Q2) $v_1 = [1,1,1]$ $v_2 = [1,0,0]$

$p_1 = [3,3,3]$ $p_2 = [1,2,3]$ $p_3 = [0,0,1]$

$$V = \begin{bmatrix} 1 & 1 \\ 1 & 0 \\ 3 & 0 \end{bmatrix} \qquad V^T V = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \\ 3 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 11 & 1 \\ 1 & 1 \end{bmatrix}$$

$$(V^T \cdot V)^{-1} = \begin{bmatrix} 0.1 & -0.1 \\ -0.1 & 1.1 \end{bmatrix}$$

$$(V^T \cdot V)^{-1} V^T = \begin{bmatrix} 0.1 & -0.1 \\ -0.1 & 1.1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 3 \\ 1 & 0 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0.1 & 0.3 \\ 1 & -0.1 & -0.3 \end{bmatrix}$$

$$\beta_1^* = (V^T \cdot V)^{-1} V^T p_1 = \begin{bmatrix} 0 & 0.1 & 0.3 \\ 1 & -0.1 & -0.3 \end{bmatrix} \begin{bmatrix} 3 \\ 3 \\ 3 \end{bmatrix}$$

$$= \boxed{\begin{bmatrix} 1.2 \\ 1.8 \end{bmatrix}}$$

$$\beta_2^* = (V^T \cdot V)^{-1} V^T p_2 = \begin{bmatrix} 0 & 0.1 & 0.3 \\ 1 & -0.1 & -0.3 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

$$= \boxed{\begin{bmatrix} 1.1 \\ -0.3 \end{bmatrix}}$$

$$\beta_3^* = (V^T \cdot V)^{-1} V^T p_3 = \begin{bmatrix} 0 & 0.1 & 0.3 \\ 1 & -0.1 & -0.3 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$= \boxed{\begin{bmatrix} 0.3 \\ -0.3 \end{bmatrix}}$$