

Engineering Maths First Aid Kit

5.1

Determinants

Introduction

Determinants are mathematical objects which have applications in engineering mathematics. For example, they can be used in the solution of simultaneous equations, and to evaluate matrix inverses. This leaflet will show you how to calculate the value of a determinant.

1. Evaluating a determinant

The symbol $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$ represents the expression $ad - bc$ and is called a determinant.

For example

$$\begin{vmatrix} 2 & 3 \\ 1 & 4 \end{vmatrix} \quad \text{means} \quad 2 \times 4 - 1 \times 3 = 8 - 3 = 5$$

Because $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$ has two rows and two columns we describe it as a "2 by 2" or second-order determinant. Its value is given by

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

If we are given values for a , b , c and d we can use this to calculate the value of the determinant. Note that, once we have worked it out, a determinant is a single number.

Example:

Evaluate the following determinants.

a) $\begin{vmatrix} 2 & 4 \\ 6 & 3 \end{vmatrix}$ b) $\begin{vmatrix} 2 & -2 \\ 1 & 4 \end{vmatrix}$ c) $\begin{vmatrix} 8 & 5 \\ -2 & 4 \end{vmatrix}$ d) $\begin{vmatrix} 6 & 10 \\ -2 & 5 \end{vmatrix}$ e) $\begin{vmatrix} 2 & 3 \\ 2 & 2 \end{vmatrix}$

Answers:

a) $2 \times 3 - 6 \times 4 = -24 = -6$, b) $2 \times 4 - (-2) \times 1 = 10$, c) $8 \times 4 - (-2) \times 5 = 42$, d) $6 \times 5 - (-2) \times 10 = 60$, e) $2 \times 2 - 3 \times 2 = -2$.

2. Third-order determinants

A third-order, or "3 by 3" determinant can be written

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$



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