P 165 #7

$\frac{\Delta m}{\Delta t} = .25m - .0005m^2 - .0025mn$

$\frac{\Delta n}{\Delta t} = .001mn - .4n$

Type of model - (based on interaction terms)

m has negative interaction coefficient

n ... positive

So m is prey, n is predator.

Which logistic (based on "squared" terms)

m is logistic

Eq Pts Equilibrium Points

$\Delta M = 0$

$.25 - .0005m - .0025n = 0$

$m = 0$

Let $n = 0$ in ↑

$.25 - .0005m = 0$ ← solve for m

$m = \frac{-.25}{-.0005} = 500$ (500, 0)

$\Delta n = 0$

$n = 0$, $(m, n) = (0, 0)$

$.001m - .4 = 0$

$m = \frac{.4}{.001} = 400$

Let $m = 400$ in above equation

$.25 - .0005(400) - .0025n = 0$

$.05 - .0025n = 0$

$\frac{-.0025n}{-.0025} = \frac{-.05}{-.0025}$

$n = 20$

(400, 20)

# How to find equilibrium points from Lotka Volterra Equations.

$$\frac{\Delta r}{\Delta t} = .9r - .03rm$$

$$\frac{\Delta m}{\Delta t} = .00001667rm - .01667m$$

Last time: If $(r, m) = (1000, 30)$, $\Delta r = 0 = \Delta m$

Solve $\Delta r = 0$, $\Delta m = 0$

Factor $r$ in $\Delta r = 0$ common

$$r(.9 - .03m) = 0$$

$r = 0$ or $.9 - .03m = 0$

$m = 30 \Leftarrow \frac{-.03m}{-.03} = \frac{-.9}{.03}$

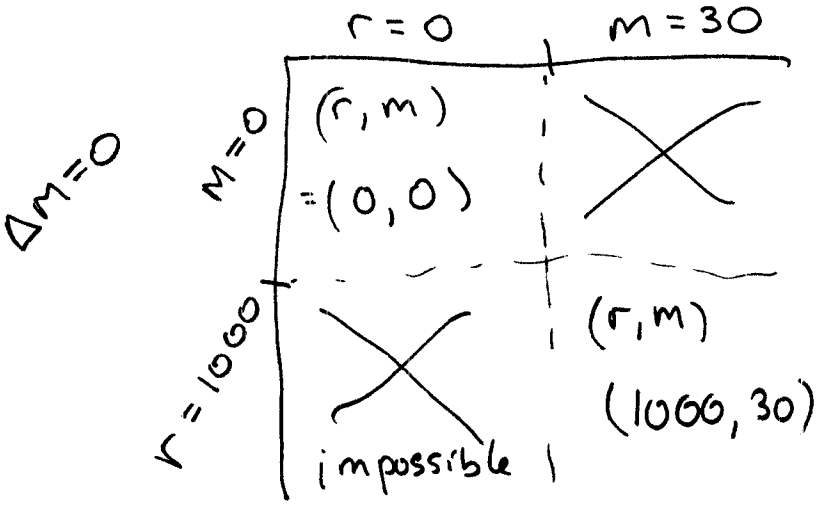
Solve $\Delta m = 0$

$$m \cdot (.0000167r - .01667) = 0$$

$m = 0$ or $.00001667r - .01667 = 0$

$$r = \frac{.01667}{.00001667} = 1000$$

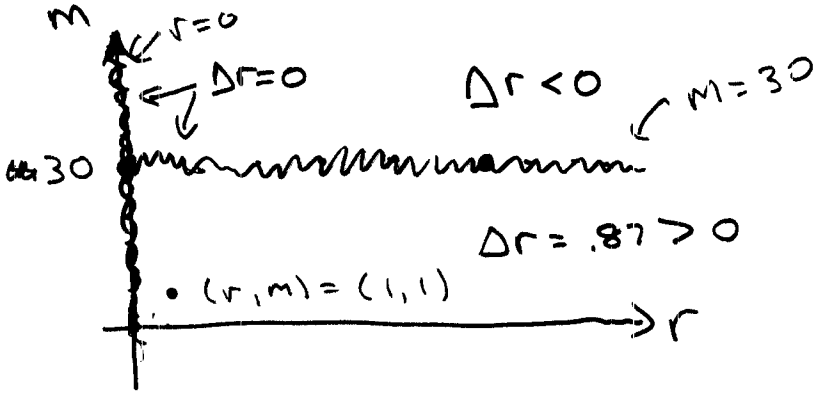
$\Delta r = 0$



# How to find regions of Consistent Change in a phase plane.

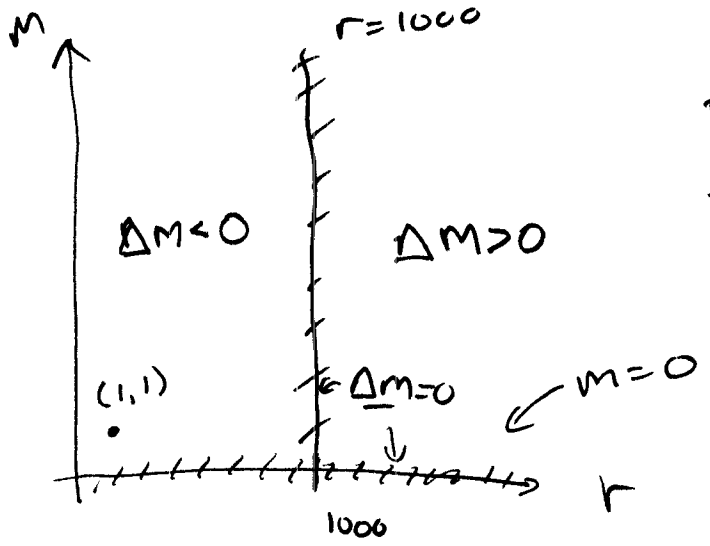
$$\frac{\Delta r}{\Delta t} = .9r - .03rm$$

$\Delta r = 0 \iff r = 0$ or $m = 30$

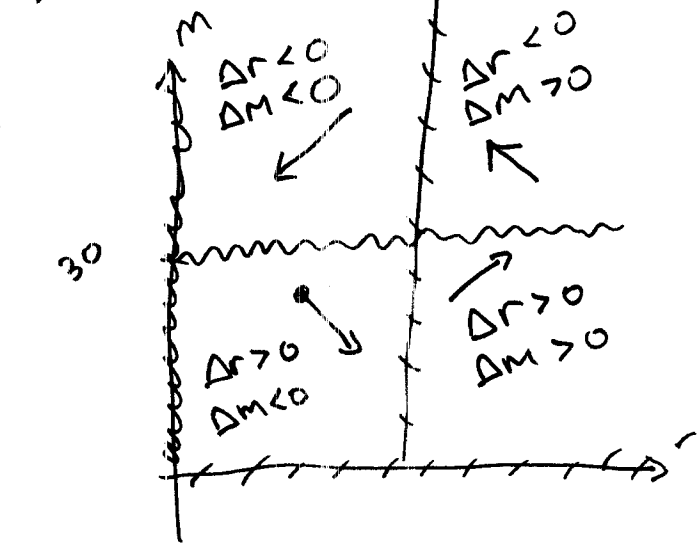



$\Delta m = 0$ $\quad \frac{\Delta m}{\Delta t} = .00001667rm - .01667m = 0 \iff$

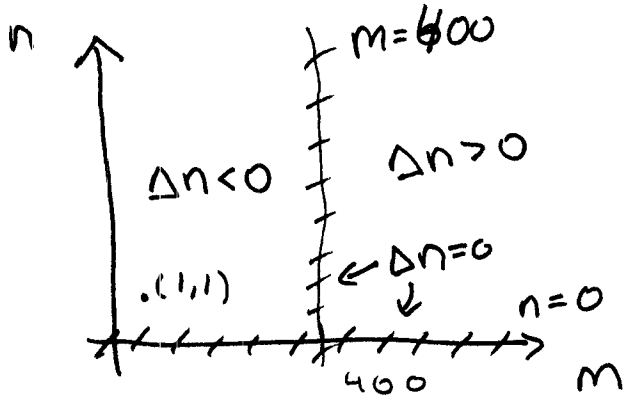
$r = 0$ or $m = 0$ or $r = 1000$



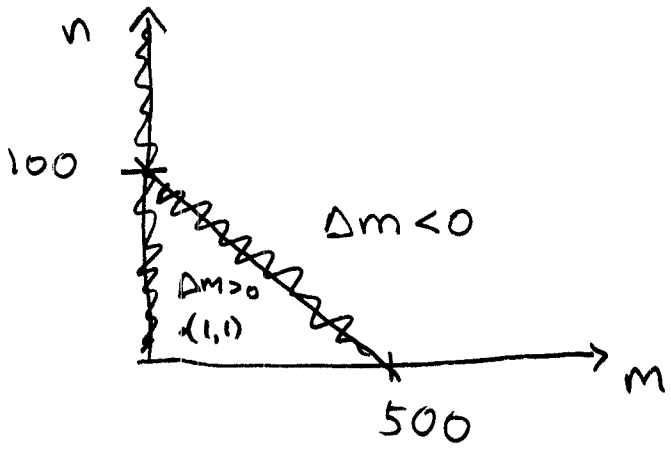

Put pictures together



#7 $\Delta m = 0$ $\dot{n} = 0$ $.001m - .4 = 0$




$\Delta m = 0$ $m = 0$ or $.25 - .0005m^2 - .0025n = 0$




diagonal line

| m | n |
|---|---|
| 0 | $\frac{.25}{.0025} = 100$ |
| 500 $= \frac{.25}{.0005}$ | 0 |

Combining $\Delta m, \Delta n$ on single phase plane