

[Help](#)

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#include "cgmy1d_pad.h"
#include "enums.h"
#include "pnl/pnl_cdf.h"
#include "pnl/pnl_random.h"
#include "pnl/pnl_specfun.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els
static int CHK_OPT(MC_CGMY_FixedLookback)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(MC_CGMY_FixedLookback)(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 > l) + (l + 1) * (temp <= l);
                }
            }
        }
        z = pow(1 / pow(cdf_jump_points[q], Y) - (y - cdf_jump_vect[q]) * Y * exp(
    }
    return z;
}

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static int CGMY_Mc_FixedLookback(double s_maxmin, NumFunc_2 *P, double S0, doubl
{
    double eps, s, s1, s2, s3, s4, s5, s6, sup, inf, infS, supS, payoff, control,
    double sigma, lambda_p, control_expec, lambda_m, cdf_jump_bound, pas, min_M_G,
    double var_payoff, var_control, cor_payoff_control, control_coef, var_proba, *
    double *cdf_jump_vect_p, *cdf_jump_vect_m, *X, tau, *jump_time_vect_p, *jump_t
    int i, j, k, jump_number_p, jump_number_m, m1, m2, cdf_jump_vect_size, *N_p, *
    K = P->Par[0].Val.V_DOUBLE;
    discount = exp(-r * T);
    err = 1E-16;
    eps = 0.1;

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beta = 0; //0.5826;
cdf_jump_vect_size = 100000;
X = malloc((n_points + 1) * sizeof(double));
W = malloc((n_points + 1) * sizeof(double));
t = malloc((n_points + 1) * sizeof(double));
N_p = malloc((n_points + 1) * sizeof(int));
N_m = malloc((n_points + 1) * sizeof(int));
X[0] = 0;
W[0] = 0;
t[0] = 0;
pas = T / n_points;
for (i = 1; i <= n_points; i++)
{
    t[i] = i * pas;
}
N_p[0] = 0;
N_m[0] = 0;
control_expec = exp((r - divid) * T);
s = 0;
s1 = 0;
s2 = 0;
s3 = 0;
s4 = 0;
s5 = 0;
s6 = 0;
if (M < 1 || G < 1 || Y >= 2 || Y == 0)
{
    printf("Function CGMY_MC_LookbackFixed : invalid parameters. We must have
}
lambda_p = C * pow(M, Y) * pnl_sf_gamma_inc(-Y, eps * M); //positive jump inte
while (lambda_p * T < 30)
{
    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 < 30)
{
    eps = eps * 0.9;
    lambda_m = C * pow(G, Y) * pnl_sf_gamma_inc(-Y, eps * G);
}

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    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++);
    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 -
    }
    //////////////////////////////////////
    sigma = sqrt(C * (pow(M, Y - 2) * (pnl_tgamma(2 - Y) - pnl_sf_gamma_inc(2 - Y,
    if (Y == 1)
        drift = (r - divid) - C * ((M - 1) * log(1. - 1 / M) + (G + 1) * log(1. + 1
    else
        drift = (r - divid) - C * pnl_tgamma(-Y) * (pow(M, Y) * (pow(1 - 1 / M, Y) -
        drift = drift - C * (pow(M, Y - 1) * (pnl_sf_gamma_inc(1 - Y, eps * M) - pnl_s
    //////////////////////////////////////
    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;
    //////////////////////////////////////
    pnl_rand_init(generator, 1, n_paths);
    //Call options case
    if ((P->Compute) == &Call_OverSpot2)
    {
        s_maxmin = MAX(s_maxmin, K);
    }

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s_maxmin = exp(-beta * sigma * sqrt(T / n_points)) * s_maxmin; //shifting
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] = 0;
    jump_time_vect_m[jump_number_m + 1] = 0;
    //////////////////////////////////////
    // simulation of one CGMY path
    for (k = 1; k <= n_points; k++)
    {
        W[k] = sigma * pnl_rand_normal(generator) * sqrt(t[k] - t[k - 1])
        N_p[k] = N_p[k - 1];
        j = N_p[k - 1] + 1;
        while (jump_time_vect_p[j] <= t[k] && j <= jump_number_p)
        {
            N_p[k]++;
            j++;
        }
        s0 = 0;
        for (j = N_p[k - 1] + 1; j <= N_p[k]; j++)
            s0 += jump_generator_CGMY(cdf_jump_vect_p, cdf_jump_points, cdf_
        N_m[k] = N_m[k - 1];
        j = N_m[k - 1] + 1;
        while (jump_time_vect_m[j] <= t[k] && j <= jump_number_m)

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        {
            N_m[k]++;
            j++;
        }
        for (j = N_m[k - 1] + 1; j <= N_m[k]; j++)
            s0 -= jump_generator_CGMY(cdf_jump_vect_m, cdf_jump_points, cdf_
            X[k] = X[k - 1] + (W[k] - W[k - 1]) + s0;
    }
    //////////////////////////////////////
    //computation of the supremum and the infimum of the CGMY path
    inf = X[0];
    sup = X[0];
    for (j = 1; j <= n_points; j++)
    {
        if (inf > X[j])
            inf = X[j];
        if (sup < X[j])
            sup = X[j];
    }
    proba = 0;
    supS = S0 * exp(sup);
    if (supS < s_maxmin)
    {
        supS = s_maxmin;
        proba = 1.;
    }
    payoff = supS;
    supS = S0 * exp(X[n_points] - inf); //antithetic variable associated w
    if (supS < s_maxmin)
    {
        supS = s_maxmin;
        proba += 1.;
    }
    proba = proba / 2;
    payoff = discount * (payoff + supS) / 2;
    control = exp(X[n_points]);
    s += control;
    s1 += payoff;
    s2 += payoff * payoff;
    s3 += control * payoff;
    s4 += control * control;

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        s5 += proba;
        s6 += proba * proba;
    }
    cov_payoff_control = s3 / n_paths - s1 * s / ((double)n_paths * n_paths);
    var_payoff = (s2 - s1 * s1 / ((double)n_paths)) / (n_paths - 1);
    var_control = (s4 - s * s / ((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_proba = (s6 - s5 * s5 / ((double)n_paths)) / (n_paths - 1);
    *ptprice = exp(beta * sigma * sqrt(T / n_points)) * (s1 / n_paths - control_coef * s);
    *priceerror = exp(beta * sigma * sqrt(T / n_points)) * 1.96 * sqrt(var_payoff);
    *ptdelta = (*ptprice + (K * exp(-r * T) - S0 * exp(-divid * T)) - discount) * control_coef;
    *deltaerror = (*priceerror + discount * s_maxmin * 1.96 * sqrt(var_proba));
}
else//Put
if ((P->Compute) == &Put_OverSpot2)
{
    s_maxmin = MIN(s_maxmin, K);
    s_maxmin = exp(beta * sigma * sqrt(T / n_points)) * s_maxmin; //shifting
    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] = 0;
        jump_time_vect_m[jump_number_m + 1] = 0;
    }
}

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////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
// simulation of one CGMY path
for (k = 1; k <= n_points; k++)
{
    W[k] = sigma * pnl_rand_normal(generator) * sqrt(t[k] - t[k - 1])
    N_p[k] = N_p[k - 1];
    j = N_p[k - 1] + 1;
    while (jump_time_vect_p[j] <= t[k] && j <= jump_number_p)
    {
        N_p[k]++;
        j++;
    }
    s0 = 0;
    for (j = N_p[k - 1] + 1; j <= N_p[k]; j++)
        s0 += jump_generator_CGMY(cdf_jump_vect_p, cdf_jump_points, cd
    N_m[k] = N_m[k - 1];
    j = N_m[k - 1] + 1;
    while (jump_time_vect_m[j] <= t[k] && j <= jump_number_m)
    {
        N_m[k]++;
        j++;
    }
    for (j = N_m[k - 1] + 1; j <= N_m[k]; j++)
        s0 -= jump_generator_CGMY(cdf_jump_vect_m, cdf_jump_points, cd
    X[k] = X[k - 1] + (W[k] - W[k - 1]) + s0;
}
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//computation of the supremum and the infimum of the CGMY path
inf = X[0];
sup = X[0];
for (j = 1; j <= n_points; j++)
{
    if (inf > X[j])
        inf = X[j];
    if (sup < X[j])
        sup = X[j];
}
proba = 0;
infS = S0 * exp(inf);
if (infS > s_maxmin)
{

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        infS = s_maxmin;
        proba = 1;
    }
    payoff = infS;
    infS = S0 * exp(X[n_points] - sup); //antithetic variable associated
    if (infS > s_maxmin)
    {
        infS = s_maxmin;
        proba += 1.;
    }
    proba = proba / 2;
    payoff = discount * (payoff + infS) / 2;
    control = exp(X[n_points]);
    s += control;
    s1 += payoff;
    s2 += payoff * payoff;
    s3 += control * payoff;
    s4 += control * control;
    s5 += proba;
    s6 += proba * proba;
}
cov_payoff_control = s3 / n_paths - s1 * s / ((double)n_paths * n_paths);
var_payoff = (s2 - s1 * s1 / ((double)n_paths)) / ((double)n_paths - 1);
var_control = (s4 - s * s / ((double)n_paths)) / ((double)n_paths - 1);
cor_payoff_control = cov_payoff_control / (sqrt(var_payoff) * sqrt(var_c
control_coef = cov_payoff_control / var_control;
var_proba = (s6 - s5 * s5 / ((double)n_paths)) / ((double)n_paths - 1);
*ptprice = -exp(-beta * sigma * sqrt(T / n_points)) * (s1 / (double)n_pa
*priceerror = exp(-beta * sigma * sqrt(T / n_points)) * 1.96 * sqrt(var_
*ptdelta = (*ptprice + (S0 * exp(-divid * T) - K * exp(-r * T)) + discou
*deltaerror = (*priceerror + discount * s_maxmin * 1.96 * sqrt(var_proba
}
free(X);
free(W);
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(t);
free(N_p);

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    free(N_m);
    return OK;
}

int CALC(MC_CGMY_FixedLookback)(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_FixedLookback((ptOpt->PathDep.Val.V_NUMFUNC_2)->Par[4].Val.V_P

static int CHK_OPT(MC_CGMY_FixedLookback)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "LookBackCallFixedEuro") == 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_lookbackfixed";
        Met->Par[0].Val.V_ENUM.value = 0;
        Met->Par[0].Val.V_ENUM.members = &PremiaEnumMCRNGs;
        Met->Par[1].Val.V_PINT = 100;
        Met->Par[2].Val.V_LONG = 100000;
    }
    return OK;
}

PricingMethod MET(MC_CGMY_FixedLookback) =
{
    "MC_CGMY_FixedLookback",

```

```
{ {"RandomGenerator", ENUM, {100}, ALLOW},
  {"Number of discretization steps", LONG, {100}, ALLOW}, {"N iterations", LONG, {100}, ALLOW},
},
CALC(MC_CGMY_FixedLookback),
{
  {"Price", DOUBLE, {100}, FORBID},
  {"Delta", DOUBLE, {100}, FORBID},
  {"Price Error", DOUBLE, {100}, FORBID},
  {"Delta Error", DOUBLE, {100}, FORBID},
  {" ", PREMIA_NULLTYPE, {0}, FORBID}
},
CHK_OPT(MC_CGMY_FixedLookback),
CHK_ok,
MET(Init)
} ;
```