

APPENDIX A2
MATLAB CODE FOR THE CASE III

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clear
clc
tic
multiNE = zeros(101,101);
profit_for_m1 = -ones(101,101);
profit_for_m2 = -ones(101,101);
for j1 = 0:100;
for j2 = 0:100;

for i=1:1:101;
    a = [0:1:100];
    n2(i,:) = [a];
end
n1 = n2';
m1 = j1.*ones(101,101)/100;
m2 = j2.*ones(101,101)/100;
%% Each firm's profit calculation
if j1==j2 | j1==1 | j2==0;
    C = zeros(101,101);
    pf1 = zeros(101,101);
    pf2 = zeros(101,101);

else
pf1    =    (((m1.^2).*(1+(6.*m2)-(n1.^2)-(2.*n2)+(n2.^2))+m2.*(1-
(2.*n1)+m2.*(5-((2+n1).*n1)+(n2.^2)))-m1.*(-(1+n1-n2).*(-
1+n1+n2)+m2.*(6+(6.*m2)-(n1.^2)+(n2.^2))))).^2)./(72.*(-1+m1).*(m1-
m2).*m2.*((m1.^2)+(m2.^2)-m1.*(1+m2)));
pf2    =    ((m1.*(1-(n1.^2))-m2.*(6+(6.*m2)+(n1.^2))-
(2.*n2)+(1+m2).*(n2.^2)))+(m1.^2).*((6.*m2)+(1+n1-n2).*(-1+n1+n2))+m2.*(-

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1+(2.*n1)+m2.*(7+((-2+n1).*n1)-(n2.^2))).^2)/(72.*(-1+m1).*(m1-
m2).*m2.*((m1.^2)+(m2.^2)-m1.*(1+m2)));
p1    =    -((7.*m1)-(7.*(m1.^2))-(4.*m2)+(27.*m1.*m2)-(24.*(m1.^2).*m2)-
(23.*(m2.^2))+(24.*m1.*(m2.^2))+(8.*m2.*n1)-(8.*(m2.^2).*n1)+(8.*m1.*(n1.^2))-
(8.*(m1.^2).(n1.^2))+(8.*m1.*m2.*(n1.^2))-(8.*(m2.^2).(n1.^2))-
(8.*m1.*n2)+(8.*(m1.^2).*n2)+(4.*m1.*(n2.^2))-
(4.*(m1.^2).(n2.^2))+(4.*m1.*m2.*(n2.^2))-(4.*(m2.^2).(n2.^2)))/(24.*(-
m1+(m1.^2)-(m1.*m2)+(m2.^2)));
p2    =    -(-m1+(m1.^2)+(4.*m2)+(27.*m1.*m2)-(24.*(m1.^2).*m2)-
(31.*(m2.^2))+(24.*m1.*(m2.^2))-(8.*m2.*n1)+(8.*(m2.^2).*n1)+(4.*m1.*(n1.^2))-
(4.*(m1.^2).(n1.^2))+(4.*m1.*m2.*(n1.^2))-(4.*(m2.^2).(n1.^2))+(8.*m1.*n2)-
(8.*(m1.^2).*n2)+(8.*m1.*(n2.^2))-(8.*(m1.^2).(n2.^2))+(8.*m1.*m2.*(n2.^2))-
(8.*(m2.^2).(n2.^2)))/(24.*(-m1+(m1.^2)-(m1.*m2)+(m2.^2)));
k1    =    (m1+1)./2-(n1-1/2)./(2.*(m1-1))+(p1-p2)./(2.*(m1-1))-1;
k2    =    -(m2./2-(1./2-n2)./(-2.*m2)+(p1-p2)./(-2.*m2));
k3    =    ((m1+m2)./2-(n1-n2)./(2.*(m1-m2))+(p1-p2)./(2.*(m1-m2)))-
((m1+1)./2-(n1-1/2)./(2.*(m1-1))+(p1-p2)./(2.*(m1-1)));
k4    =    (m2./2-(1./2-n2)./(-2.*m2)+(p1-p2)./(-2.*m2))-((m1+m2)./2-(n1-
n2)./(2.*(m1-m2))+(p1-p2)./(2.*(m1-m2)));
    if k1<0 & k2<0 & k3<0 & k4<0 & p1>0 & p2>0;
        C = ones(101,101);
    else C = zeros(101,101);
    end
end
pf1s = pf1.*C-1.*(1-C);
pf2s = pf2.*C-1.*(1-C);

%%Nash Equilibrium of n1, n2 finding
for i = 1:101;
    maxn1(i,:) = max(max(pf1s),0);
    maxn2(:,i) = max(max(pf2s'),0)';
end

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checkn1 = (pf1s == maxn1);
checkn2 = (pf2s == maxn2);
equi_for_n = checkn1 .* checkn2;

%% Record profit for m1, m2 that is the N.E. from n1, n2

if sum(sum(equi_for_n))>0
[r,c] = find(equi_for_n>0,1, 'first');
profit_for_m1(j1+1,j2+1) = pf1s(r,c);
profit_for_m2(j1+1,j2+1) = pf2s(r,c);
if sum(sum(equi_for_n))>1
multiNE(j1+1,j2+1) = 1;
end
end
end
end

%% Nash Equilibrium for m1, m2 finding
for i = 1:101;
    maxm1(i,:) = max(max(profit_for_m1),0);
    maxm2(:,i) = max(max(profit_for_m2'),0)';
end

checkm1 = (profit_for_m1 == maxm1);
checkm2 = (profit_for_m2 == maxm2);
equi_for_m = checkm1 .* checkm2;
NEpl_for_m1 = equi_for_m.*profit_for_m1;
NEpl_for_m2 = equi_for_m.*profit_for_m2;

%% To check whether there is any N.E. or not
[NEr,NEc] = find(equi_for_m>0)

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