

Description

- This project is aimed at building a discrete-time tree that is consistent with observed option prices and historical prices.
- The final goal will be to code the implied tree of Rubinstein (The Journal of Finance. Vol. LXIX, No. 3. July 1994). This model is an extension of the basic Cox, Ross, Rubinstein's Binomial model which attempts to incorporate not only volatility information of the stock, but also current market prices of liquid options.
- The algorithms will be calibrated to current and historical market price data of options of a liquid stock (say, Google, Microsoft, or SPX index). The maturity of interest is of about six months. Market data of options is widely available online.

Tasks:

1. Use appropriate current Treasury bill data to determine a continuously compounded interest rate suitable to price your options.
Note: You need to indicated precisely your sources of data and document your procedure.
2. Write code(s) to determine the “posterior risk-neutral prices” described in pp. 782-785 of Rubinstein's referred paper. This can be done using a Matlab's minimization routine called `fmincon`, that you will have to get familiar with, or any other minimization routine with constrains.
3. Apply your code in (2) to determine the implied risk-neutral probability measures for each of the two following priori volatilities: (a) a 6 month or 1 year historical volatility based on daily prices of the asset; (b) the implied volatility of the two closest-the-money option prices as in Rubisntein's paper¹. For each case, provide a graph of the risk-neutral probabilities similar to Figure 4 in Rubinstein's paper.
4. Write code(s) to find the implied Binomial tree along the lines of Rubinstein's paper, pp. 785-793.
5. Implement your code of (4) to determine the implied tree for your stock.
6. Use your tree to find the price an American put option of the stock traded in the market.

¹The implied volatility of an option is that value of the volatility that makes the Black-Scholes option price equal to the observed market price of the option. There are many online calculators of BS option prices that produce the implied volatilities automatically.