

## [Help](#)

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#include<stdlib.h>
#include<time.h>
#include"pnl/pnl_specfun.h"
#include "
href../../mod/nig1d/nig1d_pad/nig1d_pad_h_src.pdfnig1d_pad.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els
static int CHK_OPT(AP_CernyKyriakou_NIG_FixedAsian)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(AP_CernyKyriakou_NIG_FixedAsian)(void *Opt, void *Mod, PricingMethod *M
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else
//Laplace transform of NIG process
static dcomplex NIG_laplace_transform(dcomplex u, double t, double alpha, double
{
    dcomplex temp;

    temp = RCsub(delta * sqrt(alpha * alpha - beta * beta), RCmul(delta, Csqrt(RCs

    return Cexp(RCmul(t, Cadd(RCmul(drift, u), temp)));
}
//The generalized discrete Fourier transform (DFT) of a from x onto u
static void DFT(dcomplex *a, double *x, int n, double *u, int m, dcomplex *b)
{
    int j, k;

    for (k = 0; k <= m; k++)
    {
        b[k] = CZERO;
        for (j = 1; j <= n; j++)
            b[k] = Cadd(Cmul(a[j], CIexp(x[j] * u[k])), b[k]);
        b[k] = CRmul(b[k], fabs(x[1] - x[0]));
    }
}
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int nig_ap_cernykyriakou_asianfixed(NumFunc_2 *P, double S0, double T, double r,
{
    double *lambda, drift, *L, *L_bar, *u, *U, *U_bar, rho, u_max, *x, *y, x_step,
    double u_step, *u_minus, *h, u_em, l_em, *a, *b, exp_X, alpha, beta, delta, K,
    int i, k, i_up, i_down, x_nb, y_nb, u_nb, i_temp, i_x, test;
    dcomplex *q, *p, *P_vect, *phi, *temp;

    alpha = sqrt(theta * theta + sigma * sigma / kappa) / (sigma * sigma);
    beta = theta / (sigma * sigma);
    delta = sigma / sqrt(kappa);
    K = P->Par[0].Val.V_DOUBLE;
    rho = 1e-6;
    time_step = T / n_points;
    u_nb = POW(2, 10);
    x_nb = POW(2, 10);
    y_nb = POW(2, 10);
    i_x = 0;
    coef = 1;
    lambda = malloc((n_points + 1) * sizeof(double));
    a = malloc((n_points + 1) * sizeof(double));
    b = malloc((n_points + 1) * sizeof(double));
    L = malloc((n_points + 1) * sizeof(double));
    U = malloc((n_points + 1) * sizeof(double));
    L_bar = malloc((n_points + 1) * sizeof(double));
    U_bar = malloc((n_points + 1) * sizeof(double));
    x = malloc((x_nb + 1) * sizeof(double));
    y = malloc((y_nb + 1) * sizeof(double));
    h = malloc((y_nb + 1) * sizeof(double));
    p = malloc((y_nb + 1) * sizeof(dcomplex));
    q = malloc((x_nb + 1) * sizeof(dcomplex));

    drift = (r - divid) - log(Creal(NIG_laplace_transform(Complex(1, 0), 1, alpha,
    u_max = 5.;
    while (Cabs(NIG_laplace_transform(Complex(0, u_max), time_step, alpha, beta, d
    {
        u_max += 5.;
    }
    u_step = 2 * u_max / u_nb;
    if (u_step > 0.125)
    {
        u_nb = trunc(16 * u_max);

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        u_nb += PNL_IS_ODD(u_nb);
        u_step = 2 * u_max / u_nb;
    }
    u = malloc((u_nb + 1) * sizeof(double));
    u_minus = malloc((u_nb + 1) * sizeof(double));
    P_vect = malloc((u_nb + 1) * sizeof(dcomplex));
    phi = malloc((u_nb + 1) * sizeof(dcomplex));
    temp = malloc((u_nb + 1) * sizeof(dcomplex));
    for (i = 0; i <= u_nb; i++)
    {
        u[i] = -u_max + i * u_step;
        u_minus[i] = -u[i];
        phi[i] = NIG_laplace_transform(Complex(0, u[i]), time_step, alpha, beta, d
    }
    /*Call Case*/
    lambda[0] = 1. / (n_points + 1) - K / S0;
    for (i = 1; i <= n_points; i++)
        lambda[i] = 1. / (n_points + 1);
    do
    {
        u_em = 5 * coef;
        l_em = -5 * coef;
        //////////////////////////////////////
        a[n_points] = 1;
        b[n_points] = lambda[0] * (lambda[0] > 0);
        exp_X = Creal(NIG_laplace_transform(Complex(1, 0), time_step, alpha, beta,
        for (i = n_points; i > 0; i--)
        {
            a[i - 1] = a[i] * exp_X;
            b[i - 1] = b[i] + a[i - 1] * lambda[n_points - i + 1];
        }
        //////////////////////////////////////
        L_bar[0] = log(lambda[n_points]);
        U_bar[0] = log(lambda[n_points]);
        for (i = 1; i < n_points; i++)
        {
            L[i] = L_bar[i - 1] + l_em;
            U[i] = U_bar[i - 1] + u_em;
            L_bar[i] = log(exp(L[i]) + lambda[n_points - i]);
            U_bar[i] = log(exp(U[i]) + lambda[n_points - i]);
        }

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L[n_points] = L_bar[n_points - 1] + l_em;
U[n_points] = U_bar[n_points - 1] + u_em;
y_step = (U[n_points] - L[n_points]) / y_nb;
for (i = 0; i <= y_nb; i++)
{
    y[i] = L[n_points] + i * y_step;
    p[i] = Complex((exp(y[i]) + lambda[0]) * (exp(y[i]) + lambda[0] > 0),
    }
coef *= 0.95;
}
while (y[y_nb] > 10);
for (k = n_points; k > 1; k--)
{
    x_step = (U_bar[k - 1] - L_bar[k - 1]) / x_nb;
    for (i = 0; i <= x_nb; i++)
    {
        x[i] = L_bar[k - 1] + i * x_step;
    }
    DFT(p, y, y_nb, u, u_nb, P_vect);
    for (i = 0; i <= u_nb; i++)
    {
        temp[i] = Cmul(P_vect[i], Conj(phi[i]));
    }
    DFT(temp, u_minus, u_nb, x, x_nb, q);
    for (i = 0; i <= x_nb; i++)
    {
        q[i] = CRdiv(q[i], 2 * M_PI);
    }
    //////////////////////////////////////
    y_step = (U[k - 1] - L[k - 1]) / y_nb;
    for (i = 0; i <= y_nb; i++)
    {
        y[i] = L[k - 1] + i * y_step;
        h[i] = log(exp(y[i]) + lambda[n_points - (k - 1)]);
        test = 0;
        if (h[i] <= x[0])
        {
            i_x = 0;
            test = 1;
            p[i] = Cadd(q[i_x], CRmul(CRdiv(Csub(q[i_x + 1], q[i_x]), x[i_x +
}

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if (h[i] >= x[x_nb])
{
    i_x = x_nb;
    test = 1;
    p[i] = Cadd(q[i_x - 1], CRMul(CRdiv(Csub(q[i_x], q[i_x - 1]), x[i_
}
if ((h[i] > x[0]) && (h[i] < x[x_nb]))
{
    i_down = x_nb / 2;
    i_up = x_nb;
    if (x[i_down] > h[i])
    {
        i_down = 0;
        i_up = x_nb / 2;
    }
    while (test == 0)
    {
        if (x[i_down + 1] > h[i])
        {
            i_x = i_down;
            test = 1;
        }
        else
        {
            i_temp = (i_up - i_down - 1) / 2 + i_down;
            if (x[i_temp] > h[i])
            {
                i_up = i_temp;
                i_down = i_down + 1;
            }
            else
            {
                i_down = i_temp * (i_temp > i_down) + (i_down + 1) * (
            }
        }
    }
    p[i] = Cadd(q[i_x], CRMul(CRdiv(Csub(q[i_x + 1], q[i_x]), x[i_x +
}
}
}
////////////////////////////////////
}

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x_step = (U_bar[0] - L_bar[0]) / x_nb;
for (i = 0; i <= x_nb; i++)
{
    x[i] = L_bar[0] + i * x_step;
}
DFT(p, y, y_nb, u, u_nb, P_vect);
for (i = 0; i <= u_nb; i++)
{
    temp[i] = Cmul(P_vect[i], Conj(phi[i]));
}
DFT(temp, u_minus, u_nb, x, x_nb, q);
for (i = 0; i <= x_nb; i++)
{
    q[i] = CRdiv(q[i], 2 * M_PI);
}
/*Call Case*/
if ((P->Compute) == &Call_OverSpot2)
{
    *ptprice = S0 * exp(-r * T) * Creal(q[0]);
}
/*Put case*/
if ((P->Compute) == &Put_OverSpot2)
{
    if (r != divid)
        *ptprice = S0 * exp(-r * T) * Creal(q[0]) + K * exp(-r * T) - S0 * (exp(
    else
        *ptprice = S0 * exp(-r * T) * Creal(q[0]) - (S0 - K) * exp(-r * T);
}
free(lambda);
free(L);
free(U);
free(L_bar);
free(U_bar);
free(u);
free(u_minus);
free(x);
free(y);
free(h);
free(p);
free(P_vect);
free(phi);

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    free(temp);
    free(q);
    free(a);
    free(b);

    return OK;
}

int CALC(AP_CernyKyriakou_NIG_FixedAsian)(void *Opt, void *Mod, PricingMethod *M)
{
    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 nig_ap_cernykyriakou_asianfixed(ptOpt->PayOff.Val.V_NUMFUNC_2, ptMod->
}

static int CHK_OPT(AP_CernyKyriakou_NIG_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 = "ap_cernykyriakou_nig_asianfixed";
        Met->Par[0].Val.V_PINT = 10;
    }
    return OK;
}

PricingMethod MET(AP_CernyKyriakou_NIG_FixedAsian) =
{
    "AP_CernyKyriakou_NIG_FixedAsian",

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    {"Number of discretization steps", LONG, {100}, ALLOW}, {" ", PREMIA_NULLTYPE
    CALC(AP_CernyKyriakou_NIG_FixedAsian),
    {"Price", DOUBLE, {100}, FORBID}, {" ", PREMIA_NULLTYPE, {0}, FORBID}},
    CHK_OPT(AP_CernyKyriakou_NIG_FixedAsian),
    CHK_ok,
    MET(Init)
} ;

```