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#include <stdlib.h>
#include "
href../../mod/bs1d/bs1d_doublim/bs1d_doublim_h_src.pdfbs1d_doublim.h"
#include "
href../../common/error_msg_h_src.pdferror_msg.h"

static int Ritchken_95_In(int am, double s, NumFunc_1 *L, NumFunc_1 *U, NumFunc_1 *D,
{

    int i, j, npoints, eta0, A0;
    double h, puu, pum, pud, pdu, pdd, pdm, rebate, z, up, down, stock, lowerstock;
    double *P, *G, *iv;

    npoints = 2 * N + 1;
    /*Price, intrinsic value arrays*/
    P = malloc(npoints * sizeof(double));
    if (P == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    G = malloc(npoints * sizeof(double));
    if (G == NULL)
        return MEMORY_ALLOCATION_FAILURE;
    iv = malloc(npoints * sizeof(double));
    if (iv == NULL)
        return MEMORY_ALLOCATION_FAILURE;

    /*Up and Down factors*/
    up = (U->Compute)(U->Par, 0);
    down = (L->Compute)(L->Par, 0);
    rebate = (Rebate->Compute)(Rebate->Par, 0);

    h = t / (double)N;

    eta = log(up / s) / (sigma * sqrt(h));
    eta0 = (int)floor(eta);

    /*The Up barrier is too close to S0-the algorithm fails*/
    if (eta0 < 2)
        return STEP_NUMBER_TOO_SMALL;
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/*Adjustment of lambda to set a level of the tree at the barrier*/
/*In case the step number is not sufficient, then take the usual parameter*/
if (eta0 > N)
{
    eta0 = N;
    /*In this case lambda keeps the value given in parameter*/
}
else
    lambda = eta / (double)eta0;

lsh = lambda * sigma * sqrt(h);
A = log(s / down) / lsh;
A0 = (int)floor(A) - 1;

/*The Down barrier is too close to S0-the algorithm fails*/
if (A0 < 0)
    return STEP_NUMBER_TOO_SMALL;

if (A0 > (N - 1))
{
    A0 = N - 1;
    gamma = 1.;
}
else
{
    sd = s * exp(-A0 * lsh);
    gamma = log(sd / down) / lsh;
}

npoints = eta0 + A0;

/*Up and Down factors*/
u = exp(lsh);
d = 1. / u;

/*Disconunted Probability*/
z = (r - divid) - SQR(sigma) / 2.;
puu = (1. / (2.*SQR(lambda)) + z * sqrt(h) / (2.*lambda * sigma));
pum = (1. - 1. / SQR(lambda));

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pud = (1. - puu - pum);
puu *= exp(-r * h);
pum *= exp(-r * h);
pud *= exp(-r * h);

a = z * sqrt(h) / (lambda * sigma);
b = 1.0 / SQR(lambda);
pdu = (b + a * gamma) / (1. + gamma);
pdd = (b - a) / (gamma * (1. + gamma));
pdm = (1. - pdu - pdd);
pdu *= exp(-r * h);
pdm *= exp(-r * h);
pdd *= exp(-r * h);

/*Intrinsic value initialization and terminal values*/
lowerstock = s;
for (i = 0; i < A0; i++)
{
    lowerstock *= d;
}

stock = lowerstock;

for (i = 0; i < npoints; i++)
{
    iv[i] = (p->Compute)(p->Par, stock);
    P[i] = rebate;
    G[i] = P[i];
    stock *= u;
}

if (eta0 < N)
{
    price = (p->Compute)(p->Par, up);
    P[npoints] = price;
    G[npoints] = price;
}
else
{
    P[npoints] = rebate;
    G[npoints] = rebate;
}

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    }

/*Backward Resolution*/
if (A0 < eta0) /*The Down barrier is hit first*/
{
    for (i = 1; i <= N - eta0; i++)
        /*Both barriers are active*/
        {
            price = Boundary(down, p, (double)i * h, r, divid, sigma);
            P[0] = pdd * price + pdm * G[0] + pdu * G[1];
            if (am)
                P[0] = MAX(iv[0], P[0]);
            for (j = 1; j < npoints; j++)
            {
                P[j] = pud * G[j - 1] + pum * G[j] + puu * G[j + 1];
                if (am)
                    P[j] = MAX(iv[j], P[j]);
            }
            price = Boundary(up, p, (double)i * h, r, divid, sigma);
            P[npoints] = price;
            for (j = 0; j <= npoints; j++)
                G[j] = P[j];
        }
    for (i = N - eta0 + 1; i <= N - A0; i++)
        /*Only the Down barrier is active*/
        {
            npoints -= 1;
            price = Boundary(down, p, (double)i * h, r, divid, sigma);
            P[0] = pdd * price + pdm * G[0] + pdu * G[1];
            if (am)
                P[0] = MAX(iv[0], P[0]);
            for (j = 1; j <= npoints; j++)
            {
                P[j] = pud * G[j - 1] + pum * G[j] + puu * G[j + 1];
                if (am)
                    P[j] = MAX(iv[j], P[j]);
            }
            for (j = 0; j <= npoints; j++)
                G[j] = P[j];
        }
}
}/*endif*/

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else if (A0 > eta0) /*The Down barrier is hit first*/
{
    for (i = 1; i <= N - A0; i++)
        /*Both barriers are active*/
        {
            price = Boundary(down, p, (double)i * h, r, divid, sigma);
            P[0] = pdd * price + pdm * G[0] + pdu * G[1];
            if (am)
                P[0] = MAX(iv[0], P[0]);
            for (j = 1; j < npoints; j++)
            {
                P[j] = pud * G[j - 1] + pum * G[j] + puu * G[j + 1];
                if (am)
                    P[j] = MAX(iv[j], P[j]);
            }
            price = Boundary(up, p, (double)i * h, r, divid, sigma);
            P[npoints] = price;
            for (j = 0; j <= npoints; j++)
                G[j] = P[j];
        }
    for (i = N - A0 + 1; i <= N - eta0; i++)
        /*Only the Up barrier is active*/
        {
            npoints -= 1;
            for (j = 0; j < npoints; j++)
            {
                P[j] = pud * P[j] + pum * P[j + 1] + puu * P[j + 2];
                if (am)
                    P[j] = MAX(iv[j + i], P[j]);
            }
            price = Boundary(up, p, (double)i * h, r, divid, sigma);
            P[npoints] = price;
        }
    }/*endelse*/
else if (A0 == eta0)
{
    for (i = 1; i <= N - A0; i++)
    {
        price = Boundary(down, p, (double)i * h, r, divid, sigma);
        P[0] = pdd * price + pdm * G[0] + pdu * G[1];
        if (am)

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        P[0] = MAX(iv[0], P[0]);
        for (j = 1; j < npoints; j++)
        {
            P[j] = pud * G[j - 1] + pum * G[j] + puu * G[j + 1];
            if (am)
                P[j] = MAX(iv[j], P[j]);
        }
        price = Boundary(up, p, (double)i * h, r, divid, sigma);
        P[npoints] = price;
        for (j = 0; j <= npoints; j++)
            G[j] = P[j];
    }
}/*endelse*/

/*None of the barriers is active*/
if (A0 > eta0)
    A0 = eta0;
npoints++;
for (i = N - A0 + 1; i < N; i++)
{
    npoints -= 2;
    for (j = 0; j < npoints; j++)
    {
        P[j] = pud * P[j] + pum * P[j + 1] + puu * P[j + 2];
        if (am)
            P[j] = MAX(iv[j + i - (N - A0 + 1)], P[j]);
    }
}

/*Delta*/
*ptdelta = (P[2] - P[0]) / (s * u - s * d);

/*First time step*/
P[0] = pud * P[0] + pum * P[1] + puu * P[2];
if (am)
    P[0] = MAX(iv[A0], P[0]);

/*Price*/
*ptprice = P[0];

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    free(P);
    free(G);
    free(iv);

    return OK;
}

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

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

    return Ritchken_95_In(ptOpt->EuOrAm.Val.V_BOOL, ptMod->S0.Val.V_PDOUBLE,
                          ptOpt->LowerLimit.Val.V_NUMFUNC_1, ptOpt->UpperLimit.Val.V_NUMFUNC_1,
                          ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE, r, divid,
                          Met->Par[0].Val.V_INT2, Met->Par[1].Val.V_RGDOUBLE, &(Met->Par[2].Val.V_INT2));
}

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

    if ((opt->TwoDoubleStep).Val.V_BOOL == FALSE)
        if ((opt->Parisian).Val.V_BOOL == FALSE)
            if ((opt->OutOrIn).Val.V_BOOL == IN)
                return OK;

    return WRONG;
}

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    if (Met->init == 0)
    {

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        Met->init = 1;

        Met->Par[0].Val.V_INT2 = 100;
        Met->Par[1].Val.V_RGDOUBLE12 = 1.22474;
    }
    return OK;
}

PricingMethod MET(TR_Ritchken_In) =
{
    "TR_Ritchken_In",
    { {"StepNumber", INT2, {100}, ALLOW},
      {"Lambda", RGDOUBLE12, {1}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(TR_Ritchken_In),
    { {"Price", DOUBLE, {100}, FORBID},
      {"Delta", DOUBLE, {100}, FORBID} ,
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CHK_OPT(TR_Ritchken_In),
    CHK_tree,
    MET(Init)
};

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