
Lesson 55 - Solving Homogeneous Linear Systems I
Objectives

- Use Mathematica to find the eigenvalues and eigenvectors of a matrix.
- Write the general solution of a system of differential equations.

READ

- Differential Equations Supplemental, section 8.2 (Homogeneous Linear Systems), minus section titled “Phase Portrait”, page 340-341.
- Review MA103 Student Text, Chapter 4.4, 4.5, and 4.6 (Eigenvalues and Eigenvectors)

MATHEMATICA COMMANDS AND TASKS YOU NEED TO KNOW**Finding the eigenvalues and eigenvectors of a matrix:**

The command `Eigensystem` can be used to find the eigenvalues and associated eigenvectors of a matrix. For example, to find the eigenvalues and eigenvectors of the matrix

$$\begin{bmatrix} 3 & 4 \\ 1 & 0 \end{bmatrix}$$

You can input the following into Mathematica:

```
In[1]:= Eigensystem[ $\begin{pmatrix} 3 & 4 \\ 1 & 0 \end{pmatrix}$ ]
```

```
Out[1]= {{4, -1}, {{4, 1}, {-1, 1}}}
```

The output of the system is a list with two items. The first item in the list is the list of eigenvalues. In this case, the eigenvalues are $\lambda_1 = 4$, and $\lambda_2 = -1$. The second item in the list is another list containing the eigenvectors associated with the eigenvalues in the first list. In this case, the eigenvector associated with the eigenvalue $\lambda_1 = 4$ is the vector $\mathbf{K}_1 = \begin{bmatrix} 4 \\ 1 \end{bmatrix}$, and the eigenvector associated with the eigenvalue $\lambda_2 = -1$ is the vector $\mathbf{K}_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$.