$$F_X(x) = \int_{-\infty}^{x} f(t)dt$$

$$P(a < X \leq b) = F(b) - F(a), \qquad a < b$$

$$\mu_n = \int_{-\infty}^{\infty} (x-c)^n f(x) d_x$$

$$\mu_1 = E(x) = \int_{-\infty}^{\infty} x f(x) dx$$

$$V(X) = \sigma^2 = \frac{\sum (x_i - mean)^2}{n} = E\left[\left(x - E(X)\right)^2\right]$$

$$V(X) = \frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2 = E(X^2) - E(X)^2$$

$$P_{ber}(x) = \begin{cases} p, & x = 1 \\ 1-p, & x = 0 \end{cases}, \qquad E[X] = p, \qquad V(X) = pq$$

$$P_{bin}(x) = \binom{n}{x} p^x q^{n-x}, \qquad E[X] = np, \qquad V(X) = npq$$

$$P_{geo}(x) = q^{x-1}p, \qquad E[X] = \frac{1}{p}, \qquad V(X) = \frac{q}{p^2}$$

$$P_{-bin}(x) = \binom{x-1}{k-1} q^{x-k} p^k, \qquad E[X] = \frac{k}{p}, \qquad V(X) = \frac{kq}{p^2}$$

$$P_{poi}(x) = \frac{e^{-\alpha}\alpha^x}{x!}, \qquad \alpha = \lambda t, \qquad E[X] = V(X) = \alpha$$

$$f_{uni}(x) = \frac{1}{n} = \frac{1}{b-a}, \qquad a \leq x \leq b$$

$$f_{exp}(x) = \lambda e^{-\lambda x}, (x \geq 0), \qquad \theta = \frac{1}{\lambda}; E(X) = \theta;\ V(X) = \theta^2$$
$$, F_X(x) = 1 - e^{-\lambda x}$$

$$f_{gam}(x) = \frac{\beta\theta}{\Gamma(\beta)}(\beta\theta x)^{\beta-1} e^{-\beta\theta x}, \qquad \Gamma(\beta) = \int_0^{\infty} x^{\beta-1}e^{-x}dx$$
$$, \Gamma(\beta) = (\beta-1)!, \qquad E(X) = \frac{1}{\theta}, \qquad V(X) = \frac{1}{\beta\theta^2}$$

$$F_{erl}(x) = 1 - \sum_{i=0}^{k-1} \frac{e^{-k\theta x}(k\theta x)^i}{i!};\ E(X) = \frac{1}{\theta};\ V(X) = \frac{1}{k\theta^2}$$

$$f_{nor}(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}, \qquad Z = \frac{X-\mu}{\sigma}$$

$$f_{wei}(x) = \frac{\beta}{\alpha}\left(\frac{x-v}{\alpha}\right)^{\beta-1} \exp\left[-\left(\frac{x-v}{\alpha}\right)^{\beta}\right]$$
$$, E(X) = v + \alpha\Gamma\left(\frac{1}{\beta}+1\right), V(X) = \alpha^2\left[\Gamma\left(\frac{2}{\beta}+1\right) - \Gamma\left(\frac{1}{\beta}+1\right)^2\right]$$
$$, F_X(x) = 1 - e^{-\left(\frac{x-v}{\alpha}\right)^{\beta}}$$

$$f_{lnor}(x) = \frac{1}{\sqrt{2\pi}\sigma x} \exp\left[-\frac{(\ln x - \mu)^2}{2\sigma^2}\right]$$
$$, E(X) = e^{\mu + \frac{\sigma^2}{2}}, \qquad V(X) = e^{2\mu + \frac{\sigma^2}{2}}(e^{\sigma^2} - 1)$$

$$f_{tri}(x) = \begin{cases} \dfrac{2(x-a)}{(b-a)(c-a)}, a \leq x \leq b \\ \dfrac{2(c-x)}{(c-b)(c-a)}, b < x \leq c \end{cases}, E(X) = \frac{a+b+c}{3}$$

$$, F_X(x) = \begin{cases} \dfrac{(x-a)^2}{(b-a)(c-a)}, a < x \leq b \\ 1 - \dfrac{(c-x)^2}{(c-b)(c-a)}, b < x \leq c \end{cases}$$

$$f_{bet}(x) = \frac{x^{\beta_1 - 1}(1-x)^{\beta_2 - 1}}{\mathrm{B}(\beta_1, \beta_2)}, \qquad \mathrm{B}(\beta_1, \beta_2) = \frac{\Gamma(\beta_1)\Gamma(\beta_2)}{\Gamma(\beta_1 + \beta_2)}$$
$$, E(X) = \frac{\beta_1}{\beta_1 + \beta_2}, \qquad V(X) = \frac{\beta_1\beta_2}{(\beta_1+\beta_2)^2(\beta_1+\beta_2+1)}$$
$$, Z = a + (b-a)X, \qquad R_X = (0,1), R_Z = (a,b)$$

$$\Lambda_{\mathrm{SPSS}}(t) = \int_0^t \lambda(s)ds$$

$$P_{HMC} = [X_n = j\ | x_{n-1} = i] = P[X_1 = j\ | X_0 = i]$$

$$P_{DTMC}(n) = P \times P(n-1) = P^n$$

$$p_{DTMC}(n) = p(0)P(n) = p(0)P^n$$

$$d_{ii} = \gcd\{n\ | P(X_{m+n} = i | X_m = i) > 0\}$$

$$\pi_i = P\left(X(t) = s_j\right), \qquad \sum \pi_j = 1$$

$$\frac{d}{dt}\pi_{tr}(t) = \pi_{tr}(t)Q, \qquad q_{i,i} = -\sum q_{i,j}$$

$$\pi_{ss}Q = 0, \qquad \rho = \frac{\lambda}{\mu}$$

$$\mathcal{L}\{f'(t)\} = s\mathrm{F}(s) - f(0), \qquad \mathcal{L}\{u(t)\} = \frac{1}{s}$$

$$\mathcal{L}\{f''(t)\} = s^2F(s) - sf(0) - f'(0)$$

$$\mathcal{L}\{tf(t)\} = -F'(s), \qquad \mathcal{L}\{(1-e^{-\alpha t})u(t)\} = \frac{\alpha}{s(s+\alpha)}$$

$$\mathcal{L}\{e^{at}f(t)\} = F(s-a), \qquad \mathcal{L}\{f(t-a)u(t-a)\} = e^{-as}F(s)$$

$$\mathcal{L}\{f(at)\} = \frac{1}{a}F\left(\frac{s}{a}\right), \qquad \mathcal{L}\{\sin(\omega t)\, u(t)\} = \frac{\omega}{s^2+\omega^2}$$