SML Final Project Problem 2

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1 Traversing the Tree Diagonally

We had studied various Option Pricing Models like Black Scholes Option Pricing Model, Monte Carlo Simulation, and Binomial Option Pricing Model.Traversing via the Binomial Tree is the simplest method for pricing options.

One of the simplest and fastest method for Traversing through the Binomial model for option pricing is the use of *Traversal Through the Diagonal of the Binomial Tree.* This is a method to price the call and Put options which is generally faster than the usual *Standard Quadratic Time Backward Induction* through the Binomial Tree.

While traversing through Diagonals, there are two kinds of nodes to keep in mind: Early Exercise Nodes and Non-Early Exercise Nodes. Early Exercise Nodes: These are the nodes whose both successor nodes are exercised early. These are the nodes which are exercised early. Non-Early Exercise Node: These are the nodes whose all earlier nodes at the same horizontal level.

Since all the nodes on the Diagonal will have been evaluated by the time when the result is moved up and down, the time complexity of the Binomial tree using this method would be O(n) with linear space requirement.

When the early-exercise node has been found on a diagonal, the traversal is stopped and moved to the new diagonal. The option value which has been calculated is equal to the sum of the discounted option values on the Diagonal Node. For a node on the diagonal, resulted due to the i ups and j downs from the root, the probability that the stock hits the diagonal for the first time is $\binom{i+j-1}{i}\ p^i\ (1-p)^j$

In case of a dividend paying stock, the probability is given by $p = \frac{e^{(r-q)\Delta t}}{u-d}$

The percentage of the visited nodes by this method is seen to be almost constant with the increasing volatility.

Conclusion: The method of using Traversing The Tree Diagonally for Option Pricing is linear and is faster than using the Standard Quadratic Time Backward Induction Method and the computation time is in the order of *O(n).*