

[Help](#)

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#include <stdlib.h>
#include "bs1d_lim.h"
#include "error_msg.h"

static int Ritchken_95_DownIn(int am, double s, NumFunc_1 *p, double rebate, dou
{
    int i, j, npoints, eta0;
    double h, pu, pm, pd, z, u, d, stock, upperstock, eta, lambda, price, delta;
    double *P, *iv;

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

    h = t / (double) N;
    eta = log(s / l) / (sigma * sqrt(h));
    eta0 = (int) floor(eta);

    lambda = eta / (double) eta0;
    if (eta0 > N)
    {
        eta0 = N;
        lambda = 1.22474;
    }
    u = exp(lambda * sigma * sqrt(h));
    d = 1. / u;

    /*Discounted Probability*/
    z = (r - divid) - SQR(sigma) / 2.;
    pu = (1. / (2.*SQR(lambda)) + z * sqrt(h) / (2.*lambda * sigma));
    pm = (1. - 1. / SQR(lambda));
    pd = (1. - pu - pm);
    pu *= exp(-r * h);
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pm *= exp(-r * h);
pd *= exp(-r * h);

/*Intrinsic value initialisation and terminal values*/
upperstock = s;
for (i = 0; i < N; i++)
    upperstock *= u;

stock = upperstock;
for (i = 0; i < N + eta0; i++)
{
    iv[i] = (p->Compute)(p->Par, stock);
    P[i] = rebate;
    stock *= d;
}

npoints = N + eta0;
if ((p->Compute) == &Call)
    pnl_cf_call_bs(1, p->Par[0].Val.V_PDOUBLE, 0., r, divid, sigma, &price, &delt
else
    pnl_cf_put_bs(1, p->Par[0].Val.V_PDOUBLE, 0., r, divid, sigma, &price, &delt
P[npoints] = price;

/*Backward Resolution*/
for (i = 1; i <= N - eta0; i++)
{
    npoints -= 1;
    for (j = 0; j < npoints; j++)
    {
        P[j] = pu * P[j] + pm * P[j + 1] + pd * P[j + 2];
        if (am)
            P[j] = MAX(iv[j + i], P[j]);
    }
    if ((p->Compute) == &Call)
        pnl_cf_call_bs(1, p->Par[0].Val.V_PDOUBLE, (double)i * h, r, divid, sigma
    else
        pnl_cf_put_bs(1, p->Par[0].Val.V_PDOUBLE, (double)i * h, r, divid, sigma
    P[npoints] = price;
}
npoints++;

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for (i = N - eta0 + 1; i < N; i++)
{
    npoints -= 2;
    for (j = 0; j < npoints; j++)
    {
        P[j] = pu * P[j] + pm * P[j + 1] + pd * P[j + 2];
        if (am)
            P[j] = MAX(iv[j + i], P[j]);
    }
}

/*Delta*/
*ptdelta = (P[0] - P[2]) / (s * u - s * d);
/*First time step*/
P[0] = pu * P[0] + pm * P[1] + pd * P[2];
if (am)
    P[0] = MAX(iv[N], P[0]);
/*Price*/
*ptprice = P[0];

free(P);
free(iv);

return OK;
}

int CALC(TR_Ritchken_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.);
    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 Ritchken_95_DownIn(ptOpt->EuOrAm.Val.V_BOOL,
                               ptMod->S0.Val.V_PDOUBLE, ptOpt->PayOff.Val.V_NUMFUNC_1,
                               limit, ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,
                               r, divid, ptMod->Sigma.Val.V_PDOUBLE, Met->Par[0].Val.V_DOUBLE);
}

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    &(Met->Res[0].Val.V_DOUBLE), &(Met->Res[1].Val.V_DOU
}

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

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

    return WRONG;
}

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

    return OK;
}

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

```