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

static int Cryer_UpOut(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, up, upwind_alphacoef;
    double   *Obst, *A, *B, *C, *P, *S, *Z, *Q, pricenh, pricep2h, 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;

    /*Time Step*/
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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);
up = log(1);
h = (up - (y - loc)) / (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(y - loc + 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] = 0.0;
        Z[PriceIndex] = 0.0;
    }
    ssl = false;

    /*Finite Difference Cycle*/
    for (TimeIndex = 1; TimeIndex <= M; TimeIndex++)
    {
        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];
        Q[0] += alpha * (p->Compute)(p->Par, exp(y - loc));
        Q[N - 2] += gamma * rebate;

        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];

    Index = (int)floor(loc / h) - 1;

    *ptprice = P[Index] + (P[Index + 1] - P[Index]) * (exp(y) - exp(y - loc + h +

    /*Delta*/

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priceph = P[Index - 1] + (P[Index] - P[Index - 1]) * (exp(y - h) - exp(y - loc
if (y != up)
{
    pricenh = P[Index + 1] + (P[Index + 2] - P[Index + 1]) * (exp(y + h) - exp
    *ptdelta = (pricenh - priceph) / (2 * s * h);
}
else
{
    pricep2h = P[Index - 2] + (P[Index - 3] - P[Index - 2]) * (exp(y - 2 * h)
    *ptdelta = (-4 * priceph + pricep2h + 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;
}

int CALC(FD_Cryer_UpOut)(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_
    rebate = ((ptOpt->Rebate.Val.V_NUMFUNC_1)->Compute)((ptOpt->Rebate.Val.V_NUMFU

    return Cryer_UpOut(ptMod->S0.Val.V_PDOUBLE, ptOpt->PayOff.Val.V_NUMFUNC_1,
        limit, rebate, ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_
        Met->Par[0].Val.V_INT2, Met->Par[1].Val.V_INT2,

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

static int CHK_OPT(FD_Cryer_UpOut)(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, "CallUpOutAmer") == 0) || (strcmp(((Option *)Opt)->Name, "CallUpOutAmer") == 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_UpOut) =
{
    "FD_Cryer_UpOut",
    { {"SpaceStepNumber", INT2, {100}, ALLOW }, {"TimeStepNumber", INT2, {100},
        {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(FD_Cryer_UpOut),
    {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID} , {" ", PREMIA_NULLTYPE, {0}, FORBID},
    CHK_OPT(FD_Cryer_UpOut),
    CHK_split,
    MET(Init)
};

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