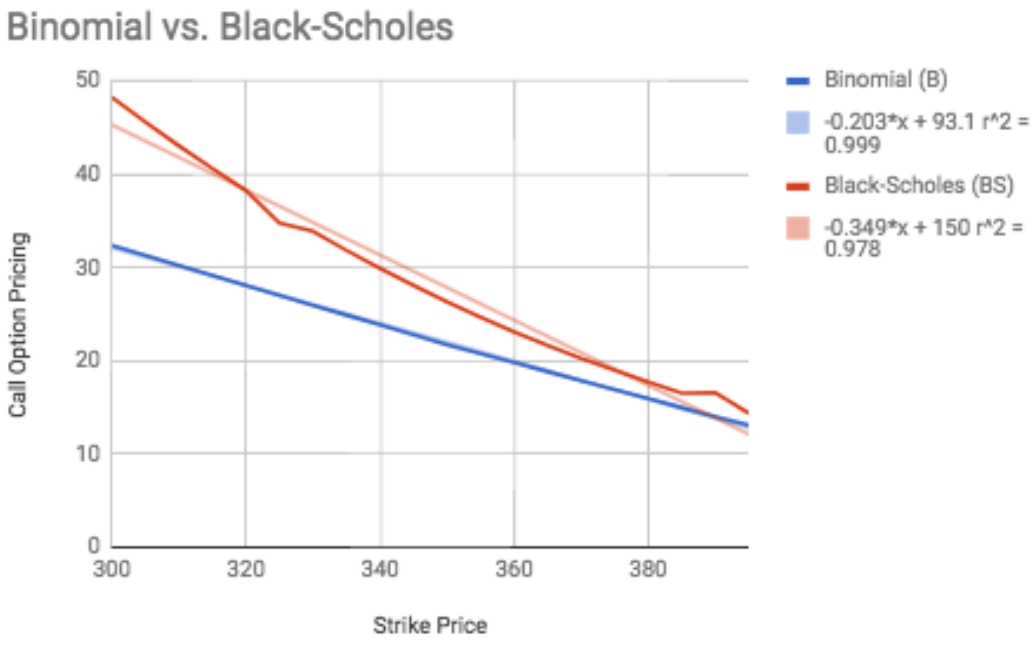
t = time, 1/52 * 10 for a one week periods for 10 weeks total

σ^2 =volatility, can't be measured but we use variance as a guess

To get the volatility, we calculated the standard deviation of the closing price for Tesla stocks from the NASDAQ from a 5 year period, from 2012 to 2014. We used 20 different exercise prices starting at 300 and increasing in increments of 5. We chose the risk free rate of 20%. Time was measured at 10 weeks total, and used a current stock price of $315. The graph below shows the option pricing of the Black-Scholes Model and the actual pricing of the option.

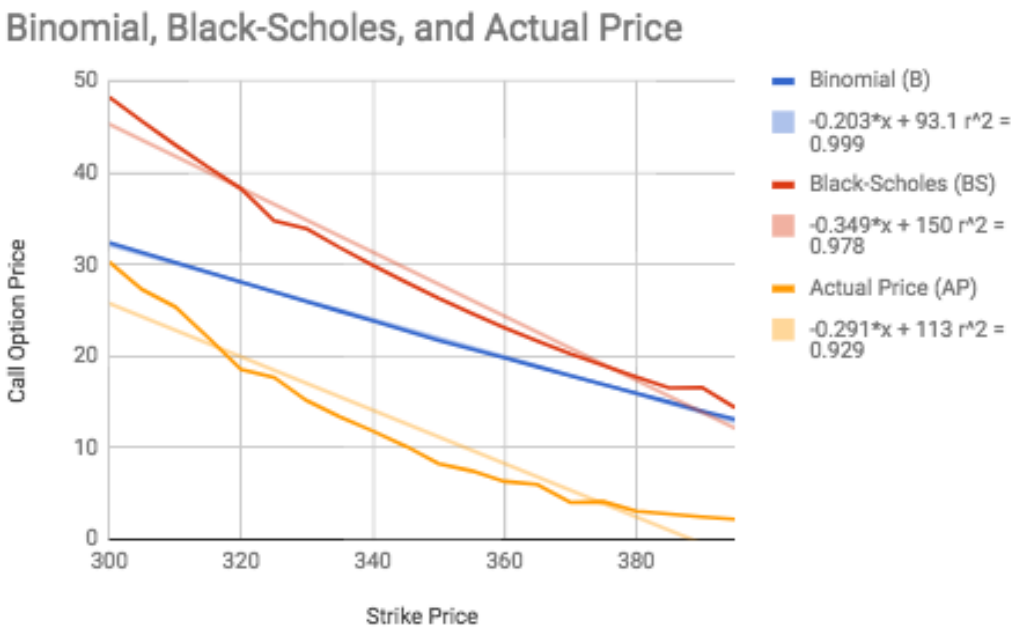
It can be seen that the actual pricing of the model was off compared to the actual pricing, but the trends are similar. They are both decreasing with a similar slope of which the Black-Scholes being -.349 and the slope of actual prices being -.291.

Binomial vs. Black-Scholes



Both models have underlying assumptions, that stock prices follow a stochastic process determined by brownian motion. Because of this, the Binomial Model and the Black-Scholes Model converge as the number of binomial calculation steps increase. It can be seen in the graph above, that as we continue to increase the strike price input, the models converge toward each other.

Comparison of Binomial, Black-Scholes and Actual Call Option Pricing :



Strike Price	Binomial (B)	Black-Scholes (BS)	Actual Price (AP)	B - AP	BS - B	BS - AP
300	32.42	48.28	30.3	2.12	15.86	17.98
305	31.32	45.6	27.27	4.05	14.28	18.33
310	30.23	43.07	25.4	4.83	12.84	17.67
315	29.17	40.62	22.05	7.12	11.45	18.57
320	28.12	38.27	18.55	9.57	10.15	19.72
325	27.04	34.8	17.7	9.34	7.76	17.1
330	25.98	33.89	15.15	10.83	7.91	18.74
335	24.92	31.86	13.4	11.52	6.94	18.46
340	23.85	29.94	11.85	12	6.09	18.09
345	22.79	28.11	10.2	12.59	5.32	17.91
350	21.75	26.36	8.3	13.45	4.61	18.06
355	20.79	24.71	7.5	13.29	3.92	17.21
360	19.83	23.14	6.35	13.48	3.31	16.79
365	18.86	21.66	6	12.86	2.8	15.66
370	17.9	20.27	4.05	13.85	2.37	16.22
375	16.94	18.99	4.14	12.8	2.05	14.85
380	15.98	17.74	3.11	12.87	1.76	14.63
385	15.01	16.55	2.8	12.21	1.54	13.75
390	14.05	16.59	2.49	11.56	2.54	14.1
395	13.16	14.42	2.23	10.93	1.26	12.19

The results showed that the Binomial Model produced more accurate results compared to the Black Scholes Model. The Binomial Model allows for more flexibility with each step, as inputs can be changed since it uses discrete time periods where Black Scholes using continuous time. Because Black Scholes depends on a constant risk free rate, it causes challenges for accuracy as interest rates fluctuate a lot in the market. Regardless, both models produced values that were considerably off from the actual price. This can result from the risk free rate we chose which was 20% and the strike price. Volatility can't be measured as well, so we used the standard deviation of closing prices as an estimator for volatility, which could have affected the results as well.

Stock price of Tesla in the Last 5 years :

Works Cited

"Tesla, Inc. Common Stock (TSLA)." NASDAQ.com, www.nasdaq.com/symbol/tsla.