

[Help](#)

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#include <stdlib.h>
#include "sg1d_std.h"
#include "math/InterestRateModelTree/TreeShortRate/TreeShortRate.h"
#include "pnl/pnl_vector.h"
#include "math/read_market_zc/InitialYieldCurve.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2007+2) //The "#els
int CALC(TR_CapFloorSG1D)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
static int CHK_OPT(TR_CapFloorSG1D)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
#else

static void CapFloor_InitialPayoffSG1D(TreeShortRate *Meth, ModelParameters *Mod
{
    int jminprev, jmaxprev;
    int j;

    double ZCPrice;

    jminprev = pnl_vect_int_get(Meth->Jminimum, Meth->Ngrid); // jmin(Ngrid)
    jmaxprev = pnl_vect_int_get(Meth->Jmaximum, Meth->Ngrid); // jmax(Ngrid)

    pnl_vect_resize(ZCbondPriceVect, jmaxprev - jminprev + 1);

    pnl_vect_set_double(ZCbondPriceVect, 1.0); // Payoff = 1 for a ZC bond

    BackwardIteration(Meth, ModelParam, OptionPriceVect, ZCbondPriceVect, Meth->Ng

    p->Par[0].Val.V_DOUBLE = 1.0 ;

    for (j = 0 ; j < ZCbondPriceVect->size ; j++)
    {

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        ZCPrice = GET(ZCbondPriceVect, j);

        LET(OptionPriceVect, j) = (p->Compute)(p->Par, (1 + periodicity * CapFloor
    }
}

static void CapFloor_BackwardIteration(TreeShortRate *Meth, ModelParameters *Mod
{
    double a , sigma;

    int jmin; // jmin[i+1], jmax[i+1]
    int jminprev, jmaxprev; // jmin[i], jmax [i]
    int i, j, k; // i = represents the time index. j, k represents the nodes index

    double eta_over_delta_x;
    double delta_x1, delta_x2; // delta_y1 = space step of the process y at time i
    double delta_t1, delta_t2; // time step
    double beta_x; // quantity used in the computation of the probabilities. it

    double current_rate;
    double ZCPrice;

    double Pup, Pmiddle, Pdown;

    ///*****Parameters of the processes r, u and y *****
    a = ModelParam->MeanReversion;
    sigma = ModelParam->RateVolatility;

    jminprev = pnl_vect_int_get(Meth->Jminimum, index_last); // jmin(index_last)
    jmaxprev = pnl_vect_int_get(Meth->Jmaximum, index_last); // jmax(index_last)

    pnl_vect_resize(ZCbondPriceVect2, OptionPriceVect2->size);

    pnl_vect_set_double(ZCbondPriceVect2, 1.0); // Payoff = 1 for a ZC bond

    /** Backward computation of the option price from "index_last-1" to "index_f
    for (i = index_last - 1; i >= index_first; i--)
    {
        jmin = jminprev; // jmin := jmin(i+1)
        jminprev = pnl_vect_int_get(Meth->Jminimum, i); // jminprev := jmin(i)
        jmaxprev = pnl_vect_int_get(Meth->Jmaximum, i); // jmaxprev := jmax(i)
    }

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pnl_vect_resize(OptionPriceVect1, jmaxprev - jminprev + 1); // OptionPrice
pnl_vect_resize(ZCbondPriceVect1, jmaxprev - jminprev + 1);

delta_t1 = GET(Meth->t, i) - GET(Meth->t, MAX(i - 1, 0));
delta_t2 = GET(Meth->t, i + 1) - GET(Meth->t, i);

delta_x1 = SpaceStep(delta_t1, a, sigma); // SpaceStep (i)
delta_x2 = SpaceStep(delta_t2, a, sigma); // SpaceStep (i+1)

beta_x = (delta_x1 / delta_x2) * exp(-a * delta_t2);

// Boucle sur les noeuds
for (j = jminprev ; j <= jmaxprev ; j++)
{
    k = pnl_iround(j * beta_x); // index of the middle node emanating from
    eta_over_delta_x = j * beta_x - k; // quantity used in the computation

    Pup = ProbaUp(eta_over_delta_x); // Probability of an up move from (i,
    Pmiddle = ProbaMiddle(eta_over_delta_x); // Probability of a middle mo
    Pdown = 1 - Pup - Pmiddle; // Probability of a down move from (i,j)

    current_rate = func_model_sg1d(j * delta_x1 + GET(Meth->alpha, i)); //

    LET(OptionPriceVect1, j - jminprev) = exp(-current_rate * delta_t2) *

    LET(ZCbondPriceVect1, j - jminprev) = exp(-current_rate * delta_t2) *

}

// Copy OptionPrice1 in OptionPrice2
pnl_vect_clone(OptionPriceVect2, OptionPriceVect1);
pnl_vect_clone(ZCbondPriceVect2, ZCbondPriceVect1);

} // END of the loop on i

p->Par[0].Val.V_DOUBLE = 1.0 ;

for (j = 0 ; j < ZCbondPriceVect2->size ; j++)
{
    ZCPrice = GET(ZCbondPriceVect2, j);

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        LET(OptionPriceVect2, j) += (p->Compute)(p->Par, (1 + periodicity * CapFlo
    }

}

/// Price of a Cap/Floor using a trinomial tree

static double tr_sg1d_capfloor(TreeShortRate *Meth, ModelParameters *ModelParam,
{
    double OptionPrice, Ti2, Ti1;
    int i, i_Ti2, i_Ti1, n;

    PnlVect *OptionPriceVect1; // Vector of prices of the option at i
    PnlVect *OptionPriceVect2; // Vector of prices of the option at i+1
    PnlVect *ZCbondPriceVect1; // Vector of prices of the option at i+1
    PnlVect *ZCbondPriceVect2; // Vector of prices of the option at i+1
    OptionPriceVect1 = pnl_vect_create(1);
    OptionPriceVect2 = pnl_vect_create(1);
    ZCbondPriceVect1 = pnl_vect_create(1);
    ZCbondPriceVect2 = pnl_vect_create(1);

    ///***** PAYOFF at the MATURITY of the OPTION : T(n-1)*****
    Ti2 = contract_maturity;
    Ti1 = Ti2 - periodicity;
    i_Ti1 = IndexTime(Meth, Ti1);

    CapFloor_InitialPayoffSG1D(Meth, ModelParam, ZCbondPriceVect2, OptionPriceVect

    ///***** Backward computation of the option price *****/

    n = (int)((contract_maturity - first_reset_date) / periodicity + 0.1);

    for (i = n - 2; i >= 0; i--)
    {
        Ti1 = first_reset_date + i * periodicity; // Ti1 = T(i)
        Ti2 = Ti1 + periodicity; // Ti2 = T(i+1)

        i_Ti2 = IndexTime(Meth, Ti2);
        i_Ti1 = IndexTime(Meth, Ti1);
    }
}

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    CapFloor_BackwardIteration(Meth, ModelParam, p, ZCbondPriceVect1, ZCbondPr
    }

    ///***** Price of the option at initial time s *****

    BackwardIteration(Meth, ModelParam, OptionPriceVect1, OptionPriceVect2, i_Ti1,

    OptionPrice = GET(OptionPriceVect1, 0);

    pnl_vect_free(& OptionPriceVect1);
    pnl_vect_free(& OptionPriceVect2);
    pnl_vect_free(& ZCbondPriceVect1);
    pnl_vect_free(& ZCbondPriceVect2);

    return OptionPrice;

}

static int tr_capfloor1d(int flat_flag, double r0, char *curve, double a, double
{
    TreeShortRate Tr;
    ModelParameters ModelParams;
    ZCMarketData ZCMarket;

    /* Flag to decide to read or not ZC bond datas in "initialyields.dat" */
    /* If P(0,T) not read then P(0,T)=exp(-r0*T) */
    if (flat_flag == 0)
    {
        ZCMarket.FlatOrMarket = 0;
        ZCMarket.Rate = r0;
    }

    else
    {
        ZCMarket.FlatOrMarket = 1;
        ZCMarket.filename = curve;
        ReadMarketData(&ZCMarket);

        if (contract_maturity > GET(ZCMarket.tm, ZCMarket.Nvalue - 1))
        {
            printf("\ nError : time bigger than the last time value entered in ini

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        exit(EXIT_FAILURE);
    }
}

ModelParams.MeanReversion = a;
ModelParams.RateVolatility = sigma;

SetTimeGrid_Tenor(&Tr, N_steps, first_reset_date, contract_maturity, periodicity);

SetTreeShortRate(&Tr, &ModelParams, &ZCMarket, &func_model_sg1d, &func_model_d);

*price = Nominal * tr_sg1d_capfloor(&Tr, &ModelParams, &ZCMarket, N_steps, p);

DeleteTreeShortRate(&Tr);
DeleteZCMarketData(&ZCMarket);

return OK;
}

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///***** PREMIA FUNCTIONS *****/

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int CALC(TR_CapFloorSG1D)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;

    return tr_capfloor1d(ptMod->flat_flag.Val.V_INT,
                        MOD(GetYield)(ptMod),
                        MOD(GetCurve)(ptMod),
                        ptMod->a.Val.V_DOUBLE,
                        ptMod->Sigma.Val.V_PDOUBLE,
                        ptOpt->BMaturity.Val.V_DATE - ptMod->T.Val.V_DATE,
                        ptOpt->FirstResetDate.Val.V_DATE - ptMod->T.Val.V_DATE,
                        ptOpt->ResetPeriod.Val.V_DATE,
                        ptOpt->Nominal.Val.V_PDOUBLE,
                        ptOpt->FixedRate.Val.V_PDOUBLE,
                        ptOpt->PayOff.Val.V_NUMFUNC_1,
                        Met->Par[0].Val.V_LONG,
                        &(Met->Res[0].Val.V_DOUBLE));
}

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}
static int CHK_OPT(TR_CapFloorSG1D)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "Cap") == 0) || (strcmp(((Option *)Opt)->Na
        return OK;
    else
        return WRONG;
}
#endif //PremiaCurrentVersion

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->HelpFilenameHint = "tr_quadratic1d_capfloor";
        Met->Par[0].Val.V_INT = 50;

    }
    return OK;
}

PricingMethod MET(TR_CapFloorSG1D) =
{
    "TR_SquareGaussian1d_CapFloor",
    { {"TimeStepNumber per Period", INT, {100}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(TR_CapFloorSG1D),
    {"Price", DOUBLE, {100}, FORBID}, {" ", PREMIA_NULLTYPE, {0}, FORBID}},
    CHK_OPT(TR_CapFloorSG1D),
    CHK_ok,
    MET(Init)
} ;

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