Matrices

Matrix A matrix is a mathematical construct which is a two-dimensional table of **elements**.

For our purposes, our matrix elements will always be real numbers.

Notation A matrix is represented as a rectangular set of elements, nested inside brackets. For example:

$$\begin{bmatrix} 3 & 6 & -4 \\ 2 & -5 & 3.2 \end{bmatrix}$$

Like any mathematical construct, a matrix may be represented by a variable. Mathematical convention is to use *upper case* letters for matrix variables. For example:

$$A = \begin{bmatrix} 3 & 6 & -4 \\ 2 & -5 & 3.2 \end{bmatrix}$$

$$B = \begin{bmatrix} 4 & 1 & -4 \\ 2 & 33 & 5 \end{bmatrix}$$

$$C = A + B$$

Dimensions The dimensions, or **order** of a matrix is written as (row#) x (column#).

For example, matrix A is a 2×3 matrix:

$$A = \begin{bmatrix} 3 & 6 & -4 \\ 2 & -5 & 3.2 \end{bmatrix}$$

A has two rows and three columns.

Determinant If a matrix is *square*, you can calculate its determinant. A square matrix is a matrix that has the same number of rows as columns (e.g., a 5×5 matrix, a 3×3 matrix, etc.).

Multiplication Two matrices may be multipled **only** if the column dimension of the first matrix is equal to the row dimension of the second matrix. Matrix multiplication is **not commutative**.

The dimensions of the product matrix will be the two remaining dimensions. If you multiply a 5×4 matrix by a 4×7 matrix, the product matrix will be 5×7.

For example:

A 3×2 can be multiplied by a 2×4. The product will be 3×4.

A 2×4 cannot be multiplied by a 3×2.

Inverse A square matrix *may* have an inverse. If so, the inverse of matrix X is named X^{-1}. Not all square matrices do have inverses; only those with a *non-zero determinant* have an inverse.

If two matrices are inverses, then their product $X \cdot X^{-1}$ will yield an *identity matrix*.

Example identity matrices:

$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$