HW 13

1

$$a_1(n+1) = \frac{a_1(n)}{3+a_2(n)} \qquad x = \frac{x}{3+y} \qquad x - \frac{x}{3+y} = 0$$

$$a_2(n+1) = \frac{a_2(n)}{2+a_1(n)} \qquad y = \frac{y}{2+x} \qquad y - \frac{y}{2+x} = 0$$

$(0,0)$ $(-1,-2)$

$$x\left(1 - \frac{1}{3+y}\right) = 0$$

$x=0,\ y=-2$

$$y\left(1 - \frac{1}{2+x}\right) = 0$$

$$J = \begin{bmatrix} \frac{1}{3+y} & -\frac{x}{(3+y)^2} \\ -\frac{y}{(2+x)^2} & \frac{1}{(2+x)} \end{bmatrix}$$

$y=0,\ x=-1$

$$J_{(0,0)} = \begin{bmatrix} \frac{1}{3} & 0 \\ 0 & \frac{1}{2} \end{bmatrix} \qquad J_{(0,0,\lambda)} = \begin{bmatrix} \frac{1}{3}-\lambda & 0 \\ 0 & \frac{1}{2}-\lambda \end{bmatrix}$$

$\lambda = \frac{1}{3}, \frac{1}{2}$ 2 ✓

$$J_{(-1,-2)} = \begin{bmatrix} 1 & \frac{1}{1^2} \\ \frac{2}{1} & 1 \end{bmatrix} \qquad J_{(-1,-2,\lambda)} = \begin{bmatrix} 1-\lambda & 1 \\ 2 & 1-\lambda \end{bmatrix}$$

$$\lambda^2 - 2\lambda + 1 - 2 = 0$$

$\lambda = 1 \pm \sqrt{2} \neq 1$

$(0,0)$ IS STEADY

HW 13

2]

$$a_1(n+1) = \frac{a_1(n)}{3a_1(n) + 5a_2(n)} \qquad x = \frac{x}{3x+5y}$$

$$a_2(n+1) = \frac{a_2(n)}{2a_1(n) + 7a_2(n)} \qquad y = \frac{y}{2x+7y}$$

$$x\left(1 - \frac{1}{3x+5y}\right) = 0$$

$x = 0$, ~~$y = 0$~~ $x = \frac{1}{3}$

$$y\left(1 - \frac{1}{2x+7y}\right) = 0$$

$y = \frac{1}{7}$ ~~$y = 0$~~ $y = 0$

$(1/3, 0)$ $(0, 1/7)$ $(2/11, 1/11)$

$-1(3x+5y) = -2$

$(3x+5y = 1)\,-2$

$(2x+7y = 1)\,3$

$21y = 3$

$11y = 1$

$y = 1/11$, $x = 2/11$

$$J = \begin{bmatrix} \frac{5y}{(3x+5y)^2} & -\frac{5x}{(3x+5y)^2} \\ -\frac{2y}{(2x+7y)^2} & \frac{2x}{(2x+7y)^2} \end{bmatrix}$$

$$J_{(1/3,0)} = \begin{bmatrix} 0 & -5/7 \\ 0 & 2/7 \end{bmatrix} \quad -\lambda(\lambda - 8/27)$$

$$J_{(0,1/7)} = \begin{bmatrix} 5/7 & 0 \\ 25/49 & 0 \\ -2/7 & \end{bmatrix} \quad -\lambda(\lambda - 5^3/7^3)$$

$$J_{(2/11,1/11)} = \begin{bmatrix} 5/11 & -10/11 \\ -2/11 & 4/11 \end{bmatrix} \quad \lambda^2 - \frac{9\lambda}{11} =$$

ALL POINTS ARE STABLE

$\lambda = 0, 8/27 < 1$

$\lambda = 0, \frac{125}{343} < 1$

$\lambda = 0, 9/11 < 1$