Riya Danait
CSCE 1030 Computer Science I – Section 002
Professor Helsing
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Sample Calculations (flow chart on next page)

$S_i = S_{i-1} - \beta I_{i-1} S_{i-1}$ $I_i = I_{i-1} + \beta I_{i-1} S_{i-1} - \gamma I_{i-1}$ $R_i = R_{i-1} + \gamma I_{i-1}$

Total Population = 100, Number of infectious = 1, Contact Rate = 0.02, Recovery rate = 0.65

Susceptible = 100 - 1 =99

$S_i = S_{i-1} - (0.02)(I_{i-1})(S_{i-1})$

$I_i = I_{i-1} + (0.02)(I_{i-1})(S_{i-1}) - (0.65)(I_{i-1})$

$R_i = R_{i-1} + (0.65)(I_{i-1})$

Since we set the previous to be the initial values for Day 0, we can calculate:

$S_i = 99 - (0.02)(1)(99) \Rightarrow S_i = 97.02$ or 97

$I_i = 1 + (0.02)(1)(99) - (0.65)(1) \Rightarrow I_i = 2.33$ or 2

$R_i = 0 + (0.65)(1) \Rightarrow R_i = 0.65$ or 0

Then Day 1 can be calculated with setting these values and solving again:

$S_i = 97 - (0.02)(2)(97) \Rightarrow S_i = 93.12$ or 93

$I_i = 2 + (0.02)(2)(97) - (0.65)(2) \Rightarrow I_i = 4.58$ or 4

$R_i = 0 + (0.65)(2) \Rightarrow R_i = 1.3$ or 1

So far, the data seems to match what the program output is. So, for Day 2:

$S_i = 93 - (0.02)(4)(93) \Rightarrow S_i = 85.56$ or 85

$I_i = 4 + (0.02)(4)(93) - (0.65)(4) \Rightarrow I_i = 8.84$ or 8

$R_i = 1 + (0.65)(4) \Rightarrow R_i = 3.6$ or 3

For Day 3:

$S_i = 85 - (0.02)(8)(85) \Rightarrow S_i = 71.4$ or 71

$I_i = 8 + (0.02)(8)(85) - (0.65)(8) \Rightarrow I_i = 16.4$ or 16

$R_i = 3 + (0.65)(8) \Rightarrow R_i = 8.2$ or 8

For Day 4:

$S_i = 71 - (0.02)(16)(71) \Rightarrow S_i = 48.28$ or 48

$I_i = 16 + (0.02)(16)(71) - (0.65)(16) \Rightarrow I_i = 28.32$ or 28

$R_i = 8 + (0.65)(16) \Rightarrow R_i = 18.4$ or 18

For Day 5:

$S_i = 48 - (0.02)(28)(48) \Rightarrow S_i = 21.12$ or 21

$I_i = 28 + (0.02)(28)(48) - (0.65)(28) \Rightarrow I_i = 36.68$ or 36

$R_i = 18 + (0.65)(28) \Rightarrow R_i = 36.2$ or 36

For Day 6:

$S_i = 21 – (0.02)(36)(21) \Rightarrow S_i = 5.88$ or 5

$I_i = 36 + (0.02)(36)(21) – (0.65)(36) \Rightarrow I_i = 27.72$ or 27

$R_i = 36 + (0.65)(36) \Rightarrow R_i = 59.4$ or 59

For Day 7:

$S_i = 5 – (0.02)(27)(5) \Rightarrow S_i = 2.3$ or 2

$I_i = 27 + (0.02)(27)(5) – (0.65)(27) \Rightarrow I_i = 12.15$ or 12

$R_i = 59 + (0.65)(27) \Rightarrow R_i = 76.55$ or 76

For Day 8:

$S_i = 2 – (0.02)(12)(2) \Rightarrow S_i = 1.52$ or 1

$I_i = 12 + (0.02)(12)(2) – (0.65)(12) \Rightarrow I_i = 4.68$ or 4

$R_i = 76 + (0.65)(12) \Rightarrow R_i = 83.8$ or 83

For Day 9:

$S_i = 1 – (0.02)(4)(1) \Rightarrow S_i = 0.92$ or 0

$I_i = 4 + (0.02)(4)(1) – (0.65)(4) \Rightarrow I_i = 1.48$ or 1

$R_i = 83 + (0.65)(4) \Rightarrow R_i = 85.6$ or 85

For Day 10:

$S_i = 0 – (0.02)(4)(0) \Rightarrow S_i = 0$

$I_i = 1 + (0.02)(1)(0) – (0.65)(1) \Rightarrow I_i = 0.35$ or 0

$R_i = 85 + (0.65)(1) \Rightarrow R_i = 85.65$ or 85

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Please enter a positive, whole number for the total of the population you wish t
o simulate: 100

Please enter a positive, whole number that is less than the total population for
 the number of infectious individuals: 1

Please enter a positive number greater than 0 and less than 1 for the contact ra
te: 0.02

Please enter a positive number greater than 0 and less than 1 for the recovery r
ate: 0.65
Day:    0 S:       97 I:        2 R:        0
Day:    1 S:       93 I:        4 R:        1
Day:    2 S:       85 I:        8 R:        3
Day:    3 S:       71 I:       16 R:        8
Day:    4 S:       48 I:       28 R:       18
Day:    5 S:       21 I:       36 R:       36
Day:    6 S:        5 I:       27 R:       59
Day:    7 S:        2 I:       12 R:       76
Day:    8 S:        1 I:        4 R:       83
Day:    9 S:        0 I:        1 R:       85
Day:   10 S:        0 I:        0 R:       85
The outbreak took 11 days to end.
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Flow chart explaining the Algorithm for Homework 2