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#include <stdlib.h>
#include "bs1d_std.h"
#include "error_msg.h"
#define BIG_DOUBLE 1.0e6

int CALC(DynamicHedgingSimulatorTempsdeter1)(void *Opt, void *Mod, PricingMethod

{

    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;
    int type_generator, error;
    long path_number, step_number, hedge_number, i, j;
    double step, initial_stock, initial_time, stock, selling_price, delta, previous
    double cash_account, stock_account, cash_rate, stock_rate;
    double pl_sample, mean_pl, var_pl, min_pl, max_pl;
    double exp_trendxh, sigmaxsqqrth;
    double r, divid;

    /* Variables needed for Graphic outputs */
    double *stock_array, *pl_array, *hedge_time, *hedge_spot, current_mean_pl, med
    double *delta_array;
    int k, indicehedge;
    long size, size2;
    double current_date;

    /****** Initialization of the test's parameters *****/
    initial_stock = ptMod->S0.Val.V_PDOUBLE;
    initial_time = ptMod->T.Val.V_DATE;

    type_generator = Test->Par[0].Val.V_INT;
    path_number = Test->Par[1].Val.V_LONG;
    step_number = Test->Par[2].Val.V_LONG;
    current_date = ptMod->T.Val.V_DATE;
    hedge_number = Test->Par[3].Val.V_LONG;

    step = (ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE) / (double)step_numbe
    //step_hedge=(ptOpt->Maturity.Val.V_DATE-ptMod->T.Val.V_DATE)/(double)hedge_nu
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r = log(1. + ptMod->R.Val.V_DOUBLE / 100.);
divid = log(1. + ptMod->Divid.Val.V_DOUBLE / 100.);
cash_rate = exp(r * step);
stock_rate = exp(divid * step) - 1.;

sigmaxsqrth = ptMod->Sigma.Val.V_PDOUBLE * sqrt(step);
exp_trendxh = exp(ptMod->Mu.Val.V_DOUBLE * step - 0.5 * SQR(sigmaxsqrth));

mean_pl = 0.0;
var_pl = 0.0;
min_pl = BIG_DOUBLE;
max_pl = -BIG_DOUBLE;

pnl_rand_init(type_generator, 1, path_number);

/* Graphic outputs initializations and dynamical memory allocutions */
current_mean_pl = 0.0;
size = step_number + 1;
size2 = hedge_number + 1;

if ((stock_array = malloc(size * sizeof(double))) == NULL)
    return MEMORY_ALLOCATION_FAILURE;
if ((pl_array = malloc(size * sizeof(double))) == NULL)
    return MEMORY_ALLOCATION_FAILURE;
if ((hedge_time = malloc(size2 * sizeof(double))) == NULL)
    return MEMORY_ALLOCATION_FAILURE;
if ((hedge_spot = malloc(size2 * sizeof(double))) == NULL)
    return MEMORY_ALLOCATION_FAILURE;
if ((delta_array = malloc(size * sizeof(double))) == NULL)
    return MEMORY_ALLOCATION_FAILURE;

for (k = 5; k <= 14; k++)
{
    pnl_vect_resize(Test->Res[k].Val.V_PNLVECT, size);
}
for (k = 15; k <= 20; k++)
{
    pnl_vect_resize(Test->Res[k].Val.V_PNLVECT, size2);
}

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for (k = 0; k <= step_number; k++) /* Time */
    Test->Res[5].Val.V_PNLVECT->array[k] = current_date + k * step;

/***** Trajectories of the stock *****/
for (i = 0; i < path_number; i++)
{
    /* computing selling-price and delta */
    ptMod->T.Val.V_DATE = initial_time;
    ptMod->S0.Val.V_PDOUBLE = initial_stock;
    delta = 0.;
    hedge_number = Test->Par[3].Val.V_LONG;

    if ((error = (Met->Compute)(Opt, Mod, Met)))
    {
        ptMod->T.Val.V_DATE = initial_time;
        ptMod->S0.Val.V_PDOUBLE = initial_stock;
        return error;
    };
    selling_price = Met->Res[0].Val.V_DOUBLE;
    delta = Met->Res[1].Val.V_DOUBLE;
    delta_array[0] = delta;

    /* computing cash_account and stock_account */
    cash_account = selling_price - delta * initial_stock;
    stock_account = delta * initial_stock;

    stock = initial_stock;
    stock_array[0] = stock;
    pl_array[0] = 0;
    hedge_time[0] = 0.;
    hedge_spot[0] = stock;
    indicehedge = 1;

    /***** Dynamic Hedge *****/
    for (j = 1; j < step_number; j++)

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{
    previous_delta = delta;

    /* Capitalization of cash_account and yielding dividends */
    cash_account *= cash_rate;
    cash_account += stock_rate * stock_account;

    /* computing the new stock's value */
    stock *= exp_trendxh * exp(sigmamaxsrth * pnl_rand_normal(type_generato

    /* computing the new selling-price and the new delta */
    ptMod->T.Val.V_DATE = ptMod->T.Val.V_DATE + step;
    ptMod->S0.Val.V_PDDOUBLE = stock;
    if ((error = (Met->Compute)(Opt, Mod, Met)))
    {
        ptMod->T.Val.V_DATE = initial_time;
        ptMod->S0.Val.V_PDDOUBLE = initial_stock;
        return error;
    };

    if ((hedge_number != 0) && (j % (step_number / hedge_number)) == 0)
    {
        delta = Met->Res[1].Val.V_DOUBLE;
        hedge_time[indicehedge] = ptMod->T.Val.V_DATE;
        hedge_spot[indicehedge] = stock;
        indicehedge++;
    }

    delta_array[j] = delta;

    /* computing new cash_account and new stock_account */
    cash_account -= (delta - previous_delta) * stock;
    stock_account = delta * stock;

    stock_array[j] = stock;
    pl_array[j] = cash_account - Met->Res[0].Val.V_DOUBLE + delta * stock;

} /*j*/

/***** Last hedge *****/
/* Capitalization of cash_account and yielding dividends */

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cash_account *= cash_rate;
cash_account += stock_rate * stock_account;

/* computing the new stock's value */
stock *= exp_trendxh * exp(sigmaxsqrth * pnl_rand_normal(type_generator));

delta_array[step_number] = delta;
hedge_time[hedge_number] = ptMod->T.Val.V_DATE;
hedge_spot[hedge_number] = stock;

/* Capitalization of cash_account and computing the P&L using the PayOff*/
cash_account = cash_account - ((ptOpt->PayOff.Val.V_NUMFUNC_1)->Compute)((
pl_sample = cash_account;

stock_array[step_number] = stock;
pl_array[step_number] = pl_sample;

mean_pl = mean_pl + pl_sample;
var_pl = var_pl + SQR(pl_sample);
min_pl = MIN(pl_sample, min_pl);
max_pl = MAX(pl_sample, max_pl);

/* Selection of trajectories (Spot and P&L) for graphic outputs */
if (i == 0)
{
    for (k = 0; k <= step_number; k++)
    {
        Test->Res[6].Val.V_PNLVECT->array[k] = stock_array[k];
        Test->Res[7].Val.V_PNLVECT->array[k] = stock_array[k];
        Test->Res[8].Val.V_PNLVECT->array[k] = stock_array[k];
        Test->Res[9].Val.V_PNLVECT->array[k] = pl_array[k];
        Test->Res[10].Val.V_PNLVECT->array[k] = pl_array[k];
        Test->Res[11].Val.V_PNLVECT->array[k] = pl_array[k];
        Test->Res[12].Val.V_PNLVECT->array[k] = delta_array[k];
        Test->Res[13].Val.V_PNLVECT->array[k] = delta_array[k];
        Test->Res[14].Val.V_PNLVECT->array[k] = delta_array[k];
    }
    for (k = 0; k < size2; k++)
    {
        Test->Res[15].Val.V_PNLVECT->array[k] = hedge_time[k];
    }
}

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        Test->Res[16].Val.V_PNLVECT->array[k] = hedge_spot[k];
        Test->Res[17].Val.V_PNLVECT->array[k] = hedge_time[k];
        Test->Res[18].Val.V_PNLVECT->array[k] = hedge_spot[k];
        Test->Res[19].Val.V_PNLVECT->array[k] = hedge_time[k];
        Test->Res[20].Val.V_PNLVECT->array[k] = hedge_spot[k];
    }
    median_pl = pl_sample;
}
else
{
    current_mean_pl = mean_pl / i;
    if (pl_sample == min_pl)
    {
        for (k = 0; k <= step_number; k++)
        {
            Test->Res[6].Val.V_PNLVECT->array[k] = stock_array[k];
            Test->Res[9].Val.V_PNLVECT->array[k] = pl_array[k];
            Test->Res[12].Val.V_PNLVECT->array[k] = delta_array[k];
        }
        for (k = 0; k < size2; k++)
        {
            Test->Res[15].Val.V_PNLVECT->array[k] = hedge_time[k];
            Test->Res[16].Val.V_PNLVECT->array[k] = hedge_spot[k];
        }
    }
    else if (pl_sample == max_pl)
    {
        for (k = 0; k <= step_number; k++)
        {
            Test->Res[7].Val.V_PNLVECT->array[k] = stock_array[k];
            Test->Res[10].Val.V_PNLVECT->array[k] = pl_array[k];
            Test->Res[13].Val.V_PNLVECT->array[k] = delta_array[k];
        }
        for (k = 0; k < size2; k++)
        {
            Test->Res[17].Val.V_PNLVECT->array[k] = hedge_time[k];
            Test->Res[18].Val.V_PNLVECT->array[k] = hedge_spot[k];
        }
    }
    else if (SQR(pl_sample - current_mean_pl) < SQR(median_pl - current_me
    {

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        median_pl = pl_sample;
        for (k = 0; k <= step_number; k++)
        {
            Test->Res[8].Val.V_PNLVECT->array[k] = stock_array[k];
            Test->Res[11].Val.V_PNLVECT->array[k] = pl_array[k];
            Test->Res[14].Val.V_PNLVECT->array[k] = delta_array[k];
        }
        for (k = 0; k < size2; k++)
        {
            Test->Res[19].Val.V_PNLVECT->array[k] = hedge_time[k];
            Test->Res[20].Val.V_PNLVECT->array[k] = hedge_spot[k];
        }
    }
} /*i*/

free(stock_array);
free(pl_array);
free(hedge_time);
free(hedge_spot);
free(delta_array);

mean_pl = mean_pl / (double)path_number;
var_pl = var_pl / (double)path_number - SQR(mean_pl);

Test->Res[0].Val.V_DOUBLE = mean_pl;
Test->Res[1].Val.V_DOUBLE = var_pl;
Test->Res[2].Val.V_DOUBLE = min_pl;
Test->Res[3].Val.V_DOUBLE = max_pl;
Test->Res[4].Val.V_DOUBLE = median_pl;

ptMod->T.Val.V_DATE = initial_time;
ptMod->S0.Val.V_PDOUBLE = initial_stock;

return OK;
}

static int TEST(Init)(DynamicTest *Test, Option *Opt)
{
    static int first = 1;

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int i;
if (first)
{
    Test->Par[0].Val.V_INT = 0;          /* Random Generator */
    Test->Par[1].Val.V_LONG = 10;        /* PathNumber */
    Test->Par[2].Val.V_LONG = 200; /* StepNumber */
    Test->Par[3].Val.V_LONG = 20; /*hedgenumber*/
    Test->Par[4].Vtype = PREMIA_NULLTYPE;

    for (i = 5 ; i <= 20 ; i++)
    {
        Test->Res[i].Val.V_PNLVECT = pnl_vect_create(0);
    }

    Test->Res[21].Vtype = PREMIA_NULLTYPE;

    first = 0;
}

return OK;
}

int CHK_TEST(test3)(void *Opt, void *Mod, PricingMethod *Met)
{
    if ((strcmp(Met->Name, "TR_PatryMartini") == 0) || (strcmp(Met->Name, "TR_Patr
        return WRONG;
    else
        return OK;
}

DynamicTest MOD_OPT(test3) =
{
    "bs1d_std_test3",

    { {"RandomGenerator", INT, {100}, ALLOW},
      {"PathNumber", LONG, {1000}, ALLOW},
      {"StepNumber", LONG, {200}, ALLOW},
      {"HedgeNumber", LONG, {20}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },

    CALC(DynamicHedgingSimulatorTempsdeter1),

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{ {"Mean_P&l", DOUBLE, {100}, FORBID},
  {"Var_P&l", DOUBLE, {100}, FORBID},
  {"Min_P&l", DOUBLE, {100}, FORBID},
  {"Max_P&l", DOUBLE, {100}, FORBID},
  {"Median_P&l", DOUBLE, {100}, FORBID},

  {"Time", PNLVECT, {100}, FORBID},
  {"Stockmin", PNLVECT, {0}, FORBID},
  {"Stockmax", PNLVECT, {0}, FORBID},
  {"Stockmean", PNLVECT, {0}, FORBID},
  {"PLmin", PNLVECT, {0}, FORBID},
  {"PLmax", PNLVECT, {0}, FORBID},
  {"PLmean", PNLVECT, {0}, FORBID},
  {"deltamin", PNLVECT, {0}, FORBID},
  {"deltamax", PNLVECT, {0}, FORBID},
  {"deltamean", PNLVECT, {0}, FORBID},
  {"HedgeTimemin", PNLVECT, {0}, FORBID},
  {"HedgeSpotmin", PNLVECT, {0}, FORBID},
  {"HedgeTimemax", PNLVECT, {0}, FORBID},
  {"HedgeSpotmax", PNLVECT, {0}, FORBID},
  {"HedgeTimemean", PNLVECT, {0}, FORBID},
  {"HedgeSpotmean", PNLVECT, {0}, FORBID},
  {" ", PREMIA_NULLTYPE, {0}, FORBID}
},
CHK_TEST(test3),
CHK_ok,
TEST(Init)
};

```