n-Permutation of n objects: $P(n,n) = n! =$ number of ways to place n nonattacking rooks on an $n \times n$ chessboard.

r-Permutation of n objects: $P(n,r) = n(n-1)...(n-r+1) =$ number of ways to place r nonattacking rooks on an $r \times n$ chessboard, $r \leq n$.

$C(n,r)P(n,r) = \frac{[n(n-1)...(n-r+1)]^2}{r!} =$ number of ways to place r nonattacking rooks on an $n \times n$ chessboard, $r \leq n$.

2.4 Permutations of Multisets

Thm 2.4.1: Let $A = \{\infty \cdot 1, \infty \cdot 2, ..., \infty \cdot k\}$

The number of r permutations of $A = k^r$.

Thm 2.4.2: Let $B = \{n_1 \cdot 1, n_2 \cdot 2, ..., n_k \cdot k\}$

$n = n_1 + n_2 + ... + n_k$

The number of n-permutations of $B = \frac{n!}{n_1!n_2!\cdots n_k!}$.

If want r-permutations of B, need to use or statements or technique from later chapter.

Combinations: order does NOT matter

$\binom{n}{r} = \#$ of r combinations of $\{1, 2, ..., n\}$

$= $ subsets of $\{1, 2, ..., n\}$ containing exactly r elements.

$2^n = \Sigma_{i=0}^{n} \binom{n}{i} = \#$ of subsets of $\{1, 2, ..., n\}$.

Pascal's Triangle: $C(n,r) = C(n-1, r-1) + C(n-1, r)$

2.4 Combinations of Multisets

Let $A = \{\infty \cdot 1, \infty \cdot 2, ..., \infty \cdot k\}$

The number of r combinations of $A = \binom{r+k-1}{r}$

$= \#$ of solutions to $x_1 + x_2 + ... + x_k = r$ such that $x_i \geq 0, x_i \in \mathcal{Z}$

$= \#$ of permutations of $\{r \cdot 1, (k-1) \cdot +\}$

$=$ partitions of r indistinguishable objects into k distinguishable boxes.

if need $x_i \geq a_i$ replace x_i with $y_i + a_i$ since $y_i = x_i - a_i \geq 0$