

## [Help](#)

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#include <stdlib.h>
#include "
href../../mod/blackkarasinski1d/blackkarasinski1d_std/blackkarasinski1d_std
#include "pnl/pnl_vector.h"
#include "
href../../common/math/InterestRateModelTree/TreeShortRate/TreeShortRate_h_src
#include "
href../../common/math/read_market_zc/InitialYieldCurve_h_src.pdfmath/read_mar

//The "#else" part of the code will be freely available after the (year of creat
#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2007+2)
static int CHK_OPT(TR_ZBOBK1D)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(TR_ZBOBK1D)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

/// TreeShortRate      : structure that contains components of the tree (see Tree
/// ModelParameters    : structure that contains the parameters of the Hull&Whi
/// ZCMarketData : structure that contains the Zero Coupon Bond prices of the ma

/// Computation of the payoff of the ZC bond at the final time of the tree (ie t
static void ZCBond_InitialPayoffBK1D(TreeShortRate *Meth, PnlVect *ZCbondPriceVe
{
    int jminprev, jmaxprev;

    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
}

/// Computation of the payoff at the final time of the tree (ie the option matur
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static void ZCOption_InitialPayoffBK1D(PnlVect *ZCbondPriceVect, PnlVect *Option
{
    int j;

    double ZCPrice;

    pnl_vect_resize(OptionPriceVect, ZCbondPriceVect->size);

    /** Calcul du vecteur des payoffs a l'instant de maturite de l'option

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

        LET(OptionPriceVect, j) = (p->Compute)(p->Par, ZCPrice); // Payoff of the
    }
}

/// Backward computation of the price of an option on a Zero Coupon Bond
void ZCOption_BackwardIterationBK1D(TreeShortRate *Meth, ModelParameters *ModelP
{
    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_x1 = space step of the process x at time i
    double delta_t1, delta_t2; // time step
    double beta_x; // quantity used in the computation of the probabil
    double ZCPrice; //ZC price

    double current_rate;

    double Pup, Pmiddle, Pdown;

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

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

/** 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)

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

    if (Eur_Or_Am != 0)
    {
        pnl_vect_resize(ZCbondPriceVect1, jmaxprev - jminprev + 1); // OptionP
    }

    delta_t1 = GET(Meth->t, i) - GET(Meth->t, MAX(i - 1, 0)); // Pas de temps
    delta_t2 = GET(Meth->t, i + 1) - GET(Meth->t, i); // Pas de temps entre t[

    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_bk1d(j * delta_x1 + GET(Meth->alpha, i)); //

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

        if (Eur_Or_Am != 0)

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

        ZCPrice = GET(ZCbondPriceVect1, j - jminprev); // ZC price P(ti, S
        // In the case of american option, decide wether to exerice the op
        if (GET(OptionPriceVect1, j - jminprev) < (p->Compute)(p->Par, ZCP
            {
                LET(OptionPriceVect1, j - jminprev) = (p->Compute)(p->Par, ZCP
            }
        }

    }

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

    if (Eur_Or_Am != 0)
    {
        pnl_vect_clone(ZCbondPriceVect2, ZCbondPriceVect1);
    }

} // END of the loop on i
}

/// Prix at time s of an option, maturing at T, on a ZC, with maturity S, using
double tr_bk1d_zcoption(TreeShortRate *Meth, ModelParameters *ModelParam, ZCMark
{
    int i_T;
    double OptionPrice;

    PnlVect *OptionPriceVect1; // Vector of prices of the option at time i
    PnlVect *OptionPriceVect2; // Vector of prices of the option at time i+1

    PnlVect *ZCbondPriceVect1; // Vector of prices of the option at time i
    PnlVect *ZCbondPriceVect2; // Vector of prices of the option at time i+1

    OptionPriceVect1 = pnl_vect_create(1);
    OptionPriceVect2 = pnl_vect_create(1);
    ZCbondPriceVect1 = pnl_vect_create(1);
    ZCbondPriceVect2 = pnl_vect_create(1);

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//***** Computation of the vector of payoff at the maturity of t
i_T = IndexTime(Meth, T); // Localisation of s on the tree

ZCBond_InitialPayoffBK1D(Meth, ZCbondPriceVect2);

ZCOption_BackwardIterationBK1D(Meth, ModelParam, ZCbondPriceVect1, ZCbondPriceVect2);

ZCOption_InitialPayoffBK1D(ZCbondPriceVect2, OptionPriceVect2, p);

//***** Backward computation of the option price until initial time t
ZCOption_BackwardIterationBK1D(Meth, ModelParam, ZCbondPriceVect1, ZCbondPriceVect2);

OptionPrice = GET(OptionPriceVect1, 0);

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

return OptionPrice;

} // FIN de la fonction ZCOption

static int tr_zbold(int flat_flag, double r0, char *curve, double a, double sigma)
{
    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
    {

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

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

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

SetTimeGrid_Tenor(&Tr, N_steps, 0, S, S);

SetTreeShortRate(&Tr, &ModelParams, &ZCMarket, &func_model_bk1d, &func_model_d

//Price of an option on a ZC
*price = tr_bk1d_zcoption(&Tr, &ModelParams, &ZCMarket, T, S, p, r0, am);

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

return OK;
}

///***** PREMIA FUNCTIONS *****/
int CALC(TR_ZBOBK1D)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;

    return tr_zbold(ptMod->flat_flag.Val.V_INT,
                    MOD(GetYield)(ptMod),
                    MOD(GetCurve)(ptMod),
                    ptMod->a.Val.V_DOUBLE,
                    ptMod->Sigma.Val.V_PDOUBLE,

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        ptOpt->BMaturity.Val.V_DATE - ptMod->T.Val.V_DATE,
        ptOpt->OMaturity.Val.V_DATE - ptMod->T.Val.V_DATE,
        ptOpt->PayOff.Val.V_NUMFUNC_1,
        ptOpt->EuOrAm.Val.V_BOOL,
        Met->Par[0].Val.V_LONG,
        &(Met->Res[0].Val.V_DOUBLE));
    }
static int CHK_OPT(TR_ZBOBK1D)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "ZeroCouponCallBondEuro") == 0) || (strcmp(
        return OK;
    else
        return WRONG;
}
#endif //PremiaCurrentVersion

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->Par[0].Val.V_LONG = 200;
    }
    return OK;
}

PricingMethod MET(TR_ZBOBK1D) =
{
    "TR_BlackKarasinski1d_ZB0",
    { {"TimeStepNumber", LONG, {100}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(TR_ZBOBK1D),
    {"Price", DOUBLE, {100}, FORBID}, {" ", PREMIA_NULLTYPE, {0}, FORBID}},
    CHK_OPT(TR_ZBOBK1D),
    CHK_ok,
    MET(Init)
} ;

```