Table 1: Discrete and Continuous Distributions

Distribution	Notation	Probability Function	Parameters	Support	Moment Gen. Function	Expectation	Variance	Comments
Binomial	$N \sim \mathrm{Bin}(n,p)$	$p(k) = \binom{n}{k} p^k q^{n-k}$	$0 \le p = 1-q \le 1; n \ge 1$	$k = 0, 1, \ldots, n$	$[p \cdot e^t + q]^n$	np	npq	
Multi-nomial	$X \sim \mathrm{Mult}(n,p)$	$p(x) = \frac{n!}{x_1! \ldots x_k!} \prod_1^k p_i^{x_i}$ $x = (x_1, \ldots, x_k)$	$0 \le p_i; \sum_1^k p_i = 1; n \ge 1$ $p = (p_1, \ldots, p_k)$	$0 \le x_i; \sum_1^k x_i = n$		$E(X_i) = np_i$ $i = 1, \ldots, k$	$\mathrm{cov}(X_i, X_j) = -np_i p_j$ $(i \ne j)$	$X_i \sim \mathrm{Bin}(n, p_i)$
Negative Binomial	$X \sim NB(m,p)$	$p(k) = \binom{k-1}{m-1} p^m q^{k-m}$	$0 \le p = 1-q \le 1; m \ge 1$	$k = m, m+1, \ldots$	$\left[\frac{p \cdot e^t}{1 - q \cdot e^t}\right]^m$	$\frac{m}{p}$	$\frac{mq}{p^2}$	Number of trials till m-th success
Geometric	$X \sim G(p)$	$p(k) = q^{k-1} \cdot p$	$0 \le p \le 1$	$k = 1, 2, \ldots$	$\frac{p \cdot e^t}{1 - q \cdot e^t}$	$\frac{1}{p}$	$\frac{q}{p^2}$	$X \sim NB(1,p)$
Poisson	$X \sim \mathcal{P}(\lambda)$	$p(k) = \frac{e^{-\lambda} \lambda^k}{k!}$	$\lambda \ge 0$	$k = 0, 1, \ldots$	$\exp\{-\lambda(1 - e^t)\}$	λ	λ	
Hyper-geometric	$X \sim HG(N,M,n)$	$p(k) = \frac{\binom{N}{k}\binom{M}{n-k}}{\binom{N+M}{n}}$	$N, M > 0;$ $1 \le n \le N+M$	$\max(0, n-M) \le k$ $k \le \min(n, N)$	$\sum_k e^{tk} p(k)$	$\frac{n \cdot N}{N+M}$	$n \cdot \frac{N}{N+M} \cdot \frac{M}{N+M} \cdot$ $\cdot \frac{N+M-n}{N+M-1}$	N – special elements M – ordinary ones n – sample size k – special in sample
		Density Function						
Beta	$X \sim \mathrm{Beta}(\alpha, \beta)$	$f(t) =$ $\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} t^{\alpha-1}(1-t)^{\beta-1}$	$\alpha, \beta > 0$	$0 \le t \le 1$	Complicated	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha \cdot \beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$	$\alpha = \beta = 1 \to$ Uniform
Gamma	$X \sim \mathrm{Gamma}(\alpha, \lambda)$	$f(t) = \frac{\lambda^\alpha \cdot t^{\alpha-1} e^{-\lambda t}}{\Gamma(\alpha)}$	$\alpha, \lambda > 0$	$t \ge 0$	$(1 - \frac{t}{\lambda})^{-\alpha}$	$\frac{\alpha}{\lambda}$	$\frac{\alpha}{\lambda^2}$	$\Gamma(x) = \int_0^\infty u^{x-1} e^{-u} dx$ $= (x-1)\Gamma(x-1)$
Erlang	$X \sim \mathrm{Erlang}(n, \lambda)$	$f(t) = \frac{\lambda^n \cdot t^{n-1} e^{-\lambda t}}{(n-1)!}$	$n = 1, 2, \ldots; \lambda > 0$	$t \ge 0$	$\left(1 - \frac{t}{\lambda}\right)^{-n}$	$\frac{n}{\lambda}$	$\frac{n}{\lambda^2}$	$X \sim \mathrm{Gamma}(n, \lambda)$
Expo-nential	$X \sim \mathrm{Exp}(\lambda)$	$f(t) = \lambda e^{-\lambda t}$	$\lambda > 0$	$t \ge 0$	$\left(1 - \frac{t}{\lambda}\right)^{-1}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$	$X \sim \mathrm{Gamma}(1, \lambda)$
Normal	$X \sim N(\mu, \sigma^2)$	$f(t) =$ $\frac{1}{\sigma\sqrt{2\pi}} \exp\left\{\frac{-(t-\mu)^2}{2\sigma^2}\right\}$	$-\infty < \mu < \infty;\ \sigma > 0$	$-\infty < t < \infty$	$\exp\left\{t\mu + \frac{1}{2}t^2\sigma^2\right\}$	μ	σ^2	