

[Help](#)

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#include <stdlib.h>
#define WITH_boundary 1
#include "bs1d_lim.h"
#include "error_msg.h"
#define PRECISION 1.0e-7 /*Precision for the localization of FD methods*/

static int Cryer_DownIn(double s, NumFunc_1 *p, double l, double rebate, double
{
    int      Index, PriceIndex, TimeIndex, ssl;
    double   k, vv, loc, h, z, alpha, beta, gamma, y, down, upwind_alphacoef, pric
    double   *Obst, *A, *B, *C, *P, *S, *Z, *Q, pricenh, pricen2h, priceph;

    /*Memory Allocation*/
    Obst = malloc((N + 1) * sizeof(double));
    if (Obst == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    A = malloc((N + 1) * sizeof(double));
    if (A == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    B = malloc((N + 1) * sizeof(double));
    if (B == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    C = malloc((N + 1) * sizeof(double));
    if (C == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    P = malloc((N + 1) * sizeof(double));
    if (P == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    S = malloc((N + 1) * sizeof(double));
    if (S == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    Z = malloc((N + 1) * sizeof(double));
    if (Z == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    Q = malloc((N + 1) * sizeof(double));
    if (Q == NULL)
        return MEMORY_ALLOCATION_FAILURE;

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/*Time Step*/
k = t / (double)M;

/*Space Localisation*/
vv = 0.5 * sigma * sigma;
z = (r - divid) - vv;
loc = sigma * sqrt(t) * sqrt(log(1.0 / PRECISION)) + fabs(z * t);

/*Space Step*/
y = log(s);
down = log(1);
h = (y + loc - down) / (double)(N);

/*Peclet Condition-Coefficient of diffusion augmented */
if ((h * fabs(z)) <= vv)
    upwind_alphacoef = 0.5;
else
{
    if (z > 0.) upwind_alphacoef = 0.0;
    else upwind_alphacoef = 1.0;
}
vv -= z * h * (upwind_alphacoef - 0.5);

/*Lhs Factor of theta-schema*/
alpha = k * (-vv / (h * h) + z / (2.0 * h));
beta = 1.0 + k * (r + 2.*vv / (h * h));
gamma = k * (-vv / (h * h) - z / (2.0 * h));

for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
{
    A[PriceIndex] = alpha;
    B[PriceIndex] = beta;
    C[PriceIndex] = gamma;
}

/*Terminal Values*/
y = log(s);
for (PriceIndex = 1; PriceIndex < N; PriceIndex++)
    Obst[PriceIndex - 1] = (p->Compute)(p->Par, exp(down + PriceIndex * h));
for (PriceIndex = 2; PriceIndex <= N - 2; PriceIndex++)
{

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        P[PriceIndex - 1] = alpha * Obst[PriceIndex - 2] +
                           beta * Obst[PriceIndex - 1] + gamma * Obst[PriceIndex]
    }

    P[0] = beta * Obst[0] + gamma * Obst[1];
    P[N - 2] = alpha * Obst[N - 3] + beta * Obst[N - 2];

    for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
    {
        S[PriceIndex] = 0.;
        Z[PriceIndex] = 0.;
    }
    ssl = false;

    /*Finite Difference Cycle*/
    for (TimeIndex = 1; TimeIndex <= M; TimeIndex++)
    {
        if (TimeIndex == 1)
            for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
                Z[PriceIndex] = rebate;
        else
            for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
                Z[PriceIndex] = Z[PriceIndex] + Obst[PriceIndex];

        for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
            Q[PriceIndex] = P[PriceIndex] - Z[PriceIndex];

        price1 = Boundary(1, p, (double)TimeIndex * k, r, divid, sigma);
        Q[0] += alpha * price1;
        Q[N - 2] += gamma * (p->Compute)(p->Par, exp(y + loc));

        AlgCrayner(N, Z, ssl, A, B, C, Q, S);

        for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
            S[PriceIndex] = Z[PriceIndex];

        ssl = true;
    }

    for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
        P[PriceIndex] = Z[PriceIndex] + Obst[PriceIndex];

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Index = (int)floor((y - down) / h) - 1;

/*Price*/
*ptprice = P[Index] + (P[Index + 1] - P[Index]) * (exp(y) - exp(down + h + Ind

/*Delta*/
pricenh = P[Index + 1] + (P[Index + 2] - P[Index + 1]) * (exp(y + h) - exp(dow
if (Index > 0)
{
    priceph = P[Index - 1] + (P[Index] - P[Index - 1]) * (exp(y - h) - exp(dow
    *ptdelta = (pricenh - priceph) / (2 * s * h);
}
else
{
    pricen2h = P[Index + 2] + (P[Index + 3] - P[Index + 2]) * (exp(y + 2 * h)
    *ptdelta = (4 * pricenh - pricen2h - 3 * (*ptprice)) / (2 * s * h);
}

/*Memory Desallocation*/
free(Obst);
free(A);
free(B);
free(C);
free(P);
free(S);
free(Z);
free(Q);

return OK;
}

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int CALC(FD_Cryer_DownIn)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;
    double r, divid, limit, rebate;

    r = log(1. + ptMod->R.Val.V_DOUBLE / 100.);
    divid = log(1. + ptMod->Divid.Val.V_DOUBLE / 100.);

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    limit = ((ptOpt->Limit.Val.V_NUMFUNC_1)->Compute)((ptOpt->Limit.Val.V_NUMFUNC_1)->Compute);
    rebate = ((ptOpt->Rebate.Val.V_NUMFUNC_1)->Compute)((ptOpt->Rebate.Val.V_NUMFUNC_1)->Compute);

    return Cryer_DownIn(ptMod->S0.Val.V_PDOUBLE, ptOpt->PayOff.Val.V_NUMFUNC_1,
                        limit, rebate, ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,
                        Met->Par[0].Val.V_INT2, Met->Par[1].Val.V_INT2,
                        &(Met->Res[0].Val.V_DOUBLE), &(Met->Res[1].Val.V_DOUBLE));
}

static int CHK_OPT(FD_Cryer_DownIn)(void *Opt, void *Mod)
{
    Option *ptOpt = (Option *)Opt;
    TYPEOPT *opt = (TYPEOPT *) (ptOpt->TypeOpt);

    if ((opt->Parisian).Val.V_BOOL == FALSE)
        if ((strcmp(((Option *)Opt)->Name, "CallDownInAmer") == 0) || (strcmp(((Option *)Opt)->Name, "PutDownInAmer") == 0))
            return OK;

    return WRONG;
}

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->Par[0].Val.V_INT2 = 100;
        Met->Par[1].Val.V_INT2 = 100;
    }

    return OK;
}

PricingMethod MET(FD_Cryer_DownIn) =
{
    "FD_Cryer_DownIn",
    { {"SpaceStepNumber", INT2, {100}, ALLOW }, {"TimeStepNumber", INT2, {100},
        {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(FD_Cryer_DownIn),
    {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID} , {" ", PREMIA_NULLTYPE, {0}, FORBID}
}

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    CHK_OPT(FD_Cryer_DownIn),  
    CHK_split,  
    MET(Init)  
};
```