4.3 Matrix Reloaded

Practice Tasks

_____

I. Concepts and Procedures

1. Matrix _____ multiplication occurs when an entire matrix is multiplied by any real number

2. For the matrices given below, perform each of the following calculations or explain why the calculation is not possible.

$$A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \qquad\qquad B = \begin{bmatrix} 2 & 1 \\ -1 & 4 \end{bmatrix}$$

$$C = \begin{bmatrix} 5 & 2 & 9 \\ 6 & 1 & 3 \\ -1 & 1 & 0 \end{bmatrix} \qquad\qquad D = \begin{bmatrix} 1 & 6 & 0 \\ 3 & 0 & 2 \\ 1 & 3 & -2 \end{bmatrix}$$

a. $A + B$

b. $2A - B$

c. $A + C$

d. $-2C$

e. $4D - 2C$

f. $3B - 3B$

g. $5B - C$

h. $B - 3A$

i. $C + 10D$

j. $\frac{1}{2}C + D$

k. $\frac{1}{4}B$

l. $3D - 4A$

m. $\frac{1}{3}B - \frac{2}{3}A$

3. For the matrices given below, perform each of the following calculations or explain why the calculation is not possible.

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 3 & 0 & 2 \end{bmatrix} \qquad\qquad B = \begin{bmatrix} 2 & 1 \\ 3 & 6 \\ 1 & 0 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & -2 & 3 \\ 1 & 1 & 4 \end{bmatrix} \qquad\qquad D = \begin{bmatrix} 2 & -1 \\ -1 & 0 \\ 4 & 1 \end{bmatrix}$$

a. $A + 2B$

b. $2A - C$

c. $A + C$

d. $-2C$

e. $4D - 2C$

f. $3D - 3D$

g. $5B - D$

h. $C - 3A$

i. $B + 10D$

j. $\frac{1}{2}C + A$

k. $\frac{1}{4}B$

l. $3A + 3B$

m. $\frac{1}{3}B - \frac{2}{3}D$

4. Let $A = \begin{bmatrix} 3 & \frac{2}{3} \\ -1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} \frac{1}{2} & \frac{3}{2} \\ 4 & 1 \end{bmatrix}$

a. Let $C = 6A + 6B$. Find matrix C.

b. Let $D = 6(A + B)$. Find matrix D.

c. What is the relationship between matrices C and D? Why do you think that is?

5. Let $A = \begin{bmatrix} 3 & 2 \\ -1 & 5 \\ 3 & -4 \end{bmatrix}$ and X be a 3×2 matrix. If $A + X = \begin{bmatrix} -2 & 3 \\ 4 & 1 \\ 1 & -5 \end{bmatrix}$, then find X.

II. Problem Solving

1. Suppose that April's Pet Supply has three stores in Cities 1, 2, and 3. Ben's Pet Mart has two stores in Cities 1 and 2. Each shop sells the same type of dog crates in size 1 (small), 2 (medium), 3 (large), and 4 (extra large).

   April's and Ben's inventory in each city are stored in the tables below.

April's Pet Supply			
	City 1	City 2	City 3
Size 1	3	5	1
Size 2	4	2	9
Size 3	1	4	2
Size 4	0	0	1

Ben's Pet Mart		
	City 1	City 2
Size 1	2	3
Size 2	0	2
Size 3	4	1
Size 4	0	0

   a. Create a matrix A so that $a_{i,j}$ represents the number of crates of size i available in April's store j.

   b. Explain how the matrix $B = \begin{bmatrix} 2 & 3 & 0 \\ 0 & 2 & 0 \\ 4 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ can represent the dog crate inventory at Ben's Pet Mart.

   c. Suppose that April and Ben merge their inventories. Find a matrix that represents their combined inventory in each of the three cities.

2. Jackie has two businesses she is considering buying and a business plan that could work for both. Consider the tables below, and answer the questions following.

Horus's One-Stop Warehouse Supply		
	If business stays the same	If business improves as projected
Expand to Multiple States	−$75,000,000	$45,000,000
Invest in Drone Delivery	−$33,000,000	$30,000,000
Close and Sell Out	$20,000,000	$20,000,000

Re's 24-Hour Distributions		
	If business stays the same	If business improves as projected
Expand to Multiple States	−$99,000,000	$62,500,000
Invest in Drone Delivery	−$49,000,000	$29,000,000
Close and Sell Out	$35,000,000	$35,000,000

  a. Create matrices H and R representing the values in the tables above such that the rows represent the different options and the columns represent the different outcomes of each option.
  b. Calculate $R - H$. What does $R - H$ represent?
  c. Calculate $H + R$. What does $H + R$ represent?
  d. Jackie estimates that the economy could cause fluctuations in her numbers by as much as 5% both ways. Find matrices to represent the best and worst case scenarios for Jackie.
  e. Which business should Jackie buy? Which of the three options should she choose? Explain your choices.

III.   Reasoning

1. Let $A = \begin{bmatrix} 1 & 3 & 2 \\ 3 & 1 & 2 \\ 4 & 3 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 & 3 \\ 2 & 2 & 1 \\ 1 & 3 & 1 \end{bmatrix}$ represent the bus routes of two companies between three cities.
  a. Let $C = A + B$. Find matrix C. Explain what the resulting matrix and entry $c_{1,3}$ mean in this context.
  b. Let $D = B + A$. Find matrix D. Explain what the resulting matrix and entry $d_{1,3}$ mean in this context.
  c. What is the relationship between matrices C and D? Why do you think that is?