

1. Consider the linear systems

$$\frac{dY}{dt} = AY,$$

where

(a)  $A = \begin{pmatrix} -2 & -1 \\ 1 & -4 \end{pmatrix}$

(b)  $A = \begin{pmatrix} 2 & 4 \\ 3 & 6 \end{pmatrix}$

For each system

- Use Matlab (command window) to set up  $A$  (for example,  $A=[2 \ -2;-1 \ 3]$ )
- Use Matlab to find the eigenvalues and eigenvectors ( $[v,d]=\text{eig}(A)$ ). Note that Matlab find the eigenvectors so that their norm is 1. You may want to divide through by one of the components to make them easier to draw.
- Write down the general solution of the linear system, and sketch the phase portrait
- Use `pplane` to draw the phase portrait and compare with your sketch. Describe the long term behaviour of the solutions.

2. Consider the system

$$\frac{dY}{dt} = \begin{pmatrix} a & a \\ 1 & 2a \end{pmatrix} Y,$$

where  $a$  is a parameter. For each of the values of  $a$  in  $\{2, -2, -8, 1/2\}$ :

- Use Matlab (command window) to set up the matrix above
- Use Matlab to find the eigenvalues and eigenvectors of the matrix
- Use `pplane` to draw the phase portrait. What do you notice?