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fd_fem_updownout_bs

Input parameters:

- SpaceStepNumber N
- TimeStepNumber M
- Theta $\frac{1}{2} \leq \theta \leq 1$
- Raffinement $1 \leq ref \leq 4$

Output parameters:

- Price
- Delta

This finite element scheme there used a trapeizodal grid that is refined near the barriers, using a simple bell-shaped function to compute the point density in space.[1] In the american case we use the splitting method. It seems that it converges very slowly.

/*Initial Mesh*/
Computation of initial mesh.

/*New Mesh*/
Computaton of new mesh.

/*Memory Allocation*/

/*Time Step*/
Define the time step $k = \frac{T}{N}$.

/*Space Step*/
Define the space step $h = \frac{2l}{M}$.

/*Terminal value*/
Put the value of the payoff into a vector P_Old which will be used to save the option value.

/*Finite difference Cycle*/
At any time step, described by the loop in the variable *TimeIndex*, we have to solve the system $M^h v = NP$.

/*New Mesh computing*/

/*Computation of Lhs coefficients*/

/*Computation of Rhs coefficients*/

/*Right factor*/
Compute the right side factor NP and save the result in the vector V.

/*Dirichlet Boundary Condition*/
We set Dirichlet Boundary conditions on the barrier.

/*Gauss method*/
We solve the system $M^h v = S$ in two steps:

1. First loop consists in solving $L\bar{v} = S$. The result is saved in S.
   there.
2. Second loop consists in solving $Uv = \bar{v} = S$. The result is saved in P.

/*Splitting for American case*/
For American options, we compare at each time step the solution of $M^h v = NP$ saved in P with the payoff function saved in *Obst*. We save the result in P there.

/*Price*/
One uses linear interpolation to find the option value corresponding to the initial stock price.

/*Delta*/
One uses linear interpolation to find the delta value corresponding to the initial stock price.

/*Memory Desallocation*/

References

[1] J.BUSCA. A finite element method for the valuation of american options. Technical report, C.A.R. Internal Report, 1998. 1