

[Help](#)

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#include "optype.h"
#include "pnl/pnl_mathtools.h"
#include "pnl/pnl_cdf.h"
#include "numfunc.h"
/*F(double)*/
double Call(VAR *param, double spot)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0., spot - strike);
}

double Put(VAR *param, double spot)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0., strike - spot);
}

double CallSpread(VAR *param, double spot)
{
    double strike1 = (*param).Val.V_PDDOUBLE, strike2 = (*(param + 1)).Val.V_PDDOUBLE;

    return MAX(0., spot - strike1) - MAX(0., spot - strike2);
}

double Butterfly(VAR *param, double spot)
{
    double val;
    double strike1 = (*param).Val.V_PDDOUBLE, strike2 = (*(param + 1)).Val.V_PDDOUBLE;

    val = (strike1 + strike2) / 2.;

    return MAX(0., spot - strike1) - 2 * MAX(0., spot - val) + MAX(0., spot - strike2);
}

double Digit(VAR *param, double spot)
{
    double strike = (*param).Val.V_PDDOUBLE, rebate = (*(param + 1)).Val.V_PDDOUBLE;
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    return ((spot >= strike) ? rebate : 0.0);
}

double Zero(VAR *param, double spot)
{
    return 0.;
}

double Const(VAR *param, double spot)
{
    return param[0].Val.V_DOUBLE;
}

double ConstLim(VAR *param, double spot)
{
    return param[3].Val.V_DOUBLE;
}

double DigitSpecialPayoff(VAR *param, double spot)
{
    double sigmasqrth, d1, critic;
    double r, sigma;
    double k = param[0].Val.V_DOUBLE, h = param[1].Val.V_DOUBLE;

    r = log(1.1);
    sigma = 0.2;

    sigmasqrth = sigma * sqrt(h);
    d1 = (log(spot / k) + r * h) / sigmasqrth + sigmasqrth / 2.;
    critic = k * exp(r * h + sigmasqrth * sigmasqrth / 2.);
    if (spot < critic)
    {
        return spot * cdf_nor(d1);
    }
    else
    {
        return spot * cdf_nor(sqrt((4.0 * r / (sigma * sigma) + 2.) * log(spot / k)
    }
}
```

```
/*F(double,double)*/
double BestOf(VAR *param, double spot1, double spot2)
{
    double strike1 = (*param).Val.V_PDDOUBLE, strike2 = (*(param + 1)).Val.V_PDDOUBLE;

    return MAX(0, MAX(spot1 - strike1, spot2 - strike2));
}

double CallMax(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, MAX(spot1, spot2) - strike);
}

double Geom(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, sqrt(spot1 * spot2) - strike);
}

double Arim(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, 0.5 * (spot1 + spot2) - strike);
}

double CallBasket_2d(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, 0.5 * (spot1 + spot2) - strike);
}

double PutBasket_2d(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, strike - 0.5 * (spot1 + spot2));
}
```

```
double PutMin(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, strike - MIN(spot1, spot2));
}

double Exchange(VAR *param, double spot1, double spot2)
{
    double ratio = (*param).Val.V_PDDOUBLE;

    return MAX(0, spot1 - ratio * spot2);
}

double Zero2d(VAR *param, double spot1, double spot2)
{
    return 0.;
}

double Const2d(VAR *param, double spot1, double spot2)
{
    return param[0].Val.V_DOUBLE;
}

double Call_2arg(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, spot1 - strike);
}

double Put_2arg(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, strike - spot1);
}
```

```
double Call_OverSpot2(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, spot2 - strike);
}
double Put_OverSpot2(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, strike - spot2);
}

double Call_StrikeSpot2(VAR *param, double spot1, double spot2)
{
    return MAX(0, spot1 - spot2);
}

double Put_StrikeSpot2(VAR *param, double spot1, double spot2)
{
    return MAX(0, spot2 - spot1);
}

double CallSpread2d(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, spot1 - spot2 - strike);
}

double PutSpread2d(VAR *param, double spot1, double spot2)
{
    double strike = (*param).Val.V_PDDOUBLE;

    return MAX(0, strike - spot1 + spot2);
}

/*F(double,double,double)*/
double Minimum(VAR *param, double spot, double time)
{
    double minimum = (*(param + 4)).Val.V_PDDOUBLE;
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    return MIN(spot, minimum);
}

double Maximum(VAR *param, double spot, double time)
{
    double maximum = (*(param + 4)).Val.V_PDOUBLE;

    return MAX(spot, maximum);
}

double Asian(VAR *param, double spot, double time)
{
    double average = (*(param + 4)).Val.V_PDOUBLE,
        frequency = (*(param + 2)).Val.V_PDOUBLE,
        starting_date = (*param).Val.V_DOUBLE;

    return ((time - frequency - starting_date) * average + spot * frequency) / time;
}

double PutBasket_nd(VAR *param, const PnlVect *VStock)
{
    double aux = 0;
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;
    for (i = 0; i < BS_Dimension; i++)
        aux += GET(VStock, i);
    return MAX(Strike - aux / BS_Dimension, 0.);
}

double CallBasket_nd(VAR *param, const PnlVect *VStock)
{
    double aux = 0;
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;
    for (i = 0; i < BS_Dimension; i++)
        aux += GET(VStock, i);
    return MAX(aux / BS_Dimension - Strike, 0.);
}

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}

double CallMultiSpread_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    double aux = 0;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;

    for (i = 1; i < BS_Dimension; i++) aux += GET(VStock, i);
    return MAX(GET(VStock, 0) - aux - Strike, 0.);
}

double PutMultiSpread_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    double aux = 0;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;

    for (i = 1; i < BS_Dimension; i++) aux += GET(VStock, i);
    return MAX(Strike - GET(VStock, 0) + aux, 0.);
}

double CallMax_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;
    double aux = GET(VStock, 0);
    for (i = 1; i < BS_Dimension; i++)
        aux = MAX(aux, GET(VStock, i));
    return MAX(aux - Strike, 0.);
}

double PutMin_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDOUBLE;
    double aux = GET(VStock, 0);
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    for (i = 1; i < BS_Dimension; i++)
        aux = MIN(aux, GET(VStock, i));
    return MAX(Strike - aux, 0.);
}

double PutGeom_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDDOUBLE;
    double aux = GET(VStock, 0);
    for (i = 1; i < BS_Dimension; i++)
        aux *= GET(VStock, i);
    return MAX(Strike - exp(log(aux) / (double)BS_Dimension), 0.);
}

double CallGeom_nd(VAR *param, const PnlVect *VStock)
{
    int i;
    int BS_Dimension = VStock->size;
    double Strike = (*param).Val.V_PDDOUBLE;
    double aux = GET(VStock, 0);
    for (i = 1; i < BS_Dimension; i++)
        aux *= GET(VStock, i);
    return MAX(exp(log(aux) / BS_Dimension) - Strike, 0.);
}
```