

Problem Q5.2. *Solution.* We have $b = [3, 1, 0]^T$. We know that $b = Pb + (b - Pb)$. We calculate the orthogonal projection $Pb = AA^Tb$:

$$\begin{aligned} \begin{bmatrix} 1 & 2 \\ 0 & 1 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} 1 & 0 & -1 \\ 2 & 1 & 2 \end{bmatrix} \begin{bmatrix} 3 \\ 1 \\ 0 \end{bmatrix} &= \begin{bmatrix} 5 & 2 & 3 \\ 2 & 1 & 2 \\ 3 & 2 & 5 \end{bmatrix} \begin{bmatrix} 3 \\ 1 \\ 0 \end{bmatrix} \\ &= \begin{bmatrix} 17 \\ 7 \\ 11 \end{bmatrix}. \end{aligned}$$