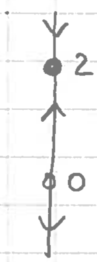
Solutions

a) Competing species: both interaction terms $-2xy$ and $-xy$ are negative, so interactions are bad for both species.

b) If $x(0)=0$, then $dx/dt = 0 \Rightarrow x(t)$ will be zero at all times. Then $dy/dt = y(2-y) \leftarrow$ logistic population equation with the phase line:



Any solution with $0 < y(0) < 2$ will increase to $y=2$, and any solution with $y(0) > 2$ will decrease to $y=2$.

c) Equilibrium points are solutions to

$$\begin{cases} 0 = x(3-x) - 2xy, \\ 0 = y(2-y) - xy, \end{cases} \qquad \begin{cases} x(3-x-2y)=0, \\ y(2-x-y)=0, \end{cases}$$

$$\begin{cases} x=0 \quad \text{or} \quad 3-x-2y=0 \\ y=0 \quad \text{or} \quad 2-x-y=0 \end{cases} \Rightarrow$$

$$\begin{cases} x=0 \\ y=0 \end{cases}; \quad \begin{cases} x=0 \\ 2-x-y=0 \end{cases}; \quad \begin{cases} 3-x-2y=0 \\ y=0 \end{cases}; \quad \begin{cases} 3-x-2y=0 \\ 2-x-y=0 \end{cases}$$

$(0,0)$ $\qquad (0,2)$ $\qquad (3,0)$ $\qquad (1,1)$

d) $F(1,0) = (2,0)$

$F(0,4) = (0,-8)$

$F(1,1) = (0,0)$

$F(3,2) = (-12,-6)$