REPORT 1, Call Option pricing Using Static Binomial Model

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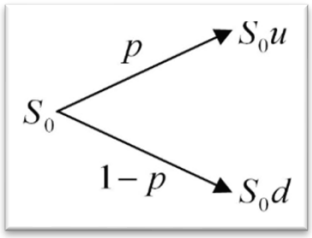
Option pricing or the estimation of the value of an option contract, can be carried out using several models for the stock price. In this report we try to estimate the call option price of a specific underlying using static binomial model.



First, we should choose a non-dividant underlying. We choose Charter Communications, Inc.

Choosing fixed maturities, 3 month or 6 month, we look through all the deals for call and put options with different strike prices. For this report we choose a contrat with ATM strike price; A strike price equal to current value of the underlying. One of the key paramteres of static binomial model is volatility.

In order to estimate volatility we use the historical data of underlying price. Through Yahoo Finanace website, we download the 6 months stock price of Charter company and import it on Excel (data column is hidden). Dropping all uncessecary coloumns, we end up with adj close price of charter during 6 last months. The return of each day is calcluated using:

$$R(t) = \frac{S(t) - S(t-1)}{S(t-1)}$$

As a rule of thumb, for a maturity T, we should look back at T days before to calculate the volatility. Based on this rule, we specify the corresponding time window of the underlying price and obtain the corresponding dailiy volatility.

We use Excel STD.D function to calculate the standard deviation of last T days, which corresponds to our daily volatility. We then convert the daily volatility to yearly volatility based on the follwing:

$$\text{Sigma(yearly)}=\sqrt{252}\ *\text{Sigma(daily)}$$

Another paramtere we need is r, the interest rate. We can find it using global-rates.com. The 3 and 6 month interest rate on 22 march is written in the table below.

	T (working days)	Volatility (yearly)	K	R (march 22 2022)
3 Month	0.25	0.265498826	560	0.95%
6 Month	0.5	0.271673879	560	1.38%

with all cards on the table, we try to estimate the price of our option using static binomial model

$$q = \frac{e^{RT} - d}{u - d}$$

$$C = e^{-RT}[q(Su - k) + (1 - q)(Sd - k)]$$

u	d	q	Estimation	Real Price	est. Error
1.13275	0.867250587	0.508973674	47.708669	40	19%
1.1921	0.807897558	0.518011223	65.962138	46	43%

$$est.error = \frac{\text{real price} - \text{est. price}}{\text{real price}}$$

First Columns of Data

3 sig yearly	0.265498826	6 sig yearly	0.271673879
3 sigma	0.016724854	6 sigma	0.017113846

3 month	3 month return	6 month	6 month return
652.349976		734.40997	
655.789978	0.005273246	727.48999	-0.009422507
656.280029	0.000747268	733.17999	0.007821418

657.22998	0.001447478	727.56	-0.007665232
651.969971	-0.0080033	738.08002	0.014459315
647.580017	-0.006733368	740.96002	0.003902023
640.77002	-0.01051607	747.78998	0.009217712
624.859985	-0.024829556	743.75	-0.005402557
631.950012	0.011346585	741.95001	-0.002420152
610.48999	-0.033958417	706.13001	-0.048278195
605.429993	-0.008288419	695.22998	-0.015436286
612.099976	0.011016935	690.62	-0.006630878
613.97998	0.0030714	696.22998	0.008123114