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HansenMath[™] Pre-calc: 7.4 Matrices and Systems of Equations, Day 1

is a rectangular array of Scal Damber S.

Definition of Matrix

If m and n are positive integers, an $m \times n$ (read "m by n") matrix is a rectangular array

	Column 1	Column 2	Column 3	E. BL	Column n
Row 1	[a ₁₁	a ₁₂	a ₁₃		a_{1n}
Row 2	a ₂₁	a ₂₂	a ₂₃		a _{2n}
	a ₃₁	a ₃₂	a ₃₃		a_{3n}
-					
Row m	La _{m1}	a,,,,	a_{m^3}		amn

in which each entry a_{ii} of the matrix is a real number. An $m \times n$ matrix has m rows and n columns.

A matrix having m rows and n columns is said to have be of $0 \vee dev = m \times n$. This can also be called its dimensions. If m = n the matrix is square of order n.

Example 1 Order of Matrices

Determine the order of each matrix.

a. [2] b. $\begin{bmatrix} 1 & -3 & 0 & \frac{1}{2} \end{bmatrix}$ c. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ d. $\begin{bmatrix} 5 & 0 \\ 2 & -2 \\ 7 & 4 \end{bmatrix}$

A matrix derived from a system of linear equations (each written in standard form with the constant term on the right) is the <u>Augmented</u> matrix of the system.

Moreover, the matrix derived from the coefficients of the system is the <u>Coefficient</u>

of the system.

$$\begin{cases} x - 4y + 3z = 5 \\ -x + 3y - z = -3 \\ 2x - 4z = 6 \end{cases}$$

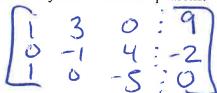
Augmented Matrix $\begin{bmatrix} 1 & -4 & 3 & 5 \\ -1 & 3 & -1 & -3 \\ 2 & 0 & -4 & 6 \end{bmatrix}$

Coefficient Matrix
$$\begin{bmatrix} 1 & -4 & 3 \\ -1 & 3 & -1 \\ 2 & 0 & -4 \end{bmatrix}$$

Example 2 Writing an Augmented Matrix

Write the augmented matrix for the system of linear equations.

$$\begin{cases} x + 3y = 9 \\ -y + 4z = -2 \\ x - 5z = 0 \end{cases}$$



In Section 7.3, we studied three operations that can be used on a system of linear equations to produce an equivalent system. We can also apply these operations in Matrix form.

Elementary Row Operations for Matrices

- 1. Interchange two rows.
- 2. Multiply a row by a nonzero constant.
- 3. Add a multiple of a row to another row.

Example 3: Use row operations to re-write the system as a matrix in row-echelon form.

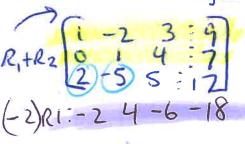
$$\begin{cases} x - 2y + 3z = 9 \\ -x + 3y + z = -2 \\ 2x - 5y + 5z = 17 \\ 2x -$$

Row-Echelon Form and Reduced Row-Echelon Form

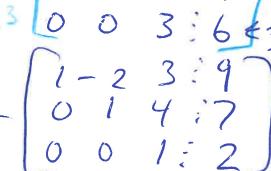
A matrix in row-echelon form has the following properties.

- Any rows consisting entirely of zeros occur at the bottom of the matrix.
- 2. For each row that does not consist entirely of zeros, the first nonzero entry is 1 (called a leading 1).
- 3. For two successive (nonzero) rows, the leading 1 in the higher row is farther to the left than the leading 1 in the lower row.

A matrix in row-echelon form is in reduced row-echelon form if every column that has a leading 1 has zeros in every position above and below its leading 1.







Example 5 Row-Echelon Form

Determine whether each matrix is in row-echelon form. If it is, determine whether the matrix is in reduced row-echelon form.

a.
$$\begin{bmatrix} 1 & 2 & -1 & 4 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & -2 \end{bmatrix}$$
c.
$$\begin{bmatrix} 1 & -5 & 2 & -1 & 3 \\ 0 & 0 & 3 & 3 & -2 \\ 0 & 0 & 0 & 4 & 4 \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix}$$

$$\begin{array}{c|cccc}
\mathbf{b} & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 2 & -4 \end{bmatrix} \\
\mathbf{d} & \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix} \\
\mathbf{f} & \begin{bmatrix} 0 & i & 0 & 5 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix}
\end{array}$$

a de f