

Michaelis-Menten Kinetics

Remark: Before proceeding, we recommend that you familiarize yourself with basic XPP syntax via the introductory Chapter 1 examples `ch1-riccati.ode` and `ch1-van-der-Pol.ode` and their accompanying documentation.

The plain text file `ch4-mm.ode` is an XPP script for numerical solution of the equations

$$\begin{aligned}x' &= -x(1 - y) + y \\ \varepsilon y' &= x(1 - y) - (1 + \kappa)y,\end{aligned}$$

where ε and κ are positive parameters (See Section 4.4.5 of our textbook for details).

The default parameter values, initial conditions, and viewing window are all specified in the `ch4-mm.ode` file. For the purposes of the following exercises, the default viewing window and parameter values serve as a useful starting point.

Here are some experiments to try with this XPP script:

1. Load the file `ch4-mm.ode` into XPP. Use **I**nitialconds and **G**o to plot a solution trajectory (in the y versus x phase plane) using the default initial conditions and parameter choices.
2. Have XPP plot the *nullclines*: From the main XPP menu, select **N**ullclines and then choose **N**ew.
3. With $\varepsilon = 0.1$ and $\kappa = 4$, sketch a phase portrait for these equations. From the main menu select **D**ir. field/flow and then **F**low. At the top of the screen, you will be prompted to enter a number that tells XPP how fine of a “Grid” to sample from when selecting initial conditions for the trajectories that will be plotted (the default value is 10). Either hit **E**nter to accept the default value or consider changing the 10 to a 5 in order to reduce the number of trajectories that are plotted.
4. If you execute the preceding step correctly, you should see that for those parameter choices, trajectories are nearly vertical during their rapid approach to the y -nullcline. Then, they hug the y -nullcline, gradually approaching the equilibrium at the origin.
5. For more XPP documentation, be sure to refer to Bard Ermentrout’s XPP website at

<http://www.math.pitt.edu/~bard/xpp/xpp.html>