

[Help](#)

```
/* 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 */

#include "
href../../mod/bs1d/bs1d_doublim/bs1d_doublim_h_src.pdfbs1d_doublim.h"
#include "
href../../common/enums_h_src.pdfenums.h"

static int MC_ParisianOut(NumFunc_1 *L, NumFunc_1 *U, double s,
                          NumFunc_1 *PayOff, double t, double delay, double r,
{
    double g, h;
    double time, lnspot, lastlnspot, price_sample = 0., delta_sample;
    double lnspot_increment = 0., lastlnspot_increment, price_sample_increment = 0
    double gt_increment, hd_increment;
    double rloc, sigmaloc, up, low, lastup, lastlow, proba = 0., rap, gt, hd;
    double mean_price, var_price, mean_delta, var_delta;
    long i;
    double uniform = 0., proba_increment;
    int k, inside, inside_increment, 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;
```

```

    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;

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.;
        gt_increment = 0.;
        hd_increment = 0.;
        lnspot = log(s);

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

        time = 0.;
        k = 0;
    }
}

```

```

/*Up and Down Barrier at time*/
up = log((U->Compute)(U->Par, time));
low = log((L->Compute)(L->Par, time));

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

    lastlnspot = lnspot;
    lastup = up;
    lastlow = low;

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

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

    up = log((U->Compute)(U->Par, time));
    low = log((L->Compute)(L->Par, time));

    /*Check if the i-th path has reached the barriers at time*/
    /*Otherwise there is no extinction*/
    if (inside)
        if (lnspot > up)
        {
            if (lastlnspot > up)
            {
                proba = exp(-2.*rap * ((lastlnspot - lastup) * (lnspot - lastlow)));
                correction_active = 1;
                uniform = pnl_rand_uni(generator);
                if (uniform < proba)
                    gt = time;
            }
            else gt = (time - h) + (up - lastlnspot) / (lnspot - lastlnspot);
        }
    else gt = (time - h) + (low - lastlow) / (lnspot - lastlnspot);

    if (inside_increment)
        if (lnspot_increment > up)

```

```

{
    if (lastlnspot_increment > up)
    {
        proba_increment = exp(-2.*rap * ((lastlnspot_increment -
        if (!correction_active)
            uniform = pnl_rand_uni(generator);
        if (uniform < proba)
            gt_increment = time;
        }
        else gt_increment = (time - h) + (up - lastlnspot_increment)
    }

if (inside_increment)
    if (lnspot_increment < low)
    {
        if (lastlnspot_increment < low)
        {
            proba_increment = exp(-2.*rap * ((lastlnspot_increment -
            correction_active = 1;
            uniform = pnl_rand_uni(generator);
            if (uniform < proba_increment)
                gt_increment = time;
            }
            else gt_increment = (time - h) + (low - lastlnspot_increment)
        }

if (inside)
    if (lnspot < low)
    {
        if (lastlnspot < low)
        {
            proba = exp(-2.*rap * ((lastlnspot - lastlow) * (lnspot
            if (!correction_active)
                uniform = pnl_rand_uni(generator);
            if (uniform < proba)
                gt = time;
            }
            else gt = (time - h) + (low - lastlnspot) / (lnspot - lastln

if (inside)

```

```

    {

        if ((lnspot <= up) && (lnspot >= low))
            gt = time;
        hd = time - gt;
        if (hd > delay)
        {
            inside = 0;
            price_sample = 0.;
        }
    }

    if (inside_increment)
    {

        if ((lnspot_increment <= up) && (lnspot_increment >= low))
            gt_increment = time;

        hd_increment = time - gt_increment;

        if (hd_increment > delay)
        {
            inside_increment = 0;
            price_sample_increment = 0.;
        }
    }

    k++;
}

if (inside)
    price_sample = exp(-r * t) * (PayOff->Compute)(PayOff->Par, exp(lnspot));

if (inside_increment)
    price_sample_increment = exp(-r * t) * (PayOff->Compute)(PayOff->Par, exp(lnspot_increment));

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

/*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((double)M - 1)

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

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

```

```

int CALC(MC_ParisianOut)(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 MC_ParisianOut(ptOpt->LowerLimit.Val.V_NUMFUNC_1,
                           ptOpt->UpperLimit.Val.V_NUMFUNC_1,
                           ptMod->S0.Val.V_PDOUBLE, ptOpt->PayOff.Val.V_NUMFUNC_1,
                           ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,

```

```

        (ptOpt->LowerLimit.Val.V_NUMFUNC_1)->Par[1].Val.V_PDOUBL
        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),
        &(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_ParisianOut)(void *Opt, void *Mod)
{
    Option *ptOpt = (Option *)Opt;
    TYPEOPT *opt = (TYPEOPT *) (ptOpt->TypeOpt);

    if ((opt->TwoDoubleStep).Val.V_BOOL == FALSE)
        if ((opt->RebOrNo).Val.V_BOOL == NOREBATE)
            if (((opt->OutOrIn).Val.V_BOOL == OUT) && ((opt->EuOrAm).Val.V_BOOL == EUR)
                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_Parisianupdownout_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;

}

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_ParisianOut) =
{
    "MC_ParisianOut",

```



```

{ {"Iterations", LONG, {100}, ALLOW},
  {"RandomGenerator", ENUM, {100}, ALLOW},
  {"TimeStepNumber", INT2, {100}, ALLOW},
  {"Delta Increment Rel", PDOUBLE, {100}, ALLOW},
  {"Confidence Value", DOUBLE, {100}, ALLOW},
  {" ", PREMIA_NULLTYPE, {0}, FORBID}
},
CALC(MC_ParisianOut),
{ {"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_ParisianOut),
CHK_mc,
MET(Init)
} ;

```