Help

```
#include <stdlib.h>
#include  "bs1d_doublim.h"
#include "error_msg.h"

static int Psor_In(double s,NumFunc_1  *L, NumFunc_1  *U,
    NumFunc_1  *Rebate,NumFunc_1  *p,double t,double r,double divid,
    double sigma,int N,int M,double theta,double omega,double epsi
    lon,double *ptprice,double *ptdelta)
{
  int      Index,PriceIndex,TimeIndex;
  int      j,loops;
  double   k,vv,h,z,alpha,beta,gamma,y,alpha1,beta1,gamma1,
    down,upwind_alphacoef;
  double   error,norm,x,up,rebate,l,u,pricenh,pricen2h,
    priceph;
  double   *P,*Obst,*Rhs;

  /*Memory Allocation*/
  P= malloc((N+2)*sizeof(double));
  if (P==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  Obst= malloc((N+2)*sizeof(double));
  if (Obst==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  Rhs= malloc((N+2)*sizeof(double));
  if (Rhs==NULL)
    return MEMORY_ALLOCATION_FAILURE;

  /*Time Step*/
  k=t/(double)M;

  /*Space Step*/
  u=(U->Compute)(U->Par,0);
  l=(L->Compute)(L->Par,0);
  rebate=(Rebate->Compute)(Rebate->Par,0);
  x=log(s);
  down=log(l);
  up=log(u);
  h=(up-down)/(double)(N+1);
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/*Coefficient of diffusion augmented*/
vv=0.5*sigma*sigma;
z=(r-divid)-vv;
if ((h*fabs(z))<=vv)
  upwind_alphacoef=0.5;
else {
  if (z>0.) upwind_alphacoef=0.0;
  else  upwind_alphacoef=1.0;
}
vv-=z*h*(upwind_alphacoef-0.5);

/*Lhs factor of theta-schema*/
alpha=theta*k*(-vv/(h*h)+z/(2.0*h));
beta=1.0+k*theta*(r+2.*vv/(h*h));
gamma=k*theta*(-vv/(h*h)-z/(2.0*h));

/*Rhs factor of theta-schema*/
alpha1=k*(1.0-theta)*(vv/(h*h)-z/(2.0*h));
beta1=1.0-k*(1.0-theta)*(r+2.*vv/(h*h));
gamma1=k*(1.0-theta)*(vv/(h*h)+z/(2.0*h));

/*Terminal Values*/
for(PriceIndex=1;PriceIndex<=N;PriceIndex++)
  {
    Obst[PriceIndex]=(p->Compute)(p->Par,exp(down+(
  double)PriceIndex*h));
    P[PriceIndex]= rebate;
  }
P[0]=(p->Compute)(p->Par,l);
P[N+1]=(p->Compute)(p->Par,u);

/*Finite Difference Cycle*/
for(TimeIndex=1;TimeIndex<=M;TimeIndex++)
  {
    /*Init Rhs*/
    for(j=1;j<=N;j++)
      Rhs[j]=alpha1*P[j-1]+beta1*P[j]+gamma1*P[j+1];

    P[0]=Boundary(l,p,(double)TimeIndex*k,r,divid,sigma);
    P[N+1]=Boundary(u,p,(double)TimeIndex*k,r,divid,sigma
  );
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    /*Psor Cycle*/
    loops=0;
    do
      {
        error=0.;
        norm=0.;

        for(j=1;j<=N;j++)
          {
            y=(Rhs[j]-alpha*P[j-1]-gamma*P[j+1])/beta;
            y=MAX(Obst[j],P[j]+omega*(y-P[j]));

            error+=(double)(j+1)*fabs(y-P[j]);
            norm+=fabs(y);
            P[j]=y;
          }

        if (norm<1.0) norm=1.0;
        error=error/norm;

        loops++;
      }
    while ((error>epsilon) && (loops<MAXLOOPS));
  }
Index=(int)floor((x-down)/h);

/*Price*/
if ((x==up)&&(x==down))
  *ptprice=P[0];
else
  *ptprice=P[Index]+(P[Index+1]-P[Index])*(exp(x)-exp(dow
  n+Index*h))/(exp(down+(Index+1)*h)-exp(down+Index*h));

/*Delta*/
if ((x==up)&&(x==down))
  *ptdelta=0.0;
else {
  pricenh=P[Index+1]+(P[Index+2]-P[Index+1])*(exp(x+h)-
  exp(down+(Index+1)*h))/(exp(down+(Index+2)*h)-exp(down+(Ind
  ex+1)*h));
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    if (Index>0) {
      priceph=P[Index-1]+(P[Index]-P[Index-1])*(exp(x-h)-
    exp(down+(Index-1)*h))/(exp(down+(Index)*h)-exp(down+(Index-
    1)*h));
      *ptdelta=(pricenh-priceph)/(2*s*h);
    } else {
      pricen2h=P[Index+2]+(P[Index+3]-P[Index+2])*(exp(x+2*
    h)-exp(down+(Index+2)*h))/(exp(down+(Index+3)*h)-exp(down+(
    Index+2)*h));
      *ptdelta=(4*pricenh-pricen2h-3*(*ptprice))/(2*s*h);
    }
  }

  /*Memory Desallocation*/
  free(P);
  free(Obst);
  free(Rhs);

  return OK;
}

int CALC(FD_Psor_In)(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 Psor_In(ptMod->S0.Val.V_PDOUBLE,ptOpt->LowerLimit.
    Val.V_NUMFUNC_1,ptOpt->UpperLimit.Val.V_NUMFUNC_1,ptOpt->Reb
    ate.Val.V_NUMFUNC_1,ptOpt->PayOff.Val.V_NUMFUNC_1,ptOpt->
    Maturity.Val.V_DATE-ptMod->T.Val.V_DATE,r,divid,ptMod->Sigma.
    Val.V_PDOUBLE,Met->Par[0].Val.V_INT,Met->Par[1].Val.V_INT,
    Met->Par[2].Val.V_RGDOUBLE,Met->Par[3].Val.V_RGDOUBLE,Met->
    Par[4].Val.V_RGDOUBLE,&(Met->Res[0].Val.V_DOUBLE),&(Met->Res[
    1].Val.V_DOUBLE));
}
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```
static int CHK_OPT(FD_Psor_In)(void *Opt, void *Mod)
{
  Option* ptOpt=(Option*)Opt;
  TYPEOPT* opt=(TYPEOPT*)(ptOpt->TypeOpt);

  if ((opt->Parisian).Val.V_BOOL==WRONG)
    if ( (strcmp( ((Option*)Opt)->Name,"DoubleCallInAmer")=
    =0) || (strcmp( ((Option*)Opt)->Name,"DoublePutInAmer")==0
    ) )
      return OK;
  return WRONG;
}

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

      Met->Par[0].Val.V_INT2=100;
      Met->Par[1].Val.V_INT2=100;
      Met->Par[2].Val.V_RGDOUBLE=0.5;
      Met->Par[3].Val.V_RGDOUBLE=1.5;
      Met->Par[4].Val.V_RGDOUBLE=1.0e-7;


    }

  return OK;
}

PricingMethod MET(FD_Psor_In)=
{
  "FD_Psor_In",
  {{"SpaceStepNumber",INT2,{100},ALLOW    },{"TimeStepNumb
    er",INT2,{100},ALLOW},
   {"Theta",RGDOUBLE051,{100},ALLOW},{"Omega",RGDOUBLE12,{1
    00},ALLOW}, {"Epsilon",RGDOUBLE,{100},ALLOW},{" ",PREMIA_
    NULLTYPE,{0},FORBID}},
  CALC(FD_Psor_In),
  {{"Price",DOUBLE,{100},FORBID},{"Delta",DOUBLE,{100},FORB
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    ID} ,{" ",PREMIA_NULLTYPE,{0},FORBID}},
  CHK_OPT(FD_Psor_In),
  CHK_psor,
  MET(Init)
};
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References