**Activity 8.3.1 Matrix Multiplication Scenarios**

1. A building contractor constructs three different models of homes: Colonial, Cape and

Split Level. The contractor plans to build these homes in three cities. The following table shows the number of each model to be built in each city.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Colonial | Cape | Split Level |
| Newington | 9 | 6 | 2 |
| New Britain | 6 | 8 | 3 |
| Southington | 8 | 9 | 4 |

Each model has a specific requirement for exterior windows and doors and bundles of siding as listed in this table.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Windows | Doors | Siding Bundles |
| Colonial | 18 | 4 | 12 |
| Cape | 16 | 3 | 12 |
| Split Level | 14 | 2 | 10 |

1. Create a *3* × *3* matrix *H* to represent the data in the first table.
2. The columns of matrix *H* represent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. The rows of matrix *H* represent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Create a *3* × *3* matrix *M* to represent the data in the second table.
5. The columns of matrix *M* represent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. The rows of matrix *M* represent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Consider the product matrix $HM=P$.

What size is matrix *HM*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Looking at the procedure for finding *P,* what is the meaning of entry $p\_{11}=h\_{11}m\_{11}+h\_{12}m\_{21}+h\_{13}m\_{31}$?

$$HM=\left[\begin{matrix}h\_{11}&h\_{12}&h\_{13}\\&&\\&&\end{matrix}\right]\left[\begin{matrix}m\_{11}&&\\m\_{21}&&\\m\_{31}&&\end{matrix}\right]=\left[\begin{matrix}p\_{11}&&\\&&\\&&\end{matrix}\right]=P$$

1. Rewrite the entries for matrices *H* and *M* next to each other below and then calculate the product matrix *P*.

$$HM=\left[\begin{matrix}&&\\&&\\&&\end{matrix}\right]\left[\begin{matrix}&&\\&&\\&&\end{matrix}\right]=\left[\begin{matrix}&&\\&&\\&&\end{matrix}\right]=P$$

1. Write the entries for matrix *P* in the table below and then write headings in the rows and columns that explain the meanings of the entries.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | $$p\_{11}=$$ | $$p\_{12}=$$ | $$p\_{13}=$$ |
|  | $$p\_{21}=$$ | $$p\_{22}=$$ | $$p\_{23}=$$ |
|  | $$p\_{31}=$$ | $$p\_{32}=$$ | $$p\_{33}=$$ |

1. When multiplying the two matrices *H* and *M*, what is the meaning of the rows of the product matrix *P*?
2. When multiplying the two matrices *H* and *M*, what is the meaning of the columns of the product matrix *P*?
3. This is the first week collection table and matrix from investigation one of this unit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Clothing | Wool | Shoes-pairs | Rags |
| Pickup Site A | 92 | 36 | 14 | 88 |
| Pickup Site B | 46 | 87 | 34 | 73 |
| Pickup Site C | 57 | 44 | 37 | 44 |

 The 3×4 matrix *A* is:

$$A=\left[\begin{matrix}92&36&14&88\\46&87&34&73\\57&44&37&44\end{matrix}\right]$$

The benefits of reusing items in dollars and equivalent carbon dioxide emission reduction are shown in this spreadsheet. The first column shows the dollar value of collections per unit. The unit is specified with the item. The second column shows the reduction of atmospheric emissions in pounds of CO2.

|  |  |  |
| --- | --- | --- |
|  | $ per unit |  lb CO2 |
| Clothing (lb) | .67 | 5.9 |
| Wool (lb) | 1.20 | 14 |
| Shoes (pairs) | 2.50 | 30 |
| Rags (lb) | .50 | 1.7 |

 We can organize the data in this 4×2 benefit matrix: $ B=\left[\begin{matrix}.67&5.9\\1.2&14\\2.5&30\\.5&1.7\end{matrix}\right]$

1. Consider the product matrix $AB=C$

What size is matrix *AB*?

1. Think about the procedure for finding *AB.* What is the meaning of entry $c\_{11}?$
2. Rewrite the entries for matrices *A* and *B* next to each other below and then calculate the product matrix *C*. Calculate some entries by hand, then find the product matrix using technology.
3. Write the entries for matrix *C* in the table below and then write headings in the rows and columns that explain the meanings of the entries.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | $$c\_{11}=$$ | $$c\_{12}=$$ |
|  | $$c\_{21}=$$ | $$c\_{22}=$$ |
|  | $$c\_{31}=$$ | $$c\_{32}=$$ |