Chapter 1. Probility and Distribution

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用有效的方式收集数据的问题的研究， 构成了数理统计学中两个分支， 其一叫做抽样理论，其二叫做实验设计（试验设计）。

1 Probalility

1.1 Some note

The number of permuations of n distinct objectes taken r at a time is

$$_nP_r = n(n-1)\cdots(n-r+1) = \frac{n!}{(n-r)!}, r = 0, 1, 2, ..., n.$$

The number of combinations of n distinct objects taken r at a time is

$$\left(\begin{array}{c} n \\ r \end{array} \right) = \frac{n(n-1)\cdots(n-r+1)}{r!} = \frac{n!}{r!(n-r)!}, r = 0, 1, 2, ..., n.$$

The binomial coeffient of the term of $x^r y^{n-r}$ in the expansion of

$$(x+y)^n = \sum_{r=0}^{n} \left(\begin{array}{c} n \\ r \end{array} \right) x^r y^{n-r}$$

is $\left(\begin{array}{c} n \\ r \end{array} \right)$, where n is a positive integer and r is a non-negative less than or equal to n.

The number of ways in which a set of n distinct objects can be partitioned into k subsets with n_1 objects in the first subset, n_2 objects in the second subset,..,and n_k objects in the k-th subset is

$$\left(\begin{array}{c} n \\ n_1, ..., n_k \end{array} \right) = \frac{n!}{n_1! \cdots n_k!},$$

which is the multinomial coefficient of the term of $x_1^{n_1} \cdots x_k^{n_k}$ in the expansion of $(x_1 + \cdots + x_k)^n$, where $n_1 + \cdots + n_k = n$.

Here are some useful formulae

- $\left(\begin{array}{c} x \\ r \end{array} \right) = \left(\begin{array}{c} n-1 \\ r \end{array} \right) + \left(\begin{array}{c} n-1 \\ r-1 \end{array} \right)$

1.2 Sample Space

1.3 Moment Generating Function