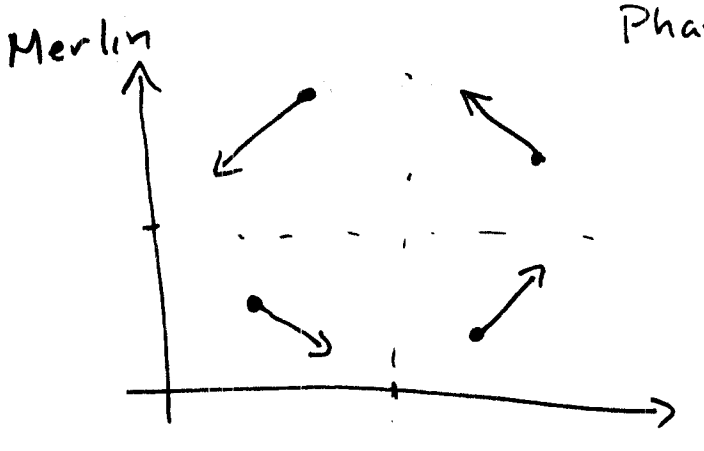
Predator - Prey Relationships

(Merlin) (Rat)



Phase-Plane ← What one should look like

What would formulas for this scenario be like?

r = # rats m = # merlins (death rate depends on m)

$\frac{\Delta r}{\Delta t}$ = births − deaths = birth rate · r − death rate · r

$\frac{\Delta m}{\Delta t}$ = births − deaths = birth rate · m − death rate · m

(birth rate depends on r)

$\frac{\Delta r}{\Delta t} = .90r - (.03m)r$

$\frac{\Delta m}{\Delta t} = .0000167 r \cdot m - .01667 m$

Lotka Volterra Equations

t = time (months)

tomorrow = # today + change

Suppose there 950 rats & 28 merlins on Eden Island. Predict how many of each species there will be next month.

$$r_{\text{next month}} = r_{\text{this mo}} + \Delta r$$
$$= 950 + .90(950) - (.03)(28)(950)$$
$$= 1007$$

$$m_{\text{next mo}} = m_{\text{this mo}} + \Delta m$$
$$= 28 + .00001667\left(\frac{950}{\quad}\right)(28) - .01667(28)$$
$$= 27.97 \quad \cancel{28}2$$

Repeat w/ $r = 1000$ $m = 30$

$$r_{\text{next mo}} = 1000 + 0$$
$$= 1000$$

$$m_{\text{next mo}} = 30 + 0$$
$$= 30$$

A point (r, m) where $\Delta r = 0$ & $\Delta m = 0$ is called an <u>equilibrium</u> point

Lotka Volterra Equations for species x, y

+ Births − Deaths

$$\frac{\Delta x}{\Delta t} = a x - b x \cdot y$$

interaction terms

$$\frac{\Delta y}{\Delta T} = c x \cdot y - d y$$

exponential terms

predator should increase its numbers through interaction (y)

prey should decrease its numbers through interaction. (x)

Also may have competition

$$\frac{\Delta x}{\Delta t} = \ldots - d x y$$

$$\frac{\Delta y}{\Delta t} = \ldots - e x y$$

Also may have logistic growth

$$\frac{\Delta x}{\Delta t} = \ldots - f x^2 \ldots$$

$$\frac{\Delta y}{\Delta t} = \ldots - g y^2 \ldots$$

→ Check the Website for ← Sample spreadsheet