$\sum_{x=0}^{\infty} ar^x = a/(1-r)$ $\sum_{x=0}^{\infty} xr^x = r/(1-r)^2$ *for* $|r|<1$ $\sum_{k=0}^{\infty} x^k = (1-x)^{-1}$ *for* $|x|<1$

$\sum_{k=1}^{n} k = n(n+1)/2$ $\sum_{k=1}^{n} k^2 = n(n+1)(2n+1)/6$ $e^x = \sum_{k=0}^{\infty} \frac{x^k}{k!} = \lim_{n\to\infty}\left(1+\frac{x}{n}\right)^n$

$\binom{n-1+r}{r} = \frac{(n-1+r)!}{r!(n-1)!}$ "Non-negative Ball and Urn Model"

${}_nP_r = n(n-1)(n-2)\ldots(n-r+1)$ ${}_nC_r = \frac{n!}{(n-r)!r!} = \binom{n}{r}$ $P(A|B) = P(A\cap B)/P(B)$

$$P(B) = P(B\cap A_1)+\ldots+P(B\cap A_n) = P(B|A_1)P(A_1)+\ldots+P(B|A_n)P(A_n)$$

$$E(X) = \sum_{x\in S} x\,f(x) \quad or \quad \int_{x\in S} x\,f(x)dx \qquad \sigma^2 = E\left[(X-\mu)^2\right] = E(X^2)-\mu^2$$

$M(t) = E\left(e^{tX}\right)$ $\chi^2_{GOF} = \sum_i (O_i - E_i)^2 / E_i$

Discrete Distributions:

$f(x) = \binom{n}{x} p^x (1-p)^{n-x} \quad x\in S$ → $M(t) = \left[(1-p)+pe^t\right]^n$ → Binomial(n,p) → $\mu = np$

$f(x) = (1-p)^{x-1}p \quad x\in S$ → $M(t) = \frac{pe^t}{1-(1-p)e^t}$ → Geometric(p) → $\mu = 1/p$

$f(x) = \binom{x-1}{r-1} p^r (1-p)^{x-r} \quad x\in S$ → $M(t) = \left[\frac{pe^t}{1-(1-p)e^t}\right]^r$ → Neg.Binom.(r,p) → $\mu = r/p$

$f(x) = \frac{\lambda^x e^{-\lambda}}{x!} \quad x\in S$ → $M(t) = e^{\lambda(e^t-1)}$ → Poisson(λ) → $\mu = \lambda$

$f(x) = \frac{\binom{N_1}{x}\binom{N_2}{n-x}}{\binom{N}{n}} \quad x\in S$ → No closed form → Hypergeometric → $\mu = n\left(\frac{N_1}{N}\right)$

Continuous Distributions:

$f(x) = \frac{1}{(b-a)} \quad a\le x\le b, \quad z.o.w.$ → $M(t) = \frac{e^{tb}-e^{ta}}{t(b-a)}$ → Uniform(a,b) → $\mu = \theta$

$f(x) = \frac{1}{\theta}e^{-x/\theta} \quad 0\le x<\infty, \quad z.o.w.$ → $M(t) = \frac{1}{1-\theta t}$ → Exponential(θ) → $\mu = \theta$

$f(x) = \frac{1}{\Gamma(\alpha)\theta^\alpha} x^{\alpha-1}e^{-x/\theta} \quad 0\le x<\infty, z.o.w.$ → $M(t) = \frac{1}{(1-\theta t)^\alpha}$ → Gamma(α,θ) → $\mu = \alpha\theta$

$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2} \quad -\infty\le x<\infty$ → $M(t) = e^{-\mu t+\sigma^2 t^2/2}$ → Normal(μ,σ²) → $\mu = \mu$