Plant Disease Epidemiology (Instructor: L. V. Madden)
Test I (Feb. 14, 2008)

Name: ____

1. Explain or define 12 of the following 13 terms (leave one blank, your choice)

a). Inter-rater reliability

b). Linear model

c). Weighted least squares

d). Concordance correlation coefficient (CCC or ρ_C)

e). Disease incidence

f). Pandemic

g). Remote sensing

h). Simple-interest disease

i). Secondary infections

j). η shape parameter

k). *Indirect* measurement of disease severity l). J. Horsfall

m). Disease scale

2. Explain the logistic model in words, making sure you give the equation for *dy/dt*, and the meaning of all terms in the model. Show theoretical graphs for *dy/dt* versus time, *y* versus time, and *y** versus time (make sure you label the axes of the graphs). What is the meaning of the slope and intercept of the *y**-versus-time graph.

3. What is AUDPC? How does one empirically calculate it (explain in words, I don't need to see the exact formula)? Based on the description in the book, how is AUDPC affected by r_* and y_0*?

4. Below are values of disease intensity at two times (time measured in days):

t	*y*
0	0.02
10	0.06

Assume this disease is polycyclic.

a). Assuming that disease increase in of the *logistic* type, what is the estimated r_L? Show your work.

b). If one used the exponential model instead of the logistic, what value would you have obtained for r_E? Explain the similarity of r_L and r_E in this situation.

c). How long will it take y to increase to 0.50, if r_L does not change? Show your work.

d). How much time is saved if a form of ‘sanitation’ is used, and a sanitation ratio of SR=10 is achieved, so that y_0 is 0.002? That is, what is t_S?

e). What would t_S be if y_0 is reduced to 0.002 and r_L is cut in half (half the value found in part ‘a’)? In other words, how long does it take to reach a disease intensity of 0.02?

f). (Bonus—optional): Suppose another epidemic was best described by the Gompertz model, and that you found that r_G = 0.09/day. Which epidemic is increasing at a faster rate? Explain your answer.

5. For polycyclic diseases, explain why sanitation is only effective or efficient for disease management if the secondary infection rate is low.

6. Assume you have disease progress curves for two epidemics (perhaps, disease incidence at six different assessment times for each epidemic), and they both are of the *monocyclic* type. Explain in words the procedures you would follow in order to determine if disease was increasing at significantly different rates between the two epidemics. (Organize your answer and give your explanation as a series of steps. You do not need to give the formula for any statistical test [tests], but you should explain what you would do to make a decision regarding the rates for the two epidemics).

$$y = f(t; \ldots)$$

$$\frac{dy}{dt} = r_* \cdot f(y) \cdot f(1-y)$$

$$y^* = y_0^* + r_* t$$

$$y^*(t_2) = y^*(t_1) + r_*(t_2 - t_1)$$

r_* obtained by rearranging equation

$$\ln(y)$$

$$\ln\left(\frac{1}{1-y}\right) \qquad \ln\left(\frac{K}{K-y}\right)$$

$$\ln\left(\frac{y}{1-y}\right) \qquad \ln\left(\frac{y}{K-y}\right)$$

$$-\ln(-\ln(y)) \qquad -\ln(-\ln(y/K))$$

$$\ln\left(\frac{1}{1-y^{1-n}}\right) \qquad \ln\left(\frac{1}{1-(y/K)^{1-n}}\right)$$

$$\ln\left(\frac{1}{y^{1-n}-1}\right) \qquad \ln\left(\frac{1}{(y/K)^{1-n}-1}\right)$$

$$t_D = \frac{\left((2y)^* - y^*\right)}{r_*}$$

$$t_S = \frac{\left(y_0^* - y_{0S}^*\right)}{r_*}$$

$$\overline{w} = \frac{r_*}{2n+2} \quad \text{or} \quad \frac{r_* K}{2n+2}$$

Above equations are meant to help in doing any numerical problems in the test.

Below are the backtransformations for four disease progress models, if you have a predicted value of *y**. However, the table of transformations can be used directly for the test.

$$y = \exp(\hat{y}*)$$
$$y = 1 - \exp(-\hat{y}*)$$
$$y = \frac{1}{1 + \exp(-\hat{y}*)}$$
$$y = \exp(-\exp(-\hat{y}*))$$