

MATH 330 - HW #13

$$\begin{matrix} 2x + x \\ 2+y & 3x \end{matrix}$$

1.

$$\begin{cases} x = \frac{x}{3+y} \\ y = \frac{y}{2+x} \end{cases} \Rightarrow \begin{aligned} 2x+xy &= 0; \quad x(2+y)=0 \\ y+xy &= 0; \quad y(1+x)=0 \end{aligned} \quad SS_1 = (0,0), \quad SS_2 = (-1,-2)$$

$$J = \begin{bmatrix} \frac{1}{3+y} & -\frac{x}{(3+y)^2} \\ \frac{-y}{(2+x)^2} & \frac{1}{2+x} \end{bmatrix} \quad J(SS_1) = \begin{bmatrix} 1/3 & 0 \\ 0 & 1/2 \end{bmatrix} \quad \lambda_1 = 1/3, \lambda_2 = 1/2 \quad \text{stable}$$

$$J(SS_2) = \begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix} \quad (\lambda = 1 \pm \sqrt{2}) \quad \text{unstable; } |\lambda| < 1 \text{ } \lambda$$

$$\boxed{\begin{aligned} SS_1 &= (0,0); \text{stable} \\ SS_2 &= (-1,-2); \text{unstable} \end{aligned}}$$

2.

$$\begin{cases} x = \frac{x}{3x+5y} \\ y = \frac{y}{2x+7y} \end{cases} \Rightarrow \begin{aligned} 3x^2+5xy-x &= 0; \quad x(3x+5y-1)=0 \\ 7y^2+2xy-y &= 0; \quad y(7y+2x-1)=0 \end{aligned} \quad SS_1 = (2/11, 1/11)$$

$$J = \begin{bmatrix} \frac{5y}{(3x+5y)^2} & \frac{-5x}{(3x+5y)^2} \\ \frac{-2y}{(2x+7y)^2} & \frac{2x}{(2x+7y)^2} \end{bmatrix} \quad J(SS_1) = \begin{bmatrix} 5/11 & -10/11 \\ -2/11 & 4/11 \end{bmatrix} \quad \lambda_1 = 0, \lambda_2 = 9/11 \quad \text{stable}$$

$$\boxed{SS_1 = (2/11, 1/11); \text{stable}}$$