

## FORMULÁRIO

$$1. \bar{x} = \frac{\sum_{i=1}^n x_i}{n}; \quad 2. s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} = \frac{1}{n-1} \left( \sum_{i=1}^n x_i^2 - n\bar{x}^2 \right); \quad 3. C.V = \frac{s}{\bar{x}}.$$

### Probabilidade

$$1. P(A \cup B) = P(A) + P(B) - P(A \cap B); \quad 3. P(A) = \sum_{i=1}^k P(A|B_i)P(B_i);$$

$$2. P(A|B) = P(A \cap B)/P(B); \quad 4. P(B_i|A) = \frac{P(A|B_i)P(B_i)}{\sum_{i=1}^k P(A|B_i)P(B_i)}.$$

### Distribuição de probabilidade

Seja  $X$  uma variável aleatória discreta. Então,

$$\mu = \mathbb{E}(X) = \sum_x xP(X=x) \quad \text{e} \quad \text{Var}(X) = \mathbb{E}(X-\mu)^2 = \sum_x (x-\mu)^2 P(X=x).$$

$$1. \text{ Se } X \sim \text{Uniforme Discreta} \Rightarrow P(X=x) = \begin{cases} 1/k, & x=1, 2, \dots, k; \\ 0, & \text{caso contrário.} \end{cases}$$

$$2. \text{ Se } X \sim b(p) \Rightarrow P(X=x) = \begin{cases} p^x(1-p)^{1-x}, & x=0, 1; \\ 0, & \text{caso contrário.} \end{cases}$$

$$3. \text{ Se } X \sim \text{Bin}(n, p) \Rightarrow P(X=x) = \begin{cases} \binom{n}{x} p^x (1-p)^{n-x}, & x=0, 1, 2, \dots, n; \\ 0, & \text{caso contrário,} \end{cases} \quad \text{onde } \binom{n}{x} = \frac{n!}{x!(n-x)!}.$$

$$4. \text{ Se } X \sim G(p) \Rightarrow P(X=x) = p(1-p)^{x-1}, \quad x=1, 2, \dots$$

$$5. \text{ Se } X \sim \text{Hip}(N, n, r) \Rightarrow P(X=x) = \begin{cases} \frac{\binom{r}{x} \binom{N-r}{n-x}}{\binom{N}{n}}, & x=0, \dots, \min\{r, n\}; \\ 0, & \text{caso contrário.} \end{cases}$$

$$6. \text{ Se } X \sim P(\lambda) \Rightarrow P(X=x) = \begin{cases} \frac{e^{-\lambda} \lambda^x}{x!}, & x=0, 1, 2, \dots; \\ 0, & \text{caso contrário.} \end{cases}$$

### Densidade de probabilidade

Seja  $X$  uma variável aleatória contínua. Então,

$$\mu = \mathbb{E}(X) = \int_{-\infty}^{\infty} x f_X(x) dx \quad \text{e} \quad \text{Var}(X) = \mathbb{E}(X-\mu)^2 = \int_{-\infty}^{\infty} (x-\mu)^2 f_X(x) dx.$$

$$1. \text{ Se } X \sim \text{Uniforme}(a, b) \Rightarrow f(x) = \begin{cases} \frac{1}{(b-a)}, & a \leq x \leq b; \\ 0, & \text{caso contrário.} \end{cases}$$

$$2. \text{ Se } X \sim \text{Exp}(\lambda) \Rightarrow f(x) = \lambda e^{-\lambda x}, \quad x \geq 0.$$

$$3. \text{ Se } X \sim \text{Normal}(\mu, \sigma^2) \Rightarrow f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left\{-\frac{(x-\mu)^2}{2\sigma^2}\right\}, \quad -\infty \leq x \leq \infty.$$

$$4. \text{ Se } X \sim \text{Gama}(\alpha, \beta) \Rightarrow f(x) = \begin{cases} \frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}, & \text{se } x \geq 0 \\ 0, & \text{caso contrário.} \end{cases}$$

$$5. \text{ Se } X \sim \text{Beta}(\alpha, \beta) \Rightarrow f(x) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1} (1-x)^{\beta-1}, \quad x \in (0, 1) \text{ e } \alpha, \beta > 0.$$

## Inferência

1. Se  $X \sim \text{Normal}(\mu, \sigma^2)$ , então  $Z = \frac{X-\mu}{\sigma} \sim \text{Normal}(0, 1)$ ;
2.  $P(-z_{\alpha/2} < Z < z_{\alpha/2}) = 1 - \alpha$ ,  $P(Z > z_{\alpha}) = \alpha$  e  $P(Z < -z_{\alpha}) = \alpha$ ;
3.  $\hat{p} \sim \text{Normal}(p, \frac{p(1-p)}{n}) \Rightarrow \frac{\hat{p}-p}{\sqrt{p(1-p)/n}} \sim \text{Normal}(0, 1)$ ;
4.  $\left[ \hat{p} - z_{\alpha/2} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}; \hat{p} + z_{\alpha/2} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \right]$ ;
5.  $\left[ \hat{p} - z_{\alpha/2} \sqrt{\frac{1}{4n}}; \hat{p} + z_{\alpha/2} \sqrt{\frac{1}{4n}} \right]$ ;
6.  $n = \left( \frac{z_{\alpha/2}}{2m} \right)^2$ ;
7.  $\bar{X} \sim \text{Normal}(\mu, \frac{\sigma^2}{n})$ , então  $\frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim \text{Normal}(0, 1)$ ;
8.  $\left[ \bar{x} - z_{\alpha/2} \sqrt{\frac{\sigma^2}{n}}; \bar{x} + z_{\alpha/2} \sqrt{\frac{\sigma^2}{n}} \right]$ ;
9.  $\left[ \bar{x} - t_{n-1, \alpha/2} \sqrt{\frac{s^2}{n}}; \bar{x} + t_{n-1, \alpha/2} \sqrt{\frac{s^2}{n}} \right]$ ;
10.  $n = \left( \frac{z_{\alpha/2}}{m} \right)^2 \sigma^2$ ;
11. Sob  $H_0 : \mu_x = \mu_y$ ,
 
$$\frac{\bar{X} - \bar{Y}}{\sqrt{\sigma_x^2/n + \sigma_y^2/m}} \sim \text{Normal}(0, 1), \quad \frac{\bar{X} - \bar{Y}}{\sqrt{s_p^2(1/n + 1/m)}} \sim t_{n+m-2},$$
 onde  $s_p^2 = \frac{(n-1)s_x^2 + (m-1)s_y^2}{n+m-2}$ ;
12. Sob  $H_0 : p_1 = p_2$ ,
 
$$\frac{\hat{p}_1 - \hat{p}_2}{\sqrt{p_0(1-p_0)(1/n + 1/m)}} \sim \text{Normal}(0, 1),$$
 onde  $p_0 = \frac{n\hat{p}_1 + m\hat{p}_2}{n+m}$ ;
13. Sob  $H_0$ ,

$$\chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} \sim \chi_{k-1}^2.$$

## Regressão

O modelo de regressão é dado por  $Y_i = \alpha + \beta X_i + \epsilon_i$ ,  $i = 1, \dots, n$ , com  $\mathbb{E}(\epsilon_i) = 0$  e  $\text{Var}(\epsilon_i) = \sigma^2$ . A reta estimada é dada por  $\hat{Y}_i = \hat{\alpha} + \hat{\beta} X_i$ , onde

$$\hat{\alpha} = \bar{Y} - \hat{\beta} \bar{X}; \quad \hat{\beta} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^n (X_i - \bar{X})^2} = \frac{\sum_{i=1}^n X_i Y_i - n \bar{X} \bar{Y}}{\sum_{i=1}^n X_i^2 - n \bar{X}^2} = \frac{S_{XY}}{S_{XX}}.$$

Coefficiente de Correlação:

$$R = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}}.$$