

[Help](#)

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#include "
href../../../../mod/garch1d/garch1d_std/garch1d_std_h_src.pdfgarch1d_std.h"
#include "
href../../../../common/enums_h_src.pdfenums.h"
#include "
href../../../../common/error_msg_h_src.pdferror_msg.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2011+2) //The "#els
static int CHK_OPT(MC_Duan)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    return OK;
}

int CALC(MC_Duan)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

/**
 * compute the sum of all element in the row of matrix
 *
 * @param[in] mat matrix
 * @param[in] nb_row the number of row
 * @return sum of all element in the row of matrix
 *
 */
static double sum_row_matrix(const PnlMat *mat, int nb_row)
{
    double result;

    PnlVect *V = pnl_vect_create(mat->m);
    pnl_mat_get_row(V, mat, nb_row);
    result = pnl_vect_sum(V);
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    pnl_vect_free(&V);

    return result;
}

/**
 * ems carries out the EMS correction.
 *
 * @param[in] mat matrix which contains the paths that need to be corrected
 * @param[in] interest the annulized interest
 * @param[in] frequency the rate at which the quotes contained in matrix are given
 * for example :1 for daily 5 for weekly
 * @param[out] ems_path matrix after EMS correction
 * @return OK if ok otherwise return FAIL
 *
 */

static int ems(const PnlMat *path, double interest, int frequency, PnlMat *ems_p
{

    int row, colum;
    int i = 0, j;
    double sum_row, s1 = 0;
    double r = interest * frequency / 252;

    row = path->m;
    colum = path->n;
    ems_path->m = row;
    ems_path->n = colum;
    memcpy(ems_path->array, path->array, row * colum * sizeof(double));

    if (row >= 1)
    {
        s1 = pnl_mat_get(ems_path, 0, 0);
    }

    while (i < row)
    {
        if (i == 0)
        {

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        for (j = 0; j < colum; j++)
        {
            pnl_mat_set(ems_path, i, j, s1);
        }
    }
    else
    {
        sum_row = sum_row_matrix(path, i) / (colum * pow(M_E, i * r));
        for (j = 0; j < colum; j++)
        {
            pnl_mat_set(ems_path, i, j, s1 * pnl_mat_get(ems_path, i, j) / sum_row);
        }
        i++;
    }
}

return OK;
}

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/**
 * compute the paths from vector which contains historical price and stock the r
 * @param[in] h vector which contain all values history of price
 * @param[out] path matrix stock all path after compute
 * @param[in] T Exercise time
 * @param[in] alpha_zero garch parameter
 * @param[in] alpha_one garch parameter
 * @param[in] interest interest rate
 * @param[in] lambda the constant unit risk premium
 * @param[in] beta_one parameter garch
 * @param[in] type_generator the type of generator for random number
 * @return OK if ok otherwise return FAIL
 */

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static int calculate_path(const PnlVect *h, PnlMat *path, double interest, int f
{

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    double sigma, s, sigma_t;
    int size;//size of vector
    double s_t;//price at time t

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double s_0;//price init
double presigma = alpha_zero / (1 - beta_one - alpha_one * (1 + pow(lambda, 2))
double preepsilon = 0;
PnlMat *eps;//matrix contains all variables epsilon with value random
PnlMat *array_sigma;
int dimension = N; //column of matrix
int samples;//row of matrix
int i, j;

interest = (frequency * interest) / 252.;
size = h->size;
s_0 = pnl_vect_get(h, 0);
eps = pnl_mat_create(T - size + 1, N); //matrix contains all variables epsilon
array_sigma = pnl_mat_create(T - size + 1, N);
samples = T - size + 1;
pnl_rand_init(type_generator, dimension, samples);
pnl_mat_rand_normal(eps, samples, dimension, type_generator);

if (size == 1)
{
    s_t = s_0;
}
else
{
    s_t = pnl_vect_get(h, size - 1);
}
if (size > 1)
{
    for (i = 0; i < size - 1; i++)
    {
        presigma = sqrt(alpha_zero + alpha_one * pow((presigma * preepsilon -
        preepsilon = (1 / presigma) * (log(pnl_vect_get(h, i + 1) / pnl_vect_g
    }
}

for (i = 0; i < dimension; i++)
{
    for (j = 0; j < samples; j++)
    {

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        if (j == 0)
        {
            sigma = presigma;
            pnl_mat_set(array_sigma, 0, i, sigma);
            if (size > 1)
            {
                s = s_t * pow(M_E, (interest - 0.5 * pow(pnl_mat_get(array_sig
            }
            else
            {
                s = s_0 * pow(M_E, (interest - 0.5 * pow(pnl_mat_get(array_sig
            }
            pnl_mat_set(path, 0, i, s);
        }
    else
    {
        sigma_t = pnl_mat_get(array_sigma, j - 1, i);

        sigma = sqrt(alpha_zero + alpha_one * pow((sigma_t *pnl_mat_get(ep

        pnl_mat_set(array_sigma, j, i, sigma);
        s = pnl_mat_get(path, j - 1, i) * pow(M_E, (interest - 0.5 * pow(s
        pnl_mat_set(path, j, i, s);
    }
}

}

pnl_mat_free(&eps);
pnl_mat_free(&array_sigma);
return OK;
}

/**
 * Computes garch price for GARCH model
 * @param[in] today_price today price
 * @param[in] alpha_zero garch parameter
 * @param[in] alpha_one garch parameter
 * @param[in] lambda the constant unit risk premium
 * @param[in] beta_one garch parameter
 * @param[in] interest the annulized interest
 * @param[in] K exercise price

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* @param[in] frequency frequency
* @param[in] T time to maturity
* @param[in] choice emscorrection(ems_on or ems_off)
* @param[in] type_generator the type of generator for random number
* @param[out] garch option price
*           garch->call obtains call option price
*           garch->put  obtains put option price
* @return OK if ok otherwise return FAIL
*/
static int garch_price(NumFunc_1 *p, double today_price, double alpha_zero, double
{
    double    sum_callorput;
    double    sum_delta;
    double    s_T;
    double    garch_delta;
    int        i;
    PnlMat    *path_ems, *path, *path1D;
    PnlVect    *h;
    path = pnl_mat_create(T, N);
    h = pnl_vect_create(1);

    sum_callorput = 0;
    sum_delta = 0;

    pnl_vect_set(h, 0, today_price);

    if (calculate_path(h, path, interest, frequency, N, T, alpha_zero, alpha_one,
    {
        pnl_vect_free(&h);
        pnl_mat_free(&path);
        return FAIL;
    }
    //if we choose ems option
    switch (choice)
    {
    case 1:
        pnl_vect_free(&h);
        pnl_rand_init(type_generator, N, T);
        path_ems = pnl_mat_create(T, N);
        if (ems(path, interest, frequency, path_ems) == FAIL)
        {

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        pnl_mat_free(&path);
        pnl_mat_free(&path_ems);
        return FAIL;
    }
    pnl_mat_clone(path, path_ems);
    for (i = 0; i < N; i++)
    {
        s_T = pnl_mat_get(path, T - 1, i);
        sum_callorput = sum_callorput + (p->Compute)(p->Par, pnl_mat_get(path,
        if (s_T > K) garch_delta = 1.;

        sum_delta = sum_delta + (s_T / today_price) * garch_delta;
    }
    pnl_mat_free(&path_ems);
    break;
case 2:
    path1D = pnl_mat_create(T, 1);
    pnl_rand_init(type_generator, 1, T);
    for (i = 0; i < N; i++)
    {
        calculate_path(h, path1D, interest, frequency, 1, T, alpha_zero, alpha
        s_T = pnl_mat_get(path1D, T - 1, 0);
        sum_callorput = sum_callorput + (p->Compute)(p->Par, pnl_mat_get(path,
        if (s_T > K) garch_delta = 1.;
        sum_delta = sum_delta + (s_T / today_price) * garch_delta;
    }
    pnl_vect_free(&h);
    pnl_mat_free(&path1D);
    break;
default:
    printf("Wrong value for parameter EMS\ n");
    return FAIL;
}

interest = (interest * frequency) / 252.;

//Price
*price = sum_callorput / (N * pow(M_E, (interest * T)));
*delta = sum_delta / (N * pow(M_E, (T * interest)));
if ((p->Compute) == &Put) *delta = *delta - 1;

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    pnl_mat_free(&path);
    return OK ;
}

static int MCDuan(double s, NumFunc_1 *p, double T, double r, double alpha0 , d
{
    int dummy, nb_days;
    double K, price = 0, delta = 0;

    nb_days = (int)(T * 252);
    K = p->Par[0].Val.V_PDOUBLE;
    dummy = garch_price(p, s, alpha0, alpha1, beta1, lambda, r, FREQUENCY, K, nb_d

    //Price
    *ptprice = price;

    //Delta
    *ptdelta = delta;

    return dummy;
}

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

    r = log(1. + ptMod->R.Val.V_DOUBLE / 100.);

    return MCDuan(ptMod->S0.Val.V_PDOUBLE,
                  ptOpt->PayOff.Val.V_NUMFUNC_1,
                  ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DATE,
                  r,
                  ptMod->alpha0.Val.V_PDOUBLE,
                  ptMod->alpha1.Val.V_PDOUBLE,
                  ptMod->beta1.Val.V_PDOUBLE,
                  ptMod->lambda.Val.V_PDOUBLE,
                  Met->Par[0].Val.V_PINT,
                  Met->Par[1].Val.V_LONG,
                  Met->Par[2].Val.V_ENUM.value,

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        Met->Par[3].Val.V_ENUM.value,
        &(Met->Res[0].Val.V_DOUBLE),
        &(Met->Res[1].Val.V_DOUBLE));
    }

static PremiaEnumMember EMSMethodMembers[] =
{
    { "WITH EMS CORRECTION", 1 },
    { "WITHOUT EMS CORRECTION", 2 },
    { NULL, NULLINT }
};

static DEFINE_ENUM(EMSMethod, EMSMethodMembers);

static int CHK_OPT(MC_Duan)(void *Opt, void *Mod)
{
    if ((strcmp(((Option *)Opt)->Name, "CallEuro") == 0)
        || (strcmp(((Option *)Opt)->Name, "PutEuro") == 0))

        return OK;
    return WRONG;
}

static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    int type_generator;
    if (Met->init == 0)
    {
        Met->init = 1;

        Met->Par[0].Val.V_PINT = 1;
        Met->Par[1].Val.V_LONG = 1000;
        Met->Par[2].Val.V_ENUM.value = 1;
        Met->Par[2].Val.V_ENUM.members = &EMSMethod;
        Met->Par[3].Val.V_ENUM.value = 0;
        Met->Par[3].Val.V_ENUM.members = &PremiaEnumRNGs;

    }
}

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type_generator = Met->Par[2].Val.V_ENUM.value;

if (pnl_rand_or_quasi(type_generator) == PNL_QMC)
{
    Met->Res[2].Viter = IRRELEVANT;
    Met->Res[3].Viter = IRRELEVANT;
    Met->Res[4].Viter = IRRELEVANT;
    Met->Res[5].Viter = IRRELEVANT;
    Met->Res[6].Viter = IRRELEVANT;
    Met->Res[7].Viter = IRRELEVANT;

}
else
{
    Met->Res[2].Viter = ALLOW;
    Met->Res[3].Viter = ALLOW;
    Met->Res[4].Viter = ALLOW;
    Met->Res[5].Viter = ALLOW;
    Met->Res[6].Viter = ALLOW;
    Met->Res[7].Viter = ALLOW;
}
return OK;
}
#endif //PremiaCurrentVersion

PricingMethod MET(MC_Duan) =
{
    "MC_Duan",
    { {"Frequency", PINT, {100}, ALLOW},
      {"N iterations", LONG, {100}, ALLOW},
      {"EMS", ENUM, {100}, ALLOW},
      {"RandomGenerator", ENUM, {100}, ALLOW},
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
    CALC(MC_Duan),
    { {"Price", DOUBLE, {100}, FORBID},
      {"Delta", DOUBLE, {100}, FORBID} ,
      {" ", PREMIA_NULLTYPE, {0}, FORBID}
    },
}

```

```
    CHK_OPT(MC_Duan),  
    CHK_mc,  
    MET(Init)  
};
```