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A
Distribuições probabilísticas utilizadas

A.1
Distribuição normal ou Gaussiana

A distribuição normal $\mathbf{N}(\mu,\sigma)$, figura A.1, tem suas funções densidade de probabilidade e de distribuição acumulada dadas pelas equações A-1 e A-2 [95].

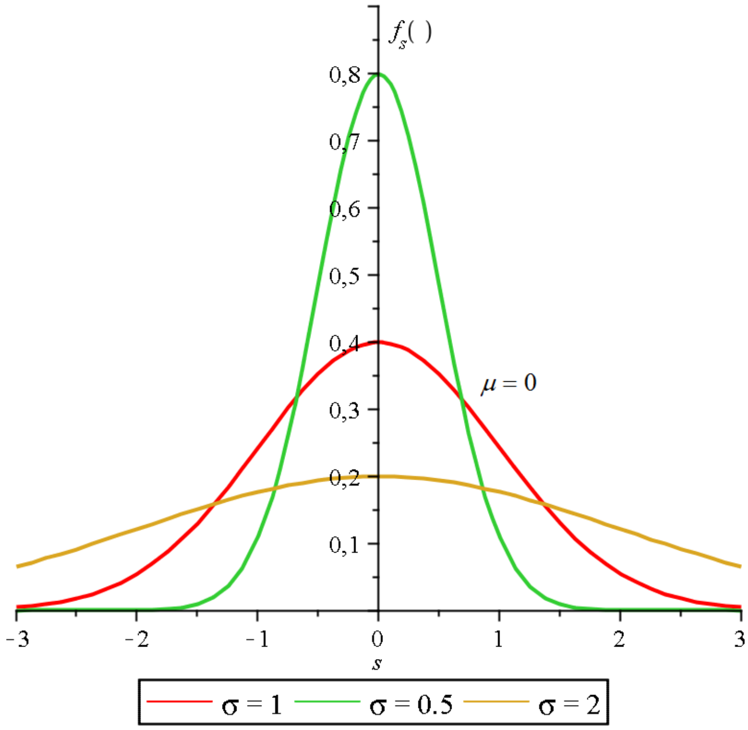

Figura A.1: Função densidade de probabilidade normal.

$$f_X(x) = \frac{1}{(2\pi)^{1/2}\sigma_X} \exp\left[-\frac{1}{2}\left(\frac{x-\mu_X}{\sigma_X}\right)^2\right] \quad -\infty \leq x \leq \infty \tag{A-1}$$

$$P(X \leq x) = F_X(x) = \frac{1}{(2\pi)^{1/2}} \int_{-\infty}^{s} e^{-\frac{1}{2}\nu^2} d\nu \quad -\infty \leq x \leq \infty \tag{A-2}$$

Onde $s = (x - \mu_X)/\sigma_X$. Não há nenhuma expressão simples para $F_X(x)$, apesar de existirem muitas aproximações. Os parâmetros da distribuição são o valor médio (μ_X) e o desvio padrão (σ_X).

A.2
Distribuição normal truncada

A distribuição normal truncada **NT**(μ,σ,a,b), figura A.2, tem suas funções densidade de probabilidade e de distribuição acumulada dadas pelas equações A-3 e A-4 [144].

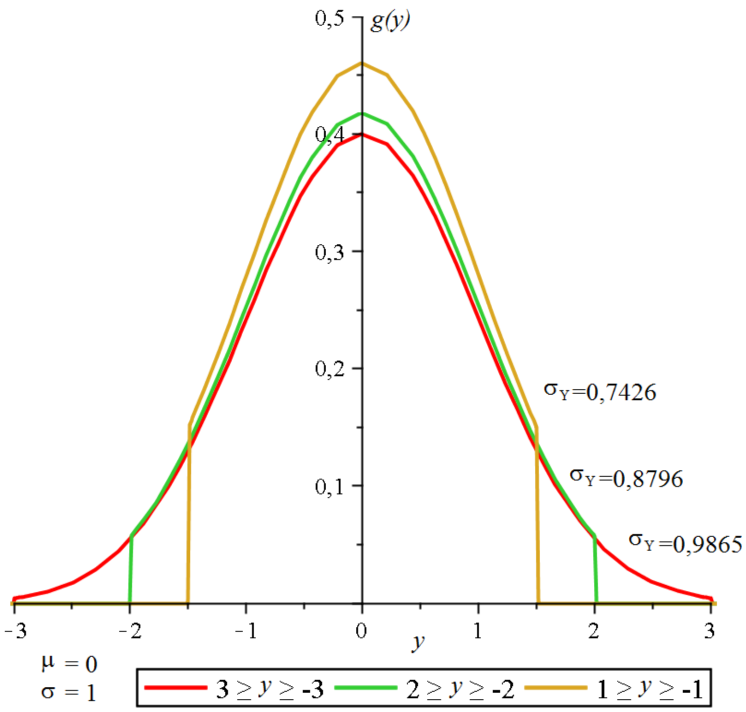

Figura A.2: Função densidade de probabilidade normal truncada.

$$g(y) = \frac{f(y)}{F(b) - F(a)} \quad a \leq y \leq b \tag{A-3}$$

$$G(y) = \frac{F\{\max[\min(y, b), a]\} - F(a)}{F(b) - F(a)} \tag{A-4}$$

Onde $f(\cdot)$ é a função densidade de probabilidade normal, equação A-1, e $F(\cdot)$ é a função de distribuição acumulada normal, equação A-2. Para todos os valores de $y \notin [a, b]$ tem-se $g(y) = 0$. Os parâmetros da distribuição são o valor médio (μ), o desvio padrão (σ), limite inferior (a) e limite superior (b). A média e o desvio padrão de Y estão relacionados com os parâmetros anteriores da seguinte maneira:

$$\mu_Y = \mu + \frac{\varphi\left(\frac{a-\mu}{\sigma}\right) - \varphi\left(\frac{b-\mu}{\sigma}\right)}{F(b) - F(a)}\sigma \tag{A-5}$$

$$\sigma_Y^2 = \left[1 + \frac{\left(\frac{a-\mu}{\sigma}\right)\varphi\left(\frac{a-\mu}{\sigma}\right) - \left(\frac{b-\mu}{\sigma}\right)\varphi\left(\frac{b-\mu}{\sigma}\right)}{F(b) - F(a)}\right]\sigma^2 - \left[\frac{\varphi\left(\frac{a-\mu}{\sigma}\right) - \varphi\left(\frac{b-\mu}{\sigma}\right)}{F(b) - F(a)}\right]^2 \sigma^2 \tag{A-6}$$

Onde φ é a função densidade de probabilidade normal padrão $[N(0,1)]$.

A.3 Distribuição lognormal

A distribuição lognormal **LN(λ,ξ)**, figura A.3, tem suas funções densidade de probabilidade e de distribuição acumulada dadas pelas equações A-7 e A-8 [89, 95].

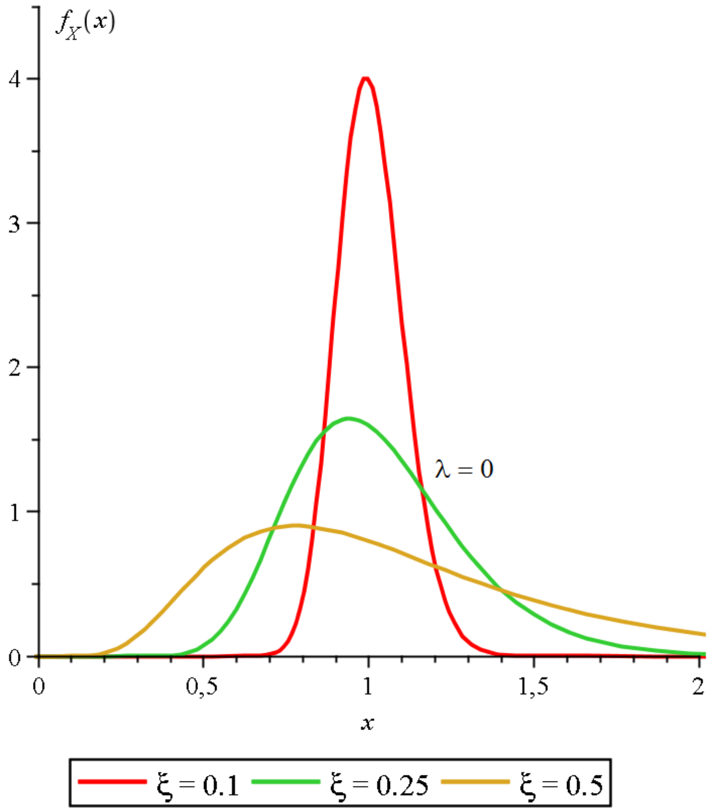

Figura A.3: Função densidade de probabilidade lognormal.

$$f_X(x) = \frac{1}{(2\pi)^{1/2} x \xi} \exp\left[-\frac{1}{2}\left(\frac{\ln x - \lambda}{\xi}\right)^2\right] \quad 0 \le x < \infty \tag{A-7}$$

$$F_X(x) = \int_{-\infty}^{x} f_X(\upsilon) d\upsilon = \Phi\left(\frac{\ln x - \lambda}{\xi}\right) \tag{A-8}$$

Os parâmetros da distribuição são $\lambda = E(\ln x)$ e $\xi = \sqrt{\text{var}(\ln x)}$, que significam, respectivamente a média e o desvio padrão de $\ln x$.

A.4 Distribuição extremo tipo I ou Gumbel

A distribuição extremo tipo I **E-I**(υ,α), figura A.4, tem suas funções densidade de probabilidade e de distribuição acumulada dadas pelas equações A-9 e A-10 [95].

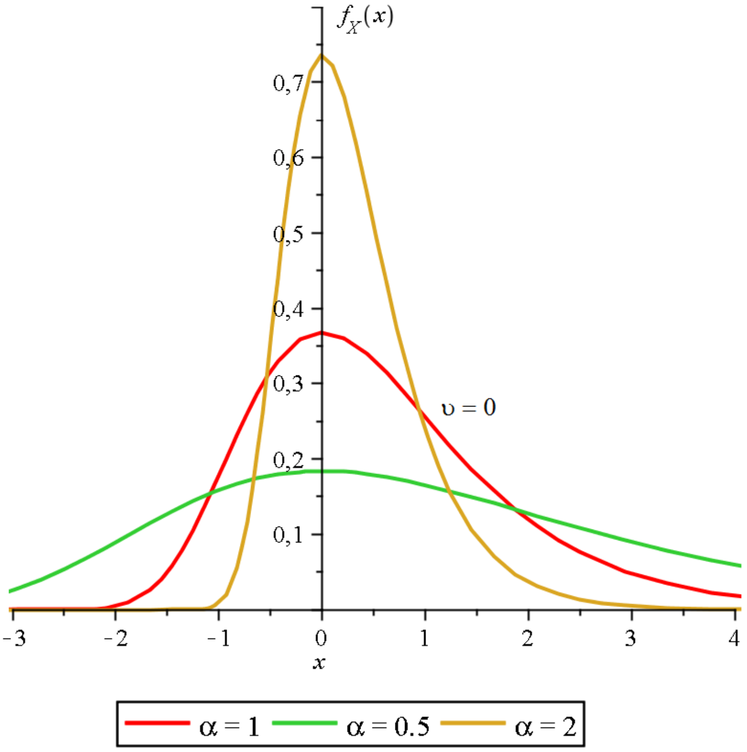

Figura A.4: Função densidade de probabilidade extremo tipo I (Gumbel).

$$f_Y(y) = \alpha \exp\left[-\alpha(y-\upsilon) - e^{-\alpha(y-\upsilon)}\right] \quad -\infty < y < \infty \tag{A-9}$$

$$F_Y(y) = \exp\left[-e^{-\alpha(y-\upsilon)}\right] \quad -\infty < y < \infty \tag{A-10}$$

Os parâmetros da distribuição são:

$$\alpha = \sqrt{\frac{\pi}{\sqrt{6}\sigma_Y}} \tag{A-11}$$

$$\upsilon = \mu_Y - \frac{1.1396}{\alpha} \tag{A-12}$$

A.5
Distribuição extremo tipo III ou Weibull

A distribuição extremo tipo III **E-III(**ϵ**,**u**,**k**)**, figura A.5, tem suas funções densidade de probabilidade e de distribuição acumulada dadas pelas equações A-13 e A-14 [95].

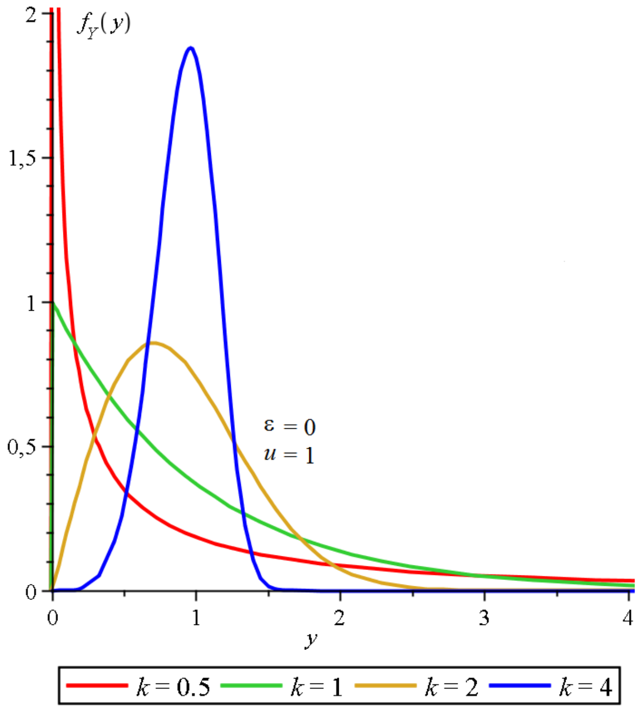

Figura A.5: Função densidade de probabilidade extremo tipo III (Weibull).

$$f_Y(y) = \frac{k}{u-\epsilon}\left(\frac{y-\epsilon}{u-\epsilon}\right)^{k-1} \exp\left[-\left(\frac{y-\epsilon}{u-\epsilon}\right)^{k}\right] \quad \text{(A-13)}$$

$$F_Y(y) = 1 - \exp\left[-\left(\frac{y-\epsilon}{u-\epsilon}\right)^{k}\right] \quad \text{(A-14)}$$

Onde u é o menor valor mais provável, k é o parâmetro de forma e ϵ é valor do limite inferior de y. A média e o desvio padrão de Y estão relacionados com os parâmetros anteriores da seguinte maneira:

$$\mu_Y = \epsilon + (u-\epsilon)\Gamma\left(1+\frac{1}{k}\right) \quad \text{(A-15)}$$

$$\sigma_Y = (u-\epsilon)\sqrt{\Gamma\left(1+\frac{2}{k}\right) - \Gamma^2\left(1+\frac{1}{k}\right)} \quad \text{(A-16)}$$

Onde $\Gamma(a)$ é a função Gamma, dada por:

$$\Gamma(a) = \int_0^{\infty} x^{a-1}e^{-x}dx \quad \text{onde} \quad a > 1,0 \quad \text{(A-17)}$$