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tr_lnthirdmoment

Input parameters:

- StepNumber N

Output parameters:

- Price
- Delta

This tree is taken from [1]. This is a trinomial tree in which the local consistency for the approximating chain, with respect to the logarithm of the Black-Scholes model, holds up to the fourth moment. This gives an order of accuracy of $o(h^2)$ and for smooth payoffs (...) an order of convergence better than h (cf. [there](#)).

The calculations are described [there](#).

/*Price array*/

/*Up and Down factors*/

Here $u = e^{\left(r - \text{diviv} - \frac{\sigma^2}{2}\right)h + \sigma\sqrt{3}h}$, $d = e^{\left(r - \text{diviv} - \frac{\sigma^2}{2}\right)h - \sigma\sqrt{3}h}$.

/*Discounted Probability*/

Plainly $e^{-rh} * \frac{1}{6}$. This is the discounted probability of the up and down states.

/*Terminal values*/

We start the indexing from below. Clearly the intermediate variable `iv` is useless. For clarity, why not?

/*Backward Resolution*/

Notice that the indexing of the price array P is relative to the lower of the underlying values at a fixed time. We recompute at each time step the lower value of the underlying (`lowerstock`) then at each node the value of the underlying. The number of points at each time step is the previous one (backward) minus 2 since this is a trinomial tree. The coding of the backward conditionnal expectation tries to minimize the number of times

operation:

$P[j] = \text{proba} * (P[j] + 4 * P[j+1] + P[j+2])$

/*Delta*/

We keep the formula of the CRR delta. The convergence can be proved in the same manner as for the CRR delta (cf [there](#)). Other maybe more clever choices are possible?

/*First Time Step*/

/*Price*/

/*Memory desallocation*/

References

- [1] D.LAMBERTON. Random walk approximation and option prices. *Proceedings of the 5th CAP Workshop on Mathematical Finance, Columbia University, November 1998*, page Unknown, 1999. 1