

4. 9H The Arithmetic of Matrices

A Practice Understanding Task

Elvira likes the way matrices organize information so she can keep track of several computations simultaneously. She decides to apply these ideas to another “sticky” situation she often encounters in the lunchroom.

Students’ favorite desert is cinnamon rolls—which they often refer to as “sticky buns”. However, not all students like their rolls with a cream cheese glaze, and some prefer rolls without raisins. Consequently, Elvira has her cooks prepare cinnamon rolls in three different varieties.

1. Organize the following information into a matrix. If helpful, label the rows and columns to show what the numbers represent.
 - One dozen plain cinnamon rolls require 2 pounds of dough, and no glaze and no raisins.
 - One dozen glazed cinnamon rolls require 1.5 pounds of dough, 0.5 pounds of cream cheese glaze, and 0.25 pounds of raisins.
 - One dozen plain cinnamon rolls with raisins require 1.75 pounds of dough, 0.25 pounds of raisins, and no glaze.
2. Organize the following information into a matrix. If helpful, label the rows and columns to show what the numbers represent.
 - On October 31 the cooks made 20 dozen plain cinnamon rolls, 30 dozen glazed cinnamon rolls and 20 dozen plain cinnamon rolls with raisins.
 - On November 20 the cooks made 15 dozen plain cinnamon rolls, 40 dozen glazed cinnamon rolls and 10 dozen plain cinnamon rolls with raisins.
3. Use the information above to find the total amount of each ingredient that was used on October 31 and November 20. Organize your work and the results into a matrix equation.

Elvira would like to use matrices to determine the best place to purchase ingredients for days when she decides to serve cinnamon rolls. She has obtained the following information from the two local markets.

If Elvira shops at *Mainstreet Market*, her costs are \$1.50 per pound for dough, \$2.00 per pound for cream cheese glaze, and \$5.00 per pound for raisins.

At *Grandpa's Grocery* her costs are \$1.75 per pound for dough, \$4.00 per pound for raisins, and \$2.25 per pound for cream cheese glaze.

4. Use all the information above and matrix multiplication to find the total cost of purchasing the ingredients at each store for October 31 and November 20.

Elvira is getting good at multiplying matrices, but realizes that sometimes she only needs one element in the sum or product (for example, the cost of buying ingredients at *Grandpa's Grocery* on a specific day) and so she would like to be able to calculate a single result without completing the rest of the matrix operation. For the following matrix operations, calculate the indicated missing elements in the sum or product, without calculating the rest of the individual elements in the sum or product matrix.

$$5. \quad \begin{bmatrix} 5 & -2 & 3 & 6 \\ 7 & 1 & -4 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 3 & 5 & -7 \\ 4 & -3 & 2 & 5 \end{bmatrix} = \begin{bmatrix} - & - & \boxed{} & - \\ - & \boxed{} & - & - \end{bmatrix}$$

$$6. \quad \begin{bmatrix} -2 & 3 \\ 4 & -1 \\ 2 & 5 \\ 1 & 3 \end{bmatrix} \times \begin{bmatrix} 2 & -3 & 4 \\ -1 & 5 & -2 \end{bmatrix} = \begin{bmatrix} - & \boxed{} & - \\ \boxed{} & - & - \\ - & - & \boxed{} \\ - & - & - \end{bmatrix}$$

$$7. \quad 3 \cdot \begin{bmatrix} 2 & 4 \\ -1 & 5 \end{bmatrix} - 4 \cdot \begin{bmatrix} 2 & -3 \\ -5 & 4 \end{bmatrix} = \begin{bmatrix} - & \boxed{} \\ \boxed{} & - \end{bmatrix}$$