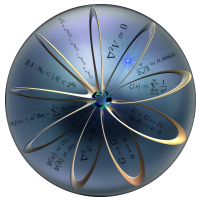

planetmath.org

Math for the people, by the people.

multinomial theorem

Canonical name	MultinomialTheorem
Date of creation	2013-03-22 13:13:05
Last modified on	2013-03-22 13:13:05
Owner	bshanks (153)
Last modified by	bshanks (153)
Numerical id	12
Author	bshanks (153)
Entry type	Theorem
Classification	msc 05A10
Related topic	BinomialFormula
Related topic	BinomialCoefficient
Related topic	GeneralizedLeibnizRule
Related topic	NthDerivativeOfADeterminant
Defines	multinomial
Defines	multinomial coefficient

A multinomial is a mathematical expression consisting of two or more terms, e.g.

$$a_1x_1 + a_2x_2 + \ldots + a_kx_k.$$

The multinomial theorem provides the general form of the expansion of the powers of this expression, in the process specifying the multinomial coefficients which are found in that expansion. The expansion is:

$$(x_1 + x_2 + \ldots + x_k)^n = \sum \frac{n!}{n_1!n_2! \cdots n_k!} x_1^{n_1} x_2^{n_2} \cdots x_k^{n_k} \tag{1}$$

where the sum is taken over all multi-indices $(n_1, \ldots n_k) \in \mathbb{N}^k$ that sum to n.

The expression $\frac{n!}{n_1!n_2!\cdots n_k!}$ occurring in the expansion is called *multinomial coefficient* and is denoted by

$$\binom{n}{n_1, n_2, \ldots, n_k}.$$