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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:

$$S_i = 99 - (0.02)(1)(99) => S_i = 97.02 \text{ or } 97$$

$$I_i = 1 + (0.02)(1)(99) - (0.65)(1) => I_i = 2.33 \text{ or } 2$$

$$R_i = 0 + (0.65)(1) => R_i = 0.65 \text{ or } 0$$

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

$$S_i = 97 - (0.02)(2)(97) => S_i = 93.12 \text{ or } 93$$

$$I_i = 2 + (0.02)(2)(97) - (0.65)(2) => I_i = 4.58 \text{ or } 4$$

$$R_i = 0 + (0.65)(2) => R_i = 1.3 \text{ or } 1$$

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

$$S_i = 93 - (0.02)(4)(93) => S_i = 85.56 \text{ or } 85$$

$$I_i = 4 + (0.02)(4)(93) - (0.65)(4) => I_i = 8.84 \text{ or } 8$$

$$R_i = 1 + (0.65)(4) => R_i = 3.6 \text{ or } 3$$

For Day 3:

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

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

$$R_i = 3 + (0.65)(8) => R_i = 8.2 \text{ or } 8$$

For Day 4:

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

$$I_i = 16 + (0.02)(16)(71) - (0.65)(16) => I_i = 28.32 \text{ or } 28$$

$$R_i = 8 + (0.65)(16) => R_i = 18.4 \text{ or } 18$$

For Day 5:

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

$$I_i = 28 + (0.02)(28)(48) - (0.65)(28) => I_i = 36.68 \text{ or } 36$$

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

For Day 6:

$$S_i = 21 - (0.02)(36)(21) \Rightarrow S_i = 5.88 \text{ or } 5$$

$$I_i = 36 + (0.02)(36)(21) - (0.65)(36) \Rightarrow I_i = 27.72 \text{ or } 27$$

$$R_i = 36 + (0.65)(36) => R_i = 59.4 \text{ or } 59$$

For Day 7:

$$S_i = 5 - (0.02)(27)(5) \Rightarrow S_i = 2.3 \text{ or } 2$$

$$I_i = 27 + (0.02)(27)(5) - (0.65)(27) \Rightarrow I_i = 12.15 \text{ or } 12$$

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

For Day 8:

$$S_i = 2 - (0.02)(12)(2) \Rightarrow S_i = 1.52 \text{ or } 1$$

$$I_i = 12 + (0.02)(12)(2) - (0.65)(12) \Rightarrow I_i = 4.68 \text{ or } 4$$

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

For Day 9:

$$S_i = 1 - (0.02)(4)(1) \Rightarrow S_i = 0.92 \text{ or } 0$$

$$I_i = 4 + (0.02)(4)(1) - (0.65)(4) => I_i = 1.48 \text{ or } 1$$

$$R_i = 83 + (0.65)(4) => R_i = 85.6 \text{ or } 85$$

For Day 10:

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

$$I_i = 1 + (0.02)(1)(0) - (0.65)(1) \Rightarrow I_i = 0.35 \text{ or } 0$$

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

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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 \theta and less than 1 for the contact ra
te: 0.02
Please enter a positive number greater than \theta and less than 1 for the recovery r
ate: 0.65
        0 S:
                   97 I:
                               2 R:
Day:
        1 5:
                   93 I:
                               4 R:
        2 5:
                   85 I:
                               8 R:
Day:
        3 S:
                              16 R:
                                           8
Day:
                   71 I:
Day:
        4 S:
                   48 I:
                              28 R:
                                          18
        5 S:
                              36 R:
                                          36
Day:
Day:
        6 S:
                    5 I:
                              27 R:
                                          59
                    2 I:
                              12 R:
                                          76
                               4 R:
                                          83
        8 S:
                    0 I:
        9 5:
                               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 Be sure to prompt the user Begin by defining the Then realize that variables for the total for inputs. If the user does the most efficient number of people in the not input the correct data way to create error simulation, the infectious type (i.e. a decimal or messages is by people, the recovered negative for a positive using a do-while people, the rates of whole number, be sure to loop that MUST run contact and recovery, the include an error message in susceptible people, and at least once. an if-else statement nested the day counter. in the do-while loop. Before we use a do-while loop to actually run the It's also important Remember that this program, we need to must be repeated 4 to clear the variable remember to set the times for the total with the input being previous values of the stored into after the number, the number of people user inputs a wrong infectious, and the susceptible, infectious, number and set it contact and and recovered to the equal to 0. recovery rates. initial values before-hand. This program will stop when infectious is exactly 0 (hence, when Use printf to print whoever is left is out the day and S.I.R. recovered). Make sure to Use the variables values corresponding include this in the while to create the 3 to that day on a new portion. Then print the equations. line each time. number of days it took for the outbreak to end.