MA 138 Worksheet #29

Sections 11.2 & 11.3

4/23/24

1. Determine the system of differential equations corresponding to the compartment model as in Figure 11.40 of the textbook (p. 677)

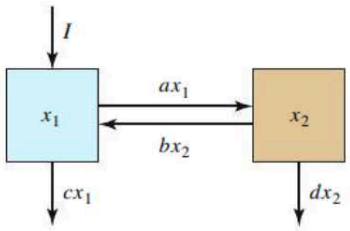

Figure 11.40 A schematic description of a general two-compartment model.

when the parameters have values $I = 0$ (no inflow of matter into the system), $a = 2.5, b = 0.7, c = 0, d = 0.1$. Then analyze the stability of the equilibrium $(0, 0)$.

2. Find all the equilibria of

$$\begin{cases} \dfrac{dx_1}{dt} &= 4x_1(1-x_1) - 2x_1x_2 \\ \dfrac{dx_2}{dt} &= x_2(2-x_2) - x_2 \end{cases}$$

and use the analytical approach to determine the stability of each equilibrium.

3. For which value of a has

$$\begin{cases} \dfrac{dx_1}{dt} &= x_2(x_1+a) \\ \dfrac{dx_2}{dt} &= x_2^2 + x_2 - x_1 \end{cases}$$

a unique equilibrium? Use the analytical approach to characterize its stability.

4. (Same system as in problem #2) Find all the equilibria of

$$\begin{cases} \dfrac{dx_1}{dt} &= 4x_1(1-x_1) - 2x_1x_2 \\ \dfrac{dx_2}{dt} &= x_2(2-x_2) - x_2 \end{cases}$$

and use the graphical approach (as described in the 3rd edition of the textbook by Neuhauser) to determine the stability of each equilibrium.