

## Multiplying Matrices

The product of two matrices A and B is defined provided the number of columns in A is equal to the number of rows in B.

If A is an  $m \times n$  matrix and B is an  $n \times p$  matrix, then the product of AB is an  $m \times p$  matrix.

$$\begin{array}{ccccc} A & \times & B & = & AB \\ m \times n & & n \times p & & m \times p \end{array}$$

State whether the product of AB is defined. If so, give the dimension of AB.

a) A:  $2 \times 3$ , B:  $3 \times 4$

b) A:  $3 \times 2$ , B:  $3 \times 4$

Yes

No.

AB:  $2 \times 4$

$$\begin{bmatrix} - & - & - & - \\ - & - & - & - \end{bmatrix}$$

Find AB if

$$A = \begin{array}{c} 3 \times 2 \\ \begin{bmatrix} -2 & 3 \\ 1 & -4 \\ 6 & 0 \end{bmatrix} \end{array} \quad \text{and} \quad B = \begin{array}{c} 2 \times 2 \\ \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix} \end{array}$$

Solution: Because A is a  $3 \times 2$  matrix and B is a  $2 \times 2$  matrix, the product AB is defined and is a  $3 \times 2$  matrix.

$$\begin{bmatrix} - & - \\ - & - \\ - & - \end{bmatrix}$$

To write the entry in the first row and first column of AB, multiply corresponding entries in the first row of A and the first column of B. Then add. Use a similar procedure to write the other entries of the product.

$$A = \begin{array}{c} \begin{bmatrix} -2 & 3 \\ 1 & -4 \\ 6 & 0 \end{bmatrix} \end{array} \quad \text{and} \quad B = \begin{array}{c} \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix} \end{array}$$

$$AB = \begin{bmatrix} -4 & 6 \\ 7 & -13 \\ 6 & 18 \end{bmatrix}$$

If  $A = \begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & -4 \\ 2 & 1 \end{bmatrix}$ , find each product.

a)  $AB$

$$\begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} 1 & -4 \\ 2 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 7 & -10 \\ -1 & 4 \end{bmatrix}$$

b)  $BA$

$$\begin{bmatrix} 1 & -4 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 7 & 2 \\ 5 & 4 \end{bmatrix}$$

If  $A = \begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix}$ ,  $B = \begin{bmatrix} -2 & 0 \\ 4 & 2 \end{bmatrix}$ , and  $C = \begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix}$ , simplify each product.

a)  $A(B + C)$

$$\begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix} \left[ \begin{bmatrix} -2 & 0 \\ 4 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix} \right]$$

$$\begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} -1 & 1 \\ 7 & 4 \end{bmatrix}$$

$$\begin{bmatrix} 5 & 6 \\ 22 & 11 \end{bmatrix}$$

b)  $AB + AC$

$$\begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} -2 & 0 \\ 4 & 2 \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 3 & 2 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 2 \\ 14 & 6 \end{bmatrix} + \begin{bmatrix} 5 & 4 \\ 8 & 5 \end{bmatrix}$$

$$\begin{bmatrix} 5 & 6 \\ 22 & 11 \end{bmatrix}$$

Assignment:

p. 211

# 18-34 evens

AND

Take-Home Quiz 4.1-4.2