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fd_fem_out

Input parameters:

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

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