Help

```
#include  "
href../../../mod/bs1d/bs1d_stda/bs1d_stda_h_src.pdfbs1d_stda.h"
#include "
href../../../common/enums_h_src.pdfenums.h"
#include "
href../../../common/error_msg_h_src.pdferror_msg.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion < (2015+2) //The "#els
static int CHK_OPT(AP_FOURIERCOSINE_GMMB_BS)(void *Opt, void *Mod)
{
  return NONACTIVE;
}
int CALC(AP_FOURIERCOSINE_GMMB_BS)(void *Opt, void *Mod, PricingMethod *Met)
{
  return AVAILABLE_IN_FULL_PREMIA;
}
#else

static void Valomega(double a_global, double b_global, int N, /*input & output*/
{
  int i;

  for (i = 0; i < N; i++)
    pnl_vect_set(omega, i, ((double)i)*M_PI / (b_global - a_global));
}

static void Valcf(double T, double a_global, double b_global, double r, int N, d
{
  double omegaj, a;
  int j;

  a = a_global - fee * T;
  for (j = 0; j < N; j++)
    {
      omegaj = pnl_vect_get(omega, j);
      pnl_vect_complex_set(cf, j, Cexp(CRsub(Cadd(Complex(0, ((r - 0.5 * pow(sig
    }
}
```

```
static void cf0(/*input & output*/PnlVectComplex *cf)
{
  pnl_vect_complex_set_real(cf, 0, 0.5 * pnl_vect_complex_get_real(cf, 0));
  pnl_vect_complex_set_imag(cf, 0, 0.5 * pnl_vect_complex_get_imag(cf, 0));
}

static void Valvt(double a_global, double b_global, double alphav, double P, dou
{
  int j;
  double omegaj, a, b;

  a = a_global - fee * T;
  b = b_global - fee * T;

  for (j = 0; j < N; j++)
    {
      omegaj = pnl_vect_get(omega, j);
      if (j == 0)
        {

          pnl_vect_set(V, 0, (exp(a) - 1.0 - a) * (2.0 / (b - a))*alphav * P * M

        }
      else
        {
          pnl_vect_set(V, j, (-pow((1 + pow(omegaj, 2)), -1) * (cos((-a)*omegaj)
        }
    }
}

static double Valgt(double T, double a_global, double b_global, double alphav, d
{
  PnlVect *gtt;
  double Vi;
  double gt;
  int i;

  gtt = pnl_vect_create(N);

  Valcf(T, a_global, b_global, r, N, sigmav, x, fee, q, omega, cf);
```

```
  Valvt(a_global, b_global, alphav, P, M, omega, V, N, fee, T);

  cf0(cf);

  for (i = 0; i < N; i++)
    {
      Vi = pnl_vect_get(V, i);
      pnl_vect_set(gtt, i, exp(-r * T)*Vi * pnl_vect_complex_get_real(cf, i));
    }
  gt = pnl_vect_sum(gtt);

  pnl_vect_free(&gtt);

  return gt;
}

static double Valft(double r, double x, double P, double alphav, double sigmav,
{
  double ft;
  double t;
  int i;

  ft = 0.;
  t = 0.;

  for (i = 0; i < 1000; i++)
    {
      ft += fee * exp(-r * t) * exp(x) * alphav * P * M * exp(T / 1000 * (r - fe
      t += T / 1000;
    }
  return ft;
}

static double fee(int maximum_number_of_loop, double tolerance, double T , doubl
{
  double fee1;
  double fee2;
  double valueg1;
  double valueg2;
  double valuef1;
```

```
  double valuef2;
  double feexx;
  double step;
  int number_of_loop;

  fee1 = 0.00;
  fee2 = 0.1;
  number_of_loop = 0;
  step = tolerance * 2.;
  while ((fabs(step) > tolerance) && (number_of_loop < maximum_number_of_loop))
    {
      number_of_loop++;
      valueg1 = Valgt(T, a, b, alphav, P, M, r, N, sigmav, x, fee1, q, omega, V,
      valueg2 = Valgt(T, a, b, alphav, P, M, r, N, sigmav, x, fee2, q, omega, V,
      valuef1 = Valft(r, x, P, alphav, sigmav, fee1, M, T);
      valuef2 = Valft(r, x, P, alphav, sigmav, fee2, M, T);
      step = (valueg1 - valuef1) / ((valueg1 - valueg2) / (fee1 - fee2) - (value
      feexx = fee1 - step;
      fee2 = fee1;
      fee1 = feexx;
    }
  return feexx;
}

/*Compute Price Option*/
int  AP_FourierCosine_GMMB_BS(double A0, double maturity, double r, double divid
{
  PnlVect *V, *omega;
  PnlVectComplex *cf;
  double M, x, L, c1, c2, a_global, b_global;
  double premium;

  premium = A0;
  L = 20;
  c1 = (r - 0.5 * pow(sigma, 2)) * maturity;
  c2 = pow(sigma, 2) * maturity;
  a_global = c1 - L * pow(fabs(c2), 0.5);
  b_global = c1 + L * pow(fabs(c2), 0.5);

  M = exp(rollup_rate * maturity);
  x = log(A0 / (alpha * premium * M));
```

```
  omega = pnl_vect_create(N);
  V = pnl_vect_create(N);
  cf = pnl_vect_complex_create(N);

  Valomega(a_global, b_global, N, omega);
  //30 is maximum number of loop in the secante method.
  //0.000001 is the tollerance
  *ptprice = fee(30, 0.00000001, maturity, x, a_global, b_global, alpha, premium

  pnl_vect_free(&omega);
  pnl_vect_free(&V);
  pnl_vect_complex_free(&cf);

  return OK;
}

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

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

  return AP_FourierCosine_GMMB_BS(ptMod->S0.Val.V_PDOUBLE,
                                  ptOpt->Maturity.Val.V_DATE - ptMod->T.Val.V_DA
                                  Met->Par[0].Val.V_PINT,
                                  &(Met->Res[0].Val.V_DOUBLE));
}

static int CHK_OPT(AP_FOURIERCOSINE_GMMB_BS)(void *Opt, void *Mod)
{
  if ((strcmp(((Option *)Opt)->Name, "GMMB") == 0))
    return OK;
  else
    return WRONG;
}
#endif //PremiaCurrentVersion
```

```
static int MET(Init)(PricingMethod *Met, Option *Opt)
{
  if (Met->init == 0)
    {
      Met->init = 1;
      Met->Par[0].Val.V_INT = 256;
    }

  return OK;
}

PricingMethod MET(AP_FOURIERCOSINE_GMMB_BS) =
{
  "AP_FOURIERCOSINE_GMMB_BS",
  {
    {"SpaceStepNumber", INT2, {100}, ALLOW},
    {" ", PREMIA_NULLTYPE, {0}, FORBID}
  },
  CALC(AP_FOURIERCOSINE_GMMB_BS),
  { {"Fair Fee", DOUBLE, {100}, FORBID},
    {" ", PREMIA_NULLTYPE, {0}, FORBID}
  },
  CHK_OPT(AP_FOURIERCOSINE_GMMB_BS),
  CHK_ok,
  MET(Init)
};
```