5.09 Matrix Applications Notes Date _____

For each, determine if you need to multiply matrices or write a matrix equation and solve using an inverse.

1. In football a touchdown is 6 points, a field goal is 3 points, a touchdown extra point is 1 point, and a two-point conversion is 2 points. The number of each for the top 3 teams in a high school league are given below. Use this information to determine the team that scored the most points.

Eagles scored the most points

TEAM	TD	FG	EP	2EP
Tigers	21	14	12	9
Rams	24	12	18	3
Eagles	27	7	21	2

$$\begin{matrix} & \text{Pts} \\ \text{TD} \\ \text{FG} \\ \text{EP} \\ \text{2EP} \end{matrix}\begin{bmatrix} 6 \\ 3 \\ 1 \\ 2 \end{bmatrix}$$

$$\begin{matrix} 21 & 14 & 12 & 9 \\ 24 & 12 & 18 & 3 \\ 27 & 7 & 21 & 2 \end{matrix}\begin{bmatrix} 6 \\ 3 \\ 1 \\ 2 \end{bmatrix} = \begin{matrix} 21(6)+14(3)+12(1)+9(2) \\ 24(6)+12(3)+18(1)+3(2) \\ 27(6)+7(3)+21(1)+2(2) \end{matrix}$$

$$\text{Points} = \begin{matrix} T \\ R \\ E \end{matrix}\begin{bmatrix} 198 \\ 204 \\ 208 \end{bmatrix}$$

$[3 \times 4] \checkmark [4 \times 1]$

2. A restaurant manager wants to purchase 200 sets of dishes. One design costs $25 per set, while another costs $45 per set. If she only has $7400 to spend, how many of each design should she order?

x = # of design 1 dishes
y = # of design 2 dishes

$$x + y = 200$$
$$25x + 45y = 7400$$

$$\begin{bmatrix} 1 & 1 \\ 25 & 45 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 200 \\ 7400 \end{bmatrix} \quad \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 80 \\ 120 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 25 & 45 \end{bmatrix}^{-1}\begin{bmatrix} 200 \\ 7400 \end{bmatrix}$$

$A^{-1} \cdot B$

$x = 80$
$y = 120$

3. A local coffee shop specializes in espresso drinks. The table shows the cups of each drink sold throughout the day. Determine the price of each espresso drink.

$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = A^{-1} \cdot B$

Hours	Cappuccino	Latte	Macchiato	Earnings
8-11	103	86	79	1040.25
11-2	48	32	26	406.50
2-5	45	25	18	334.00

x = cost of cappucino z = cost macchiato
y = cost latte

$$103x + 86y + 79z = 1040.25$$
$$48x + 32y + 26z = 406.50$$
$$45x + 25y + 18z = 334.00$$

$$\begin{bmatrix} 103 & 86 & 79 \\ 48 & 32 & 26 \\ 45 & 25 & 18 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1040.25 \\ 406.50 \\ 334.00 \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \$3.50 \\ \$4 \\ \$4.25 \end{bmatrix}$$

4. Claire purchased 25 total pounds of dog food, bird seed, and cat food for $100. The dog food costs $4.00/lb, the bird seed $7.00/lb, and the cat food $3.00/lb. She purchased 10 pounds more dog food than bird seed. Determine the number of pounds of each type of food Claire purchased.

x = # pounds (dog food)
y = # pounds (bird seed)
z = # pounds (cat food)

$$x + y + z = 25$$
$$4x + 7y + 3z = 100$$
$$x - 10 = y$$

$$x + y + z = 25$$
$$4x + 7y + 3z = 100$$
$$x - y + 0z = 10$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 4 & 7 & 3 \\ 1 & -1 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 25 \\ 100 \\ 10 \end{bmatrix} \rightarrow \begin{bmatrix} x \\ y \\ z \end{bmatrix} = A^{-1} \cdot B$$

$x = 13$ lbs
$y = 3$ lbs
$z = 9$ lbs

5.09 Practice

For each, determine if you need to multiply matrices or write a matrix equation and solve using an inverse.

1. Kelly, Joelle, and Emily are competitive skaters. Their routines are judged on skating skill (SS), choreography (C), and interpretation (I). In a recent competition, they received the following scores shown below. One of two weighted systems is used. System A weights SS 20%, C 50%, and I 30%. System B weights SS 40%, C 30%, and I 30%. Determine which systems favors each skater.

Skater	SS	C	I
Kelly	6	4	2
Joelle	3	5	1
Emily	2	4	6

B → Kelly, A → Joelle, A → Emily

System A $\begin{bmatrix} 0.20 \\ 0.50 \\ 0.30 \end{bmatrix}$ System B $\begin{bmatrix} 0.40 \\ 0.30 \\ 0.20 \end{bmatrix}$

$3\times 3 \quad 3\times 2$

$\begin{matrix} 6 & 4 & 2 \\ 3 & 5 & 1 \\ 2 & 4 & 6 \end{matrix}$

$\begin{matrix} 3.8 \\ 3.4 \\ 4.2 \end{matrix}$ $\begin{matrix} 4.2 \\ 3 \\ 3.8 \end{matrix}$

2. A recently retired couple needs $8,000 per year to supplement their Social Security. They have $100,000 to invest to obtain this income. They have decided on two investment options: AA bonds yielding 10% per annum and a Bank Certificate yielding 5%. How much money should they invest in AA bonds and how much in Bank Certificates?

x = AA bonds
y = Bank Certificates

$x + y = 100{,}000$
$0.10x + 0.05y = 8000$

$\begin{bmatrix} 1 & 1 \\ 0.10 & 0.05 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 100{,}000 \\ 8000 \end{bmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = A^{-1}\cdot B$

$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \$60{,}000 \\ \$40{,}000 \end{bmatrix}$

3. The table shows the number of individuals attending the movies over the weekend at a local theater. Determine the costs for a child, adult, and senior citizen to attend the movies.

Day	Child	Adult	Senior	Total Paid
Fri	$80x$ +	$110y$ +	$25z$ =	1755
Sat	$100x$ +	$175y$ +	$40z$ =	2685
Sun	$45x$ +	$85y$ +	$30z$ =	1385

$\begin{bmatrix} 80 & 110 & 25 \\ 100 & 175 & 40 \\ 45 & 85 & 30 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1755 \\ 2685 \\ 1385 \end{bmatrix}$

x = child cost
y = adult cost
z = senior cost

$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = A^{-1}\cdot B$

$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \$4 \\ \$11 \\ \$9 \end{bmatrix}$

4. Mr. Wiley invested $5000 in three different accounts at the beginning of last year, yielding him a total of $182.50 of interest at the end of the year. The three accounts were a simple savings account earning 1%, a certificate of deposit earning 3.5%, and municipal bonds earning 4.3%. His municipal bond investment was 5 times the amount of money invested in the simple savings account. How much did he invest in each account?

x = simple savings
y = CD
z = municipal bonds

$x + y + z = 5000$
$0.01x + 0.035y + 0.043z = 182.50$
$z = 5x$

$x + y + z = 5000$
$0.01x + 0.035y + 0.043z = 182.50$
$5x + 0y - 1z = 0$

$\begin{bmatrix} 1 & 1 & 1 \\ 0.01 & 0.035 & 0.043 \\ 5 & 0 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5000 \\ 182.50 \\ 0 \end{bmatrix}$

$X = A^{-1}\cdot B$

$x = \$500$
$y = \$2000$
$z = \$2500$