What about picking a representative and an alternate from our group of 4?

There are $4 \cdot 3 = 12$ ways. Order comes into play here.

DEFINITION. A permutation of n objects taken x at a time is an ordered subset of x of the n objects.

The number of permutations of n objects thake x at a time is

$$_nP_x = n(n-1)(n-2)\cdots(n-x+1) = \frac{n!}{(n-x)!}.$$

EXAMPLE.

$$_4P_2 = 4 \cdot 3 = \frac{4!}{2!} = 12$$

$_{20}P_5 =$

$$20 \cdot 19 \cdot 18 \cdot 17 \cdot 16 = \frac{20!}{15!} = 1,860,480$$

NOTE.

$$_nC_x = \frac{_nP_x}{x!}.$$

The order is divided out.

Binomial Distribution (formally)

$$f(x) = P(X = x) = \begin{cases} _nC_x p^x q^{n-x}, & \text{for } x = 0, 1, 2, \ldots, n \\ 0, & \text{elsewhere} \end{cases}$$

EXAMPLE.

$$f(2) = {_4C_2} p^2 q^2 = 6\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^2 = \frac{25}{216}$$