

[Help](#)

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#include <
href../../common/math/cdo/cdo_math_h_src.pdfmath.h>
#include "
href../../common/math/moments_h_src.pdfmoments.h"
#include "pnl/pnl_mathtools.h"
/* #include "complex.h" */

void gauleg(double x1, double x2, double x[], double w[], int n)
{
    int m, j, i;
    double z1, z, xm, x1, pp, p3, p2, p1;

    m = (n + 1) / 2;
    xm = 0.5 * (x2 + x1);
    x1 = 0.5 * (x2 - x1);
    for (i = 1; i <= m; i++)
    {
        z = cos(3.141592654 * (i - 0.25) / (n + 0.5));
        do
        {
            p1 = 1.0;
            p2 = 0.0;
            for (j = 1; j <= n; j++)
            {
                p3 = p2;
                p2 = p1;
                p1 = ((2.0 * j - 1.0) * z * p2 - (j - 1.0) * p3) / j;
            }
            pp = n * (z * p1 - p2) / (z * z - 1.0);
            z1 = z;
            z = z1 - p1 / pp;
        }
        while (fabs(z - z1) > EPS_MOMENT);
        x[i] = xm - x1 * z;
        x[n + 1 - i] = xm + x1 * z;
        w[i] = 2.0 * x1 / ((1.0 - z * z) * pp * pp);
        w[n + 1 - i] = w[i];
    }
}
```

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double gammadensity(double x, double a, double b)
{
    return      exp(-a * log(b) + (a - 1) * log(x) - x / b - pnl_lgamma(a));
}

double factln(int n)
{
    static double a[101] = { 0. };

    /*if (n < 0) nrerror("Negative factorial in routine factln");*/
    if (n <= 1) return 0.0;
    if (n <= 100) return a[n] ? a[n] : (a[n] = pnl_lgamma(n + 1.0));
    else return pnl_lgamma(n + 1.0);
}

double factrl(int n)
{
    static int ntop = 4;
    static double a[33] = {1.0, 1.0, 2.0, 6.0, 24.0};
    int j;

    if (n > 32) return exp(pnl_lgamma((double)n + 1.0));
    while (ntop < n)
    {
        j = ntop++;
        a[ntop] = a[j] * ntop;
    }

    return a[n];
}

double bico(int n, int k)
{
    return floor(0.5 + exp(factln(n) - factln(k) - factln(n - k)));
}

double Moments(int n, double r, double sigma, double t)
{
    double beta, lambda, v, sum, term, sigma2_t;
    int i, j;

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sigma2_t = SQR(sigma) * t;

if ((n == 1) && (r == 0.))
    return 1.;
if ((n == 2) && (r == 0.))
    return (2 * (exp(sigma2_t) - 1 - sigma2_t) / pow(sigma, 4.0));
if ((n == 3) && (r == 0.))
    return Moments(3, 0.000001, sigma, t);
if ((n == 4) && (r == 0.))
    return Moments(4, 0.000001, sigma, t);

v = (r - sigma * sigma / 2) / sigma;
lambda = sigma;
sum = 0.0;

for (j = 0; j <= n; j++)
{
    term = 1.0;
    i = 0;
    for (i = 0; i <= n; i++)
    {
        beta = v / lambda;
        if ((i != j)) term = term / ((beta + j) * (beta + j) - (beta + i) * (b
    }
    term = term * pow(2.0, (double)n);
    sum = sum + term * exp((lambda * lambda * j * j / 2 + lambda * j * v) * t)
}

return sum * factrl(n) / pow(lambda, 2.0 * (double)n);
}

double logdens(double x, double m, double sg)
{
    double num, den;

    num = exp(-(log(x) - m) * (log(x) - m) / (2.0 * sg * sg));
    den = x * sqrt(2.0 * sg * sg * M_PI);

    return num / den;
}

```

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}

double Der1Logdens(double x, double m, double sg)
{
    double num, den;

    num = exp(-(log(x) - m) * (log(x) - m) / (2 * sg * sg)) * (log(x) - m + sg * s

    den = sqrt(2.0 * M_PI) * (sg * sg * sg) * x * x;

    return -num / den;
}

double Der2Logdens(double x, double m, double sg)
{
    double num, den;

    num = exp(-(log(x) - m) * (log(x) - m) / (2 * sg * sg)) * (m * m - sg * sg - 3

    den = sqrt(2.0 * M_PI) * pow(sg, 5.0) * x * x * x;

    return num / den;
}

double Der3Logdens(double x, double m, double sg)
{
    double num, den, fact;

    num = exp(-(log(x) - m) * (log(x) - m) / (2. * sg * sg)) ;
    fact = ((((-m * m * m + 3.*m * sg * sg + 6.* m * m * sg * sg - 6.* sg * sg * s
            ((3.*m * m - 3.*sg * sg - 12.* m * sg * sg + 11.*sg * sg * sg * sg
    den = sqrt(2.0 * M_PI) * pow(sg, 7.0) * pow(x, 4.);

    return -num * fact / den;
}

double Der4Logdens(double x, double m, double sg)
{
    double num, den, fact;

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num = exp(-(log(x) - m) * (log(x) - m) / (2 * sg * sg));
fact = pow(m, 4.) - 10 * pow(m, 3) * pow(sg, 2.) + pow(m, 2.) * pow(sg, 2.) *
      pow(sg, 4.) * (3 - 35 * pow(sg, 2.) + 24 * pow(sg, 4.)) + m * (30 * pow
      2 * (2 * pow(m, 3.) - 15 * pow(m, 2) * pow(sg, 2) + 5 * pow(sg, 4.) * (
      (6 * pow(m, 2) - 6 * pow(sg, 2.) - 30 * m * pow(sg, 2.) + 35 * pow(sg,
den = sqrt(2.0 * M_PI) * pow(sg, 9.0) * pow(x, 5.);

return num * fact / den;
}

double momlog(int n, double mean, double var)
{
    return exp(mean * n + var * n * n / 2.0);
}

/*Densità normale e sue derivate per l'uso nella serie di Edgeworth*/

double Normdens(double x, double m, double sg)
{
    double num, den;

    num = exp(-(x - m) * (x - m) / (2.0 * sg * sg));
    den = sqrt(2.0 * sg * sg * M_PI);

    return num / den;
}

double Der1Normdens(double x, double m, double sg)
{
    double num, den;

    num = exp(-(x - m) * (x - m) / (2 * sg * sg)) * (x - m);

    den = sqrt(2.0 * M_PI) * (sg * sg * sg) ;

    return -num / den;
}

double Der2Normdens(double x, double m, double sg)

```

```

{
    double num, den;

    num = exp(-(x - m) * (x - m) / (2 * sg * sg)) * (-x * x + 2 * x * m - m * m +
    den = sqrt(2.0 * M_PI) * pow(sg, 5.0) ;

    return -num / den;
}

double Der3Normdens(double x, double m, double sg)
{
    double num, den, fact;

    num = exp(-(x - m) * (x - m) / (2. * sg * sg)) ;
    fact = (x - m) * (-x * x + 2 * x * m - m * m + 3 * sg * sg);
    den = sqrt(2.0 * M_PI) * pow(sg, 7.0);

    return num * fact / den;
}

double Der4Normdens(double x, double m, double sg)
{
    double num, den, fact;

    double x2 = x * x;
    double x3 = x2 * x;
    double x4 = x3 * x;
    double m2 = m * m;
    double m3 = m2 * m;
    double m4 = m3 * m;

    double sg2 = sg * sg;
    double sg4 = sg2 * sg2;
    num = exp(-(x - m) * (x - m) / (2 * sg * sg));
    fact = (x4 - 4 * x3 * m + m4 - 6 * m2 * sg2 + 3 * sg4 + 6 * x2 * (m2 - sg2) -
    den = sqrt(2.0 * M_PI) * pow(sg, 9.0);

    return num * fact / den;
}

```

