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MSDA Math Workshop

Weekly Assignment #4

1. Using matrix operations, describe the solutions for the following family of equations:

$$x + 2y - 3z = 5$$

$$2x + y - 3z = 13$$

$$-x + y = -8$$

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

$$X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$B = \begin{bmatrix} 5 \\ 13 \\ -8 \end{bmatrix}$$

$$AX = B$$

$$\begin{bmatrix} 1 & 2 & -3 \\ 2 & 1 & -3 \\ -1 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 13 \\ -8 \end{bmatrix}$$

2. Provide a solution for #1, using R functions of your choice.

Using the `pracma` package in R as another method to solve this system. The `"solve"` function would not work because the matrix is not invertible.

```
install.packages("pracma", repos="http://R-Forge.R-project.org")
```

```
require(pracma)
```

```
> A = array(c(1, 2, -1, 2, 1, 1, -3, -3, 0), dim=c(3,3))
```

```
B <- c(5, 13, -8)
```

```
> ginv(A) %*% B
```

```
      [,1]  
[1,]    5  
[2,]   -3  
[3,]   -2
```

An answer is $x = 5$, $y = -3$, $z = -2$.

3. Solve for AB by hand:

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

$$\begin{pmatrix} 4 & -3 \\ -3 & 5 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 & 4 \\ 3 & -2 \end{pmatrix}$$

$$(4, -3) \cdot (1, 3) = (4 \times 1) + (-3 \times 3) = -5$$

$$(4, -3) \cdot (4, -2) = (4 \times 4) + (-3 \times -2) = 16 + 6 = 22$$

$$(-3, 5) \cdot (1, 3) = (-3 \times 1) + (5 \times 3) = -3 + 15 = 12$$

$$(-3, 5) \cdot (4, -2) = (-3 \times 4) + (5 \times -2) = -12 - 10 = -22$$

$$(0, 1) \cdot (1, 3) = (0 \times 1) + (1 \times 3) = 3$$

$$(0, 1) \cdot (4, -2) = (0 \times 4) + (1 \times -2) = -2$$

$$AB = \begin{bmatrix} -5 & 22 \\ 12 & -22 \\ 3 & -2 \end{bmatrix}$$

4. Solve AB from #3 using R functions of your choice.

```
A = array(c(4, -3, 0, -3, 5, 1), dim=c(3,2))
```

```
B = array(c(1,3, 4, -2), dim = c(2,2))
```

```
A %*% B
```

```
      [,1] [,2]  
[1,]    -5    22  
[2,]    12   -22  
[3,]     3    -2
```