Financial Engineering II
Lab Assignment 2

Kumar Harsha, 11012318

January 17, 2014

Contents

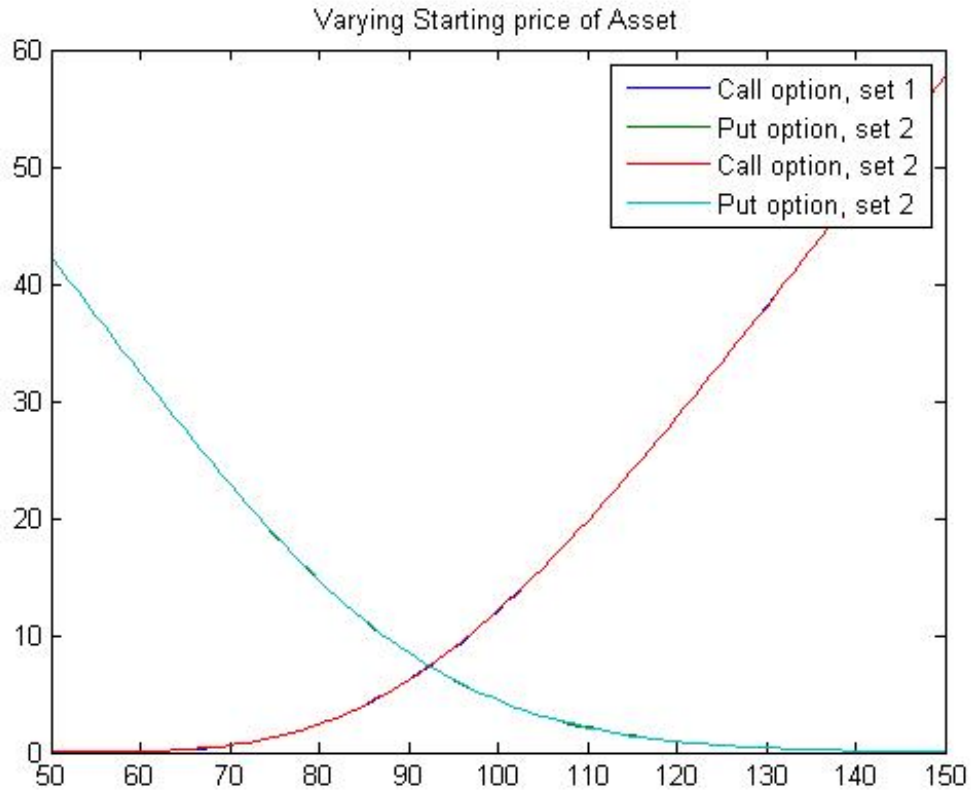
1 Question 1

1.1 Initial Price of Options

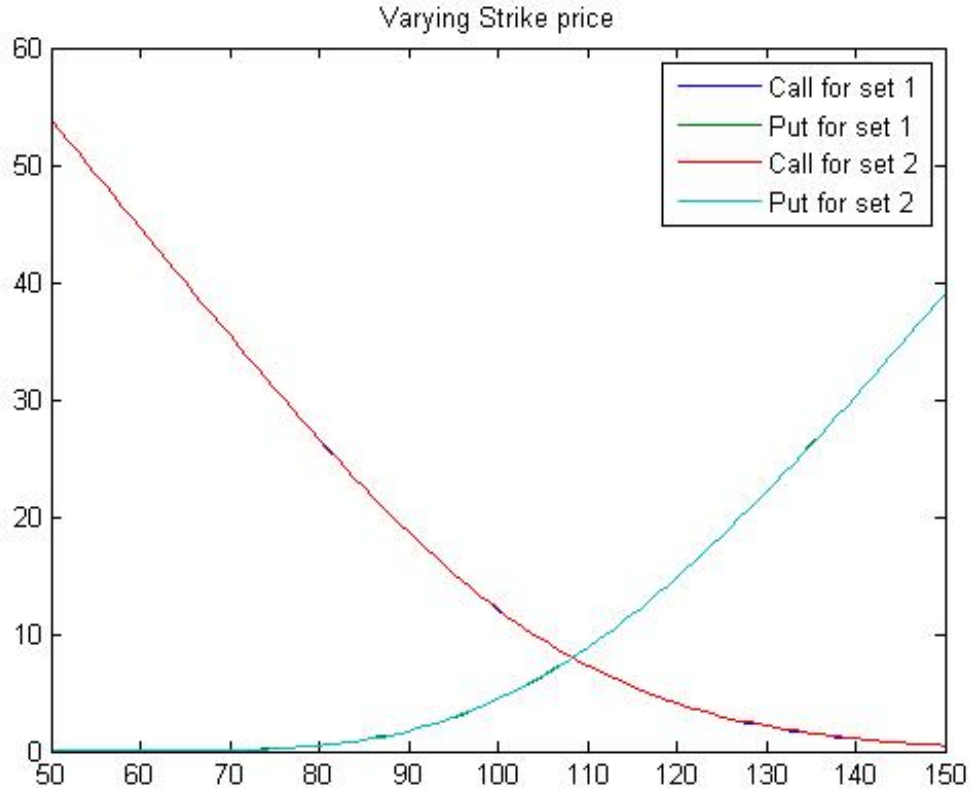
	Set 1	Set 2
Call Option	12.0854	12.1230
Put Option	4.3970	4.4347

1.2 Dependence of Option Prices on Variables

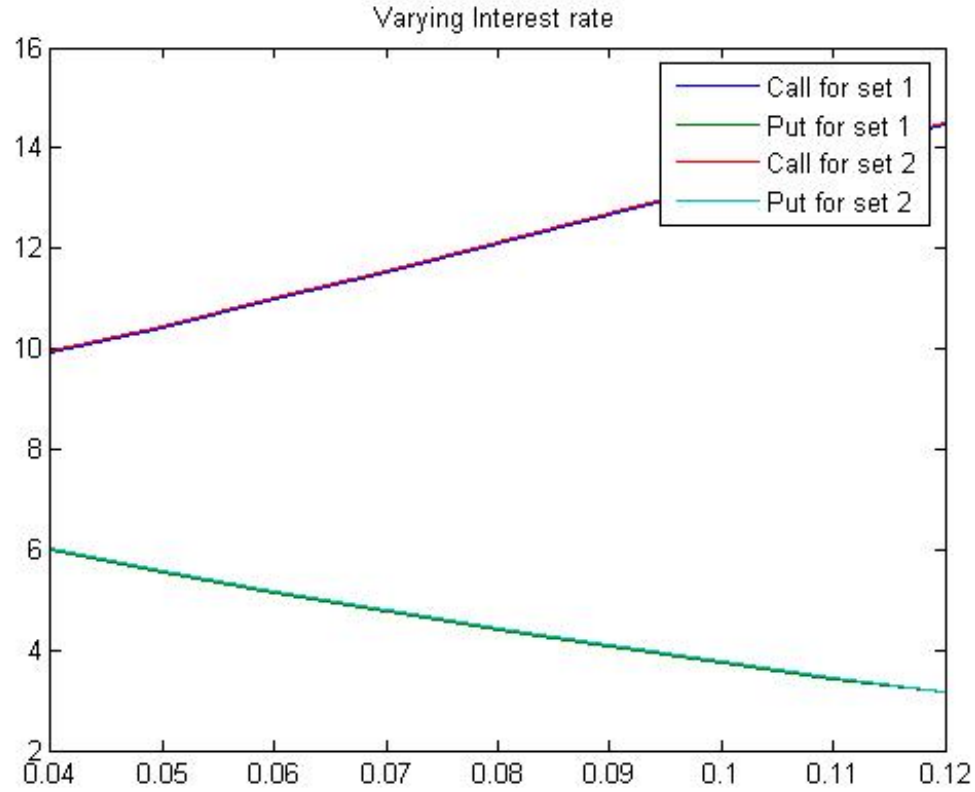
Dependence on Starting Price of Asset



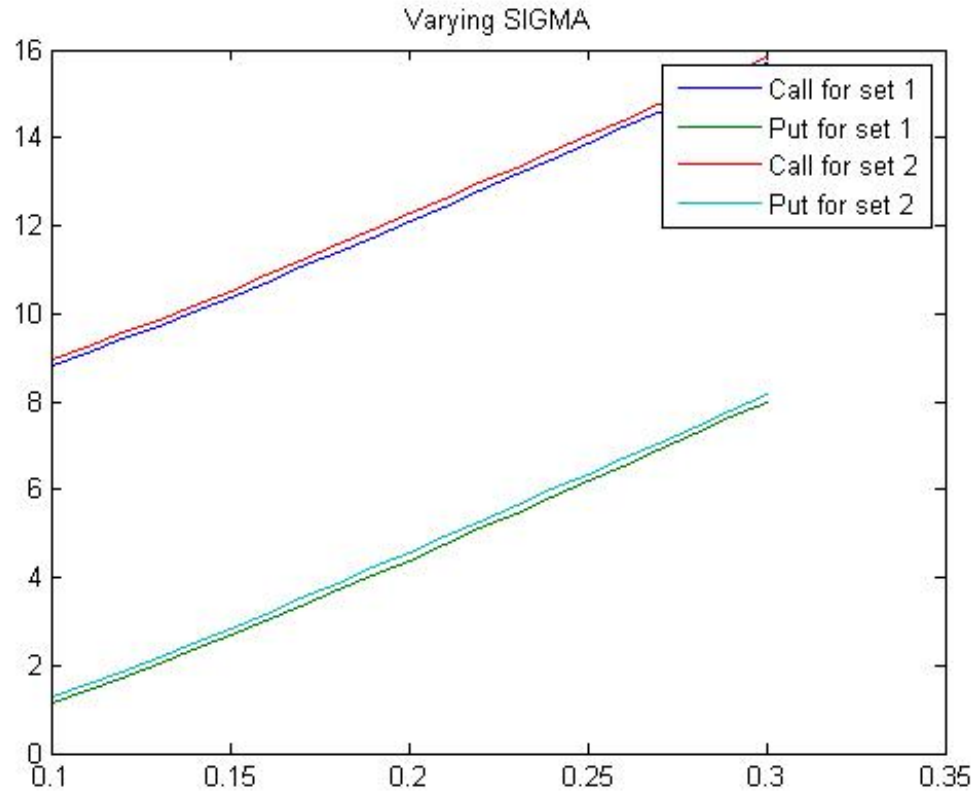
Dependence on Strike Price



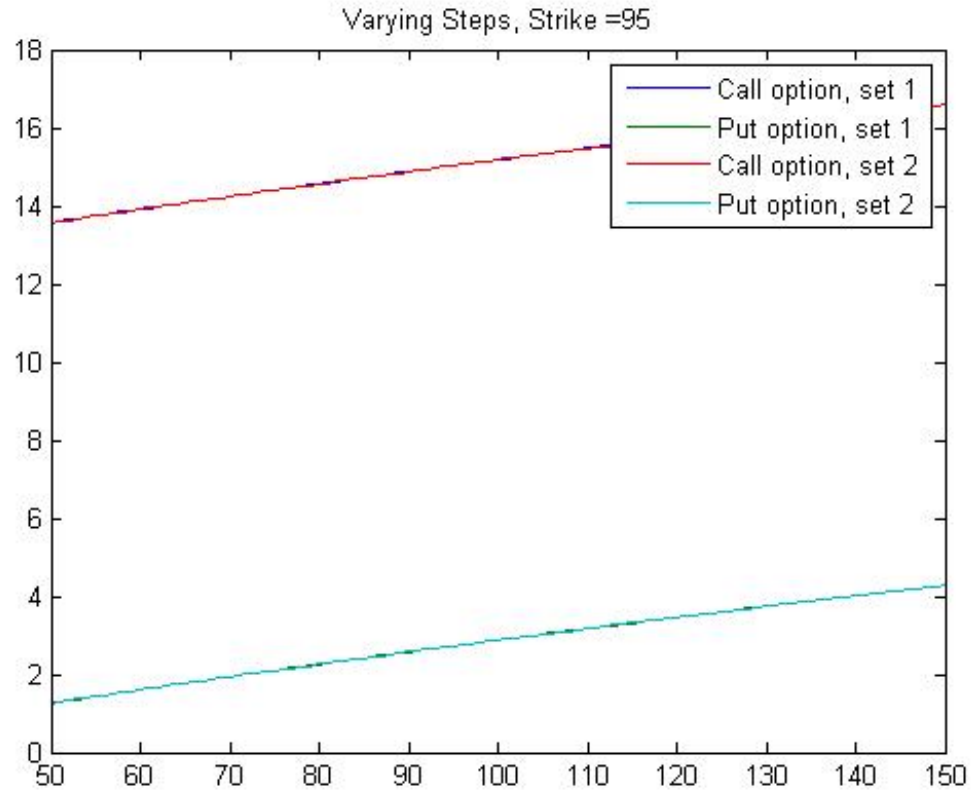
Dependence on Rate

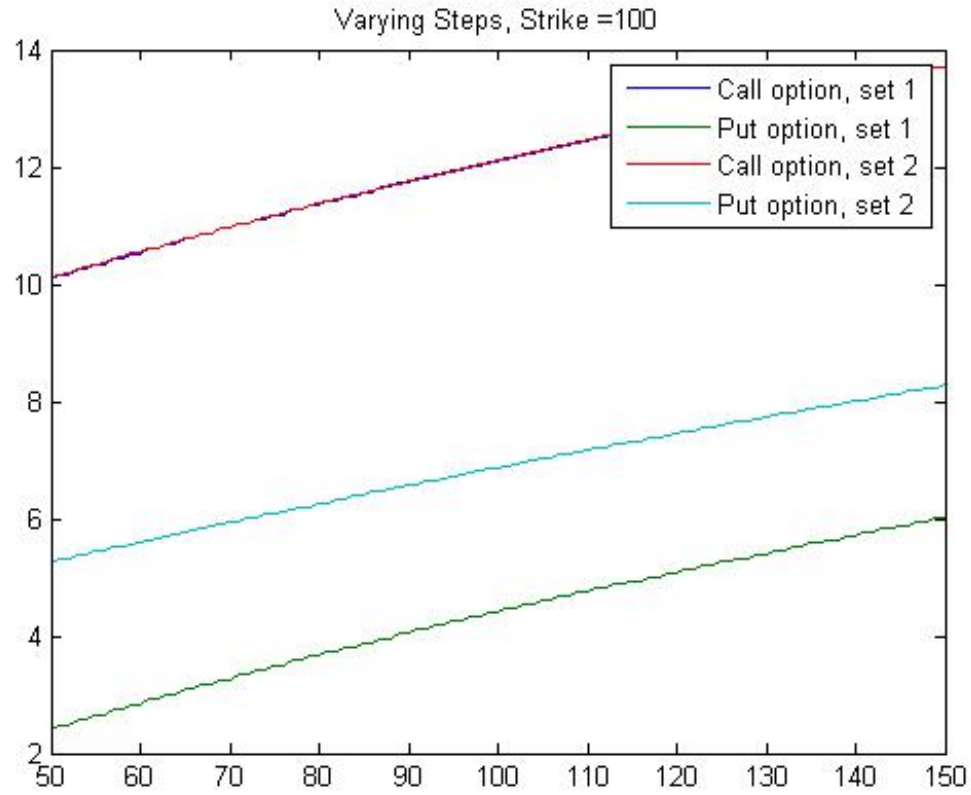


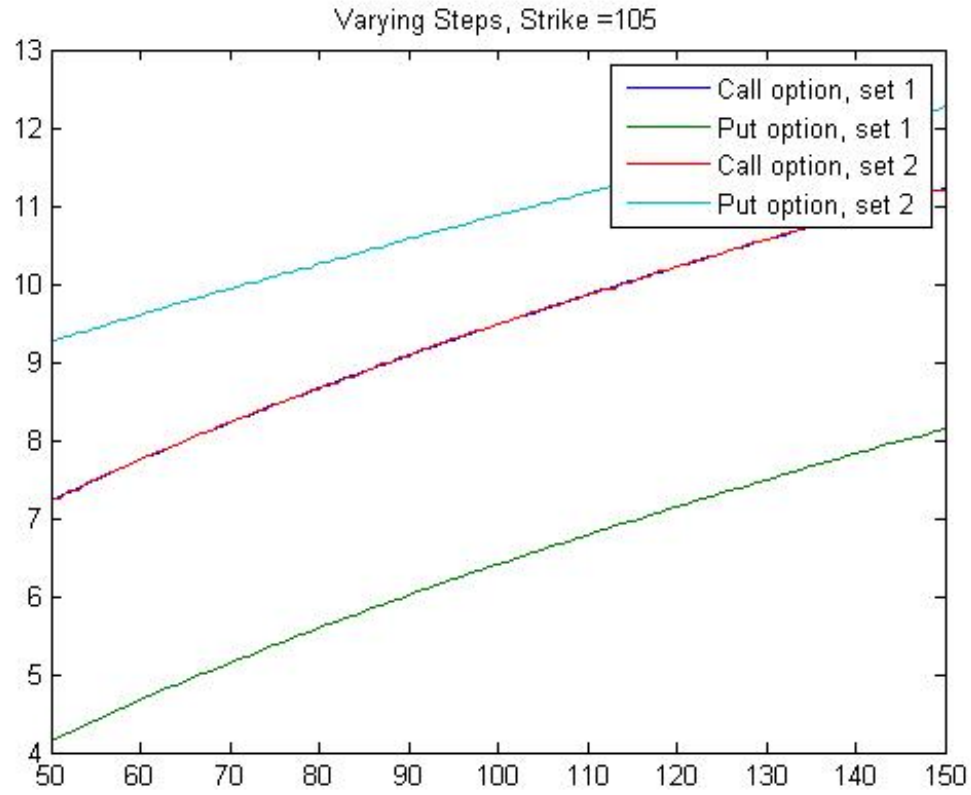
Dependence on Volatility



Dependence on Number of Steps




Varying Steps, Strike =100
Call option, set 1
Put option, set 1
Call option, set 2
Put option, set 2
14
12
10
8
6
4
2
50
60
70
80
90
100
110
120
130
140
150


Varying Steps, Strike =105
Call option, set 1
Put option, set 1
Call option, set 2
Put option, set 2
13
12
11
10
9
8
7
6
5
4
50
60
70
80
90
100
110
120
130
140
150

2 Code

2.1 Function for Valuating a European Option

```
function [ price ] = european( start, strike, rate, steps, sigma,
   T, callorput , up, down)
%compute value of european option
%   start = price of asset at t = 0
%   strike = strike price for the option
%   rate = risk free interest rate
%   steps = number of time steps
%   sigma = volatility
%   T = total time
%   callorput = 0 for call, 1 for put

optionprices = zeros(steps+1);
dt = T/steps;
p = (exp(rate*dt) - down)/(up - down);
for i = 1:steps+1
    if callorput == 0 %call option
        optionprices(i,steps+1) = max(start*(up^(steps-i+1))*(down
           ^(i-1)) - strike, 0);
    elseif callorput == 1 %put option
        optionprices(i,steps+1) = max(strike - start*(up^(steps-i
           +1))*(down^(i-1)), 0);
end
for i = 1:steps
    for j = 1:steps+1-i
        optionprices(j,steps+1-i) = (optionprices(j,steps+2-i)*p +
            optionprices(j+1,steps+2-i)*(1-p))*exp(-rate*dt);
    end
end

price = optionprices(1,1);

end
```

2.2 Code for Analysing European Options

```
format long; clc; clear all;
%initial values
s0 = 100;
strike = 100;
T = 1;
M = 100;
rate = 0.08;
sigma = 0.2;

%compute option prices for two sets of u and d
up1 = exp(sigma*sqrt(T/M));
```

```
down1 = exp(-sigma*sqrt(T/M));
ce1 = european(s0, strike, rate, M, sigma, T, 0, up1, down1);
pe1 = european(s0, strike, rate, M, sigma, T, 1, up1, down1);
up2 = exp(sigma*sqrt(T/M) + (rate-sigma*sigma*0.5)*T/M);
down2 = exp(-sigma*sqrt(T/M) + (rate-sigma*sigma*0.5)*T/M);
ce2 = european(s0, strike, rate, M, sigma, T, 0, up2, down2);
pe2 = european(s0, strike, rate, M, sigma, T, 1, up2, down2);

%varying starting price S(0)
range = 50;
optiondata = zeros(2*range+1, 5);
for i=s0-range:s0+range
    optiondata(i-s0+range+1, 1) = i;
    optiondata(i-s0+range+1, 2) = european(i, strike, rate, M,
       sigma, T, 0, up1, down1);
    optiondata(i-s0+range+1, 3) = european(i, strike, rate, M,
       sigma, T, 1, up1, down1);
    optiondata(i-s0+range+1, 4) = european(i, strike, rate, M,
       sigma, T, 0, up2, down2);
    optiondata(i-s0+range+1, 5) = european(i, strike, rate, M,
       sigma, T, 1, up2, down2);
end
figure
plot(optiondata(:,1), optiondata(:,2), optiondata(:,1), optiondata
   (:,3), optiondata(:,1), optiondata(:,4), optiondata(:,1),
   optiondata(:,5))
title('Varying Starting price of Asset')
legend('Call option, set 1', 'Put option, set 2', 'Call option,
   set 2', 'Put option, set 2')


%varying strike price K
range = 50;
strikedata = zeros(2*range+1, 5);
for i=strike-range:strike+range
    strikedata(i-s0+range+1, 1) = i;
    strikedata(i-s0+range+1, 2) = european(s0, i, rate, M, sigma,
       T, 0, up1, down1);
    strikedata(i-s0+range+1, 3) = european(s0, i, rate, M, sigma,
       T, 1, up1, down1);
    strikedata(i-s0+range+1, 4) = european(s0, i, rate, M, sigma,
       T, 0, up2, down2);
    strikedata(i-s0+range+1, 5) = european(s0, i, rate, M, sigma,
       T, 1, up2, down2);
end
figure
plot(strikedata(:,1), strikedata(:,2), strikedata(:,1), strikedata
   (:,3), strikedata(:,1), strikedata(:,4), strikedata(:,1),
   strikedata(:,5))
title('Varying Strike price')
```

```
legend('Call for set 1', 'Put for set 1', 'Call for set 2', 'Put
    for set 2')


%varying interest rate
range = 4;
r = 8;
ratedata = zeros(2*range+1, 5);
for i=r-range:r+range
    ratedata(i-r+range+1, 1) = i/100;
    ratedata(i-r+range+1, 2) = european(s0, strike, i/100, M,
        sigma, T, 0, up1, down1);
    ratedata(i-r+range+1, 3) = european(s0, strike, i/100, M,
        sigma, T, 1, up1, down1);
    ratedata(i-r+range+1, 4) = european(s0, strike, i/100, M,
        sigma, T, 0, up2, down2);
    ratedata(i-r+range+1, 5) = european(s0, strike, i/100, M,
        sigma, T, 1, up2, down2);
end
figure
x = plot(ratedata(:,1), ratedata(:,2), ratedata(:,1), ratedata
    (:,3), ratedata(:,1), ratedata(:,4), ratedata(:,1), ratedata
    (:,5));
title('Varying Interest rate')
legend('Call for set 1', 'Put for set 1', 'Call for set 2', 'Put
    for set 2')


%varying sigma
s = 20;
range = 10;
sigmadata = zeros(2*range+1, 5);
for i=s-range:s+range
    u1 = exp(i*sqrt(T/M)/100);  d1 = exp(-i*sqrt(T/M)/100);
    u2 = exp(i*sqrt(T/M)/100 + (rate-i*i*0.5/10000)*T/M); d2 = exp
        (-i*sqrt(T/M)/100 + (rate-i*i*0.5)*(T/M)/10000);
    sigmadata(i-s+range+1, 1) = i/100;
    sigmadata(i-s+range+1, 2) = european(s0, strike, rate, M, i
        /100, T, 0, u1, d1);
    sigmadata(i-s+range+1, 3) = european(s0, strike, rate, M, i
        /100, T, 1, u1, d1);
    sigmadata(i-s+range+1, 4) = european(s0, strike, rate, M, i
        /100, T, 0, u2, d2);
    sigmadata(i-s+range+1, 5) = european(s0, strike, rate, M, i
        /100, T, 1, u2, d2);
end
figure
plot(sigmadata(:,1), sigmadata(:,2), sigmadata(:,1), sigmadata
    (:,3), sigmadata(:,1), sigmadata(:,4), sigmadata(:,1),
    sigmadata(:,5))
```

```
title('Varying SIGMA')
legend('Call for set 1', 'Put for set 1', 'Call for set 2', 'Put
    for set 2')


%varying steps and strike prices
range = 50;
K = [95, 100, 105];
stepdata = zeros(2*range+1, 13);
for i=M-range:M+range
    stepdata(i-M+range+1, 1) = i;
    for j=1:3
        stepdata(i-M+range+1, 2+(j-1)*4) = european(s0, K(j), rate
            , i, sigma, T, 0, up1, down1);
        stepdata(i-M+range+1, 3+(j-1)*4) = european(s0, K(j), rate
            , i, sigma, T, 1, up1, down1);
        stepdata(i-M+range+1, 4+(j-1)*4) = european(s0, K(j), rate
            , i, sigma, T, 0, up2, down2);
        stepdata(i-M+range+1, 5+(j-1)*4) = european(s0, K(j), rate
            , i, sigma, T, 1, up2, down2);
    end
end
for i=1:3
    figure
    plot(stepdata(:,1), stepdata(:,2+(i-1)*4), stepdata(:,1),
        stepdata(:,3+(i-1)*4), stepdata(:,1), stepdata(:,4+(i-1)*4)
        , stepdata(:,1), stepdata(:,5)+(i-1)*4)
    title(['Varying Steps, Strike =', num2str(K(i))])
    legend('Call option, set 1', 'Put option, set 1', 'Call option
        , set 2', 'Put option, set 2')
end
```