Help

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

static int Cryer_Out(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 *ptprice,double *ptdelta)
{
  int      Index,PriceIndex,TimeIndex,ssl;
  double   k,vv,h,z,alpha,beta,gamma,y,down,u,l,rebate,up,
    upwind_alphacoef;
  double   *Obst,*A,*B,*C,*P,*S,*Q,*Z,pricenh,pricen2h,
    priceph;

  /*Memory Allocation*/
  Obst= malloc((N+1)*sizeof(double));
  if (Obst==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  A= malloc((N+1)*sizeof(double));
  if (A==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  B= malloc((N+1)*sizeof(double));
  if (B==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  C= malloc((N+1)*sizeof(double));
  if (C==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  P= malloc((N+1)*sizeof(double));
  if (P==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  S= malloc((N+1)*sizeof(double));
  if (S==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  Z= malloc((N+1)*sizeof(double));
  if (Z==NULL)
    return MEMORY_ALLOCATION_FAILURE;
  Q= malloc((N+1)*sizeof(double));
  if (Q==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);
y=log(s);
down=log(l);
up=log(u);
h=(up-down)/(double)(N);

/*Peclet Condition-Coefficient of diffusion augmented */
vv=0.5*SQR(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=k*(-vv/(h*h)+z/(2.0*h));
beta=1.0+k*(r+2.*vv/(h*h));
gamma=k*(-vv/(h*h)-z/(2.0*h));

for(PriceIndex=0;PriceIndex<=N-2;PriceIndex++)
  {
    A[PriceIndex]=alpha;
    B[PriceIndex]=beta;
    C[PriceIndex]=gamma;
  }

/*Terminal Values*/
y=log(s);
for (PriceIndex = 1; PriceIndex < N; PriceIndex++)
  Obst[PriceIndex - 1]=(p->Compute)(p->Par,exp(down+
  PriceIndex* h));
```

```
for (PriceIndex = 2; PriceIndex <= N - 2; PriceIndex++)
  {
    P[PriceIndex - 1] = alpha * Obst[PriceIndex - 2] +
beta * Obst[PriceIndex - 1] + gamma * Obst[PriceIndex];
  }

P[0] =beta*Obst[0]+gamma*Obst[1];
P[N - 2] = alpha*Obst[N-3] + beta * Obst[N-2];

for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
  {
    S[PriceIndex] = 0.0;
    Z[PriceIndex] = 0.0;
  }
ssl = false;

/*Finite Difference Cycle*/
for (TimeIndex= 1; TimeIndex<= M; TimeIndex++)
  {
    for (PriceIndex = 0; PriceIndex <= N- 2; PriceIndex++
  )
Z[PriceIndex] =Z[PriceIndex]+Obst[PriceIndex];

    for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex+
  +)
Q[PriceIndex]=P[PriceIndex]-Z[PriceIndex];
    Q[0] += alpha*rebate;
    Q[N-2]+=gamma*rebate;

    AlgCrayer(N,Z,ssl,A,B,C,Q,S);

    for (PriceIndex = 0; PriceIndex <=N-2; PriceIndex++)
S[PriceIndex] = Z[PriceIndex];

    ssl = true;
  }

for (PriceIndex = 0; PriceIndex <= N - 2; PriceIndex++)
  P[PriceIndex]=Z[PriceIndex]+Obst[PriceIndex];

Index=(int)floor((y-down)/h)-1;
```

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

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

  /*Memory Desallocation*/
  free(Obst);
  free(A);
  free(B);
  free(C);
  free(P);
  free(S);
  free(Z);
  free(Q);

  return OK;
}
```

```
int CALC(FD_Cryer_Out)(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 Cryer_Out(ptMod->S0.Val.V_PDOUBLE,
                   ptOpt->LowerLimit.Val.V_NUMFUNC_1,ptOpt-
    >UpperLimit.Val.V_NUMFUNC_1,ptOpt->Rebate.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->Res[0].Val.V_DOUBLE),&(Met->Res[1
    ].Val.V_DOUBLE));
}

static int CHK_OPT(FD_Cryer_Out)(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,"DoubleCallOutAmer")
    ==0) || (strcmp( ((Option*)Opt)->Name,"DoublePutOutAmer")=
    =0) )
      return OK;
  return WRONG;

  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;


    }

  return OK;
}

PricingMethod MET(FD_Cryer_Out)=
{
  "FD_Cryer_Out",
  {{"SpaceStepNumber",INT2,{100},ALLOW},{"TimeStepNumber",
    INT2,{100},ALLOW},{" ",PREMIA_NULLTYPE,{0},FORBID}},
  CALC(FD_Cryer_Out),
  {{"Price",DOUBLE,{100},FORBID},{"Delta",DOUBLE,{100},FORB
    ID} ,{" ",PREMIA_NULLTYPE,{0},FORBID}},
  CHK_OPT(FD_Cryer_Out),
  CHK_split,
  MET(Init)
};
```

References