

Help

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/* Control Variables Kemna & Vorst Monte Carlo simulation for a Call or Put Fixed
   In the case of Monte Carlo simulation, the program provides estimations for p
   In the case of Quasi-Monte Carlo simulation, the program just provides estimations
#include <stdlib.h>
#include "bs1d_pad.h"
#include "enums.h"

static double m_Mu[50000];

/* ----- */
/* Calculus of the average A'(T0,T) and C'(T0,T) of the asian option with one of
   One iteration of the Monte Carlo method called from the "FixedAsian_KemanVorst"
/* ----- */
static double gamma_step(int n, double a, double b)
{
    return a / (b + (double)n);
}

static double step(int n)
{
    return sqrt(log((double)n + 1.) / 6.) + 1.;
}

static void Simul_StockAndAverage_RobbinsMonro(int generator, int step_number, double d)
{
    int RM = 5000;
    int sig_iter = 0;
    double integral, S_t, g1;
    double h = T / step_number;
    double sqrt_h = sqrt(h);
    double trend = (r - divid) - 0.5 * SQR(sigma);

    int i, ii;
    double dot1, a, b = 1, payoff, payoffcarre, val_test, temp, expo, val;
    double dot2;
    double *NormalValue;
    double *m_Theta;
    double x_1 = -0.0925, x_2 = -0.00725;
    NormalValue = malloc(sizeof(double) * step_number * RM);

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m_Theta = malloc(sizeof(double) * (step_number + 1));
K = p->Par[0].Val.V_DOUBLE;

/* Average Computation */
/* Trapezoidal scheme */
/* Simulation of M gaussian variables according to the generator type,
   that is Monte Carlo or Quasi Monte Carlo. */

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

if ((p->Compute) == &Call_OverSpot2)
{
    if (K == x)
        a = 0.1;
    else if (K < x)
        a = 0.001;
    else /*if(K>x)*/
        a = 5.;
}
else /*if ((p->Compute) == &Put_OverSpot2)*/
{
    if (K == x)
        a = 0.1;
    else if (K < x)
        a = 5.;
    else /*if(K>x)*/
        a = 0.001;
}
for (ii = 0; ii < RM; ii++)
{

    dot1 = 0.;
    dot2 = 0.;
    integral = 0.;

    g1 = pnl_rand_gauss(step_number, CREATE, 0, generator);
    S_t = x;
    integral = x * (1. + (r - divid) * h / 2. + sigma * sqrt_h * g1 / 2.);
    for (i = 0 ; i < step_number - 1 ; i++)
    {

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        NormalValue[i + ii * step_number] = g1;
        S_t *= exp(trend * h + sigma * sqrt_h * g1);
        dot1 += g1 * m_Mu[i];
        dot2 += m_Mu[i] * m_Mu[i];
        g1 = pnl_rand_gauss(step_number, RETRIEVE, i, generator);
        integral += S_t * (1. + (r - divid) * h / 2. + sigma * sqrt_h * g1 / 2
    }

    payoff = exp(-r * T) * (p->Compute)(p->Par, S_t, integral / step_number);
    payoffcarre = payoff * payoff;
    expo = exp(-dot1 + 0.5 * dot2);
    val_test = 0.;

    for (i = 0 ; i < step_number - 1 ; i++)
    {
        val = NormalValue[i + ii * step_number];
        temp = (m_Mu[i] - val) * expo * payoffcarre;
        m_Theta[i] = temp;
        val_test += SQR(m_Mu[i] - gamma_step(ii, a, b) * temp);
    }
    val_test = sqrt(val_test);
    if (val_test <= step(sig_iter))
    {
        for (i = 0; i < step_number - 1; i++)
        {
            m_Mu[i] = m_Mu[i] - gamma_step(ii, a, b) * m_Theta[i];
        }
    }
    else
    {
        if (sig_iter - 2 * (sig_iter / 2) == 0)
            for (i = 0; i < step_number - 1; i++)
                m_Mu[i] = x_1;
        else
            for (i = 0; i < step_number - 1; i++)
                m_Mu[i] = x_2;

        sig_iter += 1;
    }
}

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    free(m_Theta);
    free(NormalValue);

    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_RobbinsMonro(double s, double K, double time_spent, NumFu
{
    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 *Normalvect;
    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;

    Normalvect = malloc(sizeof(double) * (nb * step_number + 1));

    /* 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;

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

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

    /* Price */
    (void)Simul_StockAndAverage_RobbinsMonro(generator, M, t, s, r, divid, sig

    dot2 = 0;
    for (i = 0; i < step_number - 1; i++)
        dot2 += m_Mu[i] * m_Mu[i];

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

        g1 = pnl_rand_gauss(step_number, CREATE, 0, generator);
        integral = s * (1. + (r - divid) * h / 2. + sigma * sqrt_h * g1 / 2.);
        S_t = s;
        for (i = 0 ; i < step_number - 1 ; i++)
        {
            Normalvect[i + (ipath - 1)*step_number] = g1;
            S_t *= exp(trend * h + sigma * sqrt_h * (g1 + m_Mu[i]));
            g1 = pnl_rand_gauss(step_number, RETRIEVE, i, generator);
            integral += S_t * (1. + (r - divid) * h / 2. + sigma * sqrt_h * (g

        }
        dot1 = 0.;
        for (i = 0; i < step_number - 1; i++)
            dot1 += m_Mu[i] * Normalvect[i + (ipath - 1) * step_number];

        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_num
        else delta_sample = 0.;

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

        /* Sum of squares */
        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(*ptdelta)));

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

free(Normalvect);
return init_mc;
}

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

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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.);

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,

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

    }
else
    return_value = FixedAsian_RobbinsMonro(pseudo_spot,
                                             pseudo_strike,
                                             time_spent,
                                             ptOpt->PayOff.Val.V_NUMFUNC_2,
                                             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_RobbinsMonro)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "AsianCallFixedEuro") == 0) || (strcmp(((Op
        return OK;

    return WRONG;
}

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

        Met->Par[0].Val.V_INT2 = 50;
        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;
    }
}
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    return OK;
}

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PricingMethod MET(MC_FixedAsian_RobbinsMonro) =
{
    "MC_FixedAsian_RobbinsMonro",
    { {"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_RobbinsMonro),
    { {"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_RobbinsMonro),
    CHK_ok,
    MET(Init)
};

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