Math Theory of Probability

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Basic Principle of Counting.
Suppose that 2 experiments are to be preformed. Then if exp 1 can result in any one of n_1 possible outcomes and for each of these outcomes, exp 2 can result in any one of n_2 possible outcomes, then the total number of possible outcomes for the 2 experiments is $n_1 \cdot n_2$.

Permutations.
How many ways are there of arranging n distinct things?
There are n ways to choose the first thing, $n-1$ ways to choose the second thing, $n-2$ ways to choose the third thing, and so on.
Thus, the total number of ways of arranging n distinct things is $n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 2 \cdot 1 = n!$

Permutations with repeats.

$$\frac{n!}{n_1! \cdot n_2! \cdot \ldots \cdot n_r!}$$

different permutation of n objects which any arbitrary n_i are alike.

Combinations.

$$\binom{n}{r} = \frac{n!}{(n-r)!r!}$$

How many ways are there of choosing r things from n distinct things?

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