

[Help](#)

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#include "
href../../../../mod/varswap3d/varswap3d_std/varswap3d_std_h_src.pdfvarswap3d_std.h"
#include "
href../../../../common/enums_h_src.pdfenums.h"
#include "
href../../../../common/math/equity_pricer/IMPLIED_BS_h_src.pdfmath/equity_pricer/im
#include "pnl/pnl_finance.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2009+2) //The "#els
static int CHK_OPT(MC_VARSWAP3D)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(MC_VARSWAP3D)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

/**
 * State_vector at time i
 *
 * @param State_Vector : the matrix of gaussian numbers, must already be allocat
 * @param samples : number of Monte Carlo samples (= number of rows of M)
 * @param dimension : dimension of the simulation (= number of columns of M)
 * @param type_generator : index of the generator
 */
static void Euler_discretise(VARSWAP3D_MOD *M,
                             const double Delta_t,
                             PnlVect *State_Vector,
                             double *State_Vector_control,
                             double rhot,
                             double sigma,
                             double sqrt_delta_t,
                             int type_generator)
{
    int d;
    double sum, sigma_y, Inc1, Inc2;
```

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Inc1 = pnl_rand_normal(type_generator); //MGET(Increment_Vector,w,0);
Inc2 = M->Rho * Inc1 +
      +rhot * pnl_rand_normal(type_generator);

sum = 0.;
for (d = 1; d < State_Vector->size; d++)
{
    sum += GET(M->Beta, d - 1) / GET(M->SqrtMeanReversion, d - 1) * GET(State_
    LET(State_Vector, d) += -GET(M->MeanReversion, d - 1) * Delta_t *GET(State
    + GET(M->SqrtMeanReversion, d - 1) * sqrt_delta_t
}
*State_Vector_control += sigma * (-0.5 * sigma + Inc1);
sigma_y = sigma * exp(0.5 * sum);
LET(State_Vector, 0) += sigma_y * (-0.5 * sigma_y + Inc1);

};

static void Monte_Carlo_Solve_European(double *ptprice,
                                       double *ptdelta,
                                       VARSWAP3D_MOD *M,
                                       PnlVect *Initial_Value,
                                       int N_time,
                                       int samples,
                                       int type_generator)
{
    int w, d, i, dimension;
    double mean_price, mean_delta, var_price, var_delta, Delta_t;
    PnlVect *State_Vector;
    double price_traj, delta_traj, State_Vector_control, sqrt_delta_t, rhot, sigma

    dimension = M->Nb_factor + 1;
    Delta_t = M->T / N_time;
    sqrt_delta_t = sqrt(Delta_t);
    rhot = sqrt(1 - M->Rho * M->Rho);
    sigma = sqrt_delta_t *M->V0;

    mean_price = 0;
    mean_delta = 0;
    var_price = 0;
    var_delta = 0;

```

```

State_Vector = pnl_vect_create(dimension);
// Solve SDE in all trajectories
pnl_rand_init(type_generator, 2, samples);
for (w = 0; w < samples; w++)
{
    //  $ST = F_T^T$      $F_t^T = S_t \exp((r - \text{divd})(T - t))$ 
    for (d = 0; d < State_Vector->size; d++)
        LET(State_Vector, d) = GET(Initial_Value, d);
    State_Vector_control = GET(Initial_Value, 0);
    for (i = 0; i < N_time; i++)
        Euler_discretise(M, Delta_t, State_Vector,
                        &State_Vector_control,
                        rhot, sigma, sqrt_delta_t,
                        type_generator);

    price_traj = (MAX(M->F0 * exp(GET(State_Vector, 0)) - M->Strike, 0.0)
                 - MAX(M->F0 * exp(State_Vector_control) - M->Strike, 0.0));
    if ((M->is_call))
        delta_traj = ((M->Strike < M->F0 * exp(GET(State_Vector, 0))) ? 1.0 : 0.0
                     - ((M->Strike < M->F0 * exp(State_Vector_control)) ? 1.0 : 0.0);
    else
        delta_traj = ((M->Strike > M->F0 * exp(GET(State_Vector, 0))) ? -1.0 : 0.0
                     - ((M->Strike > M->F0 * exp(State_Vector_control)) ? -1.0 : 0.0);

    mean_price += price_traj;
    mean_delta += delta_traj;

    var_price += SQR(price_traj);
    var_delta += SQR(delta_traj);
}
*ptprice = M->Bond * mean_price / (double)samples;
//error_price= M->Bond*sqrt(var_price/(double)samples-SQR(*ptprice))/sqrt((double)samples)
// Add BS price
*ptprice += pnl_bs_impli_call_put(M->is_call, M->V0, M->Bond, M->F0, M->Strike);
/* Delta estimator */
*ptdelta = (mean_delta / (double)samples);

//error_delta= sqrt((var_delta/(double)samples-SQR(*ptdelta)))/sqrt((double)samples)
// Add BS price
*ptdelta += exp((M->R - M->Divid) * M->T) * pnl_bs_impli_call_put_delta_forward(M->is_call, M->V0, M->Bond, M->F0, M->Strike);
pnl_vect_free(&State_Vector);

```

```
}
```

```
static int mc_varswap3d(VARSWAP3D_MOD *M, PricingMethod *Met)
{
    long Drawing = Met->Par[0].Val.V_LONG;
    int N_T = Met->Par[1].Val.V_INT;
    int Generator = Met->Par[2].Val.V_ENUM.value;
    PnlVect *Initial_Value = pnl_vect_create_from_zero(M->Nb_factor + 1);
    Monte_Carlo_Solve_European(&(Met->Res[0].Val.V_DOUBLE),
                               &(Met->Res[1].Val.V_DOUBLE),
                               M,
                               Initial_Value,
                               N_T,
                               Drawing,
                               Generator);
    pnl_vect_free(&Initial_Value);
    return OK;
}
```

```
int CALC(MC_VARSWAP3D)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;
    double res;
    VARSWAP3D_MOD *M = svb_model_create_from_Model(ptMod);
    svb_model_initialise_from_Option(M, ptOpt);
    res = mc_varswap3d(M, Met);
    svb_model_free(&M);
    return res;
}
```

```
static int CHK_OPT(MC_VARSWAP3D)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "CallEuro") == 0) || (strcmp(((Option *)Opt)
    return OK;

    return WRONG;
}
```

```
#endif //PremiaCurrentVersion
static int MET(Init)(PricingMethod *Met, Option *Opt)
```

```

{
    if (Met->init == 0)
    {
        Met->init = 1;
        Met->Par[0].Val.V_INT2 = 10000;
        Met->Par[1].Val.V_LONG = 100;
        Met->Par[2].Val.V_ENUM.value = 0;
        Met->Par[2].Val.V_ENUM.members = &PremiaEnumMCRNGs;
    }

    return OK;
}

PricingMethod MET(MC_VARSWAP3D) =
{
    "MC_VARSWAP3D",
    {"Number of Iterations", INT2, {100}, ALLOW}, {"TimeStepNumber", INT2, {100},
    CALC(MC_VARSWAP3D),
    { {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID},
    {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CHK_OPT(MC_VARSWAP3D),
    CHK_ok,
    MET(Init)
};

```