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fd_fixedasian_beh

Input parameters:

- TimeStepNumber N
- SpaceStepNumber1 p
- SpaceStepNumber2 q

Output parameters:

- Price
- Delta

Ben Hameur, Breton and Lécuyer [1] approximate the Amerasian call or put option by the corresponding Bermudean option with n equally spaced possible exercise states. They proposed a method based on finite elements to solve the corresponding dynamic programming problem. The approximate price $\tilde{w}_m(s, \bar{s}')$ of the Bermudean asian option at time $\frac{m}{n}T$ when the spot is equal to s and the average to $\frac{(m-1)\bar{s}'+s}{m}$ is taken globally continuous and bilinear on each rectangle of a grid of size $(p+1) \times (q+1)$. It is computed by backward recursion on the n possible exercise dates. This recursion is initialized by using a closed formula at time $\frac{n-1}{n}T$. At each step, the computation begins with the calculation of the values of \tilde{w}_m at each point of the grid using \tilde{w}_{m+1} and some values computed once and depending only of the grid : P_{ik}, Q_{ik} . Then the four coefficients of \tilde{w}_m on each rectangle are given by solving a very simple 4×4 system.

/*The standard normal cumulative distribution function*/

gives the value $N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-u^2/2} du$ using an approximation with precision 10^{-7} .

/*Computation of the grid*/

The grid used is the one given by Ben Hameur, Breton and Lecuyer; it is computed once and stored in two unidimensionnal arrays.

/*Calculation of the P_{ik} and Q_{ik} */

The P_{ik} and Q_{ik} are values used in the backward recursion; they are calculated once at the beginning and stored in two bidimensionnal arrays.

/*Calculation of w_{n-1} */

The values of \tilde{w}_{n-1} at each point of the grid are computed thanks to a Black and Scholes type closed-formula.

/*The values of \tilde{w}_m on the grid*/

They are obtained from the coefficients of \tilde{w}_{m+1} and the P_{ik} , Q_{ik} .

/*The coefficients of the bilinear approximation*/

at time $\frac{m}{n}T$ are computed from the value of \tilde{w}_m at each point of the grid by solving a 4×4 system for each finite element(function solve).

/*The end of the program*/

At time t_1 and t_0 the approximation is only linear since the variable \bar{s}' is identically equal to 0. \tilde{w}_1 and \tilde{w}_0 are computed as described above but the approximation is now linear in s .

The approximated price and delta of the option are returned by the method.

/* Memory Desallocation */

References

- [1] H.Ben Hameur M.Breton P. L'Ecuyer. A numerical procedure for pricing american-style asian option. *preprint*, 1999. 1