Week 14 Classwork/Homework Assignment

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For the assignment, you will submit the compiled pdf document as both a pdf. Make sure that the compiled documents will display all the required code to get your results.

The assignment is due Tuesday November 28 at 3:30 PM.

1. Compare and contrast stochastic and deterministic models. Make sure you discuss what they do and assume, when they are appropriate to use and

2. Outline Gillespie's direct method algorithm.

3. Assuming a deterministic model plot the trajectory of the density-dependent population model. What happens to the population over time.

$$\frac{dN}{dt} = (b_0 - b_1 N)N - (d_0 + d1N)N \tag{1}$$

Using the parameters and initial conditions

Table 1. Parameter values and initial condition for questions 3 and 5.

Parameter	Value
b0	1
b1	0.001
d0	0.5
d1	0.004
N0	1

4. Convert the deterministic model into a stochastic model using Gillespie's direct method algorithm.

5. Plot the trajectory of 50 simulations using the parameters found in Table 1. For each simulation allow the simulation to run for 500 steps.

6. Modify the algorithm to no longer require a number of time steps but rather will end the simulation when the population goes extinct.

7. Determine the probability that a population goes extinct within 50 time steps using the parameters found in table 2? At any time?

Table 2. Parameter values and initial conditions for question 7.

Parameter	Value
b0	1
b1	0.001
d0	0.5
d1	0.004
N0	1

8. Using the zombie outbreak model from the previous case studies, write a stochastic model. Develop and address 2 problems or questions using this model.

$$\frac{dS}{dt} = bS - mS - aSZ \tag{2}$$

$$\frac{dU}{dt} = aSZ - zU \tag{3}$$

$$\frac{dZ}{dt} = zU - kSZ \tag{4}$$

$$\frac{dD}{dt} = kSZ + mS \tag{5}$$