

[Help](#)

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/* Glasserman-Heidelberger-Shahabuddin Algorithm
   Importance Sampling Variance Reduction*/

#include "
href../../../../mod/bs1d/bs1d_pad/bs1d_pad_h_src.pdfbs1d_pad.h"
#include "
href../../../../common/enums_h_src.pdfenums.h"

#define FACTOR 1.6
#define JMAX 40
#define NTRY 80

static double mu[50000];
static double t, sig, ri, dvd, S0, strike, step_nb;

/* Find the domain containg the zero of the function*/
static int zbrac(double(*func)(double), double *xmin, double *xmax)
{
    int j;
    double f1, f2;

    if (*xmin == *xmax)
        printf("mauvais depart dans la fonction zbrac()");

    f1 = (*func)(*xmin);
    f2 = (*func)(*xmax);

    for (j = 1; j <= NTRY; j++)
    {
        {
            if (f1 * f2 < 0.0)
                return 1;
        }

        if (fabs(f1) < fabs(f2))
            f1 = (*func)(*xmin += FACTOR * (*xmin - *xmax));
        else
            f2 = (*func)(*xmax += FACTOR * (*xmax - *xmin));
    }
}
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    return 0; /*envoie 0 si [xmin,xmax] devient trop large*/
}

/*-----*/
/* Methode de dichotomies permet de trouver un zero d'une fonction*/
/* sachant que ce zero se trouve entre x1 et x2. Precision = xacc*/
/*-----*/
static double rtbis(double (*func)(double), double x1, double x2, double xacc)
{
    int j;
    double dx, f, fmid, xmid, rtb;

    f = (*func)(x1);
    fmid = (*func)(x2);

    if (f * fmid >= 0.0)
    {
        printf("La racine ne se trouve pas dans [x1,x2]");
        exit(-1);
    }

    rtb = f < 0.0 ? (dx = x2 - x1, x1) : (dx = x1 - x2, x2); /* oriente la recherche */

    for (j = 1; j <= JMAX; j++)
    {
        fmid = (*func)(xmid = rtb + (dx *= 0.5));
        if (fmid <= 0.0)rtb = xmid;
        if (fabs(dx) < xacc || fmid == 0.0)return rtb;
    }

    return 0.0;
}

/*-----*/
/*Premiere partie : recherche du mu optimal*/
/*La fonction ci-dessous est celle qu'il faut appeler pour trouver le mu */
/*optimal. On cherche d'abord son unique racine qu'on reinjecte ensuite*/
/*dans les z[1..PAS] et s[1..PAS]; le dernier z[] est alors le mu optimal.*/
static double ghscall(double g)
{

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int i;
double z = 0.0;
double s;
double dt, ans, s_dt, trend;

s = S0;
dt = t / step_nb;
s_dt = sig * sqrt(dt);
trend = (ri - dvd - 0.5 * sig * sig) * dt;

if (g != 0)
{
    ans = 0;
    z = s_dt * (g + strike) / g;
    for (i = 1; i < step_nb; i++)
    {
        s = s * exp(trend + s_dt * z);
        z = z - s_dt * s / (step_nb * g);
        ans += s;
    }

    ans /= step_nb;
    return (ans = (ans - strike - g));
}
return 0.0;
}
/*-----*/
static double ghspu(double g)
{
    int i;
    double z = 0.0;
    double s;
    double dt, ans, s_dt, trend;

    s = S0;
    dt = t / step_nb;
    s_dt = sig * sqrt(dt);
    trend = (ri - dvd - 0.5 * sig * sig) * dt;

    if (g != 0)
    {

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    ans = s;
    z = s_dt * (g - strike) / g;
    for (i = 1; i < step_nb; i++)
    {
        s = s * exp(trend + s_dt * z);
        z = z + s_dt * s / (step_nb * g);
        ans += s;
    }

    ans /= step_nb;
    return (ans = (strike - ans - g));
}
else
{
    printf("problem at line 138 of Pricin_util.h ...\ n");
    exit(-1);
}
}

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/* ----- */
/*  Computation of drift correction                      */
/* ----- */

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static void Drift_Computation(int generator, int step_number, double T, double
{
    double S_t;
    double h = T / step_number;
    /* double sqrt_h = sqrt(h);*/
    double trend = (r - divid) - 0.5 * SQR(sigma);
    double ss_dt = sigma * sqrt(h);
    double *xmin, *xmax, x_min, x_max, dot2;
    int i;
    double g;

    t = T;
    ri = r;
    S0 = x;
    strike = K;
    sig = sigma;
    dvd = divid;

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step_nb = step_number;

for (i = 0; i < step_number; i++)
    mu[i] = 0.;

if ((p->Compute) == &Call_OverSpot2)
{
    x_min = 2.5 * t;
    x_max = 5.0 * t;
    xmin = &x_min;
    xmax = &x_max;
    /*trouve le bon intervalle [xmin,xmax]*/
    zbrac(ghscall, xmin, xmax);
    /*resoud l equation ghs(x)=0*/
    g = rtbis(ghscall, (*xmin), (*xmax), 1e-8);
    mu[0] = ss_dt * (g + K) / g;
    dot2 = SQR(mu[0]);
    S_t = 1.0;
    for (i = 1; i < step_number; i++)
    {
        mu[i] = mu[i - 1] - ss_dt * S0 * S_t / (step_number * g);
        S_t = S_t * exp(trend * h + ss_dt * mu[i]);
        dot2 += SQR(mu[i]);
    }
}
else if ((p->Compute) == &Put_OverSpot2)
{
    x_min = -5.0;
    x_max = -0.1;
    xmin = &x_min;
    xmax = &x_max;
    /*trouve le bon intervalle [xmin,xmax]*/
    zbrac(ghsput, xmin, xmax);
    /*resoud l equation ghs(x)=0*/
    g = rtbis(ghsput, (*xmin), (*xmax), 1e-8);
    mu[0] = ss_dt * (g - K) / g;
    dot2 = SQR(mu[0]);
    S_t = 1.0;
    for (i = 1; i < step_number; i++)
    {
        mu[i] = mu[i - 1] + ss_dt * S0 * S_t / (step_number * g);
    }
}

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        S_t = S_t * exp(trend * h + ss_dt * mu[i]);
        dot2 += SQR(mu[i]);
    }
}

return;
}

/* -----*/
/* Pricing of a asian option by the Monte Carlo Kemna & Vorst method
   Estimator of the price and the delta.
   s et K are pseudo-spot and pseudo-strike. */
/* ----- */
static int FixedAsian_Glassermann(double s, double K, double time_spent, NumFun
{
    long i, ipath;
    double price_sample , delta_sample, mean_price, mean_delta, var_price, var_de
    int init_mc;
    int simulation_dim;
    double alpha, z_alpha, dot1, dot2; /* inc=0.001;*/
    double integral, S_t, g1;
    double h = t / (double)M;
    double sqrt_h = sqrt(h);
    double trend = (r - divid) - 0.5 * SQR(sigma);
    int step_number = M;

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

    /*Initialisation*/
    mean_price = 0.0;
    mean_delta = 0.0;
    var_price = 0.0;
    var_delta = 0.0;

    /* Size of the random vector we need in the simulation */
    simulation_dim = M;

    /* MC sampling */

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

    /* Price */
    (void)Drift_Computation(generator, M, t, s, r, divid, sigma, p, K);

    dot2 = 0;
    for (i = 0; i < step_number; i++)
        dot2 += mu[i] * mu[i];

    for (ipath = 1; ipath <= nb; ipath++)
    {
        /* Begin of the N iterations */

        g1 = pnl_rand_gauss(step_number, CREATE, 0, generator);
        integral = 0.0;
        S_t = s;
        dot1 = 0.;
        for (i = 0 ; i < step_number ; i++)
        {
            g1 = pnl_rand_gauss(step_number, RETRIEVE, i, generator);
            S_t *= exp(trend * h + sigma * sqrt_h * (g1 + mu[i]));
            integral += S_t;
            dot1 += mu[i] * g1;
        }

        price_sample = (p->Compute)(p->Par, s, integral / (double)step_number)

        /* Delta */
        if (price_sample > 0.0)
            delta_sample = (1 - time_spent) * (integral / (s * (double)step_number))
        else delta_sample = 0.;

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

        /* Sum of squares */

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

    /* Price estimator */
    *ptprice = (mean_price / (double)nb);
    *pterror_price = exp(-r * t) * sqrt(var_price / (double)nb - SQR(*ptprice));
    *ptprice = exp(-r * t) * (*ptprice);

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

    /* Delta estimator */
    *ptdelta = exp(-r * t) * (mean_delta / (double)nb);
    if ((p->Compute) == &Put_OverSpot2)
        *ptdelta *= (-1);
    *pterror_delta = sqrt(exp(-2.0 * r * t) * (var_delta / (double)nb - SQR(*p

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

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

    double T, t_0, T_0;
    double r, divid, time_spent, pseudo_strike, true_strike, pseudo_spot;
    int return_value;

    r = log(1. + ptMod->R.Val.V_DOUBLE / 100.);
    divid = log(1. + ptMod->Divid.Val.V_DOUBLE / 100.);

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T = ptOpt->Maturity.Val.V_DATE;
T_0 = ptMod->T.Val.V_DATE;
t_0 = (ptOpt->PathDep.Val.V_NUMFUNC_2)->Par[0].Val.V_PDOUBLE;
time_spent = (T_0 - t_0) / (T - t_0);

if (T_0 < t_0)
{
    Fprintf(TOSCREEN, "T_0 < t_0, untreated case\ n\ n\ n");
    return_value = WRONG;
}

/* Case t_0 <= T_0 */
else
{
    pseudo_spot = (1. - time_spent) * ptMod->S0.Val.V_PDOUBLE;
    pseudo_strike = (ptOpt->PayOff.Val.V_NUMFUNC_2)->Par[0].Val.V_PDOUBLE - ti

    true_strike = (ptOpt->PayOff.Val.V_NUMFUNC_2)->Par[0].Val.V_PDOUBLE;

    (ptOpt->PayOff.Val.V_NUMFUNC_2)->Par[0].Val.V_PDOUBLE = pseudo_strike;

    if (pseudo_strike <= 0.)
    {
        Fprintf(TOSCREEN, "FORMULE ANALYTIQUE\ n\ n\ n");
        return_value = Analytic_KemnaVorst(pseudo_spot,
                                           pseudo_strike,
                                           time_spent,
                                           ptOpt->PayOff.Val.V_NUMFUNC_2,
                                           T - T_0,
                                           r,
                                           divid,
                                           &(Met->Res[0].Val.V_DOUBLE),
                                           &(Met->Res[1].Val.V_DOUBLE));
    }
    else
        return_value = FixedAsian_Glassermann(pseudo_spot,
                                                pseudo_strike,
                                                time_spent,
                                                ptOpt->PayOff.Val.V_NUMFUNC_2,

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T - T_0,
r,
divid,
ptMod->Sigma.Val.V_PDOUBLE,
Met->Par[2].Val.V_LONG,
Met->Par[0].Val.V_INT2,
Met->Par[1].Val.V_ENUM.value,
Met->Par[4].Val.V_DOUBLE,
&(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));

    (ptOpt->PayOff.Val.V_NUMFUNC_2)->Par[0].Val.V_PDOUBLE = true_strike;
}
return return_value;
}

static int CHK_OPT(MC_FixedAsian_Glassermann)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "AsianCallFixedEuro") == 0) || (strcmp(((Op
        return OK;

    return WRONG;
}

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

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    Met->Par[0].Val.V_INT2 = 360;
    Met->Par[1].Val.V_ENUM.value = 0;
    Met->Par[1].Val.V_ENUM.members = &PremiaEnumRNGs;
    Met->Par[2].Val.V_LONG = 20000;
    Met->Par[4].Val.V_DOUBLE = 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_FixedAsian_Glassermann) =
{

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"MC_FixedAsian_Glassermann",
{ {"TimeStepNumber", INT2, {100}, ALLOW},
  {"RandomGenerator", ENUM, {100}, ALLOW},
  {"N iterations", LONG, {100}, ALLOW},
  {"Confidence Value", DOUBLE, {100}, ALLOW},
  {" ", PREMIA_NULLTYPE, {0}, FORBID}
},
CALC(MC_FixedAsian_Glassermann),
{ {"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_FixedAsian_Glassermann),
CHK_ok,
MET(Init)
};

```