%% PLEASE NOTE: Indexes will be displaced by one compared to the above sets of matrices due to MATLAB conventions i.e. a\_1=a(2) for j=0:M etc.

S=138.50; %% Initial Share Price

r=0.01; %% Risk-Free Interest Rate

sigma=0.16; %% Volatility

X=110; %% Example Strike Price

T=0.632876712; %% Years until Expiry

%% Grid Parameters %%

M=250; %% Asset Grid points

N=230; %% Time Grid points

Szero=0; %% Specify Minimum Share Price

Smax=250; %% Specify Maximum Share Price

%% Grid Setup and Boundary Conditions %%

j=0:M; %% Set up j vector

dt=T/N; %% Construct time step

ds=Smax/M; %% Construct price step

solngrid=zeros(M+1,N+1); %% Initialise Grid i.e. 251x2311 matrix

Sgrid=0:ds:Smax; %% Positive, equally spaced price steps . %% i.e. 251 elements

Tgrid=T:-dt:0; %% Negative(Backward), equally spaced ti %% time steps i.e. 2311 elements

solngrid(1,:)=X\*exp(-r\*Tgrid); %% Boundary Condition : Price=0

solngrid(:,end)=max(X-Sgrid,0); %% Boundary Condition : Payoff of Put

solngrid(end,:)=0; %% Boundary Condition : Price tending to %% to "infinity"

alpha=(1/2)\*dt\*(r\*j-sigma^2\*j.^2); %(29) function alpha

beta=1+(sigma^2\*j.^2 +r)\*dt; %(29) function beta

gamma=-(1/2)\*dt\*(r\*j+sigma^2\*j.^2); %(29) function gamma

%% Construction of Soln Matrix %%

A=diag(alpha(3:M),-1)+diag(beta(2:M))+diag(gamma(2:M-1),1);

% Here we create Matrix (33) with betas on the leading diagonal, alphas

% offset down(-1) and gammas offset up (+1)

Ainv=inv(A); % Create inverse of A to test stability

normi=norm(Ainv,inf); % Stability Test

C=zeros(size(A,2),1);

%Create matrix of 0's w/1 column and number of rows = =no. of columns in A

for i=N:-1:1

%For loop solves our M-1 eqns for every time grid point N=2310

C(1)=alpha(2)\*solngrid(1,i); % first element of C

C(end) = gamma(end)\*solngrid(end,i);

% Will always be zero as previously previously stated hence irrelevant

solngrid(2:M,i)=A\(solngrid(2:M,i+1)-C); %Inverted matrix soln for P\_i

end

format long

EuropeanPutOptionPrice=interp1(Sgrid,solngrid(:,1),S)

%Finally interpolate between ds intervals to get exact price for any possible S value 0 upto 250