

# ECON 512 Homework 4

Pin Sun<sup>1</sup>  
Jan 28, 2019

## Question 1

- $s$ : stock of lumber.  $x$ : quantities of harvested trees
- State Variables:  $(s, p)$ . Policy Variable:  $x$
- Firm's value function:

$$V(s, p) = \max_x px - 0.2x^{1.5} + \delta \mathbf{E}[V(s', p')|p] \quad (1)$$

$$s.t. \quad s' = s - x$$

$$0 \leq x \leq s$$

$$p' = p_0 + \rho p + u, \quad u \sim \mathcal{N}(0, 0.01) \quad (2)$$

## Question 2

```
clear;  
close all;  
p0=0.5;  
rho=0.5;  
sigmau=0.1;  
Ngrid=21;  
[pprob,pgrid]=tauchen(Ngrid,p0,rho,sigmau)
```

### Question 3

```
delta=0.95; % Discount factor
s0=100; % Initial Stock of lumber
Lens=length(s0);
Num=1000;
s=zeros(Lens,Num);
for i=1:Lens
s(i,:)=linspace(0,s0(i),Num);
end
v=zeros(Num,Ngrid); Tv=v;
x=zeros(Num,Num,Ngrid);
r=x;
%fv=zeros(Num,Num,Ngrid,Lens);
Replication=1000;
for j=1:Ngrid

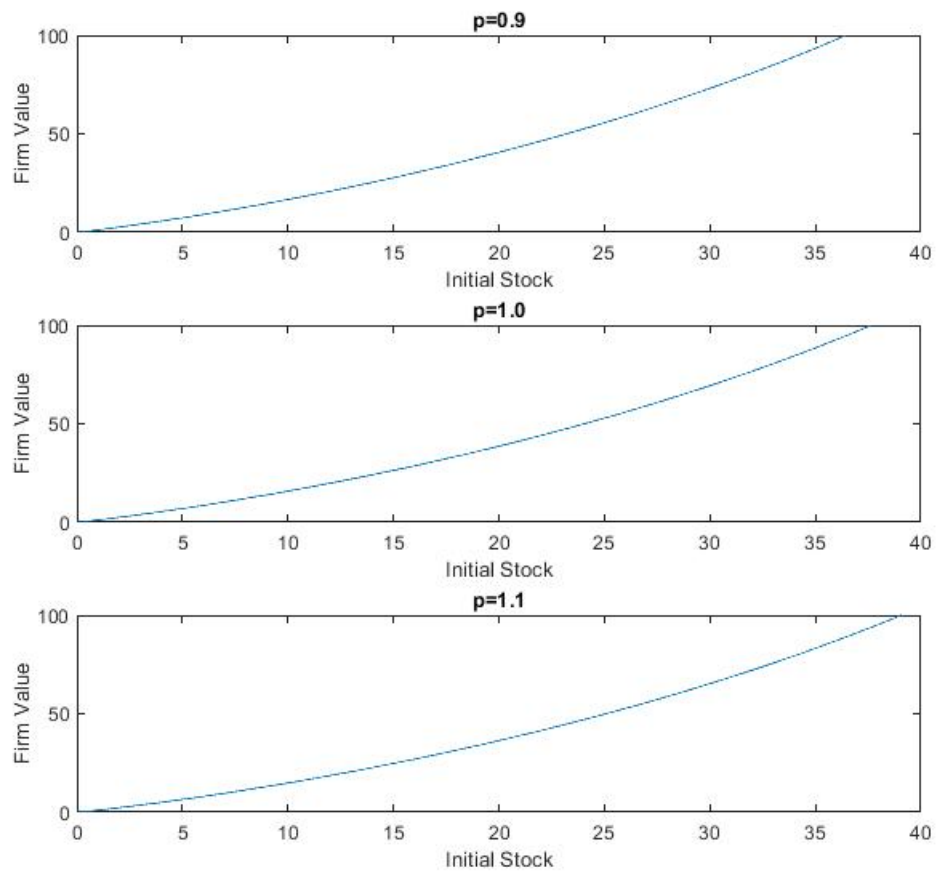
x(:,:,j)=repmat(s(1,:),Num,1)-repmat(s(1,:)',1,Num);

end
x(find(x<0))=1e10;
tic
for k=1:Replication
for j=1:Ngrid
% Tv(:,j,i)=prob(j,:)*v(:,j,i);
ev=(pprob(j,:)*v(:,j,i))';
r(:,j)=pgrid(j)*x(:,j)-0.2*x(:,j).^(3/2)+delta*repmat(ev,1,Num);
vopt=max(r(:,j));
Tv(:,j)=vopt';
end
dif = max(reshape((abs((Tv-v)./v)),Num*Ngrid,1));
%if mod(k,10)==0
%formatSpec='at %4.0f th iteration, the dif is %2.4f';
%fprintf(formatSpec,iter,dif);
%disp(' ');
%end
if dif <1e-4
```

```

break
else
v(:, :) = Tv(:, :);
end
end
toc
spolicy=zeros(Num,Ngrid);
sprime=spolicy;
for i=1:Ngrid
[vvalue,sindex]=max(r(:, :, i));
spolicy(:, i)=sindex';
v(:, i)=vvalue';
end
for i=1:Num
for j=1:Ngrid
sprime(i, j)=s(spolicy(i, j));
end
end
pindex1=find(abs(pgrid-0.9*ones(1,Ngrid))==min(abs(pgrid-0.9*ones(1,Ngrid))));
pindex2=find(abs(pgrid-ones(1,Ngrid))==min(abs(pgrid-ones(1,Ngrid))));
pindex3=find(abs(pgrid-1.1*ones(1,Ngrid))==min(abs(pgrid-1.1*ones(1,Ngrid))));
figure
subplot(3,1,1)
plot(v(:, pindex1), s(:));
title('p=0.9')
xlabel('Initial Stock')
ylabel('Firm Value')
subplot(3,1,2)
plot(v(:, pindex2), s(:));
title('p=1.0')
xlabel('Initial Stock')
ylabel('Firm Value')
subplot(3,1,3)
plot(v(:, pindex3), s(:));
title('p=1.1')
xlabel('Initial Stock')
ylabel('Firm Value')
Elapsed time is 39.282169 seconds.

```



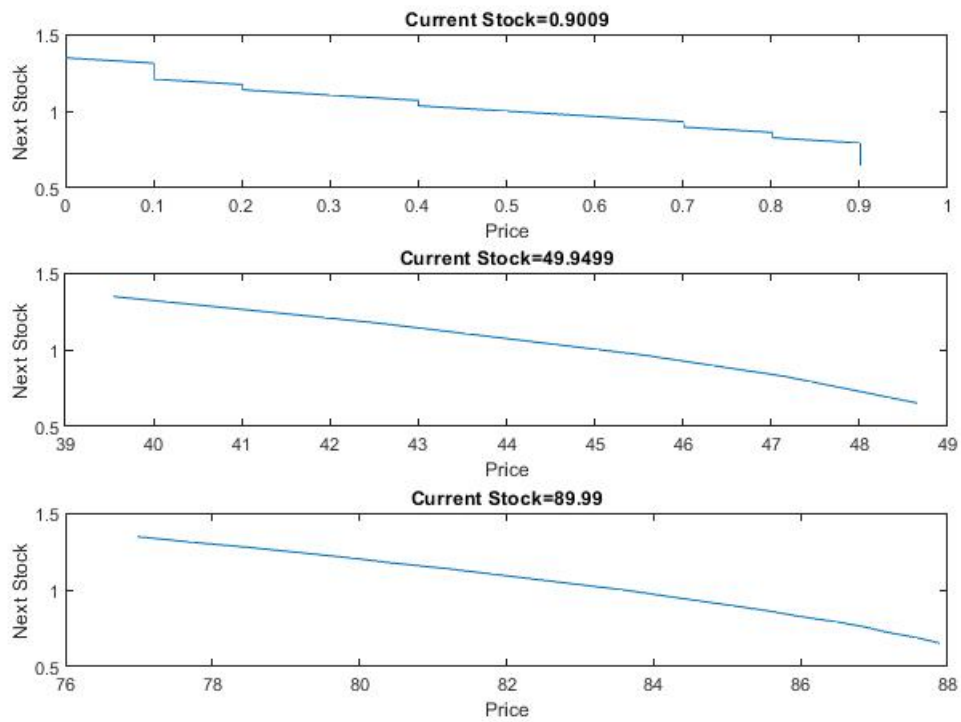
## Question 4

```
figure
subplot(3,1,1)
index1=10;
plot(sprime(index1,:),pgrid(:));
title(['Current Stock=',num2str(s(index1))])
xlabel('Price')
ylabel('Next Stock')
subplot(3,1,2)
```

```

index2=500;
plot(sprime(index2,:),pgrid(:));
title(['Current Stock=',num2str(s(index2))])
xlabel('Price')
ylabel('Next Stock')
subplot(3,1,3)
index3=900;
plot(sprime(index3,:),pgrid(:));
title(['Current Stock=',num2str(s(index3))])
xlabel('Price')
ylabel('Next Stock')

```

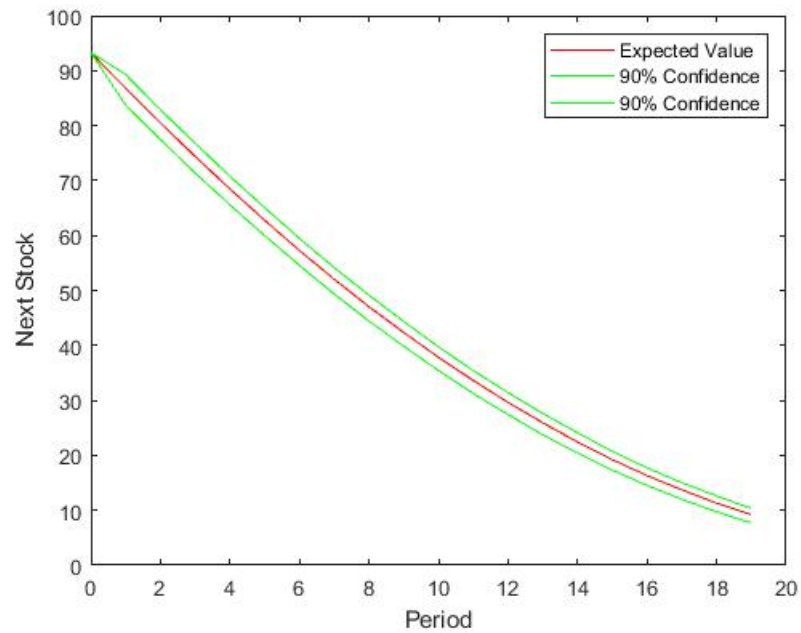


## Question 5

```
sit=100;
pit=1;
ep=zeros(1,21);
pq1=ep;
pq2=ep;
sp=zeros(3,21);
sp(:,1)=sit;
ep(1)=pit;
pq1(1)=pit;
pq2(1)=pit;
for i=1:20
    ep(i+1)=p0+rho*ep(i);
    pq1(i+1)=norminv(0.95,ep(i+1),sigmau);
    pq2(i+1)=norminv(0.05,ep(i+1),sigmau);
    pindex1=find(abs(pgrid-ep(i)*ones(1,Ngrid))==min(abs(pgrid-ep(i) ...
        *ones(1,Ngrid))));
    pindex2=find(abs(pgrid-pq1(i)*ones(1,Ngrid))==min(abs(pgrid-pq1(i) ...
        *ones(1,Ngrid))));
    pindex3=find(abs(pgrid-pq2(i)*ones(1,Ngrid))==min(abs(pgrid-pq2(i) ...
        *ones(1,Ngrid))));
    sindex1=find(abs(s-sp(1,i)*ones(1,Num))==min(abs(s-sp(1,i) ...
        *ones(1,Num))));
    sindex2=find(abs(s-sp(2,i)*ones(1,Num))==min(abs(s-sp(2,i) ...
        *ones(1,Num))));
    sindex3=find(abs(s-sp(3,i)*ones(1,Num))==min(abs(s-sp(3,i) ...
        *ones(1,Num))));
    sp(1,i+1)=sprime(sindex1,pindex1);
    sp(2,i+1)=sprime(sindex1,pindex2);
    sp(3,i+1)=sprime(sindex1,pindex3);
end

figure
plot(0:19,sp(1,2:21),'r',0:19,sp(2,2:21),'g',0:19,sp(3,2:21),'g');
xlabel('Period')
ylabel('Next Stock')
```

```
legend({'Expected Value','90% Confidence','90% Confidence'},'Location','northeast')
```



## Question 6

```
clear;
close all;
p0=0.5;
rho=0.5;
sigmau=0.1;
Ngrid=5;
[pprob,pgrid]=tauchen(Ngrid,p0,rho,sigmau);

delta=0.95;
s0=100; % Initial Stock of lumber
Lens=length(s0);
Num=1000;
s=zeros(Lens,Num);
for i=1:Lens
```

```

s(i,:)=linspace(0,s0(i),Num);
end
v=zeros(Num,Ngrid); Tv=v;
x=zeros(Num,Num,Ngrid);
r=x;
%fv=zeros(Num,Num,Ngrid,Lens);
Replication=1000;
for j=1:Ngrid

x(:,:,j)=repmat(s(1,:),Num,1)-repmat(s(1,:)',1,Num);

end
x(find(x<0))=1e10;
tic
for k=1:Replication
for j=1:Ngrid
% Tv(:,j,i)=prob(j,:)*v(:,j,i);
ev=(pprob(j,:)*v(:, :, i)')';
r(:, :, j)=pgrid(j)*x(:, :, j)-0.2*x(:, :, j).^(3/2)+delta*repmat(ev,1,Num);
vopt=max(r(:, :, j));
Tv(:, j)=vopt';
end
dif = max(reshape((abs((Tv-v)./v)),Num*Ngrid,1));
%if mod(k,10)==0
%formatSpec='at %4.0f th iteration, the dif is %2.4f';
%fprintf(formatSpec,iter,dif);
%disp(' ');
%end
if dif <1e-4
break
else
v(:, :) = Tv(:, :);
end
end
toc
spolicy=zeros(Num,Ngrid);
sprime=spolicy;
for i=1:Ngrid

```



```

[vvalue,sindex]=max(r(:,:,i));
spolicy(:,i)=sindex';
v(:,i)=vvalue';
end
for i=1:Num
for j=1:Ngrid
sprime(i,j)=s(spolicy(i,j));
end
end
pindex1=find(abs(pgrid-0.9*ones(1,Ngrid))==min(abs(pgrid-0.9*ones(1,Ngrid))));
pindex2=find(abs(pgrid-ones(1,Ngrid))==min(abs(pgrid-ones(1,Ngrid))));
pindex3=find(abs(pgrid-1.1*ones(1,Ngrid))==min(abs(pgrid-1.1*ones(1,Ngrid))));
figure
subplot(3,1,1)
plot(v(:,pindex1),s(:));
title('p=0.9')
xlabel('Initial Stock')
ylabel('Firm Value')
subplot(3,1,2)
plot(v(:,pindex2),s(:));
title('p=1.0')
xlabel('Initial Stock')
ylabel('Firm Value')
subplot(3,1,3)
plot(v(:,pindex3),s(:));
title('p=1.1')
xlabel('Initial Stock')
ylabel('Firm Value')

figure
subplot(3,1,1)
index1=10;
plot(sprime(index1,:),pgrid(:));
title(['Current Stock=',num2str(s(index1))])
xlabel('Price')
ylabel('Next Stock')
subplot(3,1,2)
index2=500;

```

```

plot(sprime(index2,:),pgrid(:));
title(['Current Stock=',num2str(s(index2))])
xlabel('Price')
ylabel('Next Stock')
subplot(3,1,3)
index3=900;
plot(sprime(index3,:),pgrid(:));
title(['Current Stock=',num2str(s(index3))])
xlabel('Price')
ylabel('Next Stock')

```

