Notes on Matrix Multiplication

	French Fries	Cheeseburger	Coke
Fat	19	12	0
Carbohydrates	48	33	58
Protein	4	15	0

1 Gram of Fat has 9 calories
1 gram of Carbohydrates has 4 calories
1 gram of Protein has 4 calories

Find the number of calories in a meal of 1 cheeseburger, an order of French fries and a coke.

To find the calories in an order of French Fries, you would multiply:

9(19) + 4(48) + 4(4).

Notice that this is

(calories/gram of fat)x(grams of fat)
+ (calories/gram of carbohydrate)(grams of carbohydrate)
+ (calories/gram of protein)x(grams of protein).

To find the calories in 1 cheeseburger, you would multiply:

9(12) + 4(33) + 4(15).

Notice that the units work out the same for the cheeseburger as they did for the order of French Fries.

To find the calories in 1 coke, you would multiply:

9(0) + 4(58) + 4(0).

Once again, the units work out the same for the coke as they did for the French Fries and cheeseburger.

All of this computation can be accomplished using matrix multiplication.

A = [9 4 4] B = $\begin{bmatrix} 19 & 12 & 0 \\ 48 & 33 & 58 \\ 4 & 15 & 0 \end{bmatrix}$

AB = $[\,9(19)+4(48)+4(4) \quad 9(12)+4(33)+4(15) \quad 9(0)+4(58)+4(0)\,]$

Try this on your graphing calculator.

[379 300 232]

The order of French Fries contains 379 calories, while the cheeseburger contains 300 calories and the coke 232 calories.

With this data, you can also determine the calories from fat, carbohydrate and protein in the meal. This can be done by transposing the rows and columns of Matrix B.

	Fat	Carbohydrate	Protein
French Fries	19	48	4
Cheeseburger	12	33	15
Coke	0	58	0

To save time, I will show you how to do this quickly.

[Fat Carbs Protein] = [219 796 96]

Procedure for Matrix Multiplication

Condition – In order to multiply two matrices together, the number of columns in the first matrix must be equal to the number of rows in the second matrix. The number of rows in the *product* matrix is equal to the number of rows in the first matrix, while the number of columns in the *product* matrix is equal to the number of columns in the second matrix.

Example:

The product of a 3 x 2 matrix and a 2 x 4 matrix is a 3 x 4 matrix.

Procedure - To get the ith row, jth column entry in a matrix, multiply the numbers across the ith row by the numbers down the jth column and add the results.

Guided Practice

1. $A = \begin{bmatrix} 2 & -1 \\ 3 & 5 \end{bmatrix}$ $B = \begin{bmatrix} 4 & -2 & 3 \\ -1 & 6 & -5 \end{bmatrix}$

a. Can you multiply AB? If so, what is the product? If not, why not?

b. Can you multiply BA? If so, what is the product? If not, why not?

2. $P = \begin{bmatrix} 1 & 3 & 2 \end{bmatrix}$ $Q = \begin{pmatrix} -10 & 4 \\ 3 & -2 \\ -1 & 1 \end{pmatrix}$

What is PQ?

3. An infamous math teacher uses the following weighting system:

40% for tests, 20% for performance tasks, 20% for quizzes, 10% for team tests and 10% for assignments. This information can be stored in a Matrix A.

$$A = \begin{pmatrix} .4 \\ .2 \\ .2 \\ .1 \\ .1 \end{pmatrix}$$

The student grades are given in the table below:

Student	Test Avg.	Performance Task	Quiz Avg.	Team Test	Assign-ments	Term Average
Moe	70	96	78	95	90	
Larry	80	85	80	95	60	
Curly	52	48	62	95	100	

Store the values above in a Matrix B.

What matrix multiplication will yield term average?

Use a graphing calculator to find term averages.