1. Let

$$w_1 = \begin{bmatrix} 2/3 \\ -1/3 \\ -2/3 \end{bmatrix}, \quad w_2 = \begin{bmatrix} 1/\sqrt{2} \\ 0 \\ 1/\sqrt{2} \end{bmatrix} \quad \text{and} \quad v = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}.$$

   Find the lengths of w_1 and w_2, their inner product, the distance between them, the angle between them, and the orthogonal complement of $W = \mathcal{L}(w_1, w_2)$. Is $v \in W^\perp$? Is $v \in W$? Find the orthogonal projection of v onto W, as well as the minimal distance from v to W.

2. Suppose that a force y is applied to one end of a spring that has its other end fixed, thus stretching it to a length x. In physics, *Hooke's law* states that (within certain limits) there is a linear relation between x and y. That is, there are constants α and β with $y = \alpha + \beta x$. The coefficient β is called the *spring constant*. Use the following data to (least-square) estimate the spring constant.

Length x (in.)	3.5	4.0	4.5	5.0
Force y (lb.)	1.0	2.2	2.8	4.3

3. Compute the determinant of

$$\begin{bmatrix} 0 & -1 & 0 & 1 \\ -2 & 3 & 1 & 4 \\ 1 & -2 & 2 & 3 \\ 0 & 1 & 0 & -2 \end{bmatrix}$$

   by a cofactor expansion along the fourth row.

4. Find all eigenvalues and corresponding eigenvectors for

$$\begin{bmatrix} 0 & -2 \\ -3 & 1 \end{bmatrix}.$$