

3. An incomplete S-I-R model for a measles epidemic is as follows:

$$\frac{\Delta S}{\Delta t} = -0.0003SI, \quad \frac{\Delta R}{\Delta t} = 0.125I$$

a) Write the change equation for I to complete the model

b) The spreadsheet below implements this model for village with a population of 10,000 people.

	A	B	C	D
1	a	0.0003		
2	b	0.125		
3				
4	Day	S	I	R
5	0	9998	2	0
6	1			
7	2			

What formula goes in the cell C6?

Below are some scenarios that could change the model. For each scenario, indicate which of the following would change and how they would change (increase/decrease): a, b, S in B5, I in C5, R in D5.

c) Half the village left to go to market on Day 0, and those who were infected stayed home.

d) A circus comes to town on Day 0, and half of the members of the troupe of 40 have the measles.

e) The village has a festival where there is more feasting, dancing and merriment than usual.

4. Consider the following two-species model:

$$\frac{dx}{dt} = 0.6x - 0.005x^2 - 0.006xy, \quad \frac{dy}{dt} = -0.05y + 0.001xy$$

- a) Is either species logistic? How can you tell?
- b) Is this a predator prey model or competing species model? How can you tell?
- c) Find the equilibrium points for this model.
- d) The Phase Plane for the model is sketched below. Label the equilibrium points on the model.

Assume a starting population of $x = 10$ and $y = 110$.

- e) What is likely to happen in the near future for the species x and y ?
- f) What is the long term biological interpretation of the model?