Help

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/*COS method for European option, Heston model*/
/*Developed by F.Fang, C.W.Oosterlee (2008), implemented by B.Zhang*/

#include <pnl/pnl_mathtools.h>
#include <pnl/pnl_complex.h>
#include <pnl/pnl_vector.h>
#include "hes1d_std.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els

static int CHK_OPT(AP_Cosine_Euro)(void *Opt, void *Mod)
{
  return NONACTIVE;
}
int CALC(AP_Cosine_Euro)(void *Opt, void *Mod, PricingMethod *Met)
{
  return AVAILABLE_IN_FULL_PREMIA;
}
#else


static void Valomega(int N, double a, double b, PnlVect *omega)
{
  int j;

  for (j = 0; j < N; j++)
    {
      pnl_vect_set(omega, j, ((double)j)*M_PI / (b - a));
    }

}

static void Valcf(int N, PnlVect *omega, double u0, double u, double r,
                  double q, double T, double eta, double rho, double
                  lambda, double x, double a, PnlVectComplex *cf)
{
  int j;

  for (j = 0; j < N; j++)
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    {
      double omegaj = pnl_vect_get(omega, j);
      dcomplex D, G, temp1, temp2, temp3, temp4;

      D = Cpow_real(Cadd(Cpow_real(RCsub(lambda, Complex(0, rho * eta * omegaj))
      G = Cdiv(Csub(Complex(lambda, -rho * eta * omegaj), D), Cadd(Complex(lambd

      temp1 = RCsub(1, Cexp(CRmul(D, -T)));
      temp2 = RCsub(1, Cmul(G, Cexp(CRmul(D, -T))));
      temp3 = Csub(Complex(lambda, -rho * eta * omegaj), D);
      temp4 = RCsub(1, G);

      pnl_vect_complex_set(cf, j, Cmul(Cmul(Cexp(Cadd(Complex(0, omegaj * (r - q

    }
}

static void cf0(PnlVectComplex *cf)
{
  pnl_vect_complex_set_real(cf, 0, 0.5 * pnl_vect_complex_get_real(cf, 0));
  pnl_vect_complex_set_imag(cf, 0, 0.5 * pnl_vect_complex_get_imag(cf, 0));
}

static void VjtM(int N, double a, double b, double K, PnlVect *omega, PnlVect *V
{
  int j;

  for (j = 0; j < N; j++)
    {
      double omegaj = pnl_vect_get(omega, j);
      pnl_vect_set(V, j, (-pow((1 + pow(omegaj, 2)), -1) * (cos((-a)*omegaj) - e
    }
}

static void VjtM0(double a, double b, double K, PnlVect *V)
{
  pnl_vect_set(V, 0, (exp(a) - 1.0 - a) * (2.0 / (b - a))*K);
}

static void VecRe(int N, double r, double T, PnlVect *V, PnlVect *omega,
                  PnlVectComplex *cf, PnlVect *fcvec)
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{
  int j;

  for (j = 0; j < N; j++)
    {
      double Vj = pnl_vect_get(V, j);
      pnl_vect_set(fcvec, j, exp(-r * T)*Vj * pnl_vect_complex_get_real(cf, j));
    }
}

static void par(double r, double q, double S0, double T, double K, double *vopt)
{
  *vopt += S0 * exp(-q * T) - K * exp(-r * T);
}

static int Cosine(double S0, double K, double T, double r, double q, double
                  u0, double u, double lambda, double eta, double rho, int
                  iscall, double *prix)
{
  /* Values of N and L are chosen from the point of view of both speed and
   * accuracy. Please do not change them. */

  double x, a, b, c1, c2;
  PnlVect *omega, *V, *fcvec;
  PnlVectComplex *cf;
  int N = 128;
  int L = 10;

  omega = pnl_vect_create(N);
  V = pnl_vect_create(N);
  fcvec = pnl_vect_create(N);
  cf = pnl_vect_complex_create(N);


  /*Transform the stock price to log-asset domain: x=log(S/K)*/
  x = log(S0 / K);

  /*Cumulants*/
  c1 = (r - q) * T + (1 - exp(-lambda * T)) * (u - u0) / (2.0 * lambda) - 0.5 *
  c2 = (1.0 / (8.0 * pow(lambda, 3))) * (eta * T * lambda * exp(-lambda * T) * (
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  /*Truncation range*/
  a = c1 - L * pow(fabs(c2), 0.5) + x;
  b = c1 + L * pow(fabs(c2), 0.5) + x;

  Valomega(N, a, b, omega);

  /*Characteristic function of Heston model*/
  Valcf(N, omega, u0, u, r, q, T, eta, rho, lambda, x, a, cf);
  cf0(cf);

  /* Fourier Cosine Coefficient of option price at expiry*/
  VjtM(N, a, b, K, omega, V);
  VjtM0(a, b, K, V);

  /* Taking the real part of characteristic function and mulitiply with
   * Fourier Cosine Coefficience of option value at expiry*/
  VecRe(N, r, T, V, omega, cf, fcvec);

  /* Sum up the Fourier Cosine series */
  *prix =  pnl_vect_sum(fcvec);

  /* The value of a call option is obtained from that of a put option, by
   * put-call parity */
  if (iscall == TRUE) par(r, q, S0, T, K, prix);

  pnl_vect_free(&omega);
  pnl_vect_free(&V);
  pnl_vect_free(&fcvec);
  pnl_vect_complex_free(&cf);

  return OK;
}

static int CALC(AP_Cosine_Euro)(void *Opt, void *Mod, PricingMethod *Met)
{
  double r, divid;
  int iscall;
  TYPEOPT *ptOpt = (TYPEOPT *)Opt;
  TYPEMOD *ptMod = (TYPEMOD *)Mod;

  iscall = FALSE;
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  if (ptOpt->PayOff.Val.V_NUMFUNC_1->Compute == &Call) iscall = TRUE;

  r = log(1. + ptMod->R.Val.V_DOUBLE / 100.);
  divid = log(1. + ptMod->Divid.Val.V_DOUBLE / 100.);
  Met->Res[1].Val.V_DOUBLE = 0.;
  return Cosine(ptMod->S0.Val.V_PDOUBLE,
                ptOpt->PayOff.Val.V_NUMFUNC_1->Par[0].Val.V_PDOUBLE,
                ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE, r, divid,
                ptMod->Sigma0.Val.V_PDOUBLE,
                ptMod->LongRunVariance.Val.V_PDOUBLE,
                ptMod->MeanReversion.Val.V_PDOUBLE,
                ptMod->Sigma.Val.V_PDOUBLE,
                ptMod->Rho.Val.V_PDOUBLE,
                iscall,
                &(Met->Res[0].Val.V_DOUBLE));
}

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

  return  WRONG;
}

#endif

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
  if (Met->init == 0)
    {
      Met->Par[0].Val.V_PDOUBLE = 0.1;
      Met->init = 1;
      Met->HelpFilenameHint = "ap_cosine_hes1d_euro";
    }
  return OK;
}


PricingMethod MET(AP_Cosine_Euro) =
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{
  "AP_Cosine_Euro",
  { {" ", PREMIA_NULLTYPE, {0}, FORBID}},
  CALC(AP_Cosine_Euro),
  { {"Price", DOUBLE, {100}, FORBID},
    {" ", PREMIA_NULLTYPE, {0}, FORBID}
  },
  CHK_OPT(AP_Cosine_Euro),
  CHK_ok,
  MET(Init)
};
```