```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%%%              ASSIGNMENT 07              %%%%%

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%% PROBLEM 01 %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


fprintf('\n\n%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n')
fprintf('\nOutput for problem 01:\n')
fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n\n')

clc
k=48;s0=50;r=.12;s1=60;s2=42;t=.5;
u=s1/s0;d=s2/s0;
Cu=max(s1-k,0);Cd=max(s2-k,0);
delta=(Cu-Cd)/(s0*(u-d));
C_0=delta*s0*(1-u*exp(-r*t))+Cu*(exp(-r*t))


p=(exp(r*t)-d)/(u-d);
C_1=exp(-r*t)*(p*Cu+(1-p)*Cd)
if(C_0-C_1<10^-12)
    fprintf('\t\t\tSame value\n\n\n')
end

clear
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%% PROBLEM 02 %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
fprintf('\nOutput for problem 02:\n')
fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n\n')



s0=30;k=30;u=1+.08;d=1-.1;r=.05;
s1=s0*u;s2=s0*d;s11=s0*u*u;s12=s0*u*d;s22=s0*d*d;
T=4/12;L=2;t=T/L;
Cuu=(max(30-s11,0))^2;
Cud=(max(30-s12,0))^2;
Cdd=(max(30-s22,0))^2;
p=(exp(r*t)-d)/(u-d);

Cu=max(exp(-r*t)*(p*Cuu+(1-p)*Cud),(max(30-s1,0))^2);
Cd=max(exp(-r*t)*(p*Cud+(1-p)*Cdd),(max(30-s2,0))^2);
C01=exp(-r*t)*(p*Cu+(1-p)*Cd);
```

```matlab
fprintf('\n\nAmericano: %f\n\n',C01);
Cu=exp(-r*t)*(p*Cuu+(1-p)*Cud);
Cd=exp(-r*t)*(p*Cud+(1-p)*Cdd);
C02=exp(-r*t)*(p*Cu+(1-p)*Cd);
fprintf('Europa: %f\n\n',C02);
if(abs(C01-C02)<10^-8)
    disp('No need to exercise early')
end




%%%%%%%%%%%
fprintf('\nN-Step Binomial Tree\n\n')
c=zeros(1000,1000);
p=(exp(r*t)-d)/(u-d);
for j=L+1:-1:1
    for i=1:j
        if(j==L+1)
            c(i,j)=(max(30-s0*u^(L-i+1)*d^(i-1),0))^2;
        else
            c(i,j)=exp(-r*t)*(p*c(i,j+1)+(1-p)*c(i+1,j+1));
        end
    end
end
for i=1:L+1%%%%%%%%%%%% Tree Printing %%%%%%%%%
    for i1=1:i-1
        fprintf('             ')
    end
   for j=i:L+1
        fprintf(" %10.6f",c(i,j))
    end
    disp(' ')
end




%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%% PROBLEM 03 %%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


fprintf('\n\n\n%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
fprintf('\nOutput for problem 03:\n')
fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n\n')




clear
s0=40; k=40; r=.04; v=.3; T=0.5;L=5%input('Step size= ');
c=zeros(1000,1000);
t=T/L;
u=exp(v*sqrt(t))
```

```matlab
d=1/u
p=(exp(r*t)-d)/(u-d)
for j=L+1:-1:1
    for i=1:j
        if(j==L+1)
            c(i,j)=(max(s0*u^(L+1-i)*d^(i-1)-k,0));
        else
            c(i,j)=exp(-r*t)*(p*c(i,j+1)+(1-p)*c(i+1,j+1));
        end
    end
end
fprintf('Option Value: %f \n\nThe %d step binomial tree is:\n
\n',c(1,1),L)

for i=1:L+1%%%%%%%%%%%%% Tree Printing %%%%%%%%% Print na korleo hobe
    for i1=1:i-1
        fprintf('              ')%%%%%%%%%%%% Space Printing
    end
   for j=i:L+1
        fprintf(" %10.6f",c(i,j))
    end
    disp(' ')
end




%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%% PROBLEM 04 %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


fprintf('\n\n\n%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
fprintf('\nOutput for problem 04:\n')
fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n\n')
disp(' ')




clear
s=[30.2 32 31.1 30.1 30.2 30.3 30.6 33 32.9 33 33.5 33.5 33.7 33.5
 33.2]';
n=length(s)-1;
for i=1:n
    u(i)=log(s(i+1)/s(i));
```

```matlab
    end
SD=sqrt(sum(u.*u)/(n-1)-(sum(u))^2/(n*(n-1)));%(u*u')
Volatility=SD/sqrt(5/252)
Standard_Error=Volatility/(sqrt(2*n))




%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%% PROBLEM 05 %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


fprintf('\n\n\n%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%')
fprintf('\nOutput for problem 05:\n')
fprintf('%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%\n\n\n')

disp(' ')


clear
k=5; r=.04; v=.2; T=.5; s(1)=5;ic=0;L=1000;R=10^4;m=10^3;step=[L:m:R];
for n=step
    phi=randn(n,1);t=T/n;
    for i=1:n
        s(i+1)=s(i)*exp((r-.5*v*v)*t+v*phi(i)*sqrt(t));
        p(i)=(max(k-s(i),0))*exp(-i*r*t);
        c(i)=(max(s(i)-k,0))*exp(-i*r*t);
    end     %N(x)=(1+Erf(x/?2))/2      N(-d1)=1-N(d1)
    ic=ic+1;s0=s(ic);
    Call(ic)=mean(c);Put(ic)=mean(p);      %%%%    Option Values
    CallParity(ic)=Call(ic)+s0;PutParity(ic)=Put(ic)+k*exp(-r*T);;   %%
 Parity Checking
    d1=(log(s0/k)+(r+v^2/2)*T)/(v*sqrt(T));     d2=d1-(v*sqrt(T));
    Nd1=(1+erf(d1/sqrt(2)))/2;                  Nd2=(1+erf(d2/sqrt(2)))/2;
    C0(ic)=s0*Nd1-k*exp(-r*T)*Nd2;      P0(ic)=k*exp(-r*T)*(1-Nd2)-
s0*(1-Nd1);
end

CallOption_____Put___CallParity__PutParity____C0_____P0_Error=[Call'
 Put' CallParity' PutParity' C0' P0',abs(CallParity'-PutParity')] %%%
 Parity checking
plot(step,Call,'*',step,Put,'d',step,CallParity,step,PutParity,step,C0,'*',step,P0
PutParity'),'h')
legend('Call','Put','CallParity','PutParity','Exact_C','Exact_P','Error')
title('Figure showing all the derivatives')
xlabel('Steps')
ylabel('Value of the derivatives')



%%%%%%%%%%%%%%%%%%%%%%%%
Output for problem 01:
%%%%%%%%%%%%%%%%%%%%%%%%
C_0 =
```

*6.9639*


*C_1 =*

*6.9639*

*Same value*


*%%%%%%%%%%%%%%%%%%%%%%*
*Output for problem 02:*
*%%%%%%%%%%%%%%%%%%%%%%*

*Americano: 5.392846*

*Europa: 5.392846*

*No need to exercise early*

*N-Step Binomial Tree*

*5.392846    0.278467    0.000000*
*           13.243528    0.705600*
*                      32.490000*


*%%%%%%%%%%%%%%%%%%%%%%*
*Output for problem 03:*
*%%%%%%%%%%%%%%%%%%%%%%*
*L =*

*5*


*u =*

*1.0995*


*d =*

*0.9095*


*p =*

*0.4974*


*Option Value: 3.922904*

*The 5 step binomial tree is:*

```
3.922904    6.137667    9.288548   13.488198   18.620266   24.278236
            1.762399    3.068415    5.206535    8.516928   13.169474
                        0.483985    0.976944    1.972001    3.980563
                                    0.000000    0.000000    0.000000
                                                0.000000    0.000000
                                                            0.000000
```
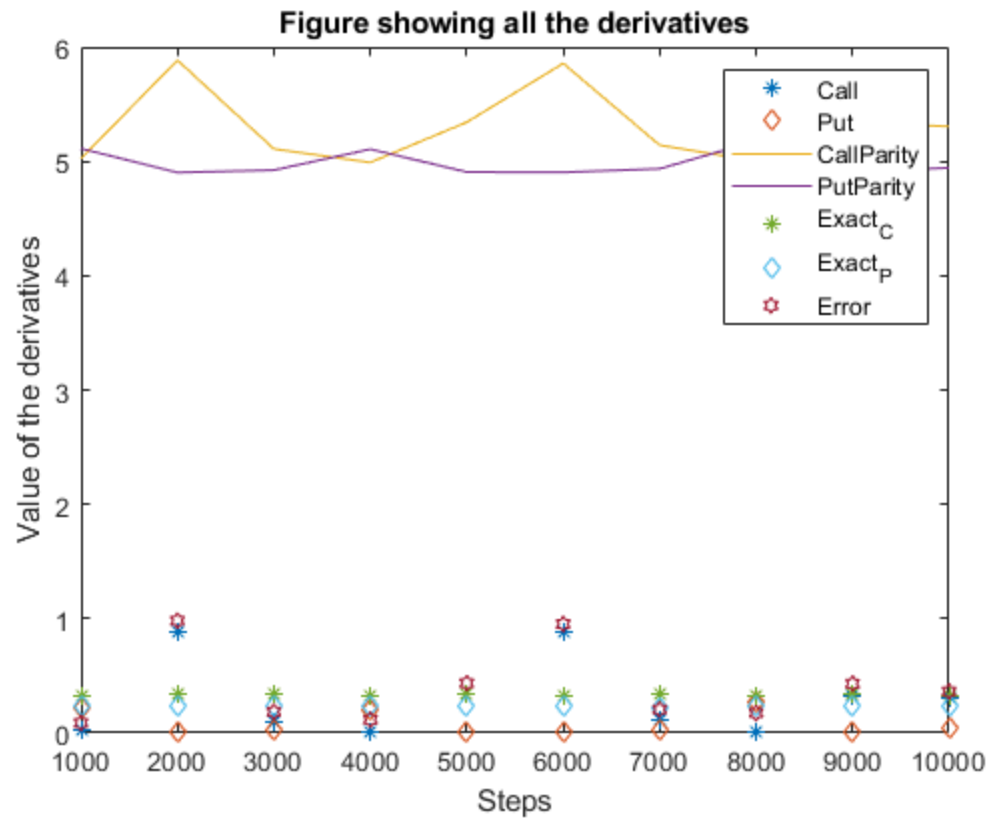
%%%%%%%%%%%%%%%%%%%%%%%%
Output for problem 04:
%%%%%%%%%%%%%%%%%%%%%%%%

Volatility =

    0.2047


Standard_Error =

    0.0387



%%%%%%%%%%%%%%%%%%%%%%%%%
Output for problem 05:
%%%%%%%%%%%%%%%%%%%%%%%%%

CallOption_____Put___CallParity__PutParity____C0_____P0_Error =

    0.0243    0.2103    5.0243    5.1113    0.3314    0.2323    0.0870
    0.8793    0.0011    5.8843    4.9021    0.3343    0.2303    0.9822
    0.0966    0.0219    5.1082    4.9229    0.3381    0.2276    0.1853
    0.0010    0.2052    4.9901    5.1062    0.3250    0.2369    0.1161
    0.3394    0.0055    5.3422    4.9065    0.3330    0.2312    0.4357
    0.8753    0.0026    5.8568    4.9036    0.3206    0.2401    0.9532
    0.1170    0.0341    5.1408    4.9351    0.3454    0.2226    0.2057
    0.0170    0.2763    5.0034    5.1773    0.3235    0.2381    0.1739
    0.3284    0.0067    5.3393    4.9077    0.3378    0.2278    0.4316
    0.3141    0.0418    5.3052    4.9428    0.3262    0.2361    0.3624
```

Figure showing all the derivatives

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