

A1 Formulas.

$$n^P_k = \frac{n!}{(n-k)!} \text{ and } \binom{n}{k} = \frac{n!}{k!(n-k)!} \text{ and } \binom{n}{n_1, n_2, \dots, n_r} = \frac{n!}{n_1!n_2!\cdots n_r!}$$

$$\text{binomial theorem: } (x+y)^n = \sum_{k=0}^n \binom{n}{k} x^k y^{n-k}$$

$$\text{multinomial theorem: } (x_1 + \cdots + x_r)^n = \sum_{\substack{n_1 + \cdots + n_r = n \\ n_1, \dots, n_r \geq 0}} \binom{n}{n_1, \dots, n_r} x_1^{n_1} \cdots x_r^{n_r}$$

number of positive (> 0) integer solutions to $x_1 + \cdots + x_r = n$ is $\binom{n-1}{r-1}$

number of nonnegative integer (≥ 0) solutions to $x_1 + \cdots + x_r = n$ is $\binom{n+r-1}{r-1}$