

## Help

```
#include "hullwhite1d_std.h"
#include "math/InterestRateModelTree/TreeShortRate/TreeShortRate.h"
#include "pnl/pnl_vector.h"

//The "#else" part of the code will be freely available after the (year of creation of this file + 2)
#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2007+2)
static int CHK_OPT(TR_ZCBondHW1D)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(TR_ZCBondHW1D)(void *Opt,void *Mod,PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

/// TreeShortRate      : structure that contains components of the tree (see TreeShortRate.h)
/// ModelParameters    : structure that contains the parameters of the Hull&White one factor model (see TreeShortRate.h)
/// ZCMarketData       : structure that contains the Zero Coupon Bond prices of the market, or given by a constant yield-to-maturity (see InitialYieldCurve.h)

/// Computation of the payoff at the final time of the tree (ie the ZCBond maturity)
static void ZCBond_InitialPayoffHW1D(TreeShortRate* Meth, PnlVect* OptionPriceVect2)
{
    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)
```

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    pnl_vect_resize(OptionPriceVect2, jmaxprev-jminprev+1);

    pnl_vect_set_double(OptionPriceVect2, 1.0); // Payoff =
        1 for a ZC bond
}

/// Price at time "s" of a ZC bond maturing at "T" using a
    trinomial tree.
static double tr_hw1d_zcbond(TreeShortRate* Meth, ModelPar
    ameters* ModelParam, ZCMarketData* ZCMarket, double T)
{
    int index_last, index_first;
    double OptionPrice;

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

    ///***** Computation of the vector of payo
        ff at the maturity of the option *****///
    ZCBond_InitialPayoffHW1D(Meth, OptionPriceVect2);

    ///***** Backward computation of the
        option price until time 0 *****///
    index_last = Meth->Ngrid;
    index_first = 0;

    BackwardIteration(Meth, ModelParam, OptionPriceVect1,
        OptionPriceVect2, index_last, index_first, &func_model_hw1d);

    OptionPrice = GET(OptionPriceVect1, 0);

    pnl_vect_free(& OptionPriceVect1);
    pnl_vect_free(& OptionPriceVect2);

    return OptionPrice;
}

```

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}

static int tr_zcbond1d(int flat_flag,double r0,double a,
    double sigma, double T,int N_steps,double *price)
{
    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  $P(0,T)=\exp(-r_0*T)$  */
    if(flat_flag==0)
    {
        ZCMarket.FlatOrMarket = 0;
        ZCMarket.Rate = r0;
    }

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

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

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

    // Construction of the Time Grid
    SetTimeGrid(&Tr, N_steps, T);

    // Construction of the tree, calibrated to the initial yield curve

```

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SetTreeShortRate(&Tr, &ModelParams, &ZCMarket, &func_
    model_hw1d, &func_model_der_hw1d, &func_model_inv_hw1d);

//Price of Zero Coupon Bond
*price = tr_hw1d_zcbond(&Tr, &ModelParams, &ZCMarket, T);

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

return OK;
}

///  

//***** PREMIA  

FUNCTIONS *****//  

int CALC(TR_ZCBondHW1D)(void *Opt,void *Mod,PricingMethod *  

    Met)  

{  

    TYPEOPT* ptOpt=(TYPEOPT*)Opt;  

    TYPEMOD* ptMod=(TYPEMOD*)Mod;  

  

    return tr_zcbond1d( ptMod->flat_flag.Val.V_INT,  

                        MOD(GetYield)(ptMod),  

                        ptMod->a.Val.V_DOUBLE,  

                        ptMod->Sigma.Val.V_PDOUBLE,  

                        ptOpt->BMaturity.Val.V_DATE-ptMod->T.  

                        Val.V_DATE,  

                        Met->Par[0].Val.V_LONG,  

                        &(Met->Res[0].Val.V_DOUBLE));  

}  

static int CHK_OPT(TR_ZCBondHW1D)(void *Opt, void *Mod)  

{  

    if ((strcmp(((Option*)Opt)->Name,"ZeroCouponBond")==0) )  

        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=50;
    }
    return OK;
}

PricingMethod MET(TR_ZCBondHW1D)=
{
    "TR_HullWhite1d_ZCBond",
    {"TimeStepNumber",LONG,{100},ALLOW},
    {" ",PREMIA_NULLTYPE,{0},FORBID}},
    CALC(TR_ZCBondHW1D),
    {"Price",DOUBLE,{100},FORBID}/*,{"Delta",DOUBLE,{100},FORBID}*/,
    {" ",PREMIA_NULLTYPE,{0},FORBID}},
    CHK_OPT(TR_ZCBondHW1D),
    CHK_ok,
    MET(Init)
} ;
```

## References