

[Help](#)

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/* Monte Carlo Simulation for Parisian option :
   The program provides estimations for Price and Delta with
   a confidence interval. */
/* Quasi Monte Carlo simulation is not yet allowed for this routine */
#define WITH_boundary 1
#include "bs1d_lim.h"
#include "enums.h"

static int check_parisianin(double *gt, double lnspot, double lastlnspot,
                           double barrier, double lastbarrier,
                           double *gt_increment,
                           double lnspot_increment, double lastlnspot_increment,
                           double rap, int upordown, double h, double time,
                           int *correction_active, int generator)
{
    double proba, uniform = 0.;

    if (((upordown == 0) && (lnspot < barrier)) || ((upordown == 1) && (lnspot > b
    {
        if (((lastlnspot > barrier) && (upordown == 1)) || ((lastlnspot < barrier)
        {
            proba = exp(-2.*rap * ((lastlnspot - lastbarrier) * (lnspot - lastbarr
            *correction_active = 1;
            uniform = pnl_rand_uni(generator);
            if (uniform < proba)
                *gt = time;
        }
        else *gt = (time - h) + (barrier - lastlnspot) / (lnspot - lastlnspot) * h
    }
    else *gt = time;

    if (((upordown == 0) && (lnspot_increment < barrier)) || ((upordown == 1) && (
    {
        if (((lastlnspot_increment > barrier) && (upordown == 1)) || ((lastlnspot_
        {
            proba = exp(-2.*rap * ((lastlnspot_increment - lastbarrier) * (lnspot_
            if (!*correction_active)

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        uniform = pnl_rand_uni(generator);
        if (uniform < proba)
            *gt_increment = time;
    }
    else *gt_increment = (time - h) + (barrier - lastlnspot_increment) / (lnsp
}
else *gt_increment = time;

return OK;

}

static int MC_ParisianIn(int upordown, double s, NumFunc_1 *PayOff, double l, do
{
    double g, h;
    double time, lnspot, lastlnspot, price_sample = 0., delta_sample, lns;
    double lnspot_increment, lastlnspot_increment, price_sample_increment = 0.;
    double rloc, sigmaloc, barrier, lastbarrier, rap;
    double gt, hd, gt_increment, hd_increment;
    double mean_price, var_price, mean_delta, var_delta;
    long i;
    int k, inside, inside_increment;
    int correction_active;
    int init_mc;
    int simulation_dim;
    double alpha, z_alpha;

    /* Value to construct the confidence interval */
    alpha = (1. - confidence) / 2.;
    z_alpha = pnl_inv_cdfnor(1. - alpha);

    /*One forces N if necessary so that delay
    !!!!!!!!!!! WARNING !!!!!!!!!!!
    be greater than the time step increment h*/
    h = t / (double)N;
    if (delay <= h)
    {
        N = (int)ceil(t / delay) + 1;
        h = t / (double)N;
    }
}

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    Fprintf(TOSCREEN, "WARNING!!! N is forced to %d\ n", N);
}

/*Initialisation*/
mean_price = 0.0;
mean_delta = 0.0;
var_price = 0.0;
var_delta = 0.0;
/* Maximum Size of the random vector we need in the simulation */
simulation_dim = N;

barrier = log(1);
lns = log(s);

rloc = (r - divid - SQR(sigma) / 2.) * h;
sigmaloc = sigma * sqrt(h);

/*Coefficient for the computation of the exit probability*/
rap = 1. / (sigmaloc * sigmaloc);

/*MC sampling*/
init_mc = pnl_rand_init(generator, simulation_dim, M);
/* Test after initialization for the generator */
if (init_mc == OK)
{

    /* Begin M iterations */
    for (i = 1; i <= M; i++)
    {

        gt = 0.;
        hd = 0.;
        lnspot = lns;

        /*Inside=0 if the path stays beyond the barrier uninterruptedly
        for longer than delay*/
        inside = 1;
        inside_increment = 1;

        time = 0;

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k = 0;

/*Barrier at time*/
barrier = log(1);

/*Simulation of i-th path until Inside=0*/
while (((inside) && (k < N)) || ((inside_increment) && (k < N)))
{
    correction_active = 0;

    lastlnspot = lnspot;
    lastbarrier = barrier;

    time += h;
    g = pnl_rand_normal(generator);
    lnspot += rloc + sigmaloc * g;

    lnspot_increment = lnspot + increment;
    lastlnspot_increment = lastlnspot + increment;

    barrier = log(1);

    /*Check if the i-th path has reached the barrier at time*/
    /*Otherwise there is no extinction*/
    if (upordown == 0)
        check_parisianin(&gt, lnspot, lastlnspot, barrier, lastbarrier,
                        &gt_increment, lnspot_increment, lastlnspot_inc
                        rap, upordown, h, time, &correction_active, gen
    else
        check_parisianin(&gt_increment, lnspot_increment, lastlnspot_inc

    hd = time - gt;
    hd_increment = time - gt_increment;

    if (hd > delay)
    {
        inside = 0;
        if (time > t) time = t;
        price_sample = exp(-r * time) * Boundary(exp(lnspot), PayOff,
    }

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        if (hd_increment > delay)
        {
            inside_increment = 0;
            if (time > t) time = t;
            price_sample_increment = exp(-r * time) * Boundary(exp(lnspot_
        }

        k++;
    }

    if (inside)
        price_sample = 0.;

    if (inside_increment)
        price_sample_increment = 0.;

    /*Delta*/
    delta_sample = (price_sample_increment - price_sample) / (increment *

    /*Sum*/
    mean_price += price_sample;
    mean_delta += delta_sample;

    /*Sum of Squares*/
    var_price += SQR(price_sample);
    var_delta += SQR(delta_sample);
}
/* End N iterations */

/*Price*/
*ptprice = mean_price / (double)M;
*pterror_price = sqrt(var_price / (double)M - SQR(*ptprice)) / sqrt(M - 1)

/*Delta*/
*ptdelta = mean_delta / (double) M;
*pterror_delta = sqrt(var_delta / (double)M - SQR(*ptdelta)) / sqrt((doubl

/* Price Confidence Interval */
*inf_price = *ptprice - z_alpha * (*pterror_price);
*sup_price = *ptprice + z_alpha * (*pterror_price);

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        /* Delta Confidence Interval */
        *inf_delta = *ptdelta - z_alpha * (*pterror_delta);
        *sup_delta = *ptdelta + z_alpha * (*pterror_delta);
    }
    return init_mc;
}

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

    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)->Par[4].Val.V_PDOUBLE,
    r,
    divid, ptMod->Sigma.Val.V_PDOUBLE,
    Met->Par[1].Val.V_ENUM.value,
    Met->Par[0].Val.V_LONG,
    Met->Par[2].Val.V_INT, Met->Par[3].Val.V_PDOUBLE,
    Met->Par[4].Val.V_PDOUBLE,
    &(Met->Res[0].Val.V_DOUBLE),
    &(Met->Res[1].Val.V_DOUBLE),
    &(Met->Res[2].Val.V_DOUBLE),

    if ((ptOpt->DownOrUp).Val.V_BOOL == DOWN)
        upordown = 0;
    else upordown = 1;

    return MC_ParisianIn(upordown,
        ptMod->S0.Val.V_PDOUBLE, ptOpt->PayOff.Val.V_NUMFUNC_1,
        limit,
        ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,
        (ptOpt->Limit.Val.V_NUMFUNC_1)->Par[4].Val.V_PDOUBLE,
        r,
        divid, ptMod->Sigma.Val.V_PDOUBLE,
        Met->Par[1].Val.V_ENUM.value,
        Met->Par[0].Val.V_LONG,
        Met->Par[2].Val.V_INT, Met->Par[3].Val.V_PDOUBLE,
        Met->Par[4].Val.V_PDOUBLE,
        &(Met->Res[0].Val.V_DOUBLE),
        &(Met->Res[1].Val.V_DOUBLE),
        &(Met->Res[2].Val.V_DOUBLE),

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        &(Met->Res[3].Val.V_DOUBLE),
        &(Met->Res[4].Val.V_DOUBLE),
        &(Met->Res[5].Val.V_DOUBLE),
        &(Met->Res[6].Val.V_DOUBLE),
        &(Met->Res[7].Val.V_DOUBLE));
    }

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

    if ((opt->RebOrNo).Val.V_BOOL == NOREBATE)
        if ((opt->OutOrIn).Val.V_BOOL == IN)
            if ((opt->EuOrAm).Val.V_BOOL == EURO)
                if ((opt->Parisian).Val.V_BOOL == TRUE)

                    return OK;

    return WRONG;
}

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    int type_generator;
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->HelpFilenameHint = "MC_Parisianin_bs";

        Met->Par[0].Val.V_LONG = 10000;
        Met->Par[1].Val.V_ENUM.value = 0;
        Met->Par[1].Val.V_ENUM.members = &PremiaEnumMCRNGs;
        Met->Par[2].Val.V_INT2 = 250;
        Met->Par[3].Val.V_PDOUBLE = 0.01;
        Met->Par[4].Val.V_PDOUBLE = 0.95;
    }
}

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    }

    type_generator = Met->Par[1].Val.V_ENUM.value;

    if (pnl_rand_or_quasi(type_generator) == PNL_QMC)
    {
        Met->Res[2].Viter = IRRELEVANT;
        Met->Res[3].Viter = IRRELEVANT;
        Met->Res[4].Viter = IRRELEVANT;
        Met->Res[5].Viter = IRRELEVANT;
        Met->Res[6].Viter = IRRELEVANT;
        Met->Res[7].Viter = IRRELEVANT;
    }
    else
    {
        Met->Res[2].Viter = ALLOW;
        Met->Res[3].Viter = ALLOW;
        Met->Res[4].Viter = ALLOW;
        Met->Res[5].Viter = ALLOW;
        Met->Res[6].Viter = ALLOW;
        Met->Res[7].Viter = ALLOW;
    }
    return OK;
}

PricingMethod MET(MC_ParisianIn) =
{
    "MC_Parisianin",
    { {"Iterations", LONG, {100}, ALLOW},
      {"RandomGenerator (Quasi Random not allowed)", ENUM, {100}, ALLOW},
      {"TimeStepNumber", INT2, {100}, ALLOW},
      {"Delta Increment Rel", DOUBLE, {100}, ALLOW},
      {"Confidence Value", DOUBLE, {100}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(MC_ParisianIn),

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{ {"Price", DOUBLE, {100}, FORBID},
  {"Delta", DOUBLE, {100}, FORBID} ,
  {"Error Price", DOUBLE, {100}, FORBID}
  , {"Error Delta", DOUBLE, {100}, FORBID} ,
  {"Inf Price", DOUBLE, {100}, FORBID},
  {"Sup Price", DOUBLE, {100}, FORBID} ,
  {"Inf Delta", DOUBLE, {100}, FORBID},
  {"Sup Delta", DOUBLE, {100}, FORBID} ,
  {" " , PREMIA_NULLTYPE, {0}, FORBID}
},
CHK_OPT(MC_ParisianIn),
CHK_mc,
MET(Init)
} ;
```