

Help

```

#include "hes1d_std.h"
#include "enums.h"
#include "math/ESM_func.h"
#include "pnl/pnl_random.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2009+2) //The "#els
static int CHK_OPT(MC_Smith_Heston)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(MC_Smith_Heston)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

int MCSmith(double S0, NumFunc_1 *pf, double T, double r, double divid, double
{
    double delta;
    int i, M;
    long k;
    double g1, g2;
    double price_sample, delta_sample, mean_price, mean_delta, var_price, var_delt
    double alpha, z_alpha;
    double u;
    double d, ekd, nekd, C0, B;
    double sq_rho, KTD, RS, KRS;
    double a, KKK;
    double Vi;
    double erT;
    double V, log_S;
    double *mean, *variance, *h;
    double **values;
    int *N_vect, NS, j;
    double Vmax, inv, Act_i, Nact_i, b, hh, m, p, Vmax_i, z, Vst, var, omega, lamb

    delta = T / N_t_grid;
    erT = exp((r - divid) * T);
    M = 10000;

```

```

//Useful constants
d = 4 * K_heston * Theta / (sigma * sigma);

ekd = exp(-K_heston * delta);
nekd = 1. - ekd;
C0 = pow(sigma, 2.) * nekd / (4 * K_heston);
B = ekd / C0;
sq_rho = sqrt(1 - rho * rho);
KTD = K_heston * Theta * delta;
RS = rho / sigma;
KRS = K_heston * RS - 0.5;
ESM_update_const_char(K_heston, sigma, delta, d);

a = 0.5 * d;
KKK = 2.*K_heston * v0 / pow(sigma, 2.);
eps1 = 1e-5;
inv = -pn1_inv_cdfnor(eps1);
Vmax = v0;
for (i = 1; i < N_t_grid + 1; i++)
{
    Act_i = pow(ekd, (double)i);
    Nact_i = 1. - Act_i;
    b = KKK * Act_i / Nact_i;
    hh = 1. - 2. / 3.*(a + b) * (a + 3.*b) / pow(a + 2 * b, 2.);
    m = (hh - 1.) * (1 - 3 * hh);
    p = .5 * (a + 2 * b) / pow(a + b, 2);

    Vmax_i = (a + b) * (.5 * pow(sigma, 2) * Nact_i / K_heston) * pow(inv * hh, m);
    Vmax = MAX(Vmax_i, Vmax);
}

NS = 2000;
omega = 0.5;

//Memory allocation
mean = malloc((NS) * sizeof(double));
if (mean == NULL)
    return MEMORY_ALLOCATION_FAILURE;

variance = malloc((NS) * sizeof(double));

```

```

if (variance == NULL)
    return MEMORY_ALLOCATION_FAILURE;

h = malloc((NS) * sizeof(double));
if (h == NULL)
    return MEMORY_ALLOCATION_FAILURE;

N_vect = malloc((NS) * sizeof(int));
if (N_vect == NULL)
    return MEMORY_ALLOCATION_FAILURE;

values = (double **)calloc(NS, sizeof(double *));
if (values == NULL)
    return MEMORY_ALLOCATION_FAILURE;
for (i = 0; i < NS; i++)
{
    values[i] = (double *)calloc(M, sizeof(double));
    if (values[i] == NULL)
        return MEMORY_ALLOCATION_FAILURE;
}

epsilon = 1.e-6;

values_all_AESM(M, Vmax, NS , K_heston, sigma, delta, d, epsilon, mean, varian

/* 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;

pnl_rand_init(generator, 1, N_sample);

for (k = 0; k < N_sample; k++)
{
    // N_path Paths

```

```

V = v0;
log_S = log(S0);
for (i = 0; i < N_t_grid; i++)
{
    u = pnl_rand_uni(generator);
    g2 = pnl_rand_normal(generator);

    Vi = V;
    lambda = B * Vi;

    if (d > 1)
    {
        g1 = pnl_rand_normal(generator);
        gen = pow(g1 + sqrt(lambda), 2.) + pnl_rand_chi2(d - 1.,
            generator);
    }
    else
    {
        pois = pnl_rand_poisson(lambda * 0.5, generator);
        gen = pnl_rand_chi2(d + 2 * pois, generator);
    }

    V = C0 * gen;

    z = omega * Vi + (1. - omega) * V;
    j = floor(z * NS / Vmax);
    if (j + 1 > NS)
        j = NS - 1;

    Vst = inverse_ESM(u, h[j], N_vect[j], values[j]);

    Moments_ESM(Vi, V, K_heston, sigma, delta, d, &m, &var);

    Vst = sqrt(var / variance[j]) * (Vst - mean[j]) + m; //moment
    //matching
    Vst = MAX(Vst, 0.);
    log_S += RS * (V - Vi - KTD) + KRS * Vst + sq_rho * sqrt(Vst) * g2;
}

/*Price*/

```

```

    price_sample = (pf->Compute)(pf->Par, erT * exp(log_S));

    /* Delta */
    if (price_sample > 0.0)
        delta_sample = (erT * exp(log_S) / S0);
    else delta_sample = 0.;

    /* 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)N_sample);

*pterror_price = exp(-r * T) * sqrt(var_price / (double)N_sample - 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)N_sample);
if ((pf->Compute) == &Put)
    *ptdelta *= (-1);
*pterror_delta = sqrt(exp(-2.0 * r * T) * (var_delta / (double)N_sample - SQR(*ptdelta)));

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

/*Memory desallocation*/
free(mean);
\

```

```

    free(variance);
    free(h);
    free(N_vect);
    for (i = 0; i < NS; i++)
        free(values[i]);
    free(values);

    return OK;
}

int CALC(MC_Smith_Heston)(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 MCSmith(ptMod->S0.Val.V_PDOUBLE,
                  ptOpt->PayOff.Val.V_NUMFUNC_1,
                  ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,
                  r,
                  divid, ptMod->Sigma0.Val.V_PDOUBLE,
                  ptMod->MeanReversion.Val.V_PDOUBLE,
                  ptMod->LongRunVariance.Val.V_PDOUBLE,
                  ptMod->Sigma.Val.V_PDOUBLE,
                  ptMod->Rho.Val.V_PDOUBLE,
                  Met->Par[0].Val.V_LONG,
                  Met->Par[1].Val.V_INT,
                  Met->Par[2].Val.V_ENUM.value,
                  Met->Par[3].Val.V_RGDOUBLE12,
                  Met->Par[4].Val.V_PDOUBLE,
                  &(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));
}

```

```

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

    return WRONG;
}

#endif //PremiaCurrentVersion
static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    //int type_generator;
    if (Met->init == 0)
    {
        Met->init = 1;

        Met->Par[0].Val.V_LONG = 10000;
        Met->Par[1].Val.V_INT = 1;
        Met->Par[2].Val.V_ENUM.value = 0;
        Met->Par[2].Val.V_ENUM.members = &PremiaEnumMCRNGs;
        Met->Par[3].Val.V_RGDOUBLE12 = 1.5;
        Met->Par[4].Val.V_DOUBLE = 0.95;
    }

    return OK;
}

PricingMethod MET(MC_Smith_Heston) =
{
    "MC_Smith",
    { {"N iterations", LONG, {100}, ALLOW},
      {"TimeStepNumber", LONG, {100}, ALLOW},
      {"RandomGenerator", ENUM, {100}, ALLOW},
      {"THRESHOLD", DOUBLE, {100}, ALLOW},
      {"Confidence Value", DOUBLE, {100}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(MC_Smith_Heston),

```

```
{ {"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_Smith_Heston),
CHK_mc,
MET(Init)
};
```