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tr_kamradritchken_bs

Input parameters:

- StepNumber N
- StretchParameter λ (should be greater than 1)

Output parameters:

- Price
- Delta

This is taken from [1]. It is a 3-node tree which is the archetype of a trinomial tree. This is a flat tree with $2N+1$ possible values of the underlying S_1 throughout the option's life.

/*Price, intrinsic value arrays*/

/*Up and Down factors*/
 Here $u = e^{\lambda\sigma\sqrt{h}}$, $d = e^{-\lambda\sigma\sqrt{h}}$. The third node is $m = 1$.

/*Discounted Probability*/

These are computed by matching the two first moment conditions with a simplifying trick: 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. The computation is detailed [there](#). The stretch parameter λ is free with the following restrictions: it should be greater than 1 for the center-node probability to be positive and smaller

$$\text{than } \frac{\sigma}{\left| r - \text{diviv} - \frac{\sigma^2}{2} \right| \sqrt{h}}$$

/*Intrinsic value initialisation and terminal values*/

Since this is a flat tree we store the intrinsic values in an array as explained in [Routine tr_coxrossrubinstein_c](#).

/*Backward Resolution*/

Notice that the indexing of the price array P is relative to the lower of the underlying values at a fixed time whereas the intrinsic value array indexing iv is absolute. This accounts for the shift j in the index in

$$P[j] = \text{MAX}(iv[j+i], P[j])$$

/*Delta*/

We keep the formula of the CRR delta. Here it is no longer a perfect-hedging delta in the discrete-time scheme since this is an incomplete market. The convergence can be proved in the same manner as for the CRR delta (cf [there](#)). There maybe other more clever choices using the center node.

/*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.