Basic Statistics

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May 30, 2012

1 Probability distributions and test statistics

See Table 1. Greek letters are known a priori, roman letters are measured.

2 Useful identities

For mean-zero Gaussian random variables, we can expand a four-point correlation into a sum of products of two-point correlations:

$$\langle abcd \rangle = \langle ab \rangle \langle cd \rangle + \text{permutations.} \tag{1}$$

hypothesis	**condition**	**test statistic**	**test distribution**
$\mu = \mu_0$	σ^2 known	$\frac{\bar{x}-\mu_0}{\sigma/\sqrt{n}}$	$N(0,1)$
$\mu = \mu_0$	σ^2 unknown	$\frac{\bar{x}-\mu_0}{s/\sqrt{n}}$	$t(n-1)$
$\sigma^2 = \sigma_0^2$	μ known	$\frac{(n-1)\,s^2}{\sigma_0^2}$	$\chi^2(n)$
$\sigma^2 = \sigma_0^2$	μ unknown	$\frac{(n-1)\,s^2}{\sigma_0^2}$	$\chi^2(n-1)$
$\mu_1 = \mu_2$	σ_1^2 and σ_2^2 known	$\frac{\bar{x}-\bar{y}}{\sqrt{\sigma_1^2/n+\sigma_2^2/m}}$	$N(0,1)$
$\mu_1 = \mu_2$	$\sigma_1^2 = \sigma_2^2$ unknown	$\frac{\bar{x}-\bar{y}}{s\sqrt{1/n+1/m}}$	$t(n+m-2)$
$\mu_1 = \mu_2$	$\sigma_1^2 \neq \sigma_2^2$ unknown	$\frac{\bar{x}-\bar{y}}{\sqrt{s_1^2/n+s_2^2/m}}$	$\approx N(0,1)$
$\sigma_1^2 = \sigma_2^2$	μ_1 and μ_2 known	s_1^2/s_2^2	$F(n,m)$
$\sigma_1^2 = \sigma_2^2$	μ_1 and μ_2 unknown	s_1^2/s_2^2	$F(n-1,m-1)$

Table 1: Choosing the right distribution.