

# Lotka-Volterra Question

Yusuf Gören

March 11, 2013

Consider the following system of differential equations

$$\begin{aligned}\dot{x} &= x(1 - 2x - y) \\ \dot{y} &= y(1 - x - 2y)\end{aligned}\tag{1}$$

- (i) Work out the equilibrium points of the system (1).
- (ii) Classify them and compute their index.
- (iii) Draw the phase portrait of (1). Do we get any periodic orbits? Why, or why not?
- (iv) A *nullcline* is a curve on the plane such that either  $\dot{x}$  or  $\dot{y}$  is 0 (hence the prefix “null”). In general, what is the relationship between nullclines and equilibrium points?
- (v) What happens if we change the coefficients of  $x$  and  $y$  in parenthesis? Work out a few examples; find the nullclines, equilibrium points, their stability, (non-)existence of periodic orbits.