Combinatorics

Factorial:

- factorial (5*4*3*2*1=5!)
- 0!=1

r-s Principle:

- 5 pairs of pants to go with 2 shirts 5*2 options
- ordered pair-pair of 'things' arranged in a certain order

Permutations and combinations:

- Permutations (care about order)
  - place n objects in k positions
  - $$ {}^{n}P_{k} = \frac{n!}{(n-k)!} $$
- combinations (dont care about order)
  - divide by n! because compared to permutation n places(order) to place first choice, n-1 to place second...
  - $$ {}^{n}C_{k} = \frac{n!}{k!(n-k)!} = \binom{n}{k} $$

Binomial Identity:

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

$$ \binom{n}{0} = \binom{n}{n} = 1 \quad \text{for all integers} $$

Sources:

- `http://world.mathigon.org/Combinatorics`