Name: Prof Deutsch Date: Sept 10, 2014

MA 226 Quiz 2B

Please show your work.

1. (5 pts) MacQuarie Island is a small island about half-way between Antarctica and New Zealand. Between 2000 and 2006 , the population of rabbits on the island rose from 4,000 to 240,000. Model the growth in rabbit population R(t) at time t using an exponential growth model $\frac{dR}{dt} = kR$ where t = 0 corresponds to the year 2000. What is an appropriate value of the growth rate parameter k and what does the model predict the rabbit population will be in the year 2010?

$R(t) = Ce^{kt}$

$R(0) = 4{,}000$

Find C

$R(0) = 4000 = Ce^{k\cdot 0}$

$\boxed{4000 = C}$

Find k

$R(6) = 240{,}000 = 4000e^{k\cdot 6}$

$60 = e^{k\cdot 6} \Rightarrow k = \frac{1}{6}\ln(60) = \boxed{.6824}$

Year 2010, $t = 10$

$R(10) = 4000e^{10(.6824)}$

$= 3678625.151$

In 2010 there will be approximately

$\boxed{3,678,625 \text{ Rabbits}}$

2. (5 pts) For the following Predator-Prey Systems, identify which dependent variable, x or y, is the prey population and which is the predator population. Is the growth rate of the prey limited by any factors other than the number of predators? Do the predators have sources of food other than the prey?

a.) $\frac{dx}{dt} = \alpha x + \beta x \cdot y$

$\frac{dy}{dt} = \gamma y - \delta x \cdot y$

x = predator b/c it grows by x and y interactions

y = prey b/c it decreases by x and y interactions

- The growth rate of the prey is not restricted by any factors other than the number of predators
- The predator do have an alternative food source b/c they do not die when $y = 0$

b.) $\frac{dx}{dt} = \alpha x\left(1 - \frac{x}{N}\right) - \beta x \cdot y$

$\frac{dy}{dt} = \gamma y + \delta x \cdot y$

x = prey

y = predator

- growth rate of prey is limited by the carrying capacity N
- predator does have an alternative food source