

[Help](#)

```
#include<stdlib.h>
#include<
href../../common/math/cdo/cdo_math_h_src.pdfmath.h>
#include"pnl/pnl_random.h"
#include"pnl/pnl_specfun.h"
#include "
href../../mod/cgmy1d/cgmy1d_pad/cgmy1d_pad_h_src.pdfcgmy1d_pad.h"
#include "
href../../common/enums_h_src.pdfenums.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els
static int CHK_OPT(MC_CGMY_FixedAsian)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(MC_CGMY_FixedAsian)(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];
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    }
    if (v == 0)
    {
        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;

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    for (i = 0; i <= n; i++)
        s += pow(x, i) / pnl_fact(i + 1);

    return s;
}

//(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_FixedAsian(NumFunc_2 *P, double S0, double T, double r, doubl
{
    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, K;
    int i, j, k, jump_number_p, jump_number_m, jump_number, m1, m2, cdf_jump_vect_
    K = P->Par[0].Val.V_DOUBLE;

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discount = exp(-r * T);
err = 1E-16;
eps = 0.1;
cdf_jump_vect_size = 100000;
if (r - divid != 0)
    control_expec = S0 * (exp((r - divid) * T) - 1) / ((r - divid) * T);
else
    control_expec = S0;
jump_number = 0;
s = 0;
s1 = 0;
s2 = 0;
s3 = 0;
s4 = 0;
s5 = 0;
s6 = 0;
/* if (M < 1 || G < 1 || Y >= 2 || Y == 0) */
/* { */
/*     fprintf(stderr, "Function CGMY_Mc_FixedAsian: invalid parameters. We mu
/* } */
lambda_p = C * pow(M, Y) * pnl_sf_gamma_inc(-Y, eps * M); //positive jump inte
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 inte
while (lambda_m * T < 10)
{
    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);
////////////////////////////////////
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 += cdf_jump_bound + 5;

pas = (cdf_jump_bound - eps) / cdf_jump_vect_size;

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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 - 1]);
    cdf_jump_vect_m[i] = cdf_jump_vect_m[i - 1] + exp(-G * cdf_jump_points[i - 1]);
}
////////////////////////////////////
sigma = sqrt(C * (pow(M, Y - 2) * (pnl_sf_gamma(2 - Y) - pnl_sf_gamma_inc(2 - Y, eps * M)) -
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) +
drift = drift - C * (pow(M, Y - 1) * (pnl_sf_gamma_inc(1 - Y, eps * M) - pnl_sf_gamma(1 - Y, eps * M)));
////////////////////////////////////
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
Xg[0] = 0;
Xd[0] = 0;
////////////////////////////////////
pnl_rand_init(generator, 1, n_paths);
/*Call Case*/
if ((P->Compute) == &Call_OverSpot2)
{

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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)
        {
            u = w1;
            k1++;
            z = jump_generator_CGMY(cdf_jump_vect_p, cdf_jump_points, cdf_
        }
        else
        {

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        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
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++)
{

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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_
    }
    g_temp = pnl_rand_normal(generator);
}

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        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)) / drift);
            cov_temp = (u - u0) * exp(drift * (u - u0)) / drift - (exp(drift * (u - u0)) / drift);
        }
        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] - u0;
        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)) / drift);
        cov_temp = (T - u0) * exp(drift * (T - u0)) / drift - (exp(drift * (T - u0)) / drift);
    }
    jump_time_vect[jump_number + 1] = T;
    vect_temp[jump_number + 1] = cov_temp * g_temp / (sqrt(T - u0)) + sqrt(var_temp);
    Xg[jump_number + 1] = drift * (T - u0) + sigma * g_temp * sqrt(T - u0) + Xd[jump_number] - 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-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 * (payoff / T) * (S0 * payoff / T < K);
        payoff = discount * (K - S0 * payoff / T) * (S0 * payoff / T < K);
        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));
    *ptdelta = s5 / (n_paths);
    *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;
}

int CALC(MC_CGMY_FixedAsian)(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.);

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

        return  CGMY_Mc_FixedAsian(ptOpt->PayOff.Val.V_NUMFUNC_2, ptMod->S0.Val.V_PDOU
    }

static int CHK_OPT(MC_CGMY_FixedAsian)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "AsianCallFixedEuro") == 0) || (strcmp(((Op
        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_asianfixed";
        Met->Par[0].Val.V_ENUM.value = 0;
        Met->Par[0].Val.V_ENUM.members = &PremiaEnumMCRNGs;
        Met->Par[1].Val.V_LONG = 100000;
    }
    return OK;
}

PricingMethod MET(MC_CGMY_FixedAsian) =
{
    "MC_CGMY_FixedAsian",
    {"RandomGenerator", ENUM, {100}, ALLOW}, {"N iterations", LONG, {100}, ALLOW},
    CALC(MC_CGMY_FixedAsian),
    {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID}, {"Price E
    CHK_OPT(MC_CGMY_FixedAsian),
    CHK_ok,
    MET(Init)
} ;

```