COST MATRICES Matrix multiplication is useful in business applications because an *inventory* matrix, when multiplied by a *cost per item* matrix, results in a *total cost* matrix.

$$\begin{bmatrix} \text{Inventory} \\ \text{matrix} \end{bmatrix} \cdot \begin{bmatrix} \text{Cost per item} \\ \text{matrix} \end{bmatrix} = \begin{bmatrix} \text{Total cost} \\ \text{matrix} \end{bmatrix}$$

$$\quad\quad\quad m \times n \quad\quad\quad\quad n \times p \quad\quad\quad\quad m \times p$$

For the total cost matrix to be meaningful, the column labels for the inventory matrix must match the row labels for the cost per item matrix.

EXAMPLE 4   Use matrices to calculate total cost

SPORTS Two hockey teams submit equipment lists for the season as shown.

Each stick costs $60, each puck costs $2, and each uniform costs $35. Use matrix multiplication to find the total cost of equipment for each team.

EQUIPMENT LISTS

Women's Team
14 sticks
30 pucks
18 uniforms

Men's Team
16 sticks
25 pucks
20 uniforms

Solution

To begin, write the equipment lists and the costs per item in matrix form. In order to use matrix multiplication, set up the matrices so that the columns of the equipment matrix match the rows of the cost matrix.

	Equipment		
	Sticks	**Pucks**	**Uniforms**
Women's team	14	30	18
Men's team	16	25	20

	Cost
	Dollars
Sticks	60
Pucks	2
Uniforms	35

The total cost of equipment for each team can be found by multiplying the equipment matrix by the cost matrix. The equipment matrix is 2×3 and the cost matrix is 3×1. So, their product is a 2×1 matrix.

$$\begin{bmatrix} 14 & 30 & 18 \\ 16 & 25 & 20 \end{bmatrix} \begin{bmatrix} 60 \\ 2 \\ 35 \end{bmatrix} = \begin{bmatrix} 14(60) + 30(2) + 18(35) \\ 16(60) + 25(2) + 20(35) \end{bmatrix} = \begin{bmatrix} 1530 \\ 1710 \end{bmatrix}$$

The labels for the product matrix are shown below.

	Total Cost
	Dollars
Women's team	1530
Men's team	1710

▶ The total cost of equipment for the women's team is $1530, and the total cost for the men's team is $1710.

✓ **GUIDED PRACTICE**   for Example 4

7. **WHAT IF?** In Example 4, suppose a stick costs $75, a puck costs $1, and a uniform costs $45. Find the total cost of equipment for each team.