Unit 2 Day 5
MATRICES

MATRIX Applications

Quiz 1

Warm-Up

Remember: Phones OFF and in Blue Pockets! Check the list. ☺

Tracey, Danica, and Sherri are having another girl's sleepover – and are buying snacks again. They each bought the items shown in the following table at the local convenience store. Calculate the unit price of each snack purchased by the girls.

	Number of bags of chips	**Number of bottles of soda**	**Number of chocolate bars**	**Cost ($)**
Tracey	4	4	6	21.00
Danica	3	2	10	20.88
Sherri	2	3	4	13.17

a. Define the variables.
b. Express the problem as a system of linear equations
c. Solve the problem using matrices
d. Express the solution as a complete sentence.

Warm-Up ANSWERS

Tracey, Danica, and Sherri bought snacks for a girls' sleepover. They each bought the items shown in the following table at the local convenience store. Calculate the unit price of each snack purchased by the girls.

Number of bags of potato chips	**Number of bottles of soda**	**Number of chocolate bars**	**Cost ($)**
4	4	6	21.00
3	2	10	20.88
2	3	4	13.17

a. Define the variables. c = price of one bag of potato chips, p = price of one bottle of soda , b = price of one chocolate bar

b. Express the problem as a system of linear equations

$$4c + 4p + 6b = 21.00$$
$$3c + 2p + 10b = 20.88$$
$$2c + 3p + 4b = 13.17$$

c. Solve the problem using matrices

$$\begin{bmatrix} 4 & 4 & 6 \\ 3 & 2 & 10 \\ 2 & 3 & 4 \end{bmatrix} \bullet \begin{bmatrix} c \\ p \\ b \end{bmatrix} = \begin{bmatrix} 21.00 \\ 20.88 \\ 13.17 \end{bmatrix} \text{ then do } A^{-1} \bullet B$$

d. Express the solution as a complete sentence.

The price of one bag of potato chips is $1.98. The price of one bottle of soda is $1.47. The price of one chocolate bar is $1.20

Tonight's Homework

Finish Coding and Decoding Handout – Front and Back (from yesterday)

Extra Practice before quiz

- If time allows…

Multiplication Practice #1

A toy maker creates toy car sets and toy train sets. The following table is used in calculating the cost of manufacturing each toy.

Labor costs $8 per hour, metal costs $1 per piece, and paint costs $2 per can.

	Labor (Hours)	Metal (Pieces)	Paint (Cans)
Car set	**6**	**4**	**3**
Train set	**3**	**4**	**2**

a. Express the data with matrices.
b. Use matrix operations to find the total cost of each car and each train.
c. Express the solution as a complete sentence.

Multiplication Practice #1

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Labor costs \$8 per hour, metal costs \$1 per piece, and paint costs \$2 per can.

	Labor (Hours)	Metal (Pieces)	Paint (Cans)
Car set	**6**	**4**	**3**
Train set	**3**	**4**	**2**

a. Express the data with matrices.

b. Use matrix operations to find the total cost of each car and train.

$$A = \begin{array}{r} \\ Cars \\ Trains \end{array}\begin{array}{c} \begin{array}{ccc} L & M & P \end{array} \\ \begin{pmatrix} 6 & 4 & 3 \\ 3 & 4 & 2 \end{pmatrix} \end{array}, \quad B = \begin{array}{r} \\ L \\ M \\ P \end{array}\begin{array}{c} \text{Cost} \\ \begin{pmatrix} 8 \\ 1 \\ 2 \end{pmatrix} \end{array}$$

$$C = AB$$

$$C = \begin{array}{r} Cars \\ Trains \end{array}\begin{pmatrix} 6(8)+4(1)+3(2) \\ 3(8)+4(1)+2(2) \end{pmatrix} = \begin{array}{c} \text{Cost} \\ \begin{pmatrix} 58 \\ 32 \end{pmatrix} \end{array}$$

c. Express the solution as a complete sentence.

The car sets cost \$58 each to manufacture and train sets cost \$32 each to manufacture.

Practice #1

Remember: Phones OFF and in Blue Pockets! Check the list. ☺

A stadium has 49,000 seats. Seats cost $25 in Section A, $20 in Section B, and $15 in Section C. The number of seats in Section A equals the total of Sections B and C. Suppose the stadium takes in $1,052,000 from each sold-out event. How many seats does each section hold?

a. Define the variables.
b. Express the problem as a system of linear equations:
c. Solve the problem using matrices
d. Express the solution as a complete sentence.

Practice #1 ANSWERS

A stadium has 49,000 seats. Seats cost $25 in Section A, $20 in Section B, and $15 in Section C. The number of seats in Section A equals the total of Sections B and C. Suppose the stadium takes in $1,052,000 from each sold-out event. How many seats does each section hold?

a. Define the variables. a = number of seats in section A
b = # of seats in section B, c = # of seats in section C

b. Express the problem as a system of linear equations

$$a + b + c = 49,000$$

$$25a + 20b + 15c = 1,052,000$$

$$a = b + c$$

c. Solve the problem using matrices

$$\begin{bmatrix} 1 & 1 & 1 \\ 25 & 20 & 15 \\ 1 & -1 & -1 \end{bmatrix} \bullet \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 49,000 \\ 1,052,000 \\ 0 \end{bmatrix}$$

$$then\, do\; A^{-1} \bullet B$$

d. Express the solution as a complete sentence.
There are 24,500 seats in section A, 14,400 seats in section B, and 10,100 seats in section C.

Systems Practice #2!

Janice, Nancy, and Donna work after school and weekends for a local shipping business. They get paid a different rate for afternoon, evenings, and weekends. The number of hours they worked during one week is given in the following information:

	Afternoons	Evenings	Weekends
Janice	5	2	3
Nancy	1	2	6
Donna	2	2	3

If Janice had worked twice the number of hours for the week, her salary would have been \$98. If Nancy had worked 2 more hours in the evening, her salary would have been \$62. If Donna had worked 1 more hour on the weekend, her salary would have been \$43. Find the rate of pay for each of the times of day worked by the girls.

Systems Practice #3

A triangle has one angle that measures 5 degrees more than twice the smallest angle, and the largest angle measures 11 degrees less than 3 times the measure of the smallest angle. Find the measures of the three angles.

a. Define the variables.
b. Express the problem as a system of linear equations
c. Solve the problem using matrices
d. Express the solution as a complete sentence.

Practice #3

A triangle has one angle that measures 5 degrees more than twice the smallest angle, and the largest angle measures 11 degrees less than 3 times the measure of the smallest angle. Find the measures of the three angles.

6. A triangle has one angle (y) that measures 5° more than twice the smallest angle, and the largest angle measures 11° less than 3 times the measure of the smallest angle. Find the measures of the three angles.

Define variable	write equations	REWRITE as systems	Matrices
x = small ∠	$y = 2x+5$	$x+y+z=180$	$A=\begin{pmatrix} 1 & 1 & 1 \\ -2 & 1 & 0 \\ -3 & 0 & 1 \end{pmatrix}$
y = Middle ∠	$z = 3x-11$	$-2x+y+0z=5$	$B=\begin{pmatrix} 180 \\ 5 \\ -11 \end{pmatrix}$
z = large ∠	$x+y+z=180$	$-3x+0y+z=-11$	

Small angle is 31° / Middle angle 67° / large angle is 82°

a. Define the variables.
b. Express the problem as a system of linear equations
c. Solve the problem using matrices
d. Express the solution as a complete sentence.

Extra practice on next slides…

Matrix Addition Examples

Ex 1:

$$\begin{bmatrix} 2 & -4 \\ 5 & 0 \\ 1 & -3 \end{bmatrix} - \begin{bmatrix} -1 & 0 \\ -2 & 1 \\ 3 & -3 \end{bmatrix} =$$

Ex 2:

$$\begin{bmatrix} 2 & -4 \\ 5 & 0 \\ 1 & -3 \end{bmatrix} - \begin{bmatrix} -1 & -2 & 3 \\ 0 & 1 & -3 \end{bmatrix} =$$

Matrix Addition Example ANSWERS

Ex 1:

$$\begin{bmatrix} 2 & -4 \\ 5 & 0 \\ 1 & -3 \end{bmatrix} - \begin{bmatrix} -1 & 0 \\ -2 & 1 \\ 3 & -3 \end{bmatrix} =$$

$$\begin{bmatrix} 3 & -4 \\ 7 & -1 \\ -2 & 0 \end{bmatrix}$$

Ex 2:

$$\begin{bmatrix} 2 & -4 \\ 5 & 0 \\ 1 & -3 \end{bmatrix} - \begin{bmatrix} -1 & -2 & 3 \\ 0 & 1 & -3 \end{bmatrix} =$$

Undefined

Adding and Subtracting Matrices

1 EXAMPLE The table shows information on ticket sales for a new movie that is showing at two theaters. Sales are for children (*C*) and adults (*A*).

Theater	*C*	*A*	*C*	*A*
1	198	350	54	439
2	201	375	58	386

a. Write two 2×2 matrices to represent matinee and evening sales.

b. Find the combined sales for the two showings.

ANSWERS Adding and Subtracting Matrices

1 EXAMPLE The table shows information on ticket sales for a new movie that is showing at two theaters. Sales are for children (C) and adults (A).

Theater	C	A	C	A
1	198	350	54	439
2	201	375	58	386

a. Write two 2 × 2 matrices to represent matinee and evening sales.

Matinee

$$\begin{array}{cc} & \begin{array}{cc} C & A \end{array} \\ \begin{array}{c} \text{Theater 1} \\ \text{Theater 2} \end{array} & \begin{bmatrix} 198 & 350 \\ 201 & 375 \end{bmatrix} \end{array}$$

Evening

$$\begin{array}{cc} & \begin{array}{cc} C & A \end{array} \\ \begin{array}{c} \text{Theater 1} \\ \text{Theater 2} \end{array} & \begin{bmatrix} 54 & 439 \\ 58 & 386 \end{bmatrix} \end{array}$$

ANSWERS Adding and Subtracting Matrices

1 EXAMPLE **(continued)**

b. Find the combined sales for the two showings.

$$\begin{bmatrix} 198 & 350 \\ 201 & 375 \end{bmatrix} + \begin{bmatrix} 54 & 439 \\ 58 & 386 \end{bmatrix} = \begin{bmatrix} 198 + 54 & 350 + 439 \\ 201 + 58 & 375 + 386 \end{bmatrix}$$

$$= \begin{array}{l} \\ \text{Theater 1} \\ \text{Theater 2} \end{array} \begin{array}{c} \begin{array}{cc} C & \;\;\;A \end{array} \\ \begin{bmatrix} 252 & 789 \\ 259 & 761 \end{bmatrix} \end{array}$$

Adding & Subtracting Matrices

You can perform matrix addition on matrices with equal dimensions.

a. $\begin{bmatrix} 9 & 0 \\ -4 & 6 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

$= \begin{bmatrix} 9+0 & 0+0 \\ -4+0 & 6+0 \end{bmatrix}$

$= \begin{bmatrix} 9 & 0 \\ -4 & 6 \end{bmatrix}$

b. $\begin{bmatrix} 3 & -8 \\ -5 & 1 \end{bmatrix} + \begin{bmatrix} -3 & 8 \\ 5 & -1 \end{bmatrix}$

$= \begin{bmatrix} 3+(-3) & -8+8 \\ -5+5 & 1+(-1) \end{bmatrix}$

$= \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

Ex. 2 Solve using matrices.

$$-3x + 4y = 5$$

$$2x - y = -10$$

$$\underbrace{\begin{bmatrix} -3 & 4 \\ 2 & -1 \end{bmatrix}}_{A} \begin{bmatrix} x \\ y \end{bmatrix} = \underbrace{\begin{bmatrix} 5 \\ -10 \end{bmatrix}}_{B}$$

$$AX = B$$

$$X = \underbrace{A^{-1}B}_{\text{We can do this in the calc.}}$$

We can do this in the calc. ☺

x = -7
y = -4

(-7, -4)