

Step-1

Thus, we have

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix} = \begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix} \begin{vmatrix} 1 & 2 \\ 4 & 5 \\ 7 & 8 \end{vmatrix}$$

The elements along the diagonal are $(1,5,9)$, $(2,6,7)$, and $(3,4,8)$. The elements along the anti diagonal are $(2,4,9)$, $(1,6,8)$, and $(3,5,7)$.

Therefore, $\det(A) = (1 \times 5 \times 9 + 2 \times 6 \times 7 + 3 \times 4 \times 8) - (2 \times 4 \times 9 + 1 \times 6 \times 8 + 3 \times 5 \times 7)$.

Step-2

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

Consider the matrix

Observe that $2A - \text{Row } 2 \hat{=} \text{Row } 3 = \text{Row } 1$.

Therefore, the rows of the above matrix are not linearly independent. Therefore, this matrix is not invertible.

Step-3

Also, note the following:

$$\begin{aligned} \det(A) &= (1 \times 5 \times 9 + 2 \times 6 \times 7 + 3 \times 4 \times 8) - (2 \times 4 \times 9 + 1 \times 6 \times 8 + 3 \times 5 \times 7) \\ &= (45 + 84 + 96) - (72 + 48 + 105) \\ &= 225 - 225 \\ &= \boxed{0} \end{aligned}$$

This also tells us that the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ is not invertible.