ECE 341 - Homework #12

Markov Chains and Corona Virus. Due Tuesday, June 9th

Simulate a disease outbreak.

Assume there are four groups of people

- Healthy: not infected yet but can be infected
- Carrier: infeted and can transmit the disease
- Cured: infected and cannot catch the disease again and cannot transmit the disease
- Dead: Cannot catch the disease and cannot transmit the disease

Assume that each person who is a carrier interracts with N other people each day (k).

- The person is selected at random from all people still alive
- If a carrier interracts with a healthy person, the person has an X% chance of being infected

$$\text{New Infections} = (\#\text{infected})(N)\left(\frac{\#\text{healthy}}{\text{total population}}\right)(X)$$

Also assume that each person who is infected has a

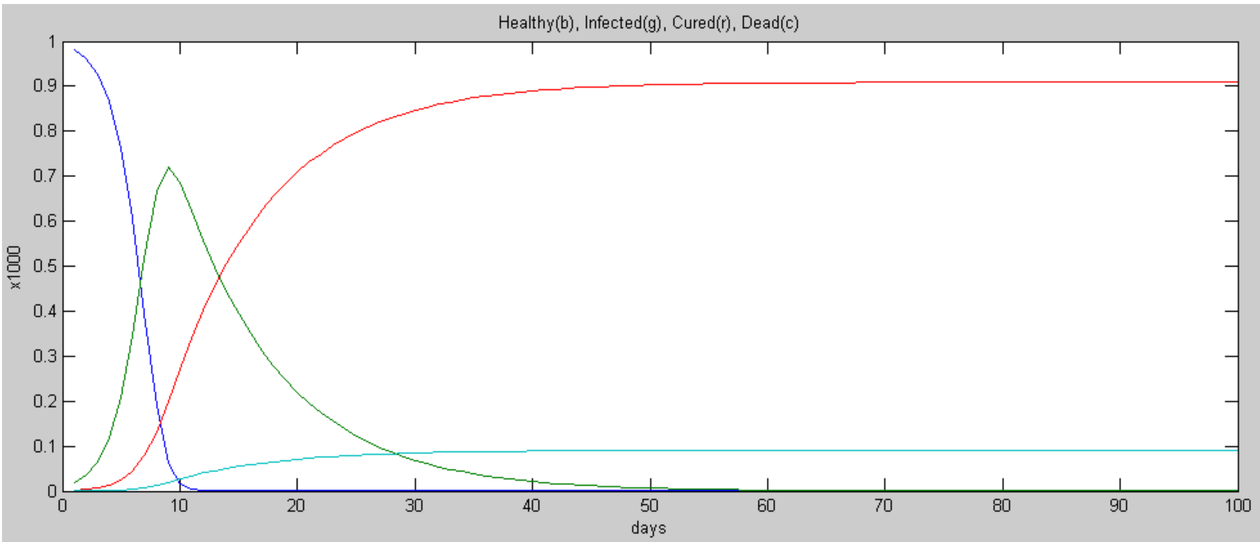
- 10% chance of being cured (10 day incubation time on average)
- 0.1% chance of dieing

Assume the initial condition is

- 990 healthy people
- 10 carriers
- 0 cured
- 0 dead

1) Simulate the disease spread for 300 days if

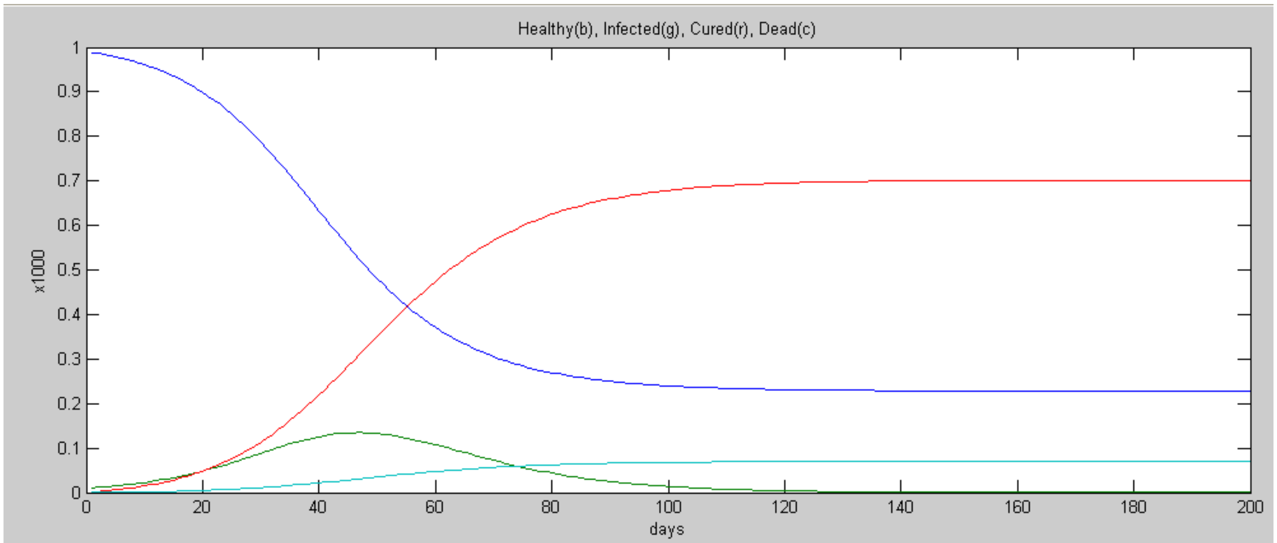
- N = 5 (each person is in close contact with 5 people each day)
- X = 20% (20% chance of the catching if exposed)




```
% States X
% X(1) = Uninfected
% X(2) = Infected
% X(3) = Cured
% X(4) = Dead;
X = [990;10;0;0];

CureRate = 0.10;
DeathRate = 0.01;
Infectivity = .20;
N = 5 ;              % interractions per person

Y = [];

for i=1:100

    NewInfections = X(1) * X(2) * Infectivity * N / sum(X(1:3)) ;
    Cures = CureRate * X(2);
    Deaths = DeathRate * X(2);

    X(1) = X(1) - NewInfections
    X(2) = X(2) + NewInfections - Cures - Deaths;
    X(3) = X(3) + Cures;
    X(4) = X(4) + Deaths;

    Y = [Y ; X'];
end

plot(Y/1000)
xlabel('days');
ylabel('x1000');
title('Healthy(b), Infected(g), Cured(r), Dead(c)');
```

2) Simulate the effect of self isolation:

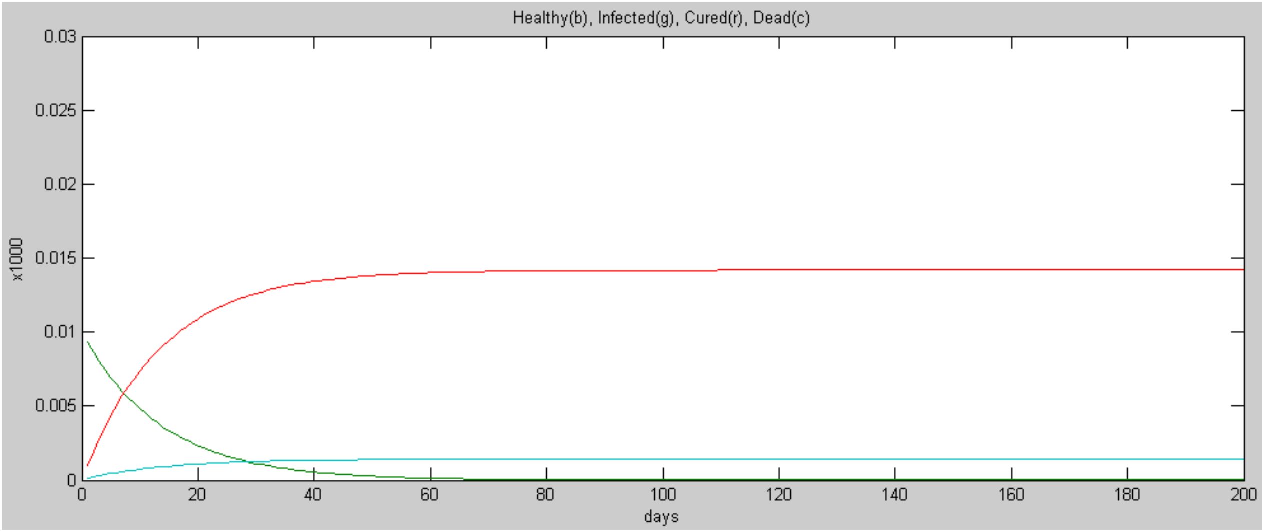
- N = 1 (each person interracts with 1/5th as many people each day)
- X = 20% (20% chance of the catching if exposed)




```
% States X
% X(1) = Uninfected
% X(2) = Infected
% X(3) = Cured
% X(4) = Dead;
X = [990;10;0;0];

CureRate = 0.10;
DeathRate = 0.01;
Infectivity = .20;
N = 1 ;                 % interractions per person

Y = [];

for i=1:200

    NewInfections = X(1) * X(2) * Infectivity * N / sum(X(1:3)) ;
    Cures = CureRate * X(2);
    Deaths = DeathRate * X(2);

    X(1) = X(1) - NewInfections
    X(2) = X(2) + NewInfections - Cures - Deaths;
    X(3) = X(3) + Cures;
    X(4) = X(4) + Deaths;

    Y = [Y ; X'];
end

plot(Y/1000)
xlabel('days');
ylabel('x1000');
title('Healthy(b), Infected(g), Cured(r), Dead(c)');
```

3) Simulate the effect of social distancing and wearing masks:

- N = 1 (each person interracts with 1 persone each day)
- X = 4% (chance of being infected is 1/5th what it was before)




```
% States X
% X(1) = Uninfected
% X(2) = Infected
% X(3) = Cured
% X(4) = Dead;
X = [990;10;0;0];

CureRate = 0.10;
DeathRate = 0.01;
Infectivity = .04;
N = 1 ;              % interractions per person

Y = [];

for i=1:200

    NewInfections = X(1) * X(2) * Infectivity * N / sum(X(1:3)) ;
    Cures = CureRate * X(2);
    Deaths = DeathRate * X(2);

    X(1) = X(1) - NewInfections
    X(2) = X(2) + NewInfections - Cures - Deaths;
    X(3) = X(3) + Cures;
    X(4) = X(4) + Deaths;

    Y = [Y ; X'];
end

plot(Y/1000)
xlabel('days');
ylabel('x1000');
title('Healthy(b), Infected(g), Cured(r), Dead(c)');
```