% code for Problem 2(i)

A = [1 1; 0 1];

B = [0 ; 1];

C = [1 0];

N = 20;

% penalty factor on output y

p\_Q = 1;

% penalty factor on control u

p\_R = 1;

Q = C.' \* p\_Q\*[1] \* C;

R = p\_R \* [1];

x\_0 = [1 ; 0];

% compute P, K matrices

P = cell(N+1,1);

K = cell(N,1);

P{N+1} = Q;

for i=1:N

t = N-i+1;

K{t} = inv(R + (B.')\*P{t+1}\*B) \* (B.')\*P{t+1}\*A;

P{t} = Q + (K{t}.')\*R\*K{t} + (A - B\*K{t}).' \* P{t+1} \* (A - B\*K{t});

end

u = zeros(1,N);

x = cell(N+1,1); x{1} = x\_0;

y = zeros(1,N);

J = zeros(1,N);

for t=2:N+1

u(t-1) = -K{t-1} \* x{t-1};

x{t} = A\*x{t-1} + B\*u(t-1);

y(t-1) = C\*x{t-1};

J(t-1) = x{t-1}.' \* P{t-1} \* x{t-1};

end

T = [1:N];

hold on

plot(T, u, 'LineWidth',2)

plot(T, y, 'LineWidth',2)

plot(T, J, 'LineWidth',2)

title('Control, Output, and Cost-to-go for p\_Q = 1, p\_R = 1')

legend('control','output', 'cost-to-go')

