

# Formulário de Estatística

## Medidas descritivas

$$\begin{aligned}\mu &= \frac{\sum_i x_i}{n} & \sigma^2 &= \frac{\sum_i (x_i - \mu)^2}{n} = \frac{\sum_i x_i^2 - n\bar{x}^2}{n} \\ \bar{x} &= \frac{\sum_i x_i}{n} & S^2 &= \frac{\sum_i (x_i - \bar{x})^2}{n-1} = \frac{\sum_i x_i^2 - n\bar{x}^2}{n-1} & CV &= 100 \frac{S}{\bar{x}} \\ \chi^2 &= \sum_i \frac{(o_i - e_i)^2}{e_i} & C &= \sqrt{\frac{\chi^2}{\chi^2 + n}} & C' &= \sqrt{\frac{\chi^2/n}{(r-1)(s-1)}} & C'' &= \frac{C}{\sqrt{(t-1)/t}} \\ r &= \frac{1}{n} \sum_{i=1}^n \left( \frac{x_i - \bar{x}}{s_x} \right) \left( \frac{y_i - \bar{y}}{s_y} \right) & &= \frac{\sum_i x_i y_i - n\bar{x}\bar{y}}{\sqrt{(\sum_i x_i^2 - n\bar{x}^2)(\sum_i y_i^2 - n\bar{y}^2)}}\end{aligned}$$

## Probabilidades

$$\begin{aligned}\mu_X &= E[X] = \sum_i x_i P(X = x_i) & \sigma_X^2 &= Var[X] = \sum_i (x_i - \mu_x)^2 P(X = x_i) \\ \mu_X &= E[X] = \int x f_X(x) dx & \sigma_X^2 &= Var[X] = \int (x - \mu_x)^2 f_X(x) dx\end{aligned}$$

## Distribuições de Probabilidade

Distribuição	Fç de Probabilidade/Densidade	Domínio	E[X]	Var[X]
$X \sim U(k)$	$\frac{1}{k}$	$x = 1, 2, \dots, k$	$\frac{\min(X) + \max(x)}{2}$	$\sqrt{\frac{(\max(X) - \min(X) + 1)^2 - 1}{12}}$
$X \sim B(n, p)$	$\binom{n}{x} p^x (1-p)^{n-x}$	$x = 0, 1, 2, \dots, n$	$np$	$np(1-p)$
$X \sim HG(N, K, n)$	$\frac{\binom{K}{x} \binom{N-K}{n-x}}{\binom{N}{n}}$	$x = 0, 1, 2, \dots, \min(K, n)$	$np$	$np(1-p) \frac{N-n}{N-1}$
$X \sim P(\lambda)$	$\frac{e^{-\lambda} \lambda^x}{x!}$	$x = 0, 1, 2, \dots$	$\lambda$	$\lambda$
$X \sim G(p)$	$(1-p)^x p$	$x = 0, 1, 2, \dots$	$\frac{1}{p}$	$\frac{(1-p)}{p^2}$
$X \sim BN(r, p)$	$\binom{x+r-1}{r-1} (1-p)^x p^r$	$x = 0, 1, 2, \dots$	$\frac{r}{p}$	$\frac{r(1-p)}{p^2}$
$X \sim U[a, b]$	$\frac{1}{b-a}$	$a \leq x \leq b$	$\frac{a+b}{2}$	$\frac{(b-a)^2}{12}$
$X \sim N(\mu, \sigma^2)$	$\frac{1}{\sqrt{2\pi\sigma^2}} \exp\{-\frac{1}{2\sigma^2}(x-\mu)^2\}$	$x \in (-\infty, \infty)$	$\mu$	$\sigma^2$
$X \sim LN(\mu, \sigma^2)$	$\frac{1}{x\sqrt{2\pi\sigma^2}} \exp\{-\frac{1}{2\sigma^2}(\ln(x)-\mu)^2\}$	$x \in (-\infty, \infty)$	$\exp\{\mu + \sigma^2/2\}$	$\exp\{2\mu + \sigma^2\}(\exp\{\sigma^2\} - 1)$
$X \sim \text{Exp}(\lambda)$	$\lambda \exp(-\lambda x)$	$x \geq 0$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
$X \sim \text{Erlang}(\lambda, r)$	$\lambda^r x^{r-1} \exp(-\lambda x) / (r-1)!$	$x \geq 0$ ; $r = 1, 2, \dots$	$\frac{r}{\lambda}$	$\frac{r}{\lambda^2}$
$X \sim G(\alpha, \beta)$	$\frac{1}{\Gamma(\alpha)\beta^\alpha} x^{\alpha-1} \exp\{-x/\beta\}$	$x \geq 0$	$\alpha\beta$	$\alpha\beta^2$
$X \sim \text{Weibull}(\alpha, \beta)$	$\frac{\alpha}{\beta} (x/\beta)^{\alpha-1} \exp\{-(x/\beta)^\alpha\}$	$x \geq 0$	$\beta \Gamma(1 + \frac{1}{\alpha})$	$\beta^2 [\Gamma(1 + \frac{2}{\alpha}) - \Gamma^2(1 + \frac{1}{\alpha})]$
$X \sim \text{Beta}(\alpha, \beta)$	$\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1} (1-x)^{\beta-1}$	$0 \leq x \leq 1$	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$

$$Z = (X - \mu)/\sigma \quad \Gamma(\alpha) = \int_0^\infty x^{\alpha-1} \exp\{-x\} dx \quad \Gamma(\alpha) = (\alpha-1)! \quad \Gamma(\alpha+1) = \alpha \Gamma(\alpha)$$

## Distribuições Amostrais, Intervalos de Confiança e Testes de Hipóteses

Estimador	Intervalo de Confiança	Estatística de Teste	Obs.
$\bar{x} \sim N(\mu, \frac{\sigma^2}{n})$	$\bar{x} \pm z_t \frac{\sigma}{\sqrt{n}}$	$z_c = \frac{\bar{x} - \mu_0}{\sqrt{\sigma^2/n}}$	
$\bar{x} \sim t_{n-1}(\mu, \frac{S^2}{n})$	$\bar{x} \pm t_t \frac{S}{\sqrt{n}}$	$t_c = \frac{\bar{x} - \mu_0}{\sqrt{S^2/n}}$	$\nu = n - 1$
$\frac{(n-1)S^2}{\sigma^2} \sim \chi_{(n-1)}^2$	$\left( \frac{(n-1)S^2}{\chi_{sup}^2}, \frac{(n-1)S^2}{\chi_{inf}^2} \right)$	$\chi_c^2 = \frac{(n-1)S^2}{\sigma_0^2}$	$\nu = n - 1$
$\hat{p} \sim N(p, \frac{p(1-p)}{n})$	$\hat{p} \pm z_t \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$	$z_c = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$	$\hat{p} \pm z_t \sqrt{\frac{1}{4n}}$
$\frac{S_1^2/\sigma_1^2}{S_2^2/\sigma_2^2} \sim F(n_1-1, n_2-1)$	$\left( \frac{1}{F_{\alpha/2, n_1-1, n_2-1}}, \frac{S_1^2}{S_2^2} F_{\alpha/2, n_2-1, n_1-1} \frac{S_1^2}{S_2^2} \right)$	$F_c = \frac{S_1^2}{S_2^2}$	$F_{1-\alpha/2, \nu_2, \nu_1} = \frac{1}{F_{\alpha/2, \nu_1, \nu_2}}$
$\bar{x}_1 - \bar{x}_2 \sim N\left(\mu_1 - \mu_2, \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}\right)$	$(\bar{x}_1 - \bar{x}_2) \pm z_{\alpha/2} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$	$z_c = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$	
$\bar{x}_1 - \bar{x}_2 \sim t_\nu\left(\mu_1 - \mu_2, \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)$	$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2, \nu} \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$	$t_c = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$	$gl = \nu = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{S_1^2/n_1}{n_1-1} + \frac{S_2^2/n_2}{n_2-1}}$
$\bar{x}_1 - \bar{x}_2 \sim t_\nu\left(\mu_1 - \mu_2, S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)\right)$	$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2, \nu} \sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$	$t_c = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{S_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$	$S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}$ $gl = \nu = n_1 + n_2 - 2$
$\bar{d} \sim t_{n-1}(\mu_d, \frac{S_d^2}{n})$	$\bar{d} \pm t_t \frac{S_d}{\sqrt{n}}$	$t_c = \frac{\bar{d} - d_0}{\sqrt{S_d^2/n_d}}$	$\nu = n_d - 1$
$\hat{p}_1 - \hat{p}_2 \sim N\left(p_1 - p_2, \frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}\right)$	$\hat{p}_1 - \hat{p}_2 \pm z_{\alpha/2} \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$	$z_c = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}}$	
		$\chi_c^2 = \sum_i \frac{(o_i - e_i)^2}{e_i}$	$\nu = (L-1)(C-1)$ $\nu = k-1$

### Regressão linear simples

$$\begin{aligned}
 y_i &= \beta_0 + \beta_1 x_i + e_i & e_i &\sim N(0, \sigma^2) & \hat{\beta}_0 &= \bar{y} - \hat{\beta}_1 \bar{x} \\
 SQ_{reg} &= \hat{\beta}_1^2 \sum_i (x_i - \bar{x})^2 & SQ_{tot} &= \sum_i (y_i - \bar{y})^2 & S_e^2 &= \frac{\sum_i (y_i - \hat{y}_i)^2}{n-2} \\
 & & & & \hat{\beta}_1 &= \frac{\sum_i x_i y_i - n \bar{x} \bar{y}}{\sum_i x_i^2 - n \bar{x}^2} \\
 & & & & R^2 &= \frac{SQ_{reg}}{SQ_{tot}}
 \end{aligned}$$