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Exercise 1:

Solve programming exercise P17.1 from Higham's book (page 170)

```
%CH16 Program for Chapter 16
%
% Implements binomial method for European call
%%%%%%%% Problem and method parameters %%%%%%%%%%%
S = 3; E = 2; T = 1; r = 0.05; sigma = 0.3;
M = 400; dt = T/M; p =0.5;
u = exp(sigma*sqrt(dt) + (r-0.5*sigma^2)*dt);
d = exp(-sigma*sqrt(dt) + (r-0.5*sigma^2)*dt);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Time T option values
S_T = S*d.^([M:-1:0]').*u.^([0:M]');
W = S*d.^([M:-1:0]').*u.^([0:M]')-E;

W(W<0)=0;
for i= 1:M+1
    if W(i)>0
        W(i) = S_T(i);
    elseif W(i) == 0
        W(i) = S_T(i)/2;
    end
end

for i = M:-1:1
    W = exp(-r*dt)*(p*W(2:i+1) + (1-p)*W(1:i));
end

disp('Option value is'), disp(W)
```

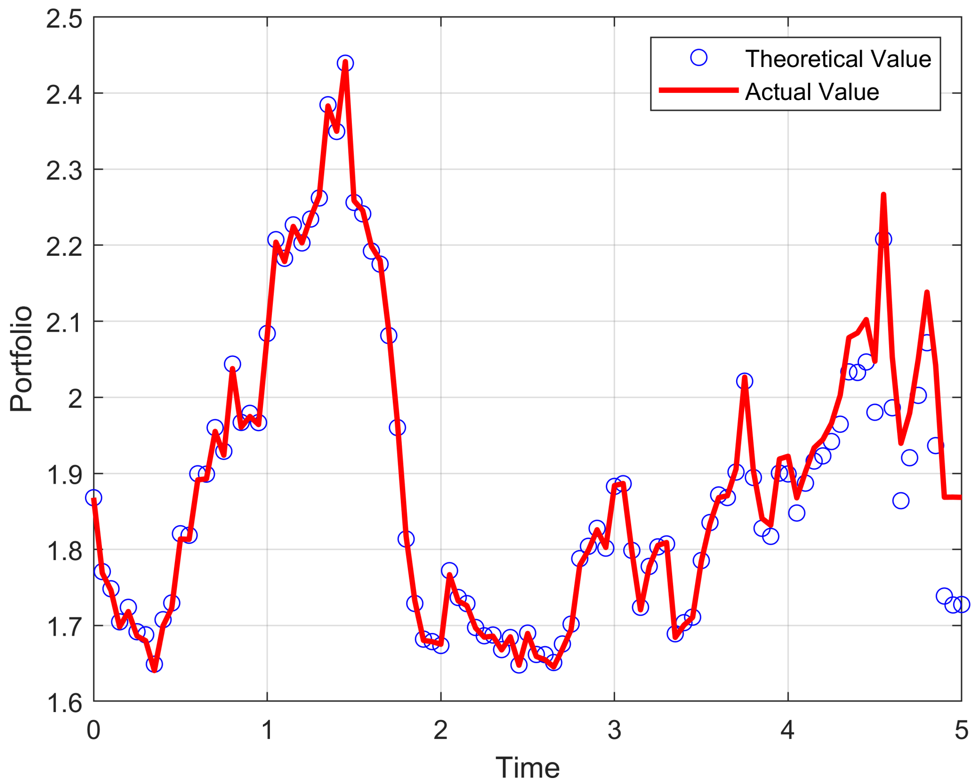
```
Option value is
    2.9258
```

Exercise 2:

Solve programming exercise P17.2 from Higham's book (page 170), but replace "cash-or-nothing" by "asset-or-nothing" option.

```
%CH09 Program for Chapter 9
%
% Illustrates delta hedging by computing an approximate
% replicating portfolio for a European call
%
% Portfolio is ‘asset’ units of asset and an amount ‘cash’ of cash
```

```matlab
% Plot actual and theoretical portfolio values
randn('state',100)
clf

%%%%%%%%% Problem parameters %%%%%%%%%%%
Szero = 1; sigma = 0.35;r= 0.03; mu = 0.02; T = 5; E = 2;
Dt = 1e-2;N= T/Dt;t= [0:Dt:T];
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

S = zeros(N,1); asset = zeros(N,1); cash = zeros(N,1);
portfolio = zeros(N,1); Value = zeros(N,1);

[C,Cdelta] = ch08(Szero,E,r,sigma,T-t(1));

S(1) = Szero;
asset(1) = Cdelta;
Value(1) = C;
cash(1) = 1;
portfolio(1) = asset(1)*S(1) + cash(1);

for i = 1:N
    S(i+1) = S(i)*exp((mu-0.5*sigma^2)*Dt+sigma*sqrt(Dt)*randn);
    portfolio(i+1) = asset(i)*S(i+1) + cash(i)*(1+r*Dt);
    [C,Cdelta] = ch08(S(i+1),E,r,sigma,T-t(i+1));
    asset(i+1) = Cdelta;
    cash(i+1) = cash(i)*(1+r*Dt) - S(i+1)*(asset(i+1) - asset(i));
    Value(i+1) = C;
end

Vplot = Value - (Value(1) - portfolio(1)).*exp(r*t.');
plot(t(1:5:end),Vplot(1:5:end),'bo')
hold on
plot(t(1:5:end),portfolio(1:5:end),'r-','LineWidth',2)
xlabel('Time'), ylabel('Portfolio')
legend('Theoretical Value', 'Actual Value')
grid on
```




```
%Adapted program for ch 8
```

```
function [C, Cdelta] = ch08(S,E,r,sigma,tau)
% ADAPTED Program for Chapter 8
% This is a MATLAB function
%
% Input arguments: S = asset price at time t
% E = Exercise price
% r = interest rate
% sigma = volatility
% tau = time to expiry (T-t)
%
% Output arguments: C = call value, Cdelta = delta value of call
% P = Put value, Pdelta = delta value of put
%
% function [C, Cdelta, P, Pdelta] = ch08(S,E,r,sigma,tau)
if tau > 0
    d1 = (log(S/E) + (r + 0.5*sigma^2)*(tau))/(sigma*sqrt(tau));
    N1 = 0.5*(1+erf(d1/sqrt(2)));
    N1acc = (1/sqrt(2*pi))*exp(-0.5*d1^2);

    %no put option in this case
    %d2 = d1 - sigma*sqrt(tau);
    %N2 = 0.5*(1+erf(d2/sqrt(2)));
    %N2acc = (1/sqrt(2*pi))*exp(-0.5*d2^2);
```

```
    C = S*N1;
    Cdelta = N1 + (S*N1acc)/(sigma*S*sqrt(tau));

else
    if S >= E
        C = S;
        Cdelta = 0;
    elseif S==E
        C = S/2;
        Cdelta = inf;
    elseif S < E
        C=0;
        Cdelta = 0;
    end
end
end
```

As you can see, cdelta becomes infinite when S==E

Exercise 3:

Solve exercise 17.4 from Higham's book (page 169)

See attachment

Exercise 4:

Solve exercise 17.6 from Higham's book (page 169)

See attachment