ECE 341 - Homework #12

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

Please make the subject "ECE 341 HW#12" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

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

- 3% chance of beinc cured (30 day incubation time on average)
- 0.1% chance of dieing

Assume the initial condition is

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

$$\begin{bmatrix} Healthy(k+1) \\ Carrier(k+1) \\ Cured(k+1) \\ Dead(k+1) \end{bmatrix} = \begin{bmatrix} 1-a & 0 & 0 & 0 \\ a & 1-0.03-0.001 & 0 & 0 \\ 0 & 0.03 & 1 & 0 \\ 0 & 0.001 & 0 & 1 \end{bmatrix} \begin{bmatrix} Healthy(k) \\ Carrier(k) \\ Cured(k) \\ Dead(k) \end{bmatrix}$$

$$a = (\#carriers)(N)(p)\left(\frac{1}{\text{Healthy+Carriers+Cured}}\right)$$

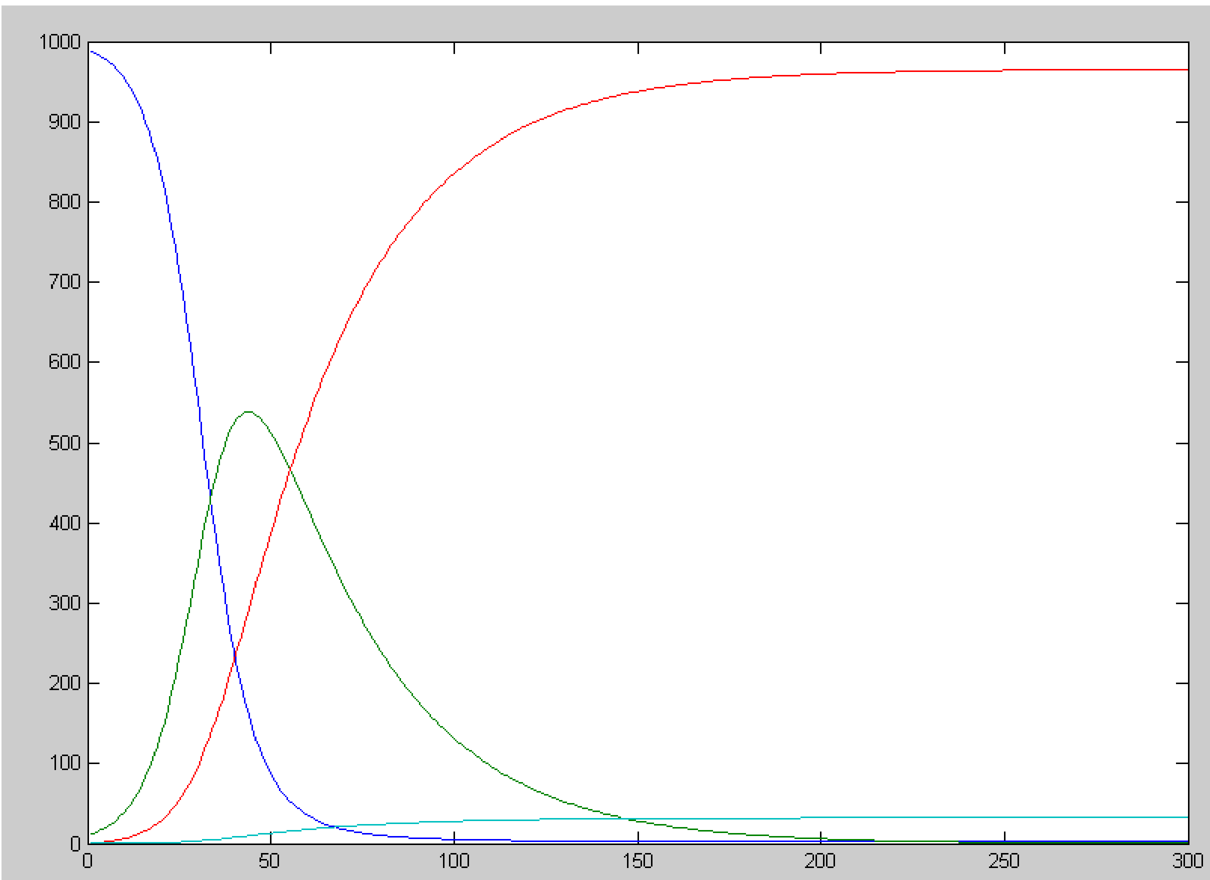
1) Simulate the disease spread for 300 days if

- N = 3 (each person is in close contact with 3 people each day)
- X = 6% (6% chance of the catching if exposed)

Result after 300 days

- # healthy 2.2743
- # infected 0.2760
- # cured 965.2738
- # dead 32.1758

Peak is at 50 days with 538 infected



Simulation Results with Np = 0.6: Healthy (blue), Infected (green), Cured (red), & Dead (cyan)

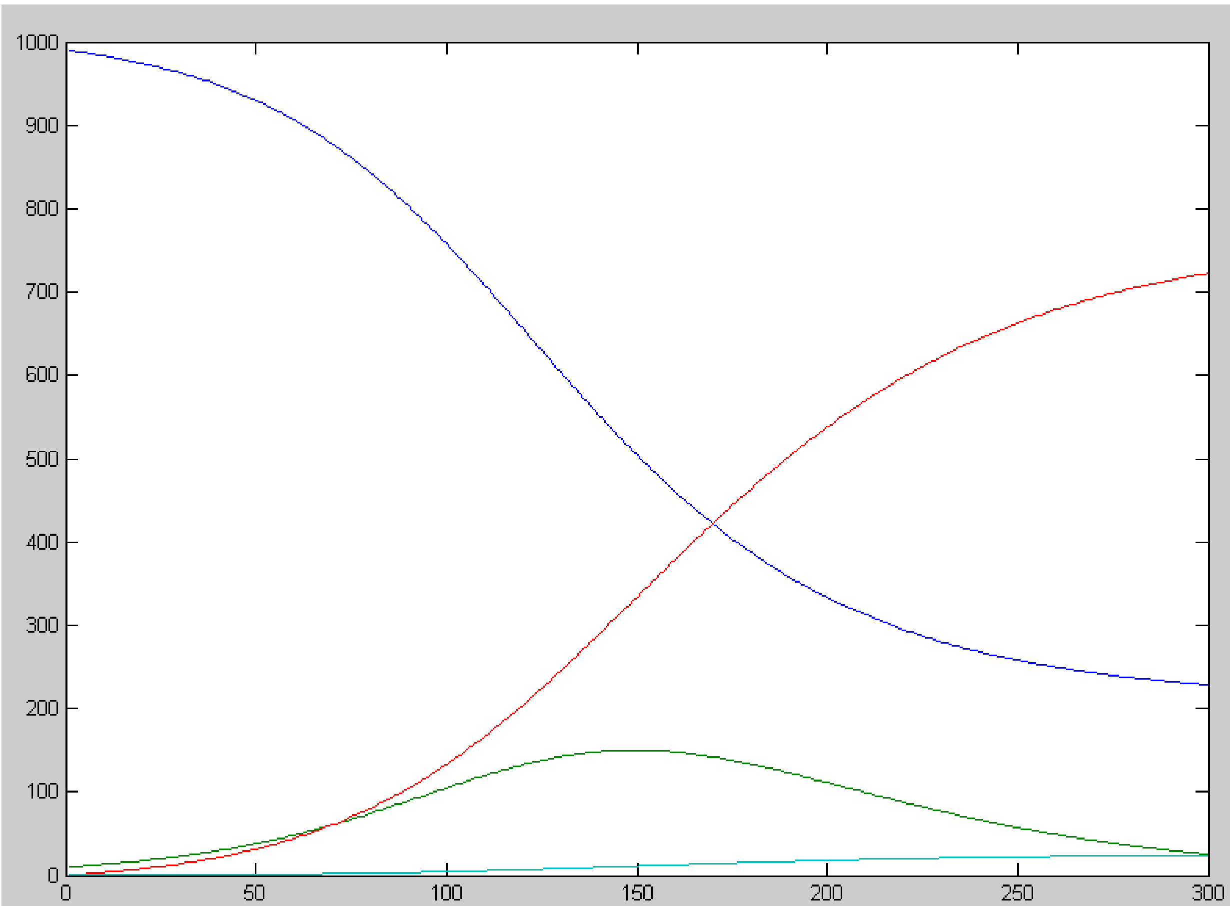
2) Simulate the effect of self isolation:

- N = 1 (each person interracts with 1/3rd as many people each day)
- X = 6% (6% chance of the catching if exposed)

Result after 300 days

- # healthy 228
- # infected 25
- # cured 721
- # dead 24

Peak is at 150 days with 150 infected



Simulation Results with Np = 0.2: Healthy (blue), Infected (green), Cured (red), & Dead (cyan)

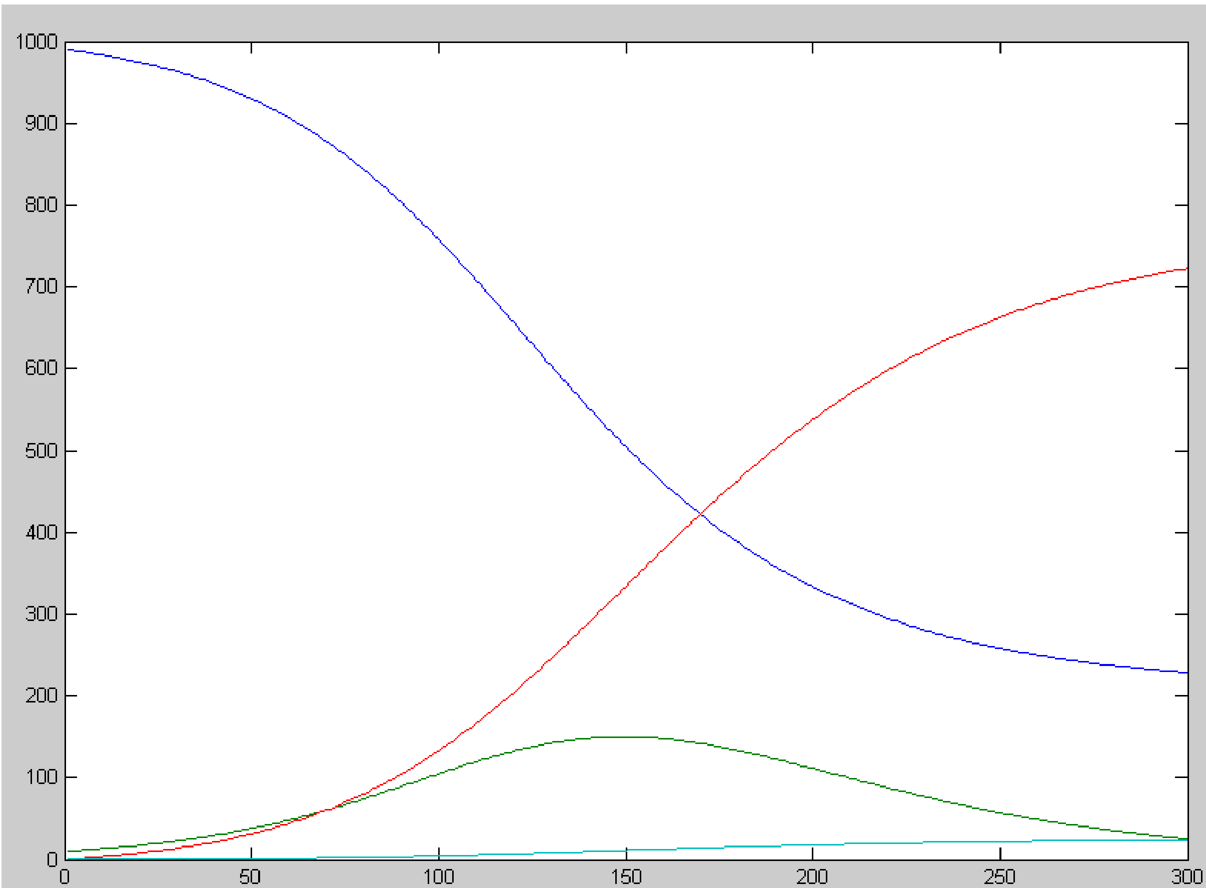
3) Simulate the effect of social distancing and wearing masks:

- N = 3 (each person interracts with 10 people each day)
- X = 2% (chance of being infected is 1/3rd what it was before)

Result after 300 days

• # healthy	228
• # infected	25
• # cured	721
• # dead	24

Peak is at 150 days with 150 infected



Simulation Results with Np = 0.2: Healthy (blue), Infected (green), Cured (red), & Dead (cyan)

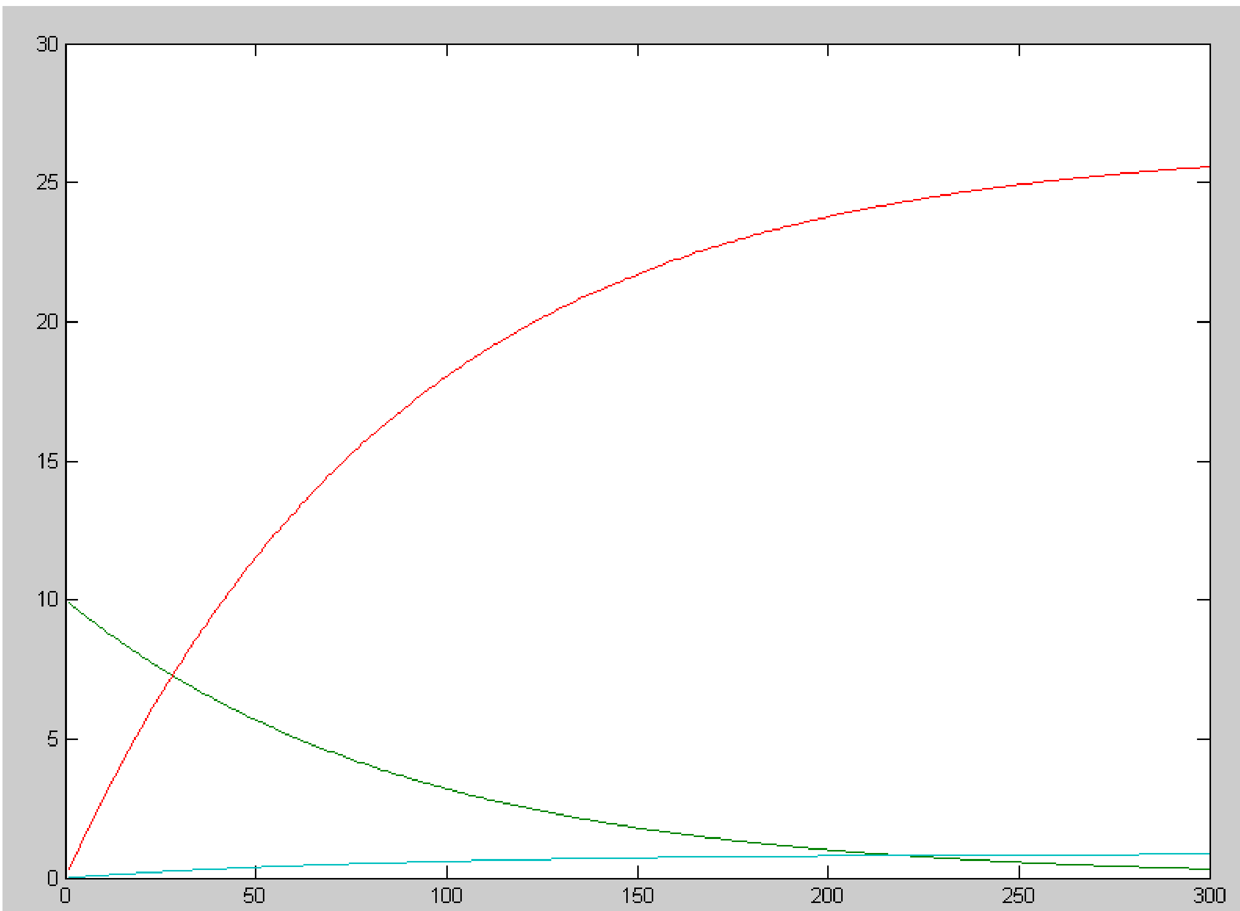
4) Simulate the effect of both social distancing and wearing masks:

- N = 1 (each person interracts with 2 people each day)
- X = 2% (2 chance of being infected is 1/3rd what is was before)

Result after 300 days

- # healthy 973.2
- # infected 0.3
- # cured 25.5
- # dead 0.9

Peak is at 0 days with 10 infected



Simulation Results with Np = 0.0667: Healthy (blue), Infected (green), Cured (red), & Dead (cyan)