-> describe how the „Eigensystem" routine works:

Eigensystem[M]

↳ M: squared matrix

Lists

{Values} {Vectors}

Normalization

- For exact or symbolic matrices m, the eigenvectors are not normalized.
- For approximate numerical matrices m, the eigenvectors are normalized.

Generalized equation for eigenvalues and eigenvectors:

$$\boxed{M v^T = v^T \Lambda}$$

v -> vectors

Λ -> diagonal matrix created from the list of eigenvalues

$$q1 = \begin{pmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{pmatrix} \quad \boxed{M} \quad (1)$$

In[17]:= Eigensystem[q1]

Out[17]= {{4, −2, −2}, {{1, 1, 2}, {−1, 0, 1}, {1, 1, 0}}}

Eigenvalues

In[18]:= Eigensystem[q1][[1]]

Out[18]= {4, −2, −2}

Eigenvectors

In[19]:= Eigensystem[q1][[2]]

Out[19]= {{1, 1, 2}, {−1, 0, 1}, {1, 1, 0}}

v_1 v_2 v_3

In[20]:= Eigensystem[q1][[2]] // MatrixForm

Out[20]//MatrixForm=

$$\begin{pmatrix} \boxed{1 \quad 1 \quad 2} \\ \boxed{-1 \quad 0 \quad 1} \\ \boxed{1 \quad 1 \quad 0} \end{pmatrix}
\begin{array}{l}
\to v_1 \quad [v_{11} \quad v_{12} \quad v_{13}] \\
\to v_2 \quad [v_{21} \quad v_{22} \quad v_{23}] \\
\to v_3 \quad [v_{31} \quad v_{32} \quad v_{33}]
\end{array}$$

In[22]:= Transpose[Eigensystem[q1][[2]]] // MatrixForm

Out[22]//MatrixForm=

$$\begin{pmatrix} 1 & -1 & 1 \\ 1 & 0 & 1 \\ 2 & 1 & 0 \end{pmatrix} \qquad \boxed{v^T} \quad (2)$$

In[23]:= DiagonalMatrix[Eigensystem[q1][[1]]] // MatrixForm

Out[23]//MatrixForm=

$$\begin{pmatrix} 4 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -2 \end{pmatrix} \qquad \boxed{\Lambda} \quad (3)$$

$$M v^T = v^T \Lambda$$

- ☐ test the symbolic calculation
- ☐ test numerical calculation