

Binomial theorem

The expansion of the binomial power $(a+b)^n$ is:

$$(a + b)^n = \sum_{k=0}^n \binom{n}{k} a^{n-k} b^k$$

$$(a + b)^n = \binom{n}{0} a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{n-2} a^2 b^{n-2} + \binom{n}{n-1} a b^{n-1} + \binom{n}{n} b^n$$

Whenever n is positive integer number.

The binomial coefficients are:

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

Where $n!$ denotes factorial of n

$$n! = n \cdot (n-1) \cdot (n-2) \cdot (n-3) \cdot \dots \cdot 4 \cdot 3 \cdot 2 \cdot 1$$

Example:

$$6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 720$$

Pascal-Tartaglia's triangle

This triangle determines the coefficients which arise in binomial expansions:

$n = 0$	1
$n = 1$	1 1
$n = 2$	1 2 1
$n = 3$	1 3 3 1
$n = 4$	1 4 6 4 1
$n = 5$	1 5 10 10 5 1
$n = 6$	1 6 15 20 15 6 1
$n = 7$	1 7 21 35 35 21 7 1
$n = 8$	1 8 28 56 70 56 28 8 1

On the zeroth row, write only the number 1.

Then, to construct the elements of following rows, add the number directly above and to the left with the number directly above and to the right to find the new value.

Some binomial expansions:

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

$$(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$

$$(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$$

$$(a - b)^4 = a^4 - 4a^3b + 6a^2b^2 - 4ab^3 + b^4$$