1 Probability and Distributions

$$\binom{n}{r} = \binom{n-1}{r} + \binom{n-1}{r-1}$$

$$\binom{-x}{r} = (-1)^r \binom{x+r-1}{r}$$

$$\binom{n}{r_1, r_2, \dots, r_k} = \binom{n}{r_1}\binom{n-r_1}{r_2}\dots\binom{n-r_1-\dots-r_{k-1}}{r_k}$$

$$\binom{x}{r} = \frac{x(x-1)\dots(x-r+1)}{r!}$$

$$\binom{a}{0}\binom{b}{n} + \binom{a}{1}\binom{b}{n-1} + \dots + \binom{a}{n}\binom{b}{0} = \binom{a+b}{n}$$

$$\mathrm{Bernoulli}(p) = p^x(1{-}p)^{1-x} | p | p(1{-}p) | 1{-}p{+}pe^t$$

$$\mathrm{Binomial}(n, p) = \binom{n}{x} p^x (1{-}p)^{n-x} | np | np(1{-}p) | (1{-}p{+}pe^t)^n$$

$$\mathrm{Poisson}(\lambda) = \frac{\lambda^x e^{-\lambda}}{x!} | \lambda | \lambda | e^{\lambda(e^t-1)}$$

$$\mathrm{Geometric}(p) = (1{-}p)^{x-1} p | \frac{1}{p} | \frac{1-p}{p^2} | \frac{pe^t}{1-(1-p)e^t}$$

$$\mathrm{Uniform}(a, b) = \frac{1}{b-a} | \frac{a+b}{2} | \frac{(b-a)^2}{12} | \frac{e^{tb}-e^{ta}}{t(b-a)}$$

$$\mathrm{Exponential}(\lambda) = \lambda e^{-\lambda x} | \frac{1}{\lambda} | \frac{1}{\lambda^2} | \frac{\lambda}{\lambda - t}$$

$$\mathrm{Normal}(\mu, \sigma^2) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}} | \mu | \sigma^2 | e^{\mu t + \frac{1}{2}\sigma^2 t^2}$$

$$\mathrm{Gamma}(\alpha, \lambda) = \frac{\lambda^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\lambda x} | \frac{\alpha}{\lambda} | \frac{\alpha}{\lambda^2} | \left(\frac{\lambda}{\lambda - t}\right)^\alpha$$

$$\mathrm{Beta}(\alpha, \beta) = \frac{x^{\alpha-1}(1-x)^{\beta-1}}{B(\alpha, \beta)} | \frac{\alpha}{\alpha+\beta} | \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} | \mathrm{N/A}$$