

NAME: \_\_\_\_\_

MATH 1470 Fall 2004 Tintera

TEST 3: Two-Species, Epidemic and Linear Programming Models. Covers Chapters 7-9

You may use calculators and one 8.5 by 11 inch page of notes. Please show all work on this test booklet. Partial credit is awarded only for work shown. Each problem is worth as indicated. Good luck!

1. A variation on the measles has broken out in a town of 25,000 people. In that town, people make 12 contacts per day and 5% of the contacts between an infected person and a susceptible person leads to the measles for the susceptible person. Since this is a new disease, no one is immune nor have they been vaccinated. It takes a week to recover from this type of measles.

a) (10 points) Write the change model (Delta model) for this situation based on the SIR model.. (I'll write the formulas for a and b on the board if you ask).

b) (5 points) Early on in the outbreak, there are 12 people infected and none have recovered. How many will there be in each category (S, I, R) the next day?

c) (5 points) Later, the number of infected has risen to 300. A reporter from a local newspaper asks you, the mayor of the town, if the number of infected will go up. Can you tell him?

d) (5 points) For which values of S will I increase (ie, have  $\Delta I > 0$ ) ?

2. Consider the following two-species model:

$$\frac{\Delta x}{\Delta t} = 0.9x - 0.003x^2 - 0.006xy, \quad \frac{\Delta y}{\Delta t} = 0.8y - .004y^2 - 0.002xy$$

- a) (5 points) Is either species logistic? How can you tell?
- b) (5 points) Is this a predator prey model or competing species model? How can you tell?
- e) (5 points) If the starting populations are  $x = 100$  and  $y = 100$ , will the species  $x$  and  $y$  increase or decrease in the near future?
- f) (10 points) Either
- (i) Compare and contrast the two species in terms of their equations. How do they compare with regard to interactions? How do they compare with regard to other terms?
  - (ii) Or Sketch a phase plane for the two species.