**Question 1.3.5**

Verify that

$$(\mathbf{A}-\mathbf{H})^{\top}(\mathbf{B}-\mathbf{C})=0 \tag{1}$$

**Solution:**

$$\mathbf{A}=\begin{pmatrix}1\\-1\end{pmatrix} \tag{2}$$

$$\mathbf{B}=\begin{pmatrix}-4\\6\end{pmatrix} \tag{3}$$

$$\mathbf{C}=\begin{pmatrix}-3\\-5\end{pmatrix} \tag{4}$$

$$\mathbf{H}=\begin{pmatrix}\frac{17}{6}\\\frac{-5}{6}\end{pmatrix} \tag{5}$$

Substitute these values in the given expression

$$=\left(\begin{pmatrix}1\\-1\end{pmatrix}-\begin{pmatrix}\frac{17}{6}\\\frac{-5}{6}\end{pmatrix}\right)^{\top}\left(\begin{pmatrix}-4\\6\end{pmatrix}-\begin{pmatrix}-3\\-5\end{pmatrix}\right) \tag{6}$$

$$=\begin{pmatrix}\frac{-11}{6}\\\frac{-1}{6}\end{pmatrix}^{\top}\begin{pmatrix}-1\\11\end{pmatrix} \tag{7}$$

$$=\begin{pmatrix}\frac{-11}{6} & \frac{-1}{6}\end{pmatrix}\begin{pmatrix}-1\\11\end{pmatrix} \tag{8}$$

$$=\frac{11}{6}-\frac{11}{6} \tag{9}$$

$$=0 \tag{10}$$

Hence verified.