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## fd\_adi

Input parameters:

- TimeStepNumber  $M$
- SpaceStepNumber  $N$

Output parameters:

- Price
- Delta1
- Delta2

Alternate Direction Implicit methods were proposed by Peachman Rachford ([2]. At each time step, one can integrate “in each direction”(cf.[there](#)).

In the american case to solve the inequality one combines the projection by the splitting scheme with A.D.I. finite difference method. The idea of this scheme ([1]) is to split the American problem in twosteps(cf.[there](#)).

**/\*Memory Allocation\*/**

**/\*Covariance Matrix\*/**

**/\*Space localisation\*/**

Define the integration domain  $D = [-l, l]^2$  using probabilistic estimation.

**/\*Space Step\*/**

Define the space step  $h = \frac{2l}{M}$ .

**/\*Time Step\*/**

**/\*Rhs Factor of first step\*/**

The right-hand side factor of the first step of ADI scheme.

**/\*Rhs Factor of second step\*/**

The right-hand side factor of the second step of ADI scheme.

**/\*Terminal Values\*/**

Put the value of the payoff into a vector  $P$

**/\*Homegenous Dirichlet Conditions\*/**

**/\*Finite difference Cycle\*/**

At any time step, described by the loop in the variable *TimeIndex*, we have to solve the system (cf. [there](#))

**/\*First step\*/**

First step of ADI scheme.

**/\*Init Rhs\*/**

Compute the right-hand side.

**/\*Gauss Algorithm\*/**

Resolution of linear system with Gauss method. (cf. [there](#))

**/\*Second step\*/**

First step of ADI scheme.

**/\*Init Rhs\*/**

Compute the right-hand side.

**/\*Gauss Algorithm\*/**

Resolution of linear system with Gauss method. (cf. [there](#))

**/\*Splitting for American case\*/**

For American options, we compare at each time step the solution in  $P$  with the payoff function saved in  $iv$ . We save the result in  $P$

/\*Price\*/

/\*Delta\*/  
cf. [there](#).

/\*Memory Desallocation\*/

## References

- [1] S.VILLENEUVE A.ZANETTE. Parabolic A.D.I. methods for pricing american option on two stocks. *Mathematics of Operations Research*, pages 121–151, Feb 2002. [1](#)
- [2] D.W.PEACEMAN-H.H.RACHFORD Jr. The numerical solution of parabolic and elliptic differential equations. *J.of Siam*, 3:28–42, 1955. [1](#)