$$B^{-1} = \frac{1}{8}\begin{bmatrix} 1 & -3 \\ 2 & 6 \end{bmatrix} \qquad (B^T)^{-1} = \frac{1}{8}\begin{bmatrix} 1 & 2 \\ -3 & 2 \end{bmatrix}$$

$$Bx_B^* = b \to x_B^* = B^{-1}b = \frac{1}{8}\begin{bmatrix} 1 & -3 \\ 2 & 2 \end{bmatrix}\begin{bmatrix} 4 \\ 2 \end{bmatrix} = \frac{1}{8}\begin{bmatrix} -2 \\ 12 \end{bmatrix}$$

$$c_1^T x_B^* = \frac{-2}{8} = \frac{-1}{4} \quad , \quad c_2^T x_B^* = \frac{12}{8} = \frac{6}{4} = \frac{3}{2}$$

$$B^T z = c_B^* \to z = (B^T)^{-1}c_B^* = \frac{1}{8}\begin{bmatrix} 1 & 2 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 4 \\ 2 \end{bmatrix} = \frac{1}{8}\begin{bmatrix} 8 \\ -8 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

$$r = c_N^* - N^T z = \begin{bmatrix} 1 \\ 4 \\ 2 \end{bmatrix} - \begin{bmatrix} -2 & 0 \\ 1 & 2 \\ 2 & 3 \end{bmatrix}\begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \\ -2 \end{bmatrix} - \begin{bmatrix} -2 \\ -1 \\ -1 \end{bmatrix} = \begin{bmatrix} 3 \\ 5 \\ \boxed{-1} \end{bmatrix}$$

most negative,
$i = 3$