

[Help](#)

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#include "hes1d_std.h"
#include "enums.h"

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

int MCZhu(double S0, NumFunc_1 *pf, double T, double r, double divid, double v0)
{
    double delta = T / N_t_grid;
    int i;
    long k;
    double g1, g2;
    double price_sample, delta_sample, mean_price, mean_delta, var_price, var_delt
    double alpha, z_alpha;
    double sq_delta, sq_rho, ED, KD, TE, KDTE; // constant of the models central di
    /* double ekd; // constant of the models Moments matching */
    double Vi, temp;
    double erT = exp((r - divid) * T);
    double V, log_S;

    //Useful constants
    sq_delta = sqrt(delta);
    sq_rho = sqrt(1 - rho * rho);
    ED = 0.5 * sigma * sq_delta;
    KD = 0.5 * K_heston * delta;
    TE = Theta - 0.25 * pow(sigma, 2.) / K_heston;
    KDTE = KD * TE;
    /* ekd=exp(-K_heston*delta); */
    //ekd1=1.-ekd;

    //ekdh=exp(-0.5*K_heston*delta);

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//ekdh1=1.-ekdh;

//Tekd=Theta*ekd1;
//m2=0.25*pow(sigma,2.)*ekd1/K_heston;

/* 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++)
    {
        g1 = pnl_rand_normal(generator);
        g2 = pnl_rand_normal(generator);

        // Transformed volatility schemes with central discretisation
        Vi = V;
        temp = Vi + KDTE / Vi - KD * Vi;
        temp = 0.5 * (Vi + temp);
        temp = TE / temp;

        V += KD * (temp - Vi) + ED * g1;
        log_S += -0.5 * delta * pow(Vi, 2.) + Vi * sq_delta * (rho * g1 + sq_r
    }

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

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/* 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);

return OK;
}
```

```

int CALC(MC_Zhu_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 MCZhu(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_Zhu_Heston)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "CallEuro") == 0) || (strcmp(((Option *)Opt)
    return OK;

    return WRONG;
}

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#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 = 15000;
        Met->Par[1].Val.V_INT = 100;
        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_Zhu_Heston) =
{
    "MC_Zhu",
    { {"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_Zhu_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}
    },
}

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    CHK_OPT(MC_Zhu_Heston),  
    CHK_mc,  
    MET(Init)  
};
```