CHOOSING k ITEMS OUT OF n POSSIBILITIES

	ORDER IMPORTANT	ORDER NOT IMPORTANT
WITH REPLACEMENT	n^k	$\binom{k+n-1}{k}$ — "dots and lines" / "balls in boxes"
WITHOUT REPLACEMENT	${}_nP_k = \frac{n!}{(n-k)!}$ ($= n(n-1)(n-2)\cdots(n-(k-1))$)	${}_nC_k = \binom{n}{k} = \frac{n!}{(n-k)!\,k!}$

BINOMIAL COEFFICIENTS

We've said $\binom{n}{k}$ is "n choose k", the number of ways of selecting k items from n, without replacement, order not important. — COMBINATIONS

Consider: $(a+b)^3 = (a+b)(a+b)(a+b)$

$= 1a^3 + 3a^2b + 3ab^2 + 1b^3$

$1 = \binom{3}{3}$, $3 = \binom{3}{2}$, $3 = \binom{3}{1}$, $1 = \binom{3}{0}$

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

They also appear in Pascal's triangle:

$\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$