

[Help](#)

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#include<stdlib.h>
#include<math.h>
#include"pnl/pnl_random.h"
#include"pnl/pnl_specfun.h"
#include "cgmy1d_pad.h"
#include "enums.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els
static int CHK_OPT(MC_CGMY_FloatingAsian)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(MC_CGMY_FloatingAsian)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else
//Compute the positive or negative jump size between the smallest and the bigges
static double jump_generator_CGMY(double *cdf_jump_vect, double *cdf_jump_points
{
    double z, v, y;
    int test, temp, l, j, q;
    test = 0;
    v = pnl_rand_uni(generator);
    y = cdf_jump_vect[cdf_jump_vect_size] * v;
    l = cdf_jump_vect_size / 2;
    j = cdf_jump_vect_size;
    z = 0;
    if (cdf_jump_vect[l] > y)
    {
        l = 0;
        j = cdf_jump_vect_size / 2;
    }
    if (v == 1)
    {
        z = cdf_jump_points[cdf_jump_vect_size];
    }
    if (v == 0)
    {

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        z = cdf_jump_points[0];
    }
    if (v != 1 && v != 0)
    {
        while (test == 0)
        {
            if (cdf_jump_vect[l + 1] > y)
            {
                q = l;
                test = 1;
            }
            else
            {
                temp = (j - l - 1) / 2 + 1;
                if (cdf_jump_vect[temp] > y)
                {
                    j = temp;
                    l = l + 1;
                }
                else
                {
                    l = temp * (temp > 1) + (l + 1) * (temp <= 1);
                }
            }
        }
        z = pow(1 / pow(cdf_jump_points[q], Y) - (y - cdf_jump_vect[q]) * Y * exp(
    }
    return z;
}

//(exp(x)-1)/x
static double p_func(double x)
{
    double s;
    int i, n;
    n = 1;
    s = 0;
    for (i = 0; i <= n; i++)
        s += pow(x, i) / pnl_fact(i + 1);

    return s;
}

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}

//(4exp(x)+(2x-3)exp(2x)-1)/x^3
static double var_func(double x)
{
    double s;
    int i, n;
    n = 1;
    s = 0;
    for (i = 0; i <= n; i++)
        s += 4 * pow(x, i) / pnl_fact(i + 3) - 3 * pow(2., i + 3) * pow(x, i) / pnl_

    return s;
}

//exp(x)/x-(exp(x)-1)/x^2
static double cov_func(double x)
{
    double s;
    int i, n;
    n = 1;
    s = 0;
    for (i = 0; i <= n; i++)
        s += pow(x, i) * (1. / pnl_fact(i + 1) - 1. / pnl_fact(i + 2));

    return s;
}

static int CGMY_Mc_FloatingAsian(NumFunc_2 *P, double S0, double T, double r, do
{
    double eps, s, s1, s2, s3, s4, s5, s6, payoff, dpayoff, control, discount, w1,
    double control_expec, lambda_m, cdf_jump_bound, pas, cov_payoff_control, var_p
    double cor_payoff_control, control_coef, var_dpayoff, *cdf_jump_points, *cdf_j
    double *cdf_jump_vect_m, *Xg, *Xd, tau, *jump_time_vect, *jump_time_vect_p, *j
    double var_temp, cov_temp, *vect_temp, g_temp, min_M_G, temp, drift_expo;
    int i, j, k, jump_number_p, jump_number_m, jump_number, m1, m2, cdf_jump_vect_
    discount = exp(-divid * T);
    err = 1E-16;
    eps = 0.1;
    cdf_jump_vect_size = 1000000;
    jump_number = 0;

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s = 0;
s1 = 0;
s2 = 0;
s3 = 0;
s4 = 0;
s5 = 0;
s6 = 0;
if (M < 2 || G <= 0 || Y >= 2 || Y == 0)
{
    printf("Function CGMY_Mc_FloatingAsian: invalid parameters. We must have M
}
////////////////////////////////////
//Measure change so that the option can be value as a fixed strike asian option
M = M - 1;
G = G + 1;
temp = M;
M = G;
G = temp;
//drift=-drift;
if (Y == 1)
    drift = -(r - divid) - C * ((M - 1) * log(1. - 1 / M) + (G + 1) * log(1. + 1 / M));
else
    drift = -(r - divid) - C * pnl_sf_gamma(-Y) * (pow(M, Y) * (pow(1 - 1 / M, Y) - 1));
////////////////////////////////////
if (Y == 1)
    drift_expo = drift + C * ((M - 1) * log(1. - 1 / M) + (G + 1) * log(1. + 1 / M));
else
    drift_expo = drift + C * pnl_tgamma(-Y) * (pow(M, Y) * (pow(1 - 1 / M, Y) - 1));
if (drift_expo != 0)
    control_expec = S0 * (exp(drift_expo * T) - 1) / (drift_expo * T);
else
    control_expec = S0;
////////////////////////////////////
lambda_p = C * pow(M, Y) * pnl_sf_gamma_inc(-Y, eps * M); //positive jump into
while (lambda_p * T < 10)
{
    eps = eps * 0.9;
    lambda_p = C * pow(M, Y) * pnl_sf_gamma_inc(-Y, eps * M);
}
lambda_m = C * pow(G, Y) * pnl_sf_gamma_inc(-Y, eps * G); //negative jump into
while (lambda_m * T < 10)

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    {
        eps = eps * 0.9;
        lambda_m = C * pow(G, Y) * pnl_sf_gamma_inc(-Y, eps * G);
    }
    lambda_p = C * pow(M, Y) * pnl_sf_gamma_inc(-Y, eps * M);
    sigma = sqrt(C * (pow(M, Y - 2) * (pnl_tgamma(2 - Y) - pnl_sf_gamma_inc(2 - Y,
    drift = drift - C * (pow(M, Y - 1) * (pnl_sf_gamma_inc(1 - Y, eps * M) - pnl_s
    //////////////////////////////////////
    cdf_jump_bound = 1;
    min_M_G = MIN(M, G);
    //Computation of the biggest jump that we tolerate
    while (C * exp(-min_M_G * cdf_jump_bound) / (min_M_G * pow(cdf_jump_bound, 1 +
        cdf_jump_bound++;

    pas = (cdf_jump_bound - eps) / cdf_jump_vect_size;
    cdf_jump_points = malloc((cdf_jump_vect_size + 1) * sizeof(double));
    cdf_jump_vect_p = malloc((cdf_jump_vect_size + 1) * sizeof(double));
    cdf_jump_vect_m = malloc((cdf_jump_vect_size + 1) * sizeof(double));
    cdf_jump_points[0] = eps;
    cdf_jump_vect_p[0] = 0;
    cdf_jump_vect_m[0] = 0;
    //computation of the cdf of the positive and negative jumps at some points
    for (i = 1; i <= cdf_jump_vect_size; i++)
    {
        cdf_jump_points[i] = i * pas + eps;
        cdf_jump_vect_p[i] = cdf_jump_vect_p[i - 1] + exp(-M * cdf_jump_points[i -
        cdf_jump_vect_m[i] = cdf_jump_vect_m[i - 1] + exp(-G * cdf_jump_points[i -
    }
    //////////////////////////////////////
    m1 = (int)(1000 * lambda_p * T);
    m2 = (int)(1000 * lambda_m * T);
    jump_time_vect_p = malloc((m1) * sizeof(double));
    jump_time_vect_m = malloc((m2) * sizeof(double));
    jump_time_vect_p[0] = 0;
    jump_time_vect_m[0] = 0;
    jump_time_vect = malloc((m1 + m2) * sizeof(double));
    vect_temp = malloc((m1 + m2) * sizeof(double));
    jump_time_vect[0] = 0;
    vect_temp[0] = 0;
    Xg = malloc((m1 + m2) * sizeof(double)); //left value of X at jump times
    Xd = malloc((m1 + m2) * sizeof(double)); //right value of X at jump times

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Xg[0] = 0;
Xd[0] = 0;
////////////////////////////////////////
pnl_rand_init(generator, 1, n_paths);
/*Call Case*/
if ((P->Compute) == &Call_StrikeSpot2)
{
    for (i = 0; i < n_paths; i++)
    {
        //simulation of the positive jump times and number
        tau = -(1 / lambda_p) * log(pnl_rand_uni(generator));
        jump_number_p = 0;
        while (tau < T)
        {
            jump_number_p++;
            jump_time_vect_p[jump_number_p] = tau;
            tau += -1 / (lambda_p) * log(pnl_rand_uni(generator));
        }
        //simulation of the negative jump times and number
        tau = -(1 / lambda_m) * log(pnl_rand_uni(generator));
        jump_number_m = 0;
        while (tau < T)
        {
            jump_number_m++;
            jump_time_vect_m[jump_number_m] = tau;
            tau += -1 / (lambda_m) * log(pnl_rand_uni(generator));
        }
        jump_time_vect_p[jump_number_p + 1] = T;
        jump_time_vect_m[jump_number_m + 1] = T;
        jump_number = jump_number_p + jump_number_m;
    }
    //////////////////////////////////////////
    //computation of Xg and Xd
    k1 = 1;
    k2 = 1;
    u0 = 0;
    u = 0;
    for (k = 1; k <= jump_number; k++)
    {
        w1 = jump_time_vect_p[k1];
        w2 = jump_time_vect_m[k2];
        if (w1 < w2)

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    {
        u = w1;
        k1++;
        z = jump_generator_CGMY(cdf_jump_vect_p, cdf_jump_points, cdf_
    }
else
    {
        u = w2;
        k2++;
        z = -jump_generator_CGMY(cdf_jump_vect_m, cdf_jump_points, cdf_
    }
g_temp = pnl_rand_normal(generator);
if (fabs(drift * (u - u0)) < 1e-4)
    {
        var_temp = (u - u0) * (u - u0) * (u - u0) * var_func(drift * (
        cov_temp = (u - u0) * (u - u0) * cov_func(drift * (u - u0));
    }
else
    {
        var_temp = (4 * exp(drift * (u - u0)) + (2 * drift * (u - u0)
        cov_temp = (u - u0) * exp(drift * (u - u0)) / drift - (exp(dri
    }
jump_time_vect[k] = u;
vect_temp[k] = cov_temp * g_temp / (sqrt(u - u0)) + sqrt(var_temp
Xg[k] = drift * (u - u0) + sigma * g_temp * sqrt(u - u0) + Xd[k -
Xd[k] = Xg[k] + z;
u0 = u;
}
g_temp = pnl_rand_normal(generator);
if (fabs(drift * (T - u0)) < 1e-4)
    {
        var_temp = (T - u0) * (T - u0) * (T - u0) * var_func(drift * (T -
        cov_temp = (T - u0) * (T - u0) * cov_func(drift * (T - u0));
    }
else
    {
        var_temp = (4 * exp(drift * (T - u0)) + (2 * drift * (T - u0) - 3)
        cov_temp = (T - u0) * exp(drift * (T - u0)) / drift - (exp(drift *
    }
jump_time_vect[jump_number + 1] = T;
vect_temp[jump_number + 1] = cov_temp * g_temp / (sqrt(T - u0)) + sqrt

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Xg[jump_number + 1] = drift * (T - u0) + sigma * g_temp * sqrt(T - u0);
Xd[jump_number + 1] = Xg[jump_number + 1];
////////////////////////////////////
//computation of the payoff
payoff = 0;
for (j = 1; j <= jump_number + 1; j++)
{
    if (fabs(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) < 1e-10)
        payoff += exp(Xd[j - 1]) * (p_func(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) - p_func(drift * (jump_time_vect[j - 1] - jump_time_vect[j - 2])));
    else
        payoff += exp(Xd[j - 1]) * ((exp(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) - exp(drift * (jump_time_vect[j - 1] - jump_time_vect[j - 2]))) / (jump_time_vect[j] - jump_time_vect[j - 2]));
}
control = S0 * payoff / T;
dpayoff = discount * (1 - payoff / T) * (payoff / T < 1);
payoff = discount * (S0 - S0 * payoff / T) * (payoff / T < 1);
s1 += payoff;
s += payoff * payoff;
s2 += control;
s3 += control * control;
s4 += control * payoff;
s5 += dpayoff;
s6 += dpayoff * dpayoff;
}
cov_payoff_control = s4 / n_paths - s1 * s2 / ((double)n_paths * n_paths);
var_payoff = (s - s1 * s1 / ((double)n_paths)) / (n_paths - 1);
var_control = (s3 - s2 * s2 / ((double)n_paths)) / (n_paths - 1);
cor_payoff_control = cov_payoff_control / (sqrt(var_payoff) * sqrt(var_control));
control_coef = cov_payoff_control / var_control;
var_dpayoff = (s6 - s5 * s5 / ((double)n_paths)) / (n_paths - 1);
*ptprice = (s1 / n_paths - control_coef * (s2 / n_paths - control_expec));
*priceerror = 1.96 * sqrt(var_payoff * (1 - cor_payoff_control * cor_payoff_control));
*ptdelta = s5 / (n_paths);
*deltaerror = 1.96 * sqrt(var_dpayoff) / sqrt(n_paths);
}
/*Put case*/
if ((P->Compute) == &Put_StrikeSpot2)
{
    for (i = 0; i < n_paths; i++)
    {
        //simulation of the positive jump times and number
        tau = -(1 / lambda_p) * log(pnl_rand_uni(generator));
    }
}

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jump_number_p = 0;
while (tau < T)
{
    jump_number_p++;
    jump_time_vect_p[jump_number_p] = tau;
    tau += -1 / (lambda_p) * log(pnl_rand_uni(generator));
}
//simulation of the negative jump times and number
tau = -(1 / lambda_m) * log(pnl_rand_uni(generator));
jump_number_m = 0;
while (tau < T)
{
    jump_number_m++;
    jump_time_vect_m[jump_number_m] = tau;
    tau += -1 / (lambda_m) * log(pnl_rand_uni(generator));
}
jump_time_vect_p[jump_number_p + 1] = T;
jump_time_vect_m[jump_number_m + 1] = T;
jump_number = jump_number_p + jump_number_m;
////////////////////////////////////
//computation of Xg and Xd
k1 = 1;
k2 = 1;
u0 = 0;
u = 0;
for (k = 1; k <= jump_number; k++)
{
    w1 = jump_time_vect_p[k1];
    w2 = jump_time_vect_m[k2];
    if (w1 < w2)
    {
        u = w1;
        k1++;
        z = jump_generator_CGMY(cdf_jump_vect_p, cdf_jump_points, cdf_
    }
    else
    {
        u = w2;
        k2++;
        z = -jump_generator_CGMY(cdf_jump_vect_m, cdf_jump_points, cdf_
    }
}

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g_temp = pnl_rand_normal(generator);
if (fabs(drift * (u - u0)) < 1e-4)
{
    var_temp = (u - u0) * (u - u0) * (u - u0) * var_func(drift * (u - u0));
    cov_temp = (u - u0) * (u - u0) * cov_func(drift * (u - u0));
}
else
{
    var_temp = (4 * exp(drift * (u - u0)) + (2 * drift * (u - u0) - 3) * exp(drift * (u - u0))) / drift - (exp(drift * (u - u0)) * (1 + drift * (u - u0)));
    cov_temp = (u - u0) * exp(drift * (u - u0)) / drift - (exp(drift * (u - u0)) * (1 + drift * (u - u0)) * (u - u0));
}
jump_time_vect[k] = u;
vect_temp[k] = cov_temp * g_temp / (sqrt(u - u0)) + sqrt(var_temp) * g_temp;
Xg[k] = drift * (u - u0) + sigma * g_temp * sqrt(u - u0) + Xd[k - 1];
Xd[k] = Xg[k] + z;
u0 = u;
}
g_temp = pnl_rand_normal(generator);
if (fabs(drift * (T - u0)) < 1e-4)
{
    var_temp = (T - u0) * (T - u0) * (T - u0) * var_func(drift * (T - u0));
    cov_temp = (T - u0) * (T - u0) * cov_func(drift * (T - u0));
}
else
{
    var_temp = (4 * exp(drift * (T - u0)) + (2 * drift * (T - u0) - 3) * exp(drift * (T - u0))) / drift - (exp(drift * (T - u0)) * (1 + drift * (T - u0)));
    cov_temp = (T - u0) * exp(drift * (T - u0)) / drift - (exp(drift * (T - u0)) * (1 + drift * (T - u0)) * (T - u0));
}
jump_time_vect[jump_number + 1] = T;
vect_temp[jump_number + 1] = cov_temp * g_temp / (sqrt(T - u0)) + sqrt(var_temp) * g_temp;
Xg[jump_number + 1] = drift * (T - u0) + sigma * g_temp * sqrt(T - u0) + Xd[jump_number];
Xd[jump_number + 1] = Xg[jump_number + 1];
////////////////////////////////////
//computation of the payoff
payoff = 0;
for (j = 1; j <= jump_number + 1; j++)
{
    if (fabs(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) < 1e-4)
        payoff += exp(Xd[j - 1]) * (p_func(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) - p_func(drift * (jump_time_vect[j - 1] - jump_time_vect[j - 2])));
    else
        payoff += exp(Xd[j - 1]) * ((exp(drift * (jump_time_vect[j] - jump_time_vect[j - 1])) - exp(drift * (jump_time_vect[j - 1] - jump_time_vect[j - 2]))) / drift);
}

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    }
    control = S0 * payoff / T;
    dpayoff = discount * (1 - payoff / T) * (payoff / T < 1);
    payoff = discount * (S0 - S0 * payoff / T) * (payoff / T < 1);
    s1 += payoff;
    s += payoff * payoff;
    s2 += control;
    s3 += control * control;
    s4 += control * payoff;
    s5 += dpayoff;
    s6 += dpayoff * dpayoff;
}
cov_payoff_control = s4 / n_paths - s1 * s2 / ((double)n_paths * n_paths);
var_payoff = (s - s1 * s1 / ((double)n_paths)) / (n_paths - 1);
var_control = (s3 - s2 * s2 / ((double)n_paths)) / (n_paths - 1);
cor_payoff_control = cov_payoff_control / (sqrt(var_payoff) * sqrt(var_control));
control_coef = cov_payoff_control / var_control;
var_dpayoff = (s6 - s5 * s5 / ((double)n_paths)) / (n_paths - 1);
if (r != divid)
    *ptprice = (s1 / n_paths - control_coef * (s2 / n_paths - control_expect));
else
    *ptprice = (s1 / n_paths - control_coef * (s2 / n_paths - control_expect));
*priceerror = 1.96 * sqrt(var_payoff * (1 - cor_payoff_control * cor_payoff_control));
if (r != divid)
    *ptdelta = s5 / (n_paths) - exp(-divid * T) + (exp(-divid * T) - exp(-r * T));
else
    *ptdelta = s5 / (n_paths) - exp(-divid * T) + exp(-r * T);
*deltaerror = 1.96 * sqrt(var_dpayoff) / sqrt(n_paths);
}
free(Xd);
free(Xg);
free(cdf_jump_points);
free(cdf_jump_vect_p);
free(cdf_jump_vect_m);
free(jump_time_vect_p);
free(jump_time_vect_m);
free(jump_time_vect);
free(vect_temp);

return OK;
}

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int CALC(MC_CGMY_FloatingAsian)(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 CGMY_Mc_FloatingAsian(ptOpt->PayOff.Val.V_NUMFUNC_2, ptMod->S0.Val.V_P
}

static int CHK_OPT(MC_CGMY_FloatingAsian)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "AsianCallFloatingEuro") == 0) || (strcmp((
        return OK;
    return WRONG;
}

#endif //PremiaCurrentVersion
static int MET(Init)(PricingMethod *Met, Option *Mod)
{
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->HelpFilenameHint = "mc_cgmy_asianfloating";
        Met->Par[0].Val.V_ENUM.value = 0;
        Met->Par[0].Val.V_ENUM.members = &PremiaEnumMCRNGs;
        Met->Par[2].Val.V_LONG = 100000;
    }
    return OK;
}

PricingMethod MET(MC_CGMY_FloatingAsian) =
{
    "MC_CGMY_FloatingAsian",
    { {"RandomGenerator", ENUM, {100}, ALLOW},
      {"N iterations", LONG, {100}, ALLOW}, {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(MC_CGMY_FloatingAsian),
    {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID}, {"Price E

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    CHK_OPT(MC_CGMY_FloatingAsian),  
    CHK_ok,  
    MET(Init)  
} ;
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