```
   Help
#include<stdlib.h>
#include<time.h>
#include"pnl/pnl_specfun.h"
#include "nig1d_pad.h"

#if defined(PremiaCurrentVersion) && PremiaCurrentVersion <
     (2011+2) //The "#else" part of the code will be freely av
    ailable after the (year of creation of this file + 2)
static int CHK_OPT(AP_CernyKyriakou_NIG_FloatingAsian)(voi
    d *Opt, void *Mod)
{
  return NONACTIVE;
}
int CALC(AP_CernyKyriakou_NIG_FloatingAsian)(void*Opt,void
    *Mod,PricingMethod *Met)
{
  return AVAILABLE_IN_FULL_PREMIA;
}
#else
//Laplace transform of NIG process
static dcomplex NIG_laplace_transform(dcomplex u,double t,
    double alpha,double beta,double delta,double drift)
{
  dcomplex temp;

  temp=RCsub(delta*sqrt(alpha*alpha-beta*beta),RCmul(delta,
    Csqrt(RCsub(alpha*alpha,Cmul(RCadd(beta,u),RCadd(beta,u))))
    ));

  return Cexp(RCmul(t,Cadd(RCmul(drift,u),temp)));
}
//The generalized discrete Fourier transform (DFT) of a fro
    m x onto u
static void DFT(dcomplex *a,double *x,int n,double *u,int
    m,dcomplex* b)
{
  int j,k;

  for(k=0;k<=m;k++)
  {
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    b[k]=CZERO;
    for(j=1;j<=n;j++)
      b[k]=Cadd(Cmul(a[j],CIexp(x[j]*u[k])),b[k]);
    b[k]=CRmul(b[k],fabs(x[1]-x[0]));
  }
}

int nig_ap_cernykyriakou_asianfloating(NumFunc_2*P,double
    S0,double T,double r,double divid,double sigma,double thet
    a,double kappa,int n_points,double *ptprice)
{
   double *lambda,drift,*L,*L_bar,*u,*U,*U_bar,rho,u_max,*x
    ,*y,x_step,y_step,time_step;
   double u_step,*u_minus,*h,u_em,l_em,*a,*b,exp_X,alpha,
    beta,delta,coef;
   int i,k,i_up,i_down,x_nb,y_nb,u_nb,i_temp,i_x,test;
   dcomplex *q,*p,*P_vect,*phi,*temp;
   alpha=sqrt(theta*theta+sigma*sigma/kappa)/(sigma*sigma);
   beta=theta/(sigma*sigma);
   delta=sigma/sqrt(kappa);
   rho=1e-6;
   time_step=T/n_points;
   u_nb=POW(2,10);
   x_nb=POW(2,10);
   y_nb=POW(2,10);
   i_x=0;
   coef=1;
   lambda=malloc((n_points+1)*sizeof(double));
   a=malloc((n_points+1)*sizeof(double));
   b=malloc((n_points+1)*sizeof(double));
   L=malloc((n_points+1)*sizeof(double));
   U=malloc((n_points+1)*sizeof(double));
   L_bar=malloc((n_points+1)*sizeof(double));
   U_bar=malloc((n_points+1)*sizeof(double));
   x=malloc((x_nb+1)*sizeof(double));
   y=malloc((y_nb+1)*sizeof(double));
   h=malloc((y_nb+1)*sizeof(double));
   p=malloc((y_nb+1)*sizeof(dcomplex));
   q=malloc((x_nb+1)*sizeof(dcomplex));

    //Measure change so that the option can be value as a
```

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    fixed strike asian option
    beta=-(beta+1);
    drift=-(r-divid)-log(Creal(NIG_laplace_transform(
    Complex(1,0),1,alpha,beta,delta,0)));
    ////////////////////////////////////////////////////
    ////////////////////////
   u_max=5.;
   while(Cabs(NIG_laplace_transform(Complex(0,u_max),time_s
    tep,alpha,beta,delta,drift))+Cabs(NIG_laplace_transform(
    Complex(0,-u_max),time_step,alpha,beta,delta,drift))>rho)
   {
     u_max+=5.;
   }
   u_step=2*u_max/u_nb;
   if(u_step>0.125)
   {
     u_nb=trunc(16*u_max);
     u_nb+=PNL_IS_ODD(u_nb);
     u_step=2*u_max/u_nb;
   }
   u=malloc((u_nb+1)*sizeof(double));
   u_minus=malloc((u_nb+1)*sizeof(double));
   P_vect=malloc((u_nb+1)*sizeof(dcomplex));
   phi=malloc((u_nb+1)*sizeof(dcomplex));
   temp=malloc((u_nb+1)*sizeof(dcomplex));
   for(i=0;i<=u_nb;i++)
   {
     u[i]=-u_max+i*u_step;
     u_minus[i]=-u[i];
     phi[i]=NIG_laplace_transform(Complex(0,u[i]),time_step
    ,alpha,beta,delta,drift);
   }
   /*Put Case*/
   lambda[0]=1./(n_points+1)-1;
   for(i=1;i<=n_points;i++)
     lambda[i]=1./(n_points+1);
   do
   {
     u_em=5*coef;
     l_em=-5*coef;
////////////////////////////////////////////////////////////
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    ////////////////////
     a[n_points]=1;
     b[n_points]=lambda[0]*(lambda[0]>0);
     exp_X=Creal(NIG_laplace_transform(Complex(1,0),time_s
    tep,alpha,beta,delta,drift));
     for(i=n_points;i>0;i--)
     {
       a[i-1]=a[i]*exp_X;
       b[i-1]=b[i]+a[i-1]*lambda[n_points-i+1];
     }
////////////////////////////////////////////////////////////
    ////////////////////
     L_bar[0]=log(lambda[n_points]);
     U_bar[0]=log(lambda[n_points]);
     for(i=1;i<n_points;i++)
     {
       L[i]=L_bar[i-1]+l_em;
       U[i]=U_bar[i-1]+u_em;
       L_bar[i]=log(exp(L[i])+lambda[n_points-i]);
       U_bar[i]=log(exp(U[i])+lambda[n_points-i]);

     }
     L[n_points]=L_bar[n_points-1]+l_em;
     U[n_points]=U_bar[n_points-1]+u_em;
     y_step=(U[n_points]-L[n_points])/y_nb;
     for(i=0;i<=y_nb;i++)
     {
       y[i]=L[n_points]+i*y_step;
       p[i]=Complex((exp(y[i])+lambda[0])*(exp(y[i])+lambd
    a[0]>0),0);
     }
     coef*=0.95;
   }
   while(y[y_nb]>10);
   for(k=n_points;k>1;k--)
   {


     x_step=(U_bar[k-1]-L_bar[k-1])/x_nb;
     for(i=0;i<=x_nb;i++)
     {
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      x[i]=L_bar[k-1]+i*x_step;
    }
    DFT(p,y,y_nb,u,u_nb,P_vect);
    for(i=0;i<=u_nb;i++)
    {
      temp[i]=Cmul(P_vect[i],Conj(phi[i]));
    }
    DFT(temp,u_minus,u_nb,x,x_nb,q);
    for(i=0;i<=x_nb;i++)
    {
      q[i]=CRdiv(q[i],2*M_PI);
    }
////////////////////////////////////////////////////////
    //////////
    y_step=(U[k-1]-L[k-1])/y_nb;
    for(i=0;i<=y_nb;i++)
    {
      y[i]=L[k-1]+i*y_step;
      h[i]=log(exp(y[i])+lambda[n_points-(k-1)]);

      test=0;
      if(h[i]<=x[0])
      {
        i_x=0;
        test=1;
        p[i]=Cadd(q[i_x],CRmul(CRdiv(Csub(q[i_x+1],q[i_x])
   ,x[i_x+1]-x[i_x]),(h[i]-x[i_x])));
      }
      if(h[i]>=x[x_nb])
      {
        i_x=x_nb;
        test=1;
        p[i]=Cadd(q[i_x-1],CRmul(CRdiv(Csub(q[i_x],q[i_x-1
   ]),x[i_x]-x[i_x-1]),(h[i]-x[i_x-1])));
      }
      if((h[i]>x[0]) && (h[i]<x[x_nb]))
      {
        i_down=x_nb/2;
        i_up=x_nb;
        if(x[i_down]>h[i])
        {
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```
          i_down=0;
          i_up=x_nb/2;
        }
        while(test==0)
        {
          if(x[i_down+1]>h[i])
          {
           i_x=i_down;
           test=1;
          }
          else
          {
            i_temp=(i_up-i_down-1)/2+i_down;
            if(x[i_temp]>h[i])
            {
              i_up=i_temp;
              i_down=i_down+1;
            }
            else
            {
              i_down=i_temp*(i_temp>i_down)+(i_down+1)*(i_
   temp<=i_down);
            }
          }
        }
        p[i]=Cadd(q[i_x],CRmul(CRdiv(Csub(q[i_x+1],q[i_x])
   ,x[i_x+1]-x[i_x]),(h[i]-x[i_x])));
      }
    }
////////////////////////////////////////////////////////////
    ///////////////
  }
  x_step=(U_bar[0]-L_bar[0])/x_nb;
  for(i=0;i<=x_nb;i++)
  {
    x[i]=L_bar[0]+i*x_step;
  }
  DFT(p,y,y_nb,u,u_nb,P_vect);
  for(i=0;i<=u_nb;i++)
  {
    temp[i]=Cmul(P_vect[i],Conj(phi[i]));
```

```
  }
  DFT(temp,u_minus,u_nb,x,x_nb,q);
  for(i=0;i<=x_nb;i++)
  {
    q[i]=CRdiv(q[i],2*M_PI);
  }
  /*Call Case*/
  if((P->Compute)==&Call_StrikeSpot2)
  {
    if(r!=divid)
      *ptprice=S0*exp(-divid*T)*Creal(q[0])+S0*exp(-divid*
   T)-S0*(exp(-divid*T)-exp(-r*T))/((r-divid)*T);
    else
      *ptprice=S0*exp(-divid*T)*Creal(q[0])+S0*(exp(-divid
   *T)-exp(-r*T));
  }
  /*Put case*/
  if((P->Compute)==&Put_StrikeSpot2)
  {
    *ptprice=S0*exp(-divid*T)*Creal(q[0]);
  }
  free(lambda);
  free(L);
  free(U);
  free(L_bar);
  free(U_bar);
  free(u);
  free(u_minus);
  free(x);
  free(y);
  free(h);
  free(p);
  free(P_vect);
  free(phi);
  free(temp);
  free(q);
  free(a);
  free(b);

  return OK;
}
```

```
int CALC(AP_CernyKyriakou_NIG_FloatingAsian)(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  nig_ap_cernykyriakou_asianfloating(ptOpt->PayOff.
    Val.V_NUMFUNC_2,ptMod->S0.Val.V_PDOUBLE,ptOpt->Maturity.Val.
    V_DATE-ptMod->T.Val.V_DATE,r,divid,ptMod->Sigma.Val.V_PDOUB
    LE,ptMod->Theta.Val.V_DOUBLE,ptMod->Kappa.Val.V_SPDOUBLE,
    Met->Par[0].Val.V_PINT,&(Met->Res[0].Val.V_DOUBLE));
}

static int CHK_OPT(AP_CernyKyriakou_NIG_FloatingAsian)(voi
    d *Opt, void *Mod)
{
  if ((strcmp(((Option*)Opt)->Name,"AsianCallFloatingEuro")
    ==0) || (strcmp( ((Option*)Opt)->Name,"    AsianPutFloatingEuro")==0) )
    return OK;
  return WRONG;
}

#endif //PremiaCurrentVersion
static int MET(Init)(PricingMethod *Met,Option *Mod)
{
  if ( Met->init == 0)
    {
      Met->init=1;
      Met->HelpFilenameHint = "    ap_cernykyriakou_nig_asianfloating";
      Met->Par[0].Val.V_PINT=10;
    }
  return OK;
}

PricingMethod MET(AP_CernyKyriakou_NIG_FloatingAsian)=
{
  "AP_CernyKyriakou_NIG_FloatingAsian",
```

```
  {{"Number of discretization steps",LONG,{100},ALLOW},{" "
    ,PREMIA_NULLTYPE,{0},FORBID}},
  CALC(AP_CernyKyriakou_NIG_FloatingAsian),
  {{"Price",DOUBLE,{100},FORBID},{" ",PREMIA_NULLTYPE,{0},
    FORBID}},
  CHK_OPT(AP_CernyKyriakou_NIG_FloatingAsian),
  CHK_ok,
  MET(Init)
} ;
```

References