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# Journal Week 4

$$\frac{dx}{dt} = -qx + V\frac{y}{K+y}\frac{z}{M+z}x$$
$$\frac{dy}{dt} = qv - qy - \frac{1}{\varepsilon}V\frac{y}{K+y}\frac{z}{M+z}x$$
$$\frac{dz}{dt} = qV - qz - \frac{1}{f}V\frac{y}{K+y}\frac{z}{M+z}x$$

1) $\frac{dx}{dt} = -qx + V\frac{y}{K+y}\frac{z}{M+z}x = 0$

$x = 0$

$-q + V\frac{y}{K+y}\frac{z}{M+z} = 0$

$q = V_{max}\ \min\left\{\frac{y}{K+y}, \frac{z}{M+z}\right\}$

$qv - qy = \frac{1}{\varepsilon}qx$

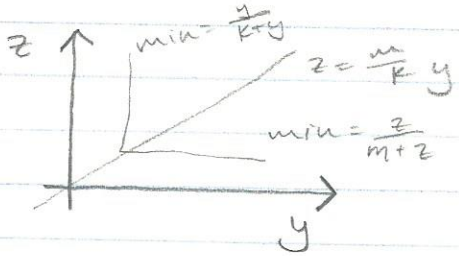
$qV - qz = \frac{1}{f}qx$

$\min\left\{\frac{y}{y+K}, \frac{z}{z+M}\right\}\frac{a}{V_{max}}$

$\begin{cases} x = \varepsilon(v-y) \\ x = f(V-z) \end{cases}$ from $\frac{dy}{dt} = 0$

$\varepsilon(v-y) = f(V-z)$

$z = \frac{\varepsilon}{f}y + V\frac{\varepsilon}{f}v$




2) $\frac{dy}{dt} = qv - qy - \frac{1}{\varepsilon}V\frac{y}{K+y}\frac{z}{M+z}x$

$\frac{dz}{dt} = qV - qz - \frac{1}{f}V\frac{y}{K+y}\frac{z}{M+z}x$

Same process as above / in class

$z = \frac{\varepsilon}{f}y + V\frac{\varepsilon}{f}v = V - \frac{\varepsilon}{f}(v-y)$

3) $z = \frac{M}{K}y$ (equilibrium) $\qquad z = V - \frac{\varepsilon}{f}(v-y)$

for y $\quad \frac{M}{K}y = V - \frac{\varepsilon}{f}(v-y)$

$\frac{M}{K}y = V - \frac{\varepsilon}{f}v - \frac{\varepsilon}{f}y$

$y\left(\frac{M}{K} + \frac{\varepsilon}{f}\right) = V - \frac{\varepsilon}{f}v$

$y = \frac{V - \frac{\varepsilon}{f}v}{\frac{M}{K} + \frac{\varepsilon}{f}} \qquad y = \frac{KVf - \varepsilon Kv}{Mf + \varepsilon K} = \frac{K(Vf - \varepsilon v)}{Mf + \varepsilon K}$

3) cont.

$z = v - \frac{\varepsilon}{\delta}(u - y)$ $\qquad z = \frac{m}{k} y$

$z = v - \frac{\varepsilon}{\delta} u - \frac{\varepsilon}{\delta} y$ $\qquad y = z \frac{k}{m}$

$\frac{z - v + \frac{\varepsilon}{\delta} u}{-\frac{\varepsilon}{\delta}}$

$\frac{-z + v - \frac{\varepsilon}{\delta} u}{\frac{\varepsilon}{\delta}} = y$

$\frac{-z + v - \frac{\varepsilon}{\delta} u}{\frac{\varepsilon}{\delta}} = z \frac{k}{m}$

$-z + v - \frac{\varepsilon}{\delta} u = z \frac{k}{m} \cdot \frac{\varepsilon}{\delta}$

$v - \frac{\varepsilon}{\delta} u = z \frac{k}{m} \frac{\varepsilon}{\delta} + z$

$v - \frac{\varepsilon}{\delta} u = z \left( \frac{k}{m} \frac{\varepsilon}{\delta} + 1 \right)$

$$\boxed{z = \frac{v - \frac{\varepsilon}{\delta} u}{\frac{k}{m} \frac{\varepsilon}{\delta} + 1}}$$

4) $y = \frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k}$ $\qquad y = \mu - \frac{\delta}{\varepsilon}(v - z)$

$\frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} = \mu - \frac{\delta}{\varepsilon}(v - z)$

$\frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} = \mu - \frac{\delta}{\varepsilon} v + z \frac{\delta}{\varepsilon}$

$\frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} - \mu + \frac{\delta}{\varepsilon} v = \frac{\delta}{\varepsilon} z$

$x = \delta v - \delta z$ $\qquad z = \frac{\varepsilon}{\delta} \left( \frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} + \mu - \frac{\delta}{\varepsilon} v \right)$

$x = \delta v - \delta \left( \frac{\varepsilon}{\delta} \left( \frac{k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} + \mu - \frac{\delta}{\varepsilon} v \right) \right)$

$x = \delta v - \frac{\varepsilon k(v\delta - \varepsilon u)}{m\delta + \varepsilon k} + \mu - \delta v$

$$\boxed{x = -\frac{\varepsilon k(u\delta - \varepsilon u)}{m\delta + \varepsilon k}}$$

5)