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#include <stdlib.h>
#include "bs1d_pad.h"
#include "error_msg.h"

static int Babbs_95_FloatingPut(int am, double s, double
                                s_max, NumFunc_2 *p, double t, double r, double
                                N, double *ptprice, double *ptdelta)
{
    int i, j, eta0, npoints;
    double u, d, h, pu, pd, a1, stock, eta, y_0;
    double *P, *iv, *Q, *Boundary;
    double upperstock, old_price = 0.;
    int odd;
    double flat_price = 0., up_price;

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

    /*Up and Down factors*/
    h = t / (double)N;
    a1 = exp(h * (r - divid));
    u = exp(sigma * sqrt(h));
    d = 1. / u;

    /*Critical Index*/
    y_0 = s_max / s;
    eta = log(y_0) / (sigma * sqrt(h));
    eta0 = (int)floor(eta);
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if (eta0 > N) eta0 = N;

/*Risk-Neutral Probability*/
pu = (a1 - d) / (u - d);
pd = 1. - pu;
pu *= exp(-r * h) * u; /*Proba Downward here*/
pd *= exp(-r * h) * d;

if (eta0 < N)
{
    /*First Stage:Computation of price value along the line
    spot=maximum*/

    /*Intrinsic value initialisation*/
    for (i = 0; i <= N; i++)
        Boundary[i] = 0.;

    stock = 1.;
    for (i = 0; i <= N + eta0; i++)
    {
        iv[i] = (p->Compute)(p->Par, 1., stock);
        P[i] = iv[i];
        Q[i] = P[i];
        stock *= u;
    }

    Boundary[N] = P[0];

    /*Backward Resolution*/
    for (i = 1; i < N - eta0; i++)
    {
        old_price = P[0]; /*Used for the delta in the case s=s_max*/
        /*Node on the line stock=1*/
        P[0] = pu * Q[0] + pd * Q[1];
        if (am)
            P[0] = MAX(iv[0], P[0]);
        Boundary[N - i] = P[0];
        /*Nodes above*/
        for (j = 1; j <= N + eta0 - i; j++)
        {
            /*Forget about the Q[j] price*/

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        P[j] = pu * Q[j - 1] + pd * Q[j + 1];
        if (am)
            P[j] = MAX(iv[j], P[j]);
    }

    for (j = 0; j <= N + eta0 - i; j++)
        Q[j] = P[j];
}

if (s_max > s)
{
    /*Second Stage:Computation of price value */
    /*Intrinsic value initialization*/
    upperstock = y_0;
    for (i = 0; i < N; i++)
        upperstock *= u;
    stock = upperstock;
    for (i = 0; i <= N + eta0; i++)
    {
        iv[i] = (p->Compute)(p->Par, 1., stock);
        stock *= d;
    }

    /*Terminal Values*/
    npoints = eta0 + (N - eta0) / 2;

    for (j = 0; j <= npoints; j++)
        P[j] = iv[2 * j]; /*indexed from above*/

    /*Backward Resolution*/
    if (eta0 > 0) /*The first mesh does not breach the barrier*/
    {
        /*First part-the barrier is active*/
        odd = 1;
        for (i = eta0; i < N - 1; i++)
            odd = !odd;

        if (!odd) npoints = npoints - 1;

        for (i = 1; i <= N - eta0; i++)

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{
  for (j = 0; j < npoints; j++)
  {
    P[j] = pd * P[j] + pu * P[j + 1];
    if (am)
      P[j] = MAX(iv[i + 2 * j], P[j]);
  }
  /*Special handling of the critical node*/
  if (odd)
  {
    P[npoints] = pd * P[npoints] + pu * Boundary[N + 1 - i];
    if (am)
      P[npoints] = MAX(iv[i + 2 * npoints], P[npoints]);
  }

  /*For the critical node at the next iteration*/
  if (!odd)
  {
    npoints = npoints - 1;
  }
  odd = !odd;
}

/*Second part-the barrier is strictly below the tree*/
npoints = eta0 - 1;
for (i = N - eta0 + 1; i < N; i++)
{
  for (j = 0; j <= npoints; j++)
  {
    P[j] = pd * P[j] + pu * P[j + 1];
    if (am)
      P[j] = MAX(iv[i + 2 * j], P[j]);
  }

  npoints = npoints - 1;
}
/*Delta*/
*ptdelta = (P[1] - P[0]) / (y_0 * (d - u));

/*First time step*/
P[0] = pd * P[0] + pu * P[1];

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    if (am)
        P[0] = MAX(iv[N], P[0]);
    /*Price*/
    *ptprice = P[0];
}

else /*eta0=0, the first mesh breaches the barrier*/
{
    /*The barrier is always active*/
    odd = 1;
    for (i = eta0; i < N - 1; i++)
        odd = !odd;

    if (!odd) npoints = npoints - 1;

    for (i = 1; i <= N - eta0 - 1; i++) /*We go backward until the next da
    {
        flat_price = P[1]; /*Only for the delta*/

        for (j = 0; j < npoints; j++)
        {
            P[j] = pd * P[j] + pu * P[j + 1];
            if (am)
                P[j] = MAX(iv[i + 2 * j], P[j]);
        }
        /*Special handling of the critical node*/
        if (odd)
        {
            P[npoints] = pd * P[npoints] + pu * Boundary[N + 1 - i];
            if (am)
                P[npoints] = MAX(iv[i + 2 * npoints], P[npoints]);
        }

        if (!odd)
        {
            npoints = npoints - 1;
        }
        odd = !odd;
    }
}

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        up_price = P[0]; /*For the delta*/

        /*First time step*/
        P[0] = pd * P[0] + pu * P[1];

        /*Special handling of the critical node*/
        P[0] = pd * P[0] + pu * Boundary[1];
        if (am)
            P[0] = MAX(iv[N], P[0]);

        /*Delta*/
        /*Corresponds to setting a third point at level s between u*s and d*s*/
        /*One computes the finite difference approximation between s and us*/
        *ptdelta = (up_price - (exp(-r * h) * flat_price + exp(r * h) * P[0])
    } /*eta0=0*/
}

else /*s=s_max*/
    *ptdelta = (P[1] - old_price) / (u - 1.);

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

/*Delta*/

*ptdelta = (*ptdelta) * (-y_0) + P[0];

/*Memory Desallocation*/
free(P);
free(Q);
free(iv);
free(Boundary);

return OK;

}

int CALC(TR_Babbs_Put)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;

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    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 Babbs_95_FloatingPut(ptOpt->EuOrAm.Val.V_BOOL, ptMod->S0.Val.V_PDOUBLE
}

static int CHK_OPT(TR_Babbs_Put)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "LookBackPutFloatingEuro") == 0) || (strcmp
        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 = 1000;

    }

    return OK;
}

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

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