

Help

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#if defined(PremiaCurrentVersion) && PremiaCurrentVersion <
    (2007+2) //The "#else" part of the code will be freely available after the (year of creation of this file + 2)
#else

#ifndef QUADRATICMODEL_H
#define QUADRATICMODEL_H

#include "math/read_market_zc/InitialYieldCurve.h"

/**
The instantaneous sport interest rate  $r_t$  is described by
 $r_t = 0.5x_t^2$ , with  $x_t$  following SDE :

 $dx_t = (\alpha_t - \beta * x_t) * dt + \sigma * dW_t$ 
 $x_0 = \sqrt{2r_0}$ 
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// Strucure which contains information on the the T-maturity
y zc bond at time t=0 under, Quadratic model.
//  $P(0, T) = \exp(- ( B*r + b * \sqrt{2*r} ) + c)$ 
typedef struct
{
    double T;
    double P; // Price of the T-maturity bond at time t=0
    double f0_T; // T-maturity forward rate at time t=0
    double B; // Coefficients of the T-maturity bond at time
        t=0 :  $P(0,T)=\exp(-(.5*B*x^2+b*x+c))$ 
    double b;
    double c;
    double dB; // Derivatives of B and b with respect to T
    double db;
    double V; // Variance of x under the T-forward probability
} Data;

// Coefficients of the omega distribution :  $.5*B*x^2+bx+c$  where x is normally distributed with mean mu and variance V
typedef struct

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{
    double B;
    double b;
    double c;
    double mu;
    double V;
} Omega;

// coefficients of the  $\chi^2$  distribution :  $\alpha + \beta X$  where X is non centrally  $\chi^2$  distributed with nu degree of freedom and non-centrality parameter lambda
typedef struct
{
    double nu;
    double lambda;
    double beta;
    double alpha;
} Chn;

// Computes the structure data at time T
void bond_coeffs(ZCMarketData *ZCMarket, Data *data,
    double T, double beta, double sigma, double x0);

// Gives the omega distribution of the zero-coupon bond P(
    T, S) data1 contains the coefficients of bond P(0,T), data2
    contains the coefficients of bond P(0,S).
void transport(Omega *om, Data data1, Data data2, double
    beta, double sigma, double x0);

// Transforms Omega distribution to a  $\chi^2$  distribution
void om2chn(Omega om, Chn *chn);

// Compute the initial rate  $r_0$  and corresponding value  $x_0$ 
void initial_short_rate(ZCMarketData *ZCMarket, double *r0,
    double *x0);

/* Price of a european option on zero coupon bond*/
double zb_call_quad1d(ZCMarketData *ZCMarket, double beta,
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        double sigma, double T, double S, double strike);  
double zb_put_quad1d(ZCMarketData *ZCMarket, double beta,  
        double sigma, double T, double S, double strike);  
  
#endif  
#endif //PremiaCurrentVersion
```

References