

BASIC MATRIX ALGEBRA

(Appendix to ch 18 Stock and Watson, appendix A Verbeek)

Notation:

matrices are represented by capital letters in bold, e.g. \mathbf{A} , vectors in lowercase bold, e.g. \mathbf{a} , and entries of vectors and matrices are italic (since they are numbers from a field), e.g. A and a . Index notation is often the clearest way to express definitions, and is used as standard in the literature. The i, j entry of matrix \mathbf{A} is indicated by $(\mathbf{A})_{ij}$, A_{ij} or a_{ij} , whereas a numerical label (not matrix entries) on a collection of matrices is subscripted only, e.g. $\mathbf{A}_1, \mathbf{A}_2$, etc.

Definitions of Vectors and Matrices

A **vector** is a collection of n numbers or elements, collected either in a column (a **column vector**) or in a row (a **row vector**). The n -dimensional column vector \mathbf{b} and the n -dimensional row vector \mathbf{c} are

$$\mathbf{b} = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{bmatrix} \text{ and } \mathbf{c} = [c_1 \quad c_2 \quad \cdots \quad c_n],$$

where b_1 is the first element of \mathbf{b} and in general b_i is the i^{th} element of \mathbf{b} .

Throughout, a boldface symbol denotes a vector or matrix.

A **matrix** is a collection, or an array, of numbers or elements in which the elements are laid out in columns and rows. The dimension of a matrix is $n \times m$, where n is the number of rows and m is the number of columns. The $n \times m$ matrix \mathbf{A} is

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{bmatrix},$$

where a_{ij} is the (i, j) element of \mathbf{A} , that is, a_{ij} is the element that appears in the i^{th} row and j^{th} column. An $n \times m$ matrix consists of n row vectors or, alternatively, of m column vectors.

To distinguish one-dimensional numbers from vectors and matrices, a one-dimensional number is called a **scalar**.

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