Math 172 Fall 2012 WS 10

1. Write the equations for dV/dt and dP/dt in a predator-prey system under the following assumtions:

We always assume that the P has intrinsic exponential decay, and the positive effect of predation is proportional to the sizes of both populations. Write the equation for dP/dt based on these assumptions.

The behavior of V is modeled by a different equation under each of the assumptions below. Write the equation in each case.

a. V has intrinsic exponential growth, and the predators have a functional response of type I

b. V has intrinsic exponential growth, and the predators have a functional response of type II

c. V has intrinsic logistic growth, and the predators have a functional response of type I

d. V has intrinsic exponential growth, and the predators have a functional response of type II.

2 Consider a predator-prey system modeled by the equations

$$\frac{dV}{dt} = 10V - 0.02V^2 - \frac{1.2V}{20+V}P$$

$$\frac{dP}{dt} = -4P + 0.1VP$$

a. Describe the behavior of the victims in the absence of the predators.

b. Find the equilibrium values when only one population is present.

c. Find the equilibrium value with both populations present, or explain that it doesn't exist.

d. Write down the equations of the isoclines. For each isocline, state if the isocline is a line or portion of a parabola. Draw the isoclines.

e. If the victim populaiton is $V = 200$, how many predators are needed to keep the victim population constant? What if $V = 400$?

The next few questions concern the functional response of the predators

f. What is the functional response of the predators in the equations given above?

g. What is the maximum amount of victims that can be consumed by the predators (if there is an unlimited amount of victims available)?

h. For what size of the victim populations does the feeding rate of the predators reach half of the maximal feeding rate?

i. Show the graph of $R(V)$ as a function of V.

3 Repeat the questions from problem 2 if the equations are replaced by

$$\frac{dV}{dt} = 10V - \frac{1.2V^2}{400+V^2}P$$

$$\frac{dP}{dt} = -4P + 0.1VP$$