tr_kamradritchken_bs2d

Input parameters:

- StepNumber N

Output parameters:

- Price
- Delta1
- Delta2

This is taken from [1]. It is a 5-node tree which is a two-dimensional version of the 3-node Kamrad-Ritchken (KR) tree. The space state is a product of the one-dimensional KR tree, with the same stretch parameter λ in the two directions (for some Barrier Options contracts it may be interesting to take differents λ's. The corresponding calculation of the risk-neutral probabilities should be done yet). This is a flat tree with $(2N+1)^2$ possible values of the underlying (S_1, S_2) throughout the option's life.

/*Memory Allocation*/

/*Up and Down factors*/
Here $u1 = e^{\lambda\sigma_1\sqrt{h}}$, $d1 = e^{-\lambda\sigma_1\sqrt{h}}$, $u2 = e^{\lambda\sigma_2\sqrt{h}}$, $d2 = e^{-\lambda\sigma_2\sqrt{h}}$: in each direction the grid is that of a standard KR tree.

/*Risk-Neutral Probabilities*/
These are computed by matching the two first moment conditions with the same trick as in the one-dimensional KR tree (cf. Routine tr_kamradritchken_bs.c) : the second moment condition is replaced by the equality of the second *moment* of the conditional random walk in the tree with the variance of the continuous limit logarithm of the Black-Scholes diffusion: the variances still match at order $o(h)$ so that convergence follows from Kushner's theorem (cf Convergence result for Tree methods in finance) whereas the calculations are simpler.

/*Terminal Values*/
Since this is a flat tree we store the intrinsic values in an array as explained in Routine tr_coxrossrubinstein.c.

/*Backward Cycle*/
Notice that the indexing of the price array P is relative to the lower-left corner of the state space values at a fixed time whereas the intrinsic value array indexing iv is absolute. This accounts for the shift k in the index in `P[i][j]`=MAX(iv[k+i][k+j],P[i][j]);

/*Deltas*/
We call a function which computes the two deltas in a finite-difference manner in bs2d_std2d.h.

/*First Time Step*/

/*Price*/

/*Memory desallocation*/

References

[1] B.KAMRAD P.RITCHKEN. Multinomial approximating models for options with k state variables. *Management Science*, 37:1640–1652, 1991. 1