

2) Scalar multiplication

Let $A = [a_{ij}]$ be $m \times n$ matrix and r is a real number then the scalar multiple of A by r

(denoted by rA) defined to the matrix $D = [d_{ij}]$, where $d_{ij} = r a_{ij}$, $1 \leq i \leq m$, $1 \leq j \leq n$

Example $A = [a_{ij}]$, $r = 2$, $2A = [2a_{ij}]$

3) Matrix multiplication

Let $A = [a_{ij}]$ be $m \times p$ matrix, $B = [b_{ij}]$ be $p \times n$ matrix then the product of A and B (denoted by

AB) defined to be the $m \times n$ matrix $C = [c_{ij}]$, where $c_{ij} = a_{i1}b_{1j} + a_{i2}b_{2j} + \dots + a_{ip}b_{pj}$, $1 \leq i \leq m$, $1 \leq j \leq n$

Example $A = [a_{ij}]$, $B = [b_{ij}]$, $AB = [c_{ij}]$

Let $A = [a_{ij}]$ be $m \times p$ matrix, $B = [b_{ij}]$ be $p \times n$ matrix
1) If $n \neq m$ then BA may not be defined

2) If $n = m$ then BA is $p \times p$, while AB is $m \times m$. Thus if $p \neq m$, AB and BA are different

sizes.

3) AB and BA are both of the same size. But $AB \neq BA$.

Example $A = [a_{ij}]$, $B = [b_{ij}]$, $AB = [c_{ij}]$, BA is not defined

Example $A = [a_{ij}]$, $B = [b_{ij}]$, $AB = [c_{ij}]$, $BA = [d_{ij}]$

$AB \neq BA$.

Example $A = [a_{ij}]$, $B = [b_{ij}]$, $AB = [c_{ij}]$, $BA = [d_{ij}]$

Properties of matrix addition

$$1) A+B = B + A$$

$$2) A+(B+C) = (A+B)+C$$

$$3) A+0 = 0+A$$

$$4) A+(-A) = (-A)+A = 0$$

Example $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$, $C = \begin{pmatrix} 9 & 10 \\ 11 & 12 \end{pmatrix}$

$$A+B = \begin{pmatrix} 1+5 & 2+6 \\ 3+7 & 4+8 \end{pmatrix} = \begin{pmatrix} 6 & 8 \\ 10 & 12 \end{pmatrix}$$

$$(A+B)+C = \begin{pmatrix} 6+9 & 8+10 \\ 10+11 & 12+12 \end{pmatrix} = \begin{pmatrix} 15 & 18 \\ 21 & 24 \end{pmatrix}$$

$$A+(B+C) = \begin{pmatrix} 1+9 & 2+10 \\ 3+11 & 4+12 \end{pmatrix} = \begin{pmatrix} 10 & 12 \\ 14 & 16 \end{pmatrix}$$

$$-A = \begin{pmatrix} -1 & -2 \\ -3 & -4 \end{pmatrix}$$

$$A+(-A) = \begin{pmatrix} 1-1 & 2-2 \\ 3-3 & 4-4 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$$(-A)+A = \begin{pmatrix} -1+1 & -2+2 \\ -3+3 & -4+4 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$

$$A+0 = \begin{pmatrix} 1+0 & 2+0 \\ 3+0 & 4+0 \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

$$0+A = \begin{pmatrix} 0+1 & 0+2 \\ 0+3 & 0+4 \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

$$A-B = A + (-B)$$

Example A = , B =

-B =

A-B = A +(-B) =