Memorandum

To: Mr. Programmer

From: Math548 Team5

Subject: Implementation of binomial model

Date: Monday, Nov. 30, 2014

Build the model

For this part you are supposed to build a function with 7 inputs and 1 output. Here is a list of 7 inputs and their required data types.

name	type
S0	float64
K	float64
r	float64
u	float64
T	float64
M	int
opType	binary('call' or 'put')

You also need to use 4 temporary variables in the function and they are all depend on the input, here is a list.

name	formula	type
d	=1/u	float64
q	=(1/df-d)/(u-d)	float64
dt	= T/M	float64
df	= 1/(1+r)*dt	float64

You then need to build a **full binary tree** with depth M rooted with value $S0$, and each two children nodes should have exactly this relation with parent node: left child $= d*$Parent, right child $= u*$Parent. Use this to initialize the whole tree.
After all nodes are initialized, assign all leaf nodes with new value:

$$= \begin{cases} \max(\text{init value} - K, 0) & \text{if opType} =' call' \\ \max(K - \text{init value}, 0) & \text{if opType} =' put' \end{cases}$$

Again for this new value each parent node has the following relation with its child nodes: $parent = [(1-q) * \text{left child} + q * \text{right child}] * df$, use this to find the new value of root node backward and that value should be your ouput.

Calculation of u

For this part, you are required to find u given the other 6 inputs in previous part and 1 more input–$Price_{market}$.

First, assume the function you defined in last part is "model", you need to define a function $F(u) = model(S0, K, r, u, T, M, opType) - Price_{market}$

Second, use a non-linear solver to solve $F(u) = 0$

Calibrate the model

For this part you need to find the best u calculated from k sets of 6+1 inputs parameters. First, with given calculate all $Price_{pred} = model(S0, K, r, u, T, M, opType)$. Then calculate $err = mean(\frac{|price_{pred} - price_{market}|}{price_{market}})$. At last, find the u corresponding to the smallest err.