

Problem Set #2: Phase planes and bifurcation diagrams

Due: Friday October 13, 2006

Consider the following models:

Model 1:

$$\frac{dx}{dt} = -k_1x + k_2\frac{y}{k_y + y^2} \quad (1a)$$

$$\frac{dy}{dt} = -k_1y + k_2\frac{x}{k_x + x^2} \quad (1b)$$

Model 2:

$$\frac{dx}{dt} = k_1x - k_2y + k_3xy^2 \quad (2a)$$

$$\frac{dy}{dt} = k_4x + k_1y + k_3y^3 \quad (2b)$$

Model 3:

$$\frac{dx}{dt} = k_4A - k_1x - k_2x + k_3x^2y \quad (3a)$$

$$\frac{dy}{dt} = k_1x - k_3x^2y \quad (3b)$$

Choose two of the three models and investigate them using the tools developed in class.

Please hand in (where applicable):

- The non-dimensional model, indicating all characteristic scales and parameter groupings
- Phase portraits for several choices of parameters, indicating interesting features and an interpretation of the solutions in terms of the dynamics of the original system
- Bifurcation diagrams with respect to parameters of interest (bifurcation parameters)
- Eigenvalue plots with respect to the bifurcation parameter, to explain what's happening at the bifurcation and why
- Two parameter continuation plots