Example of Solving Differential Equations with Matlab 5

Suppose we want to use Matlab to solve the predator-prey (Lotka-Volterra) system

$$\begin{aligned} f' &= \alpha f - \beta f s \\ s' &= -\gamma s + \delta f s \end{aligned}$$

($\alpha, \beta, \gamma, \delta$ positive contstants).

First we create a function that computes the RHS of the system of equations. To do this, put the following in the file `f.m`:

```
function y=f(t,x,flag,alpha,beta,gamma,delta)
y = [ x(1)*(alpha-beta*x(2)) ; x(2)*(-gamma+delta*x(1)) ];
```

Here x is the vector $\begin{pmatrix} f \\ s \end{pmatrix}$.

Suppose we want to solve the system for the case $\alpha = 500$, $\beta = 3$, $\gamma = 800$, $\delta = 3$, taking 3 possible initial conditions

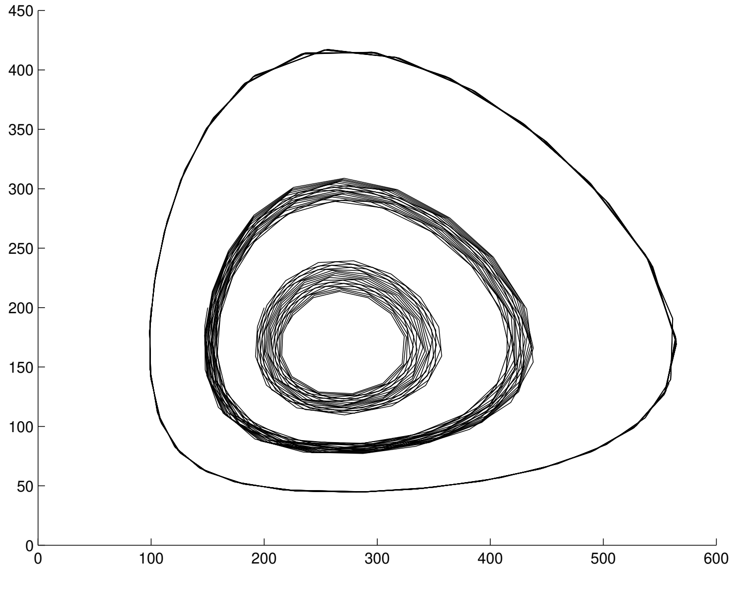
$$\begin{pmatrix} f \\ s \end{pmatrix}(0) = \begin{pmatrix} 100 \\ 200 \end{pmatrix}, \begin{pmatrix} 150 \\ 200 \end{pmatrix}, \text{ or } \begin{pmatrix} 200 \\ 200 \end{pmatrix},$$

and in each case running from $t = 0$ to $t = 0.2$. To do this (and plot the results) with the simplest solver (ode23) you can write:

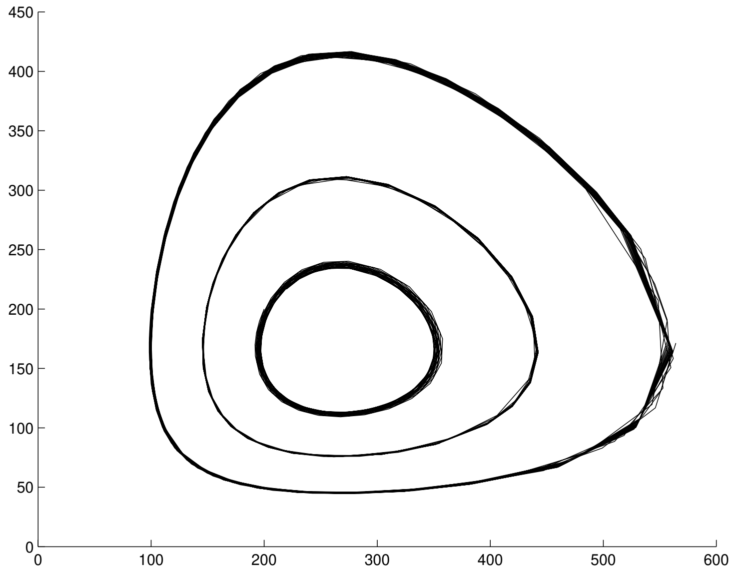
```
hold on
[t x] = ode23('f',[0 0.2],[100 200],[],500,3,800,3);
plot( x(:,1), x(:,2) )
[t x] = ode23('f',[0 0.2],[150 200],[],500,3,800,3);
plot( x(:,1), x(:,2) )
[t x] = ode23('f',[0 0.2],[200 200],[],500,3,800,3);
plot( x(:,1), x(:,2) )
```

Note the arguments of ode23. The first is the name of the function defining the system of differential equations. The second is the range of t. The third is the initial condition. The fourth is an optioon set (here I take the defaults by writing []). Then afterwards come the parameters to be passed to `f`.

Here is the result:



Slightly better results can be gained using the ode45 solver (just change "ode23" to "ode45" in the commands, everything else shouild be left the same):



0
50
100
150
200
250
300
350
400
450
0
100
200
300
400
500
600